

CSIRO

Annual Report

1993—94

Australian science, Australia's future



CSIRO
AUSTRALIA

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

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

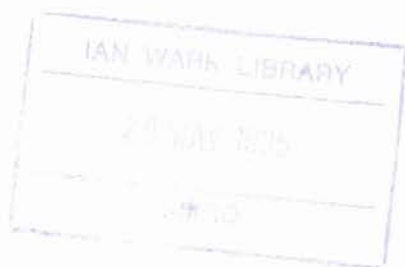
CSIRO'S MISSION

To serve Australia
by being the world's
most effective
multidisciplinary
research organisation.

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1993—94



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AUSTRALIA



Published by CSIRO
Design and artwork by City Graphics, Canberra
Printed in Australia by Pirie Printers, Canberra
ISSN 1030-4215

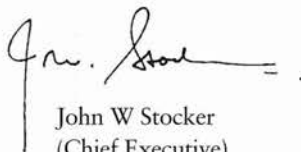
Senator the Hon Peter Cook
Minister for Industry, Science and Technology
Parliament House
CANBERRA ACT 2600

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

We commend the Organisation's achievements to you.



Adrienne E Clarke
(Chairman of the Board)



John W Stocker
(Chief Executive)

October 1994



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1993-94 AT A GLANCE

	1992-93	1993-94
Total revenue	\$679.5m	\$697.7m
Appropriation funding	\$454.3m	\$456.1m
External revenue	\$225.2m	\$241.6m
External revenue as % of total revenue	33.1%	34.6%
Total expenditure	\$685.3m	\$695.0m
Provisional patent applications	223	237
Staff numbers	7406	7402

- A Director of Corporate Business was appointed to strengthen CSIRO's capacities in business development, contract negotiation and international marketing
- A Commercial Practice Manual was produced, setting out policy and corporate best practice guidelines for all aspects of CSIRO's commercial activity
- Among commercialisation highlights:
 - CSIRO, ICI Australia and the Australian Wool Research and Promotion Organisation have reached agreement to commercialise two new processes that will reduce adverse impacts on the environment while reducing the costs of wool processing
 - CSIRO has won contracts to supply its award-winning optical technology to the US and Chinese Mints

OVERVIEW

- Research highlights included:
 - the production of genetically transformed wheat
 - the discovery of the component in fish oils that confers protection against heart disease
- The number of Multi-Divisional Programs drawing upon expertise from across CSIRO increased to 30 from the 24 reported last year
- The CSIRO Enterprise Agreement was certified in December 1993
- The CSIRO Information Network handled more than 38,000 enquiries on science and technology topics
- Membership of the Double Helix Science Club reached 23,000.

FOREWORD

*By Professor
Adrienne Clarke AO,
Chairman of CSIRO
and*

*Dr John Stocker,
Chief Executive
of CSIRO*

CSIRO has made significant progress this year towards integrating its work into long term economic, environmental and social strategies for Australia.

Over the past two years the Organisation has successfully met the external funding target set by Government and has mechanisms in place to maintain that level. We are now focusing on new, longer-term challenges — to identify the science we should do and the delivery mechanisms we need to help keep Australia among the advanced nations of the Asia Pacific Region and the world.

The CSIRO Board defined the challenge we face: how does CSIRO deliver technology to ensure Australia is a technologically competent nation in a highly competitive world; how can CSIRO help to embed science and technology in Australia's sectoral strategies?

To lay the groundwork for long term strategies, some of our leading scientists are preparing scenarios that capture the prospective advances in different fields over the next 25 years and describe some of the opportunities and challenges they present to Australia. The goal is to highlight issues and choices rather than make accurate predictions. These scenarios will be presented at the September 1994 Congress of the Australian and New Zealand Association for the Advancement of Science (ANZAAS).

We also obtained opinions from a group of our younger staff at a one-day Chief Executive's workshop during the year. Their views on issues such as management structures and corporate culture has

FOREWORD

been a valuable input to thinking about CSIRO's future and its role in the 21st century.

The Federal Government decisions to elevate Science to Cabinet level under the stewardship of Senator the Hon Peter Cook and to integrate science and technology with industry policy are both welcome signals of recognition of the vital national role of science. Measures in the Industry Statement, such as the increase in baseline funding for science agencies, the removal of the efficiency dividend from research programs and the range of incentives for business to invest in R&D, also provide recognition of the critical role of science and technology in our economy and in managing our environment and natural resources.

CSIRO took significant steps during the year to meet the challenge of ensuring that our commercial skills match our scientific excellence. Mr Peter Bradfield, a businessman with broad experience in Australia and internationally, was appointed Director of a new CSIRO Corporate Business Department, which encompasses legal, international, planning, intellectual property management and public affairs activities. The Department provides a focus in CSIRO to support Divisions in commercial matters and to help develop staff skills in dealings with businesses — small, medium and large. These changes will provide Australian industry with improved access to the benefits and opportunities arising from CSIRO research.

A major achievement by the Organisation was production of a

Commercial Practice Manual for CSIRO staff. This contains CSIRO policy and guidelines on corporate best practice for all aspects of CSIRO commercial activities. Application of the practices prescribed in the manual has improved the Organisation's performance in business dealings, particularly in contract matters.

An enhanced CSIRO capability to work with small-to-medium enterprises (SMEs) has been achieved. There has been a 20 per cent growth in 1993-94 in the



Above:
Professor Adrienne Clarke
Above right:
Dr John Stocker



number of contracts CSIRO has with such companies. Funding through the Industry Statement will enable CSIRO to further improve the level of service delivery to SMEs.

Government measures and CSIRO initiatives have improved the outlook for greater private sector involvement in R&D. The Cooperative Research Centres Program, with its substantial industry involvement, has strengthened CSIRO's many existing industry links and provided opportunities for new collaborations. CSIRO is now a participant in 43 CRCs and is a keen bidder in the final round of CRCs to be announced at the end of 1994.

New Chiefs were recruited from the private sector for the Divisions of Building, Construction & Engineering and Food Science & Technology. These appointments, along with the increased emphasis in performance assessments of Chiefs and other senior managers on management of industry interactions, demonstrate CSIRO's commitment to working more effectively with Australian business.

CSIRO's efforts to attract greater funding from both public and private sources will depend on concrete evidence that we deliver what we promise. To this end, we are well advanced on producing a set of performance indicators to show our success in achieving all our goals and objectives. CSIRO is discussing with the Australian Nuclear Science and Technology Organisation (ANSTO), the Australian Institute of Marine Science (AIMS) and the Department of Industry, Science and Technology the development of a common set of indicators for reporting purposes.

One focus of these deliberations is on financial indicators — however, we believe that CSIRO's ability to meet the 30 per cent external earnings target is inadequate as a sole indicator of performance. We are also seeking indicators that will enable us to report on CSIRO performance in a range of different areas.

This Annual Report details some of the superb scientific achievements CSIRO has made during 1993-94. These include the production of genetically transformed wheat, findings on Asian taste preferences and the winning of a US patent for gene shears technology; an

Enterprise Agreement that will enhance staff efficiency and flexibility; and the hosting of a major United Nations conference on clean production.

It is the continuing scientific excellence and achievements that give us confidence that CSIRO will continue to realise its mission: to serve Australia by being the world's most effective multidisciplinary research organisation.



*Adrienne E Clarke AO
Chairman*



*John W Stocker
Chief Executive*

MISSION AND GOALS

MISSION

To serve Australia by being the world's most effective multidisciplinary research organisation.

PRINCIPLES

Our Business

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

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

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

Effectiveness

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

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

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

Skills

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

Our People

CSIRO recruits the best and the brightest. We provide a stimulating

environment to encourage individuals to develop their full potential. We provide career opportunities which make CSIRO an attractive development base for future industry leaders.

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

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

Ethics

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

Creativity

We foster creativity which underpins our performance and delivery.

Management Practice

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

International Outlook

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

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

Learning Organisation

We use lessons from our own and others' practices and experiences to

improve our performance continually.

Education and Training

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

Performance Evaluation

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

CORPORATE GOALS

Research

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

Research support

- Further strengthen mechanisms for determining and assessing research priorities and resources allocation across the Organisation.
- Provide efficient and effective R&D support services across the Organisation.
- Maximise CSIRO's capacity to

attract and retain a high quality workforce in order to produce the best possible research and development for Australia.

- Increase recognition by government, industry and the general public of CSIRO's contribution to the nation.
- Improve Australia's ability to interpret and disseminate scientific and technical knowledge for the economic benefit of our industries.

CHARTER, FUNCTIONS AND POWERS

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

There were no amendments during 1994 to CSIRO's enabling legislation. However, a package of Bills designed to replace the *Commonwealth Audit Act 1901* was introduced into Parliament by the Minister for Finance in June 1994. One of the bills, the *Commonwealth Authorities and Companies Bill 1994* suggests numerous consequential amendments to the *Science and Industry Research Act 1949* primarily in the areas of financial accountability and management as well as the ethical responsibilities of Board members and senior managers.

From 1 July 1993 to 25 March 1994 the Minister responsible for CSIRO was Senator the Hon Chris Schacht (Minister for Science and Small Business, Minister Assisting the Prime Minister for Science).

From 25 March 1994 to 30 June 1994 the Minister responsible for CSIRO was Senator the Hon Peter Cook (Minister for Industry, Science and Technology, Minister Assisting the Prime Minister for Science).

FUNCTIONS

CSIRO's primary functions are:

- to carry out scientific research
 - to assist Australian industry and to further the interests of the Australian community;
 - to contribute to national and international objectives and responsibilities of the Commonwealth Government;

- to encourage or facilitate the application and use of the results of its own or any other scientific research.

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

POWERS

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

In particular it may:

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

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

STRUCTURE, MANAGEMENT AND STAFF

CSIRO's current structure was established by the *Science and Industry Research Amendment Act 1986*. This established a ten-member Board responsible for determining policy and ensuring the efficient functioning of CSIRO. The Chief Executive, who is a member of the Board, is responsible for the Organisation's activities.

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

This year saw the appointment of a Director of Corporate Business, whose purpose is to strengthen the Organisation's capacities in business development, contract negotiation and international marketing.

Research is performed in 35 Divisions and research units, grouped into six Institutes. Each Institute has its own management committee, which consists of the Director and Divisional Chiefs. The Institute Committee provides a forum for setting the strategic direction for the Institute and assisting in the formulation and implementation of corporate and Institute policies for research and management.

Two new Divisions — the Division of Petroleum Resources and the Division of Exploration and Mining — were established this year in the Institute of Minerals, Energy and Construction. The Divisions of Exploration Geoscience and Geomechanics ceased to exist.

Divisions and Institutes are

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

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

CSIRO staff are employed under *Section 32 of the Science and Industry Research Act 1949*. At 30 June 1994 CSIRO had a total staff of 7402, which has an equivalent full-time value of 6899 units. The numbers employed in different job categories are shown in the chart on p 68.

THE BOARD
(as at 30 June 1994)



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



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



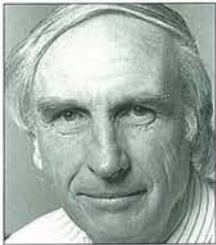
Mr Doug Shears
Executive Chairman
ICM Australia Pty Ltd
5 Dec 91—4 Dec 96



Dr John Stocker MB BS
PhD FRACP FTS
Chief Executive of CSIRO
5 Mar 90—4 Mar 95



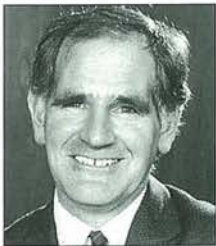
Mr Nigel Stokes BEc BA
Vice President, Bankers
Trust Aust Ltd
24 Sept 91— 31 Aug 94



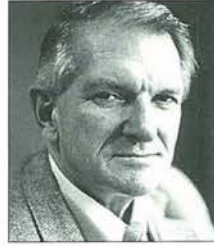
Professor John de Laeter
AO FTS FInstP FAIP
Deputy Vice-Chancellor
(Research and
Development)
Curtin University of
Technology
5 Dec 91—4 Dec 95



Mr Ralph Ward-Ambler
AM BMEchE
Company Director
8 Feb 93—7 Feb 96
(reappointment)



Dr Tony Gregson PhD DSc
FRACI
Primary producer, Director,
Grains R&D Corporation
5 Dec 92—4 Dec 94
(reappointment)



Mr Laurie Carmichael
Chairman
Employment and Skills
Formation Council
13 Mar 93—12 Mar 95
(reappointment)
(resigned 31 Dec 1993)



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



Mr Michael Forshaw
BA LLB
Joint National Secretary
The AWU-FIME
Amalgamated Union
1 Jan 94—31 Dec 97
(resigned 2 May 1994)

ORGANISATIONAL CHART

(as at 30 June 1994)

THE BOARD

Professor Adrienne Clarke AO

Dr J W Stocker

Prof J R de Laeter AO

Dr D M Richards

Mr D S Shears

Dr A K Gregson

Mr N C Stokes

Prof Sir Gustav Nossal AC

Mr C R Ward-Ambler AM

INSTITUTE OF INFORMATION SCIENCE AND ENGINEERING

Director

Dr R H Frater

DIVISIONS

Information Technology

Mathematics and Statistics

Radiophysics

Australia Telescope National
Facility

INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Director

Dr C M Adam

DIVISIONS

Applied Physics

Biomolecular Engineering

Chemicals and Polymers

Manufacturing Technology

Materials Science and
Technology

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

Director

Dr A F Reid

DIVISIONS

Building, Construction and
Engineering

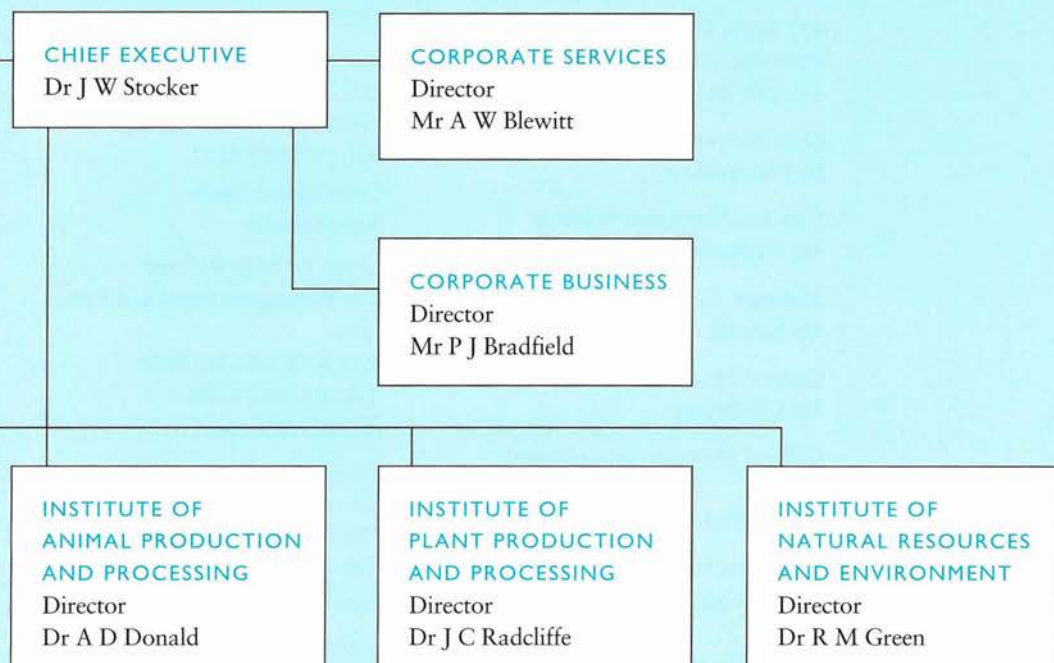
Coal and Energy Technology

Exploration and Mining

Mineral and Process
Engineering

Mineral Products

Petroleum Resources



DIVISIONS

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

DIVISIONS

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

DIVISIONS

Atmospheric Research
Fisheries
Oceanography
Water Resources
Wildlife and Ecology
Centre for Environmental Mechanics
CSIRO Office of Space Science and Applications (COSSA)

SENIOR STAFF AND ADDRESSES

(as at 30 June 1994)

HEAD OFFICE

407 Royal Parade
Parkville, VIC 3052
Tel: (03) 662 7111

Chief Executive
Dr J W Stocker

Director, Corporate Business
Mr P J Bradfield

Manager, Corporate Business
Mr K Smith

General Manager, Public Affairs
Mr L R Bevege

General Manager, International
Affairs
Dr B K Filshie

Corporate Secretary
Dr E N Cain (Canberra)

CORPORATE SERVICES

Limestone Avenue
CAMPBELL ACT 2601
Tel: (06) 276 6766

Director, Corporate Services
Mr A W Blewitt

General Manager, Corporate
Finance
Mr R J Garrett

General Manager, Human
Resources
Ms C R Macpherson

General Manager, Corporate
Property
Mr G J Harley

General Manager, Information
Technology Services
Mr D B Rofe

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

CORPORATE OVERVIEW

Principal Secretary, Government
Business and Policy
Dr T E Heyde

INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING

Director: Dr A D Donald
105 Delhi Road
NORTH RYDE NSW 2113
Tel: (02) 887 8222

Divisions and Chiefs Animal Health

Chief: Dr M D Rickard
Cnr Flemington Road and Park
Drive
PARKVILLE VIC 3052
Tel: (03) 342 9700

Animal Production

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

Food Science and Technology

Chief: Dr C P Mallett
Gate 1, 105 Delhi Road
NORTH RYDE NSW 2113
Tel: (02) 887 8333

Human Nutrition

Chief: Dr P J Nestel
Kintore Avenue
ADELAIDE SA 5000
Tel: (08) 303 8800

Tropical Animal Production

Chief: Dr P A Jennings
120 Meiers Road
INDOOROOPILLY QLD 4068
Tel: (07) 214 2700

Wool Technology

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

INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Director: Dr C M Adam
407 Royal Parade
PARKVILLE VIC 3052
Tel: (03) 662 7111

Divisions and Chiefs Applied Physics

Chief: Dr W R Blevin
Bradfield Road
LINDFIELD NSW 2070
Tel: (02) 413 7211

Biomolecular Engineering

Chief: Dr P M Colman
343 Royal Parade
PARKVILLE VIC 3052
Tel: (03) 342 4200

Chemicals and Polymers

Chief: Dr T H Spurling
Bayview Avenue
CLAYTON VIC 3169
Tel: (03) 542 2244

Manufacturing Technology

Chief: Dr P M Robinson
Cnr Raglan and Albert Streets
PRESTON VIC 3072
Tel: (03) 662 7700

Materials Science and Technology

Chief: Dr M J Murray
Normanby Road
CLAYTON VIC 3169
Tel: (03) 542 2777

INSTITUTE OF INFORMATION SCIENCE AND ENGINEERING

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

Divisions and Chiefs Information Technology

Chief: Dr J F O'Callaghan
ANUTECH Court
ANU Campus
Cnr North and Daley Roads
ACTON ACT 2601
Tel: (06) 275 0901

Mathematics and Statistics

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

Radiophysics

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

The Australia Telescope— National Facility

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

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

Director: Dr A F Reid
105 Delhi Road (Gate 4)
NORTH RYDE NSW 2113
Tel: (02) 887 8222

Divisions and Chiefs

Building, Construction and Engineering

Chief: Mr L R Little
Graham Road
HIGHTETT VIC 3190
Tel: (03) 252 6000

Coal and Energy Technology

Chief: Dr P G Alfredson
51 Delhi Road
North Ryde NSW 2113
Tel: (02) 887 8666

Exploration and Mining

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

Mineral and Process Engineering

Chief: Dr R D La Nauze
 Bayview Avenue
 CLAYTON VIC 3169
 Tel: (03) 541 1222

Mineral Products

Chief: Dr T Biegler
 339 Williamstown Road
 PORT MELBOURNE VIC 3207
 Tel: (03) 647 0211

Petroleum Resources

Chief: Dr A F Williams
 Kinnoull Grove
 SYNDAL VIC 3150
 Tel: (03) 881 1355

**INSTITUTE OF NATURAL
 RESOURCES
 AND ENVIRONMENT**

Director: Dr R M Green
 Limestone Avenue
 CAMPBELL ACT 2601
 Tel: (06) 276 6521

**Divisions and Chiefs
 Atmospheric Research**

Chief: Dr G I Pearman
 Station Street
 ASPENDALE VIC 3195
 Tel: (03) 586 7666

Fisheries

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

Oceanography

Chief: Dr A D McEwan
 Castray Esplanade
 HOBART TAS 7001
 Tel: (002) 32 5222

Water Resources

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

Wildlife and Ecology

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

Centre for Environmental Mechanics

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

CSIRO Office of Space Science and Applications (COSSA)

Head: Dr B J J Embleton
 Cnr North and Daley Roads
 ANU Campus
 ACTON ACT 2601
 Tel: (06) 279 0811

**INSTITUTE OF PLANT
 PRODUCTION AND
 PROCESSING**

Director: Dr J C Radcliffe
 Limestone Avenue
 CAMPBELL ACT 2601
 Tel: (06) 276 6512

**Divisions and Chiefs
 Entomology**

Chief: Dr M J Whitten
 Clunies Ross Street
 BLACK MOUNTAIN ACT 2601
 Tel: (06) 246 4001

Forest Products

Chief: Dr W Hewertson
 Bayview Avenue
 CLAYTON VIC 3169
 Tel: (03) 542 2244

Forestry

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

Horticulture

Chief: Dr E G Williams
Hartley Grove
URRBRAE SA 5001
Tel: (08) 303 8600

Plant Industry

Chief: Dr W J Peacock
Clunies Ross Street
BLACK MOUNTAIN ACT 2601
Tel: (06) 246 4911

Soils

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

Tropical Crops and Pastures

Chief: Dr R J Clements
306 Carmody Road
ST LUCIA QLD 4067
Tel: (07) 377 0209

RESEARCH PRIORITIES

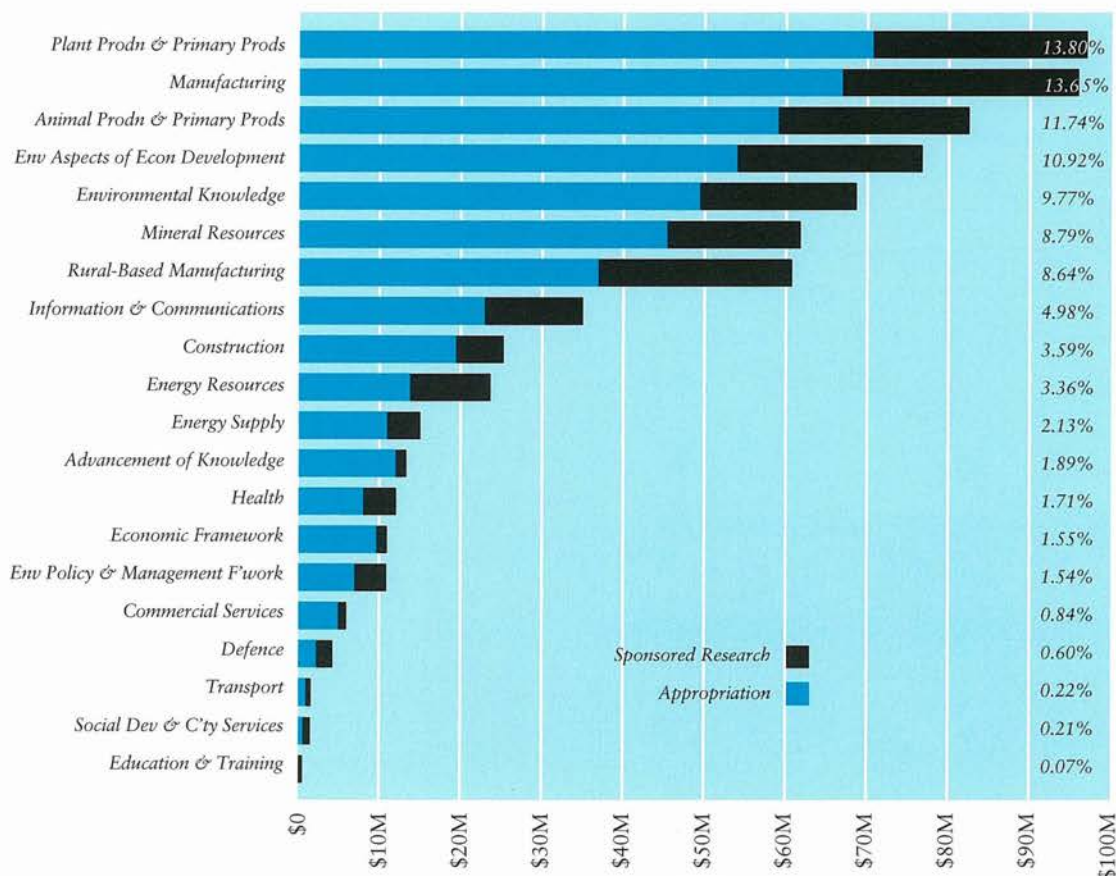
CSIRO's research priorities are established on the basis of anticipated returns to Australia, derived from comprehensive assessments of the attractiveness and feasibility of conducting research directed to identified socio-economic objectives. These assessments form the basis for CSIRO's strategic and operational planning. The distribution of research effort in 1993-94 is illustrated in the following chart.

In December 1993 the CSIRO Board approved allocations from CSIRO's priority research fund, for

each year of the triennium commencing 1 July 1994, to the programs listed in Table 1. These allocations are consistent with the Board's decision, reported last year, to increase the share of appropriation funding for research in the first three Socio-Economic Objective (SEO) sub-divisions listed in the table, namely mineral resources, manufacturing, information and communications, and to maintain the share of appropriation funding for the two environmental subdivisions, namely environmental aspects of economic development and environmental knowledge.

Distribution of research effort
1993-94

CSIRO SEO Sub-Division



SEO sub-division and Program	1994-95	1995-96	1996-97
Mineral Resources	<u>1500</u>	<u>3000</u>	<u>4500</u>
1. World Class Nickel Deposits — Prospectivity Using Geochemical and Isotopic Signatures	200	200	200
2. Accelerator Mass Spectrometry for Ultra Sensitive Trace Element and Isotope Studies	200	350	350
3. Airborne Gravity Gradiometry	200	350	400
4. Orebody Delineation by Geophysics	300	400	400
5. Mine Characterisation and Optimal Recovery	250	350	400
6. Carbothermic Smelting	250	350	350
7. Improved Production of Synthetic Rutile	100	200	200
<i>Uncommitted</i>	0	800	2200
Manufacturing	<u>1500</u>	<u>3000</u>	<u>4500</u>
1. Biosensors	500	1000	1500
2. Smart Manufacturing	1000	2000	3000
Information & Communications	<u>1500</u>	<u>3000</u>	<u>4500</u>
1. Telecommunications Engineering	800	1600	2400
2. Software Engineering	700	1400	2100
Environmental Aspects of Economic Development & Environmental Knowledge	<u>1000</u>	<u>2000</u>	<u>3000</u>
1. Environmental Aspects of Australian Tourism	100	200	500
2. Dryland Farming Systems for Catchment Care	200	400	500
3. Urban Water Systems	100	200	250
4. Urban and Regional Air Quality	100	200	250
5. Conserving Biodiversity for Australia's Future	200	400	600
6. Climate Variability and Impacts	300	600	900
Total	5500	11000	16500

Table 1:
Priority funds allocated to
programs,
1994-95 to 1996-97, \$'000

RESEARCH HIGHLIGHTS

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

The system is a modified version of the draft national research classification used by the Australian Bureau of Statistics. CSIRO has selected sub-divisions that are relevant to science and technology and re-organised them into a form more meaningful to CSIRO. The

result is a set of 17 research purposes whose principal objectives are economic development, national welfare or national security. Projects can contribute to more than one research purpose. CSIRO's work in radioastronomy is classified separately under 'advancement of knowledge'.

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

RURAL INDUSTRIES

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

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

MINERALS AND ENERGY INDUSTRIES

Minerals 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, environmental management and policy framework, other

INFRASTRUCTURE, SERVICES AND ADVANCEMENT OF KNOWLEDGE

Construction; Transport; Commercial Services; Health ; Social development; Defence; Radioastronomy

The selection of achievements and developments described in this section demonstrates how CSIRO is achieving its corporate goals and research objectives. A complete report of the year's activities in all 1000-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 30 Multi-Divisional Programs (MDPs) operating this year. Increasingly, CSIRO is looking to assemble multi-disciplinary teams from across the boundaries of its management structure to respond to research problems and opportunities.

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GOAL

Improve the international competitiveness and sustainability of rural production systems

RURAL INDUSTRIES

ACHIEVEMENTS

Golden bullets shoot success

Scientists in the Division of Plant Industry have successfully produced genetically transformed wheat — a major step towards improving disease resistance and grain quality.

This development will make it possible to introduce specific crop and marketing features into wheat varieties. It will also reduce the lead time for new varieties, thus giving growers quicker access to them.

The research will benefit the wheat industry by allowing breeders access to a wider gene pool to improve characteristics such as disease resistance and dough-making and starch qualities. In the near future, scientists will be able to introduce genes from any source into wheat so that breeders can design specific wheat varieties to suit particular market requirements.

The researchers have used a novel method of introducing genes into plant tissue, known as golden bullets. A helium-propelled gas gun shoots gene-carrying microparticles at high speed into young wheat embryos. The particles are made of tungsten or gold and coated with DNA.

Transformation has taken place in four wheat varieties, including the Spring variety Hartog, which is grown in northern New South Wales and Queensland.

Improved tropical acacia seed

The first crops of improved tropical acacia seed from orchards on Melville Island have been harvested and will be used in genetic grain trials by the Division of Forestry.

For 15 years the Division's

RESEARCH

Australian Tree Seed Centre has been working with counterparts in Indonesia, Papua New Guinea and northern Australia to collect geographic varieties (called natural provenances) of tropical acacias. Some of the fast growing species are becoming increasingly important for reforestation of degraded and infertile sites in the humid and sub-humid tropics. Some varieties are excellent substitutes for other timbers (e.g. southern blackwood).

Staff from the Tree Seed Centre have analysed field trials in many countries to determine the best provenances, enabling immediate gains in growth and form through provenance selection.

Since 1989, the Centre has established over 20 hectares of acacia seed orchards in northern Australia with the collaboration of the Queensland Forest Service and the Conservation Commission of the Northern Territory, and with funding from the Australian International Development Assistance Bureau and the Australian Centre for International Agricultural Research.

These trees are now starting to yield substantial quantities of seed. The seeds should be genetically superior to the best natural varieties, because the trees were heavily culled so that only those with good form and vigour were retained.

Improved seed from the first generation seedlings and from clonal seed orchards established from selected elite trees, should improve the prospects for commercial planting of tropical acacias in Australia. The seed should also increase the long-term value of plantings established in north Queensland's Community



From this tropical acacia orchard on Melville Island, seeds are harvested and used in genetic grain trials

Rainforest Reforestation Program and similar planting schemes. Clonal seed orchards of one species have already been established in collaboration with the Northern Territory University.

The foundations have been laid for a long-term breeding program for tropical acacias to benefit Australia and our near neighbours with whom we share these species.

Managing insects in cotton

A new identification kit to improve management of the heliothis cotton pest was released last year for commercial sale by Abbott Agricultural Products Division. The

kit was commissioned by the Cotton Research and Development Corporation (CRDC) and developed by the Division of Entomology.

Heliothis costs Australian cotton growers over \$50 million every year. One species of heliothis, the cotton bollworm, has been rapidly developing a resistance to insecticides, especially the synthetic pyrethroids and endosulfan. The other species of heliothis, the native bud-worm, has not developed resistance.

The two, however, look the same in the egg and larval stages.

By identifying the species of heliothis correctly, the new kit helps growers make the correct spraying decisions and contributes to the long-term sustainability of the cotton industry by managing insecticide resistance effectively.

The method used in the kit is very sensitive and can even be used on insect eggs. Several other potential applications for this technology are now being explored.

Genetic map for cattle

A genetic map for cattle has been constructed by an international research team led by the CSIRO Division of Tropical Animal Production.

The genetic map shows the order and distance between genes and DNA markers on chromosomes. The cattle map covers 92 per cent of the bovine genetic material and consists of more than 400 genes and DNA markers. It is the most important tool used to locate the genes for important production traits.

It is the first step in several ambitious projects that will use the map as a springboard for pinpointing genes for meat quality,

growth and parasite resistance.

Although the research using the linkage map will not reach the market place for some time, the CSIRO research has resulted in useful spinoffs for producers, such as a test for Pompe's disease and DNA fingerprinting.

The Division of Tropical Animal Production took the lead in developing the genetic linkage map in 1991 and established an international network of 23 scientists from six countries.

The project has been supported by the cattle industry through the Meat Research Corporation as well as by the Commonwealth Department of Industry, Science and Technology via the International Science and Technology Program.

Information system for Torres Strait

A Geographical Information System developed by the Division of Fisheries has become an integral tool in the management of resources in the Torres Strait Protected Zone to the north of Australia.

In 1990 the Australian Fisheries Management Authority (AFMA) funded CSIRO to develop a Torres Strait Geographical Information System as part of its fisheries research program for the protected area.

The Torres Strait Islanders rely heavily on both traditional sea-based resources, such as dugongs and turtles, and on the commercial fishing of prawns and lobsters. Changes in the populations of these species can directly affect island lifestyles and incomes.

Marine biologists Tim Skewes (left) and Brian Long digitising a series of maps for input into a Geographic Information System for use in the Torres Strait Protected Zone



CSIRO researchers spent a year collecting and reviewing information on the area's history, fisheries, environment, ocean and people. Satellite technology was used to map the inter-tidal seagrass beds, mangroves, and lobster and trochus habitats of the region. The database constructed contains information ranging from fish trawl catch data, lobster and pearl shell abundance, to human census data.

The Geographic Information System was transferred to AFMA in August 1993 and CSIRO provided a three day workshop to train staff in its use and capabilities. In addition to assisting management in the area, the GIS is also a valuable tool in helping to determine research priorities. By providing a complete picture of research work already undertaken, it gives a quick reference point to prevent researchers from repeating projects, while identifying 'gaps' in need of investigation.

Combating drench resistance

A new test, developed by the Division of Animal Health, will enter the market in 1995. The test will allow rapid detection of drench resistance on a property, enabling farmers to modify management practices and delay the spread of resistance.

Gastrointestinal worms cost Australia's pastoral industries about \$300 million a year in lost production and control costs. These worms are one of the major health factors limiting productivity in the sheep industry.

Control relies on the use of chemical drench treatment coupled with good farm management practice such as pasture rotation (based on past CSIRO research).

However, across much of the sheep country, parasites have developed resistance to the chemicals, forcing producers to use increasingly more sophisticated and more expensive drenches.

The current test for drench resistance is the faecal egg count reduction test. This involves a complex series of procedures on the farm prior to counting of the worm eggs in faecal samples back at the laboratory.

The new CSIRO test utilises a larval development assay. By comparing the development of worm larvae in a series of wells in a test plate with a reference chart, laboratory technicians will quickly be able to determine the level of resistance to a range of drench chemicals.

The McMaster Drench-Rite test is being commercialised by Horizon Technology, an Australian owned company. They will sell test kits to existing diagnostic veterinary laboratories around Australia providing testing services to farmers.

The test, as well as being more convenient and cost-effective, will detect lower levels of resistance than present methods, allowing the farm manager to respond earlier to an emerging problem. It is also playing an important role in research into improved management practices to minimise drench resistance.

DEVELOPMENTS

\$1M for CSIRO plant science

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.

Go-ahead for McMaster Laboratory

During the year the Parliamentary Public Works Committee approved the redevelopment of CSIRO's Prospect site in New South Wales. This includes establishment of the new McMaster Laboratory for Animal Health, which is currently located at the University of Sydney. The new laboratory will provide 2,200 square metres of floor space and is expected to be occupied by June 1995.

Launch of Sunset mandarin

The Division of Horticulture and the Victorian Department of Agriculture have launched the new, jointly bred Sunset mandarin to the Australian citrus industry. Its development was described in the 1991-92 Annual Report. It has a pleasant taste, low seed content, high yield and is easy to peel.

Boran and Tuli cattle embryo sale

The second Boran and Tuli pure-bred embryo sale was held in May 1994 in Rockhampton, Queensland. The Tuli embryos were in demand and a new world record price was set at \$9,500. The top price paid for the Boran embryos was \$5,000. The sale is part of a collaborative project whereby the genetic material introduced from East Africa is made available to the beef industry by the

Boran and Tuli Producer Consortium/CSIRO Joint Venture.

TickGARD

A genetically engineered vaccine against cattle tick, TickGARD, was released during the year. The cattle tick affects about one-third of the nation's cattle and costs the beef and dairy industries about \$100 million annually. Ticks feeding on vaccinated cattle suffer a massive destruction of digestive cells in their gut and other organs may be damaged. Trials have confirmed that the vaccine is a safe and effective aid in controlling ticks on beef and dairy properties. The vaccine was developed by the Division of Tropical Animal Production in conjunction with Biotech Australia.

Starfish investigation

The Division of Fisheries sent a scientific team to Japan in late 1993 on a mission to gather information about the Northern Pacific Seastar, an introduced starfish threatening Australian fisheries. The Division established contact with key Japanese research agencies and has been working closely with the National Seastar Taskforce, established by the Tasmanian government. Recommendations for research needed to help the Australian fishing industry and governments tackle this menace have been developed. Special Commonwealth funding has been provided for a National Centre for Research on Introduced Marine Pests, established within the Division of Fisheries.

GOAL

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

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

MINERALS AND ENERGY INDUSTRIES

ACHIEVEMENTS

Advanced mineral exploration techniques

CSIRO has a long history of working with industry to develop mineral exploration techniques suited to the unique Australian environment and its assistance has led to the discovery of several new deposits.

Early application of the principles established by the Division of Exploration and Mining directly assisted Great Central Mines NL in the discovery of the major Plutonic and Bronzewing gold deposits in Western Australia. Currently these deposits have a combined resource of about 4 million ounces of gold, with potential for expansion, and represent a significant economic benefit to Western Australia.

Another recent CSIRO development has the potential for both exploration and mine development in the nickel-rich Kambalda area of Western Australia. Researchers from the Division of Exploration and Mining, in collaboration with Western Mining Corporation Ltd and Port Management Services, have produced the first 3-D model of the complex geological structure known as the Kambalda Dome. The model, produced using advanced computer graphics and 3-D visualisation techniques, shows geological relationships in three dimensions, based on information from thousands of drill holes.

The Division, as part of the Co-operative Research Centre for Australian Mineral Exploration

RESEARCH

Technologies, is also applying airborne electromagnetics to mineral exploration.

Data have been successfully acquired over some 200 square kilometres in the Lawlers area of Western Australia using a prototype transient electromagnetic system developed by CSIRO and World Geoscience Corporation Ltd, with funding from the Industry Research and Development Board. Although originally designed to map salinity from the air, this system also provides information on the extent and composition of weathered surface layers for use in mineral exploration. The CRC aims to develop this airborne system to detect orebodies at depths of at least 300 metres.

Highwall mining

CSIRO research is playing a vital role in introducing new, more effective coal mining systems in BHP's Queensland operations.

The Division of Exploration and Mining, in collaboration with BHP Australia Coal Ltd, has undertaken a \$900,000 research project to develop geomechanical guidelines for highwall mining systems in Australia.

Highwall mining is a hybrid mining system that can access coal reserves lying beyond the reach of conventional surface mining operations. This new technology has the potential to transform the Australian coal mining industry by unlocking hundreds of millions of tonnes of black coal reserves more cheaply and quickly than by underground mining.

Highwall mining uses a series of unsupported roadways, which are driven underground from the open

cut highwall for a distance of up to 300 metres by remotely controlled continuous miners. The success of this system depends on the development of reliable and robust geomechanical design guidelines to cover a wide range of Australian geological conditions.

CSIRO has developed site investigation procedures, techniques for coal pillar and entry span design and methods to assess the stability of highwalls. All of these will be tested and refined during highwall mining trials at the Moura mine in Queensland in 1995.

Final design recommendations will be based on the performance of these procedures at the trial site and the rock mass response to the highwall mining system. An operational monitoring system will also be developed.

Improving alumina production

The Australia aluminium industry exports approximately \$5 billion of products (bauxite, alumina, aluminium and semi-fabricated products) annually. Alumina and aluminium products form 15 per cent of these exports.

Three CSIRO Divisions are involved in a Multi-Divisional Program aimed at solving long-standing problems in the Bayer process, which produces alumina from bauxite ore.

Work by the Division of Mineral Products, sponsored by Queensland Alumina Ltd and Comalco Ltd, is aimed at reducing the consumption of caustic soda during the Bayer process.

Caustic soda is imported into Australia and is consumed and discarded by the alumina refining industry at a cost of about \$400

million a year. Caustic soda consumption increases when the ore contains high levels of reactive silica, which also reacts with the caustic soda to form a byproduct. By investigating the interactions between silica, alumina and the Bayer liquor, CSIRO scientists will be able to modify the process in order to reduce soda losses.

For effective separation of finely divided solids from mineral processing liquors, it is usually necessary to 'floculate' the process slurry. Flocculation is the step in the process by which the finely divided alumina precipitate is aggregated into larger particles, which are easier to settle and remove. Three Divisions (Building, Construction and Engineering; Mineral and Process Engineering; and Mineral Products) are focusing on thickener technology, aiming to improve flocculation processes through a better knowledge and control of fluid mixing conditions.

This research is funded by 13 companies through the Australian Mineral Industries Research Association Limited. During the year some specialised equipment has been developed to study flocculation processes. These include an operator-independent 'sheer vessel' and a floc-density analyser.

Alumina production is limited by a slow crystallisation step, whose mechanism is not fully understood. An novel probe devised by the Division of Mineral Products has provided the first evidence of crystal growth during the early stages of crystallisation. Improved understanding of how this growth proceeds will help researchers devise ways of speeding the crystallisation process up.

The environmental problems of the 'red mud' byproduct of alumina processing are an important issue for industry. Working with Alcoa refinery staff, the Division of Mineral Products has developed a standard technique for analysing the separate contributions made by the liquid and solid components of red mud to its alkaline properties. This information can help the company reduce the environmental impact of the mud.

Products from magnesite

Since 1986 the Division of Mineral Products has been investigating various opportunities for developing Queensland Metal Corporation's large magnesite deposit near

Rockhampton, Queensland. Significant progress has been made over the past year with two products — an environmentally friendly water treatment agent and a flame-retardant additive for plastics.

Work on the water treatment agent was described in last year's Annual Report. Since then, two commercially viable processes for the production of free-flowing, non-settling, high-solids content magnesium hydroxide slurries have been developed and provisional patents applied for.

A joint venture has been formed between QMC and French company Moines de la Lucette SA to pilot a new process for producing flame retardant-grade magnesium

Magnesium hydroxide pellets, granulated and incorporated into plastics such as injection-moulded polyethylene as fire retardants



hydroxide from magnesite. QMC and CSIRO have developed technology that provides the basis for low-cost chemical treatment of magnesite to produce a range of magnesium hydroxide products for use as fire retardants and smoke suppression agents in high-temperature engineering polymers and thermoplastics. A 50-litre autoclave has been commissioned for use in testing products.

The Australian Magnesium Research and Development Project was established to develop process technology for producing high purity magnesium chloride from magnesite. This can be used as a feedstock for making magnesium metal by electrolysis.

High purity magnesium metal (exceeding 99.9 per cent) has now been produced in a small-scale electrolytic cell from QMC feedstock. Work is also being carried out at the Queensland Centre for Advanced Technologies and at MIM Holding's laboratories in Brisbane a continuous mini-pilot plant for magnesium chloride production, has been commissioned, while engineering design for the demonstration plant at Gladstone continues.

New fuel cell to deliver clean energy

Commercial interest is growing in the consortium set up in 1991 to develop CSIRO's fuel cell technology. More than \$5 million a year is being spent by the consortium over five years in an international race to develop a competitively priced ceramic fuel cell as a more efficient and less polluting alternative to current power-generation technologies.

The Ceramic Fuel Cells Ltd

consortium currently consists of BHP, CSIRO, the Electricity Trust of South Australia, the Energy Research and Development Corporation, Pacific Power, the Queensland Electricity Commission, Generation Victoria, the State Energy Commission of WA, and the Strategic Industry Research Foundation.

The major objective of the five year R&D program is to produce multi-kilowatt fuel cell stacks, for testing in a variety of applications. The team of more than 50 scientists, engineers and technologists working on it includes 20 key experts who have been seconded from BHP and CSIRO.

A ceramic fuel cell is an electrochemical device that converts fuels (such as hydrogen, natural gas or methane) and an oxidant (such as air) directly into electricity. This eliminates the usual process of combustion and conversion of heat to electricity by mechanical means. The result is a cleaner, more efficient process.

The capability of fuel cells has been recognised for many decades, but their high cost and limited life expectancy has limited them mainly to exotic uses such as in spacecraft. Recent advances on several fronts, particularly in ceramics technology and computer-modelling techniques, have now made it possible to explore a more widespread commercial use of fuel cells.

Ceramic Fuel Cells Ltd is looking at ways to reduce production costs and increase durability, as are our competitors from the United States, Europe and Japan. The consortium is developing a cell based on zirconia, derived from the beach sand zircon, of which Australia is

the world's leading producer. This whole venture thus draws on 20 years of CSIRO research into zirconia technology, based in the Division of Materials Science and Technology.

In the longer term, the company plans to establish a major international ceramic fuel cell business centred in Australia.

Age dating and petroleum exploration

Research by CSIRO has resulted in a significant lowering of risk in exploring for petroleum. A five-fold improvement over conventional stratigraphic techniques has been obtained in tests in southern Papua New Guinea.

Successful exploration for petroleum requires the delineation of potential reservoir structures. To help discover these, the Division of Petroleum Resources has improved a technique called strontium isotope chronostratigraphy, which can give precise ages for limestones in the rock sequences being explored for hydrocarbons.

The technique uses the fact that the isotopic composition of strontium in seawater varies over geological time. Seawater has a very strong uniform strontium isotopic composition worldwide and limestones have the same isotopic composition in seawater at the time they are deposited. Consequently, by measuring the isotopic composition of strontium from limestones, geological ages can often be determined.

In practice, however, chronostratigraphy can give false results if the limestone samples have been chemically altered in the time interval between deposition and the present day.

Industry-sponsored research in the Division has resulted in methods that improve the reliability of chronostratigraphy for petroleum exploration and make the technique robust and cost-effective.

Complementary research underpinning this work has also been carried out in collaboration with the University of Technology, Sydney, under the auspices of the Centre for Isotope Studies, a consortium of nine eastern Australian universities and CSIRO, receiving financial support from the Australian Research Council.

DEVELOPMENTS

Industry deal at QCAT

Digital Exploration Ltd has relocated its Australian operations from Brisbane city to the CSIRO site at Pinjarra Hills, the Queensland Centre for Advanced Technologies (QCAT). The company has entered into an agreement with CSIRO, which includes access to the advanced intensive computing facilities at the site. The agreement also includes the significant upgrading of the existing Convex computer facilities at QCAT at no cost to CSIRO. Digital Exploration is a company at the forefront of petroleum and mineral exploration and will bring a new dimension to the capacity of QCAT to meet the needs of industry.

Hismelt pilot plant opens

CSIRO is a major participant in the development of the Hismelt direct iron-making process being developed by CRA Ltd and the US based company Midrex. A 100,000 tonne/year Hismelt pilot plant was officially opened at Kwinana, Western Australia, in November

1993. CSIRO has made major contributions to the process fundamentals and the engineering of the plant. As well as creating opportunities for increased value-adding processing of Australian ore, the process offers significant environmental benefits through eliminating coke making.

SIROGAS: Australian software for Korea

SIROGAS, a computer program developed by CSIRO to simulate and investigate gas flows, is to be installed in South Korea. The principal developer of SIROGAS left the CSIRO Division of Mineral and Process Engineering in February 1993 to start his own company, William J Turner Pty Ltd, which holds the exclusive licence for SIROGAS and related software. The SIROGAS program is already in use by most of the owners of long-distance pipelines in Australia, such as The Pipeline Authority and the State Energy Commission of WA. Recently, CSIRO and Leeds & Northrup Australia collaborated to develop an online realtime simulation to run on the Australian Gas Light control centre computers at Mortlake (NSW).

Help for marketing electric vehicles

The Australian Electric Vehicle Development Task Force has been established to help the development of an Australian market for electric vehicles. There are currently eleven member organisations that represent power utilities, lead producers, battery manufacturers, electric vehicle manufacturers, CSIRO and the Australian Electric Vehicle Association. The Electricity Commission of New Zealand is also

a member, which enables coordination of activities between the two countries. A senior scientist from the Division of Mineral Products was Vice Chairman of the Task Force in 1993–94.

GOAL

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

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

MANUFACTURING

ACHIEVEMENTS

Better coatings with FADS

The Division of Applied Physics has developed a system for depositing super-smooth and hard thin film coatings on a wide range of manufactured objects. Previously, achieving brilliant smoothness and reliable hardness on a variety of materials with thin films has been impractical.

The technology used is a filtered arc deposition system (FADS). This deposits thin-film materials that are dense and free of the micro-droplets that are present in films deposited by conventional arc evaporation and which can lead to breakdown of the coating under friction.

The CSIRO technology has been developed to commercial stage as FADS 3000 in collaboration with the Royal Australian Mint and Dynavac Engineering. It is already in use in the Mint, depositing a surface film of titanium nitride on proof coin dies, giving a ten-fold increase to their working life.

The filtered arc source, the key component of the system, can also be retrofitted to existing vacuum deposition systems, providing the ability to do research in arc deposition. CSIRO is marketing this retrofit version worldwide and has sold units to the Shanghai Institute of Metallurgy in China and the University of Wollongong in Australia.

There are many other potential applications for the technology to deposit thin film, wear resistant coatings on a wide range of metal, electronic, optical and other objects. They include tools, machine and instrument parts and objects

RESEARCH

requiring a decorative finish.

In April 1994, the Institution of Engineers, Australia, gave the FADS 3000 technology its National Engineering Award for Excellence in Research and Development, an award made once every two years.

Reducing shrinkage in plastic materials

Research by the Division of Chemicals and Polymers may solve some problems in the manufacture of plastics that prevent the products reaching their full commercial potential.

Plastic materials are made by joining together simple organic molecules (monomers) into giant molecules called polymers. Different types of plastic are made by using different monomers, or joining them in different ways or including some additives.

Unfortunately, during this process volume shrinkage often occurs. This results in product problems such as the formation of holes, stress cracking, poor adhesion, delamination and warping of composite polymers.

The major method of minimising volume shrinkage is to use monomers that open up their ring shape when they are formed into polymers. The CSIRO research has developed a new class of free radical, ring-opening monomers that will give a superior performance during the manufacture of plastics; they shrink only about half as much as monomers that do not open up their structure.

These new monomers will be most useful in the manufacture of improved precision castings, adhesives, optical lenses, polymeric coatings and matrix resins for composite materials.

Spread of antibiotic resistance

In research relating to the efficacy of pharmaceutical products, scientists at the Division of Biomolecular Engineering have discovered a new mechanism for the acquisition and spread of antibiotic resistance genes.

The occurrence of bacterial infections that are increasingly resistant to antibiotics is causing new epidemics of untreatable infections in hospitals and the community. To identify strategies to combat this problem, CSIRO scientists have been studying the nature of microbial drug resistance and its dissemination in bacterial populations.

In particular, they have been examining the organisation of plasmids from Gram negative bacteria that contain several different antibiotic resistance genes. Plasmids are small DNA molecules that play an important role in the spread of resistance as they can move from one bacterium to another.

The scientists have discovered that the resistance genes are packaged as discrete 'cassettes', which can slot into a specific site where they are expressed. Several genes can be inserted at the same location and are then expressed simultaneously. The cassettes can also move readily from one plasmid to another. Recently, the enzyme responsible for inserting the cassettes has also been shown to insert cassettes at other non-specific sites, increasing the possible range of resistance genes in the plasmids.

This discovery may make it possible to target vital areas of the bacterial DNA to prevent the expression of the resistance genes.

More than a surface understanding

Fractals have been intriguing scientists and the public for some years now. They are the colourful irregular geometric shapes whose intricate structure is reproduced ad infinitum on magnification.

Fractals, quite apart from their aesthetic appeal, have a practical use for mathematicians and engineers. The concept of fractal dimension, a measure of the fractal's complexity, can be used to describe the roughness of surfaces.

Knowledge of surface roughness can be important in fields as diverse as metal manufacture and food packaging.

Research collaboration by the Division of Mathematics and Statistics and the ANU's Centre for Mathematics and its Applications has produced a rigorous statistical theory for estimating fractal dimension from surface data.

The research began several years ago by comparing the surfaces of metal rollers used in sheet metal manufacture. The roughness was measured by dragging a fine stylus across the roller. The up and down movement of the stylus, caused by the roller's roughness, produced a surface profile whose complexity was quantified by estimating its fractal dimension. The researchers devised new statistical procedures that made these estimates more useful.

They have since begun characterising the surfaces of polymers used for food packaging and biomedical applications. For food packaging, the objective is to produce a polymer that is, microscopically, very smooth to prevent bacterial growth. Biomedical applications may require

different surface characteristics depending on the end use of the polymer.

Cleaner production of wool

CSIRO, ICI Australia and the Australian Wool Research and Promotion Organisation have reached agreement to commercialise two new processes, each of which will reduce adverse impacts on the



Removing wool from a dye-bath

environment while reducing the costs of wool processing. Australian wools make up about 70 per cent of the world's apparel wool, so the impact of these processes will be

significant for the industry.

The first agreement concerns a plan to export a new Australian system for dyeing wool. The key to the new method is a novel dyeing support chemical material jointly developed by the Division of Wool Technology and ICI Valchem.

The process, called Sirolan LTD[®] (Low Temperature Dyeing) offers brighter colours, softer handling wool, longer wearing garments, cleaner effluent, less fibre damage and lower energy use. Following successful commercialisation of Sirolan LTD[®] by ICI in Australia and New Zealand, CSIRO and ICI have now reached agreement to market the process to Asia, with an initial thrust into Japan and Korea.

The second process, called Sirolan-CF (Chemical Flocculation) improves the in-line handling of waste water from wool scouring plants. The process removes up to 95 per cent of the wool wax, up to 99 per cent of the soil and about 75 per cent of the biological oxygen demand (BOD) from the waste water. It is these components that contribute most of the pollution load from the scouring process, so their removal is essential.

Sirolan-CF is particularly suited to Australian wool, which is produced in hot, dusty conditions and may contain relatively high proportions of soil. The process can be set up and used relatively cheaply and easily; discharge from processing plants to the sewer is substantially decreased, reducing plant operating costs.

Taste research in Japan leads to new markets in Asia

CSIRO research in Japan has provided Australian food producers



Meat wrapped in oxygen permeable skin film has up to four days' display life after six weeks' storage and transportation (at 0 degrees) in modified-atmosphere master packs

and processors with valuable information on sensory determinants of food preferences of Japanese consumers, the cultural context of food use in Japan and the distribution system that Australian exports go through to reach the lucrative Japanese market.

The Sensory Research Centre in the Division of Food Science and Technology stationed a scientist in Tokyo for thirty months to gather information, which was used to establish a database in Sydney run by two bilingual staff.

The 'Japan Project' team evaluated over 100 Australian products and assisted more than 400 Australian food companies by providing information on product image, suitability of packaging and Japanese sensory preferences. Their work has contributed to the rise in Australia's processed food exports to Japan from \$125 million in 1988 to \$560 million in 1993.

The CSIRO scientists have produced over 30 publications, including two major reports on Japan and Korea, and the bimonthly newsletter *Food Japan and Asia*, for the past three years. They organised and sponsored the First Australia-Japan Forum on Food Exports and collaborated in several university studies of Asian countries. They gave significant support to exporting activities by small and medium companies (SMEs) through media events, public displays, confidential seminars and meetings.

The experience gained by the Sensory Research Centre in Japan is now being used to plan an expanded service: 'Project Asia'. As a first step, facilities for undertaking both generic and contract research for Australian companies in other important markets in the Asian region (including Korea, Taiwan, Indonesia, China, Malaysia and Singapore) have been established.

Adding value to meat exports

Traditionally, Australian meat destined for retail sale has been sold and distributed as carcass sides or as primal cuts. Thanks to a new packaging technology, retail-ready consumer portions can now be prepared in Australia and distributed direct to retailers for immediate display on supermarket shelves.

The new packaging technique, developed by scientists from the Division of Food Science and Technology, combines an existing technology used for exporting chilled lamb carcasses with a thermoformed skin film specifically developed for the purpose. Scientific knowledge about the benefits of modified gas atmospheres on the consumer acceptability of meat has

enabled chilled retail portions to be stored for up to six weeks at 0°C, with a subsequent retail display life of three to four days.

Retail cuts are first vacuum sealed in a specially formulated skin film that allows carbon dioxide and oxygen gases to pass through. They are then placed in a master pack for storage and distribution.

The air in the master pack is then replaced with carbon dioxide and very little oxygen, effectively sealing the freshness into the meat.

At the destination, the vacuum-sealed consumer portions are removed from the master pack and, because the special skin they are packed in allows oxygen to pass through, contact with normal air causes the meat to bloom to a rich red, ready for retail display.

DEVELOPMENTS SAFE-T-CAM

The SAFE-T-CAM system, a CSIRO technology described in the 1991–92 Annual Report, is aimed at eliminating speeding and unsafe vehicles from Australian roads. The system is currently being installed on 20 sites across the state of NSW's road network. Trials conducted during 1992 demonstrated that SAFE-T-CAM could accurately monitor speed over long distances and identify number plates correctly. The development of SAFE-T-CAM was undertaken by a consortium of Telecom, CSIRO and the NSW-RTA.

Meat industry liaison group privatised

An agreement between CSIRO and the Meat Research Corporation has seen the industry liaison activities of the Meat Research Laboratory in

the Division of Food Science and Technology transferred to a new private company — Australian Meat Technology. This followed a recommendation from the external review of the Division conducted in 1992. Eight CSIRO officers have transferred to the company.

High speed food inspection

The Hon. Jim Elder, MLA, Queensland Minister for Business, Industry and Regional Development, launched the 'Robosorter' at the Buderim Ginger factory in Yendina in January 1994. The Robosorter is a novel computer-controlled machine for inspecting, grading and sorting food at high speeds. It was developed by Robo Foods Pty Ltd in collaboration with the Division of Manufacturing Technology and employs the Division's core technology in machine vision.

Queensland Manufacturing Institute

The Queensland Manufacturing Institute joint venture between CSIRO, Queensland University of Technology, TAFE Queensland and the Department of Business, Industry and Regional Development was officially launched in December 1993. The Institute pools technical and human resources to provide access for industry to advanced manufacturing technologies. Industry demand for rapid product prototyping by stereolithography, operated within the Institute by the CSIRO Division of Manufacturing Technology, has built up to a high level as a result of international market successes by companies that use the technique for product development.

Optical technology exported to US and China

CSIRO has won contracts to supply its award-winning optical technology to the US and Chinese Mints. Originally developed for the Royal Australian Mint, the OSP 130 instrument uses optical surface profiling to measure the master tools that mint coins. It ensures that coins and medallions are made to specification throughout the life of the die. The technology was described in the 1990–91 CSIRO Annual Report.

Smart test battery analyser

The Smart Test Battery Analyser now has nationwide distribution and several orders from the USA, Europe and Malaysia. The technology developed by the Divisions of Manufacturing Technology and Mathematics and Statistics enables the analyser to compare a battery's condition with data collected from hundreds of battery tests in different conditions. The analyser then ranks the battery as good or needing replacement. GNB Batteries, a wholly owned division of Pacific Dunlop Limited, is the sole distributor of the instrument and has placed it throughout the networks of Shell Auto Care, BP Car Care and the Bob Jane T Mart organisation.

Improved wood adhesive in commercial use

In September 1993, one of the largest Australian manufacturers of medium density fibreboard started using a new formulation adhesive resin to produce water-resistant medium density fibreboard. This new adhesive was developed jointly by the Division of Forest Products and Huntsman Chemical Company

Australia. It provides water-resistant bonding, and has the same curing properties as more generally used wood adhesives but releases much lower levels of formaldehyde. Another new resin has been tested with success by Huntsman Chemical Company for making laminated veneer lumber.

GOAL

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

INFORMATION AND COMMUNICATIONS

ACHIEVEMENTS

Multibeam antenna

A new CSIRO antenna may help hasten the end of sites with forests of conventional antennas, each tuned to a single satellite.

The multibeam antenna, developed by the Division of Radiophysics in collaboration with the Department of Defence, can access up to 20 geostationary satellites simultaneously. These satellites can be in fixed or inclined orbits and work over multiple frequency bands.

There are obvious cost advantages in installing and maintaining only one, compactly designed antenna, instead of one antenna per satellite, especially in locations where space is restricted.

The CSIRO multibeam antenna consists of two reflectors and an array of feeds, each viewing a designated satellite. Unlike a conventional antenna, which has a single focal point where the feed must be positioned, the CSIRO multibeam antenna has a focal surface on which up to 20 feeds can be placed.

Its reflectors are specially shaped and strategically positioned to broaden the scan region along the geostationary orbital arc. Only the feeds need to be moved when tracking satellites, rather than the entire antenna structure, as is the case in conventional earth stations.

The Division of Radiophysics has developed a special 'bed of bolts' manufacturing technique which, by employing a computer-controlled procedure, automatically adjusts the mould shape and panel profile of the antenna. The 'bed of bolts' was

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originally developed for building the Australia Telescope and has subsequently been used to make over 20 large antennas for Australian and overseas customers.

Land information systems

LISA (Land Information Systems Architecture), a collaborative project between the Division of Information Technology and the South Australian Department of Environment and Natural Resources, is building systems that provide fast, networked access to land-related data throughout a State.

Many agencies now have State-wide databases that have the potential to enable more effective planning, decision-making and administration in government and industry. Many important applications require fast access to information held and maintained on a number of databases by large numbers of concurrent users.

The Land Information Systems currently used to assemble and maintain the databases have not been designed to provide these capabilities. The high costs in replacing existing Land Information Systems and the many types of systems in use make it impractical to replace them — or for all agencies to buy systems from a single vendor.

In the LISA project, the integration of spatial (land) and other data is a key capability. This is achieved through research combining specialist facilities and industry-standard Open Systems technologies.

Research and development over two years has led to prototype software that has been trialled with whole-of-State databases. Core

elements of this LISA system are now available to commercial organisations intending to build distributed systems.

New microwave technology

The Division of Radiophysics and industry partners have developed a compact cost-effective microwave transceiver for use in modern telecommunications equipment. The product is expected to be available commercially in 1995.

The partners in this research project are Microwave Network Australia Pty Ltd and US company Microwave Networks Incorporated.

Microwave links are already widely used in telecommunications, but the transmitters and receivers are comparatively bulky and use considerable amounts of power. They also operate in frequency bands that are filling quickly. The aim of this research is to reduce the size and cost considerably and to open up access to the new higher frequency millimetre wave bands.

The operating frequency of the system the researchers are developing demands the use of gallium arsenide millimetre wave integrated circuits, a technology in which the Division is already well experienced. The first of CSIRO's integrated circuit designs is currently being tested. Incorporation of novel waveguide structures for filters is also a key to success in this project.

There is potential for significant export business in the exploitation of this technology as cellular telephone networks increase rapidly. There could also be a demand for its use in preference to optical fibre in linking business customers on

special networks or in areas where there may be inadequate telecommunications infrastructure.

Respirator Advisory System

A joint project by 3M and CSIRO has made available expert advice for customers buying a respirator.

A new computer program called the 'Respirator Advisory System' has captured the knowledge of the experts and put it into an easy to use form so that the complex process of respirator selection will be quicker, easier and above all, safer.

Choosing the wrong safety equipment can be potentially fatal. Only the experts really know the best respirator for a given set of circumstances, but expert opinion is not always on hand when needed.

The Respirator Advisory System contains information on over 6000 hygiene rules, 17 individual databases that list 1700 chemicals, and encompasses 100 product categories. An operator (such as a 3M retailer), in response to prompting by the computer program, keys in specific and detailed information about the customer. The software rapidly analyses the problem and presents a solution in the form of recommended safety equipment. The operator can then advise the customer accordingly.

The 3M Respirator Advisory Service was launched in May at Futuresafe '94, the major Occupational Health and Safety exhibition in Australia.

The technique of 'capturing' expert knowledge, developed by computer scientists at the Division of Information Technology, can be applied to other areas to put expert knowledge at the users' fingertips.

DEVELOPMENTS

Health effects of electromagnetic radiation

Some concerns have been raised about the safety of cellular telephones following recent media attention in the United States of America. The Division of Radiophysics was commissioned by the Spectrum Management Agency (Department of Communications and the Arts) to review the current status of research on the biological effects and safety of electromagnetic radiation and its effects on human health. Discussions with leading international researchers and representatives of regulatory authorities have provided vital input to both scientific and political implications of research into this topic. Overseas, the cellular telephone agencies are beginning to provide research funding. CSIRO will continue to monitor this area.

GOAL

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

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

ENVIRONMENT

ACHIEVEMENTS

Cleaning up contaminated soils

Scientists from the Division of Coal and Energy Technology, working with industry, are well on the way to developing a transportable cleaning unit that will extract hydrocarbons from contaminated soil. The unit will enable cleaning to occur on site and the extracted hydrocarbons to be collected and re-used for fuel.

The project is jointly funded by CSIRO, Caltex Oil (Australia) Pty Ltd and the Industrial Research and Development Board (GIRD). Scientists from the University of New South Wales are collaborating in the research.

The process can extract a full range of hydrocarbons including aromatics, phenolics, benzene, toluene and xylene compounds in a relatively short time. The technology is suited to small and medium sites, such as those around garages or storage dumps where soil loads of between 1 to 10 tonnes may need treating. An added advantage of the process is that it operates in a closed system and does not generate any secondary pollutants.

An experimental rig, capable of processing 20 kilograms of soil, is now in operation at the University of New South Wales. Results confirm that it is possible to remove 99 per cent of the petroleum hydrocarbons from the soil. The extraction efficiency depends on the type of soil and the exact method of extraction used.

The information gained from this and another, smaller, rig, will be used to model a large-scale system to obtain a better estimate of cost

RESEARCH

before proceeding with commercialisation.

New environmentally friendly fumigant

The Division of Entomology has found a new fumigant that may replace the widely used gas methyl bromide, which depletes the ozone layer.

The new gas is carbonyl sulphide, a simple compound of carbon, oxygen and sulphur. Patent applications have been made by the Division's Stored Grain Research Laboratory for its use as a fumigant for the control of insects and other pests.

The gas occurs naturally, being released by compost heaps, marshes and fires. It is the most common form of sulphur in the stratosphere. Because carbonyl sulphide breaks down quickly when it is applied to stored commodities and does not build up in living systems, it avoids many of the problems that occur with persistent chemicals. Tests have shown it will control a wide range of pests, such as beetles, fruit flies, moths, mites, termites and nematodes.

Since the Division announced its discovery in 1993, it has received many enquiries from around the world about the new fumigant.

The research on carbonyl sulphide was funded by CSIRO, the Australian Wheat Board and the State Bulk Handling Authorities.

Monitoring water quality

Difficult terrain and long distances in Australia make frequent and regular gathering of environmental data an expensive business. Scientists in the Division of Water Resources have been developing a range of technologies to help

authorities monitor the quality of our water resources.

One result is the Aqualab monitor, now being marketed by Greenspan Technology Pty Ltd.

Aqualab can be left in remote areas with hostile climates for long periods to gather and transmit essential data on water quality. It can monitor temperature, conductivity, turbidity, depth, pH, Eh, nitrate, ammonia, dissolved oxygen, chloride, sulphide, reactive phosphate and fluoride. A range of other water quality measures is also being considered for inclusion.

An on-site logger stores all measurements, as well as information on the status of the system. Data can be retrieved and instructions given by users located at their place of work by using a number of communication links, ranging from cellular phones to satellites.

Aqualab was developed by CSIRO in collaboration with the Urban Water Research Association of Australia and the Engineering and Water Supply Department of South Australia.

CSIRO research in the last few years has also been revealing the substantial potential of optical remote sensing for monitoring water quality. Earlier work had demonstrated that optical water properties, such as turbidity and plankton blooms, could be mapped by remote sensing. In 1993, Canadian remote sensing equipment was used for the first time in Australia in flights over the Hawkesbury River near Sydney, following a summer of serious outbreaks of algal blooms.

The equipment was able to provide essential information

quickly about the amount, type and condition of the algae, key information in assessing water quality. This is an important outcome, given the current reliance of local authorities on time-consuming cell count techniques in deciding whether to issue public pollution warnings.

CSIRO scientists are now collaborating with a newly formed Australian company, Earth Observation Resources, in the operational flying and application of these techniques in several national and international water resource projects.

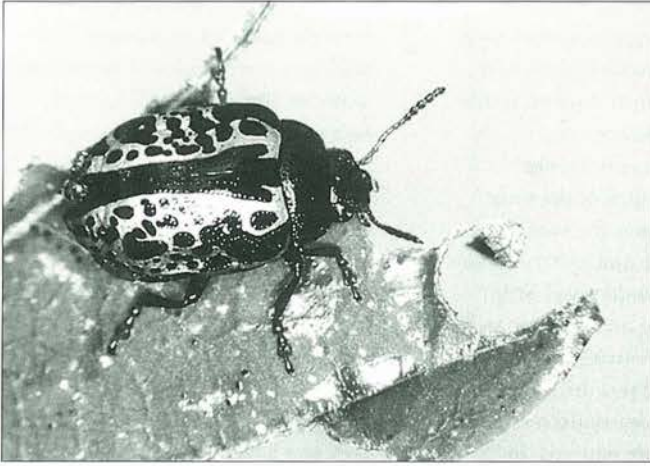
Biological control of *Sida acuta*

Scientists from the Division of Entomology are beginning to win the war against a weed causing problems in the north of Australia.

Sida acuta, or spinyhead sida, grows on land in the tropics that has been disturbed, infesting crops, orchards, roadsides and pastures. It is native to Mexico and Central America but is now widespread in Queensland and the Northern Territory. Seedlings can be controlled chemically but older plants are resistant to most herbicides.

The Division released the first biological control agent on the flood plains of the Finniss River in the Northern Territory in 1989. This agent, the leaf-eating beetle *Calligrapha pantherina* from Mexico, established rapidly and reduced the weed's seed production by over 90 per cent.

Another insect, a stem-boring weevil, *Eutinobothrus*, also from Mexico, complements the action of the leaf-eating beetle. This was released early in 1994 near the



The leaf-eating beetle
Calligrapha pantherina attacks
the weed *Sida acuta*

Darwin River Dam. As yet it is too early to see any impact but it appears to have established in the area successfully.

CSIRO is studying yet another leaf-feeder in quarantine, as it will require more than one insect before the *Sida* species is reduced to levels where it will no longer be of environmental and economic concern. As *Sida* is a weed of many tropical and sub-tropical countries, there are prospects for the export of successful biological agents in the future as a form of aid.

Mapping world vegetation

In November 1993 the US Government presented a Federal Leadership Award to an international satellite mapping project in which CSIRO is involved.

The Global Land 1-Km AVHRR Data Set Project aims to map vegetation conditions every ten days around the world, at one kilometre resolution, using the Advanced TIROS satellite series operated by the National Oceanic and Atmospheric Administration. Major contributors to the project are the US Geological Survey, NASA

(through its 'Mission to Planet Earth'), the European Space Agency and CSIRO.

The vegetation data will be used by scientists around the world for investigations of trends in land cover, including land clearance. The project assists long-term studies of global change under the International Geosphere Biosphere Programme.

Over 25 ground stations collect daily satellite data for the project. In our region these include Perth, Townsville, Darwin, Hobart, Manila and Casey in Antarctica. Information from each of these stations is extracted, re-formatted and forwarded to the US Geological Survey by the Australian Land Research Data Centre operated by CSIRO in Canberra. The Centre is cooperatively funded by CSIRO, the US Geological Survey and several Australian government agencies.

Australian participation in this global project is coordinated by the CSIRO Office of Space Science and Applications (COSSA) and forms a major contribution to the maintenance of international earth observing satellite information systems.

ASEAN ocean study

The Division of Oceanography is playing a leading role in a \$2.6 million ASEAN-Australia project funded by AIDAB, the Australian International Development Aid Bureau. The Regional Ocean Dynamics Study has as one of its main objectives the measurement of the throughflow between the Pacific and Indian Oceans. It is being coordinated by AMSAT Ltd and also involves the Australian National Tidal Facility.

The capacity of our oceans to absorb solar energy, transport it via ocean currents for thousands of kilometres, and then disperse it into the atmosphere as heat has a considerable influence on the world's climate. One of the most important regions is the western equatorial Pacific and eastern Indian Oceans, yet we understand little about the flow of ocean water and transfer of heat between them.

Knowledge of this throughflow should improve our understanding of regional climate patterns, in particular the El Nino Southern Oscillation phenomenon and the monsoon cycle.

In a joint 23 day research voyage with representatives of five ASEAN nations, five year-long deep moorings to measure throughflow in the region were deployed in June 1993 from the Indonesian research vessel Baruna Jaya 1.

In another operation, two bottom-mounted instrument packages were deployed in shallow water in Malacca and Singapore Straits by Division of Oceanography staff, in conjunction with counterparts from the Royal Malaysian Navy and the Port of Singapore Authority. The shallow instruments worked very well and were recovered successfully in November 1993. To protect them from damage, the Division developed special trawl-proof concrete housings.

An international symposium to present the results of the study will be held in Indonesia in June 1995. The project has provided an excellent opportunity for developing collaborative links with ASEAN marine scientists, and for contributing to information exchange in the region .

Measurements of the throughflow between the Indian and Pacific Oceans should improve our understanding of regional climate patterns



DEVELOPMENTS

Oil spills review

The Division of Oceanography, in conjunction with Envirotech Health Environment and Workplace Pty Ltd, completed a major report for the Australian Petroleum Exploration Association (APEA), as part of APEA's Offshore Petroleum Environmental Review Project. The report provides a comprehensive review of issues relating to the effect of oil spills on the marine environment, including effects on biota as well as aesthetic and commercial values. The report finds that less than 100,000 litres of oil has been spilled from over 1000 wells drilled, and this has resulted in minimal damage to marine ecosystems.

Land and water care outcomes

The outcomes from the Multi-Divisional Program on Land and Water Care were released in March 1994 during the Australian Farm Management Society Conference. They appeared in the form of papers and a booklet Outcomes 93. A benefit-cost analysis of the work so far showed a 60:1 benefit ratio from the research investment in the Central wheatbelt, based on a conservatively expected adoption of recommended practices by 60 percent of farmers over the next 20 years.

NSW bushfires

The Division of Forestry's bushfire group has produced detailed 'reconstructions' of the fires that killed four people in New South Wales in January 1994. The immediate purpose was to assist the coronial inquiry into the deaths but the Division has also been able to improve its models, which seem to

have underestimated what can happen on the worst fire days.

Greenhouse collaboration with Japan

During the year, the Japanese Ministry of International Trade and Industry (MITI) funded a visit to Australia by one of Japan's leading atmospheric scientists, Dr Shoichi Taguchi, from Tsukuba. He worked with scientists in the Division of Atmospheric Research as part of a major three-year collaborative global atmospheric chemistry program between Japan and the CSIRO, which is funded by MITI and MFP Australia. CSIRO has developed the world's first technique for assessing the accuracy of current estimates of global carbon dioxide release and the results are being used by the Intergovernmental Panel on Climate Change.

Rainforest identification system

The world's first interactive identification system for rain forests was launched by CSIRO in December 1993. The computer program, 'Australian Tropical Rain Forest Trees', can identify over 1000 species and is the result of over 30 years work by the Division of Plant Industry.

GOAL

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

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

INFRASTRUCTURE, SERVICES, ADVANCEMENT OF KNOWLEDGE

ACHIEVEMENTS

Re-engineering the construction process

Process re-engineering in the manufacturing sector has led to large reductions in process time. The construction sector is adopting the re-engineering concept, aiming to completely redesign processes to eliminate non value-adding activities, rather than simply improving present practices.

Over the past year, a group of construction organisations, including CSIRO, has been conducting wide-ranging research aimed at reducing the construction time process by 40 per cent. Others in the group (known as T40), are Fletcher Construction, BHP Steel, CSR, Otis Elevators, A.W. Edwards, Environ, Smith Jesse Payne Hunt, Taylor Thomson Whitting, Stuart Bros and Sly & Weigall. Each company is responsible for an aspect of the process.

The main task of CSIRO, through the Division of Building, Construction and Engineering, is to research and develop time- and cost-saving tools, such as computer software and communications systems.

BCAider software (see 1990-91 Annual Report), which enables accurate checking of compliance with the Building Code of Australia and allows designers to interpret and test variations to their plans, can be immediately integrated into a re-engineered construction process.

Computer-based communication systems that will allow a network of users to simultaneously view plans and drawings, and modify them in real time, are being worked on (see

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1992-93 Annual Report). This will reduce the time needed for face-to-face meetings between project owners, architects and engineers.

CSIRO expects to put the T40 principles into practice in a CSIRO building in the near future.

Fish oils and heart disease

The Division of Human Nutrition has been a world leader in showing that fish oils protect against heart disease. Its researchers have now discovered the component in these oils that confers this protection.

Fish oils in the diet retard development of an abnormal beating rhythm in the heart (arrhythmias) and high blood pressure (hypertension). They also increase blood vessels' ability to relax.

Recent biotechnological advances have enabled pure forms of the fatty acids in fish oils to become available in quantities that scientists can use in diets for experimental animals. This opportunity has enabled the Division, in a major collaborative project, to identify the key fatty acid in fish oils that confers protection against cardiovascular disease.

Experiments showed that the single addition of the fatty acid docosahexaenoic acid to diets of experimental animals protected their hearts against arrhythmias. In animals with a genetic disposition to hypertension, this fatty acid prevented development of high blood pressure and abolished unwanted contractions of blood vessels.

The scientists also found this fatty acid conferred a marked protection in the kidney against a serious condition that results when protein, which should be retained, is lost into urine.

This research finding should lead to improved opportunities for

preventing heart disease, through the public health advisory sector and in the production of foods and pharmaceuticals enriched with this particular fatty acid.

'Super-resolved' pictures of supernova remnant

Working right at its technical limits, the Australia Telescope Compact Array has been used to make highly resolved pictures of the radio source arising from Supernova 1987A.

Supernova 1987A — a star that exploded in 1987 — was the brightest supernova in more than 300 years and gave astronomers much information on how stars explode. In 1990 a radio source was detected at the site of the explosion, first by the University of Sydney's Molonglo Observatory Synthesis Telescope, then at higher frequencies by the Australia Telescope.

The remnant has been carefully monitored. It is growing in size, but its angular extent is still fairly small (about 1.3 arcseconds).

Using the highest angular resolution available on the Australia Telescope Compact Array and a 'super-resolution' technique to process the data, astronomers produced images of the remnant with a resolution of 0.5 arcseconds (less than 0.01 per cent of a degree). These images reveal a spherical shell-like structure and, combined with previous observations, show that the remnant is rapidly increasing in size, and will collide with the circumstellar ring in few years' time.

The ring itself is puzzling, as it appears to be a real ring and not the bright rim of a shell of material; more clues to its nature and origin should come when the supernova remnant begins to interact with it.

In late 1993, observations of the visible light from the ring showed that the ring was brightening in a pattern that followed the radio structure detected with the Australia Telescope.

DEVELOPMENTS

Building initiatives in Asia

Initiatives by the Division of Building, Construction and Engineering are helping to create commercial opportunities for Australian industry in countries throughout the Asia-Pacific region. The Division has worked with an Australian company to develop concrete suitable for a 90-storey reinforced concrete building in Bangkok, one of the tallest in the world. The Division is the coordinator of the Asia Pacific Rim group (APRIM), members of which collaborate on a technical basis on standards for building materials, with a view to developing common standards. The Division is also using its knowledge of corrosion of building materials to promote equivalent testing regimes, which would be of great benefit to Australian companies marketing products in the region.

'White dwarf' companion spotted

For the first time, scientists from CSIRO and the Australian National University have seen directly a white dwarf companion star of a millisecond pulsar. In 1992, astronomers using the CSIRO Parkes telescope discovered the closest millisecond pulsar to Earth. With the discovery of its white dwarf companion, they have been able to calculate that the pulsar collapsed about two thousand million years ago.

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.

CSIRO is involved in 43 of the 51 CRCs already established under the CRC Program. A further 10 Centres will be announced by the Prime Minister in late 1994. Total commitments to the Program by participating organisations over the initial five to seven year contract period amount to \$2245 million, including \$693 million from the Commonwealth CRC Program.

CSIRO's contribution, valued at more than \$285 million or 13 per cent of the total, is mainly through the provision of research staff, infrastructure, administrative support and access to research knowledge. The Organisation is making 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 principle guiding Organisation's involvement is that the objectives of the CRC must be consistent with the priorities determined by CSIRO in its response to national research needs.

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. The Organisation has links with 29 different universities through the Program and similar collaborative ventures. CSIRO staff are now jointly supervising over 100 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 is over 500. 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.

COOPERATIVE RESEARCH CENTRES IN WHICH CSIRO IS A PARTICIPANT

CRC

CSIRO Division

Manufacturing Technology

CRC for Materials Welding and Joining

CRC for Polymer Blends

CRC for Molecular Engineering and

Technology: Sensing and Diagnostic

Technologies

Manufacturing Technology

Chemicals and Polymers

Food Science and

Technology Applied Physics

Biomolecular Engineering

Food Science and Technology

CRC for Industrial Plant Biopolymers

CRC for Intelligent Manufacturing Systems

and Technologies

CRC for Alloy and Solidification

Technology

Manufacturing Technology

Manufacturing Technology

Information and Communications Technology

CRC for Intelligent Decision Systems

CRC for Robust and Adaptive Systems

Australian Photonics CRC

CRC for Advanced Computational Systems

Research Data Network

Information Technology

Radiophysics

Applied Physics

Information Technology

Information Technology

Mining and Energy

CRC for Mining Technology and Equipment

Exploration and Mining

Mineral and Process

Engineering

Manufacturing Technology

Coal and Energy Technology

GK Williams CRC for Extractive Metallurgy

Mineral and Process

Engineering

AJ Parker CRC for Hydrometallurgy

Mineral Products

Australian Petroleum CRC

Petroleum Resources

CRC for Australian Mineral Exploration

Technologies

Exploration and Mining

Australian Geodynamics CRC

Exploration and Mining

CRC for New Technologies for

Power Generation from Low Rank Coal

Mineral and Process

Engineering

CRC

Agriculture and Rural Based Manufacturing

CRC for Legumes in Mediterranean
Agriculture

CRC for Plant Science

CRC for Tropical Plant Pathology

CRC for Tropical Pest Management

CRC for Temperate Hardwood Forestry

CRC for Hardwood Fibre and Paper Science

CRC for Viticulture

CRC for Premium Quality Wool

CRC for the Cattle and Beef Industry
(Meat Quality)

CRC for Aquaculture

CRC for Sustainable Cotton Production

CRC for Food Industry Innovation

Environment

CRC for Waste Management
and Pollution Control

CRC for Soil and Land Management

CRC for Catchment Hydrology

CRC for Biological Control of
Vertebrate Pest Populations

CRC for Antarctic and Southern
Ocean Environment

CRC for Freshwater Ecology
and

CRC for Southern Hemisphere Meteorology

CRC for Tropical Rainforest Ecology
and Management

Materials Science and Technology

CRC for Tissue Growth and Repair

CRC for Cellular Growth Factors

CRC for Eye Research and Technology

CRC for Cardiac Technology

CRC for Vaccine Technology

CSIRO Division

Laboratory for Rural
Research WA

Plant Industry

Tropical Crops and Pastures

Entomology

Forestry

Forest Products

Horticulture

Animal Production

Wool Technology

Animal Production

Animal Health

Food Science and
Technology

Tropical Animal Production

Fisheries

Plant Industry

Entomology

Food Science and Technology

Human Nutrition

Water Resources

Chemicals and Polymers

Soils

Water Resources

Wildlife and Ecology

Oceanography

Institute of Natural Resources

Environment Project Office

Atmospheric Research

Wildlife and Ecology

Human Nutrition

Biomolecular Engineering

Chemicals and Polymers

Biomolecular Engineering

Biomolecular Engineering

Chemical and Polymers

Animal Health

AWARDS

THE CHAIRMAN'S MEDAL

Dr Brian Walker, Chief of the Division of Wildlife and Ecology, accepted the Chairman's Medal from CSIRO Chairman Professor Adrienne Clarke, on behalf of Medal winner Dr Graeme Caughley



Far Right: Sir Ian McLennan Award winner Dr Jonathan Banks (centre) with Mr Alex Dix, AO, Chairman of the NSW Science and Technology Council and Deputy Chancellor of the University of Western Sydney (left), and Sir Peter Derham, Chairman of the Board of Management of the Sir Ian McLennan Achievement for Industry Award Trust Fund

The 1993 Chairman's Medal and CSIRO Medals were presented on 24 November 1993 by Professor Adrienne Clarke AO, Chairman of the CSIRO Board.

The winner of the Chairman's Medal was Dr Graeme Caughley of the Division of Wildlife and Ecology for his outstanding research achievements and leadership in the field of vertebrate ecology.

CSIRO MEDALS

CSIRO medallists 1993.

Back row: Dr John Cannon, Dr Bob Winks, Professor Andrew Lyne, Dr Simon Johnston.
Front row: Dr Brian Walker (for the Chairman's Medallist Dr Graeme Caughley), Dr Robin Bedding, Dr John Stocker, Professor Adrienne Clarke, Dr Dick Manchester, Dr Nicolo D'Amico



The CSIRO Medals for 1993 were awarded to:

- Dr Robin Bedding, of the Division of Entomology, for outstanding work on the use of nematodes to control insect pests
- Dr Bob Winks, of the Division of Entomology, for outstanding contribution to the Australian grain industry
- Dr R N Manchester, leader of

the Pulsar Team, of the Australia Telescope National Facility. (Members of the Pulsar Team: Dr M Bailes, Dr N D'Amico, Dr S Johnston, Dr P Harrison, Professor A Lyne)

- Dr John Cannon, of the University of Sydney, for outstanding work in the field of computer algebra

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.

Winner of the Award in 1993 was Dr Jonathan Banks of the Division of Entomology for his contribution to the grain export industry.

SELECTED HIGHLIGHTS

- CSIRO, ICI Australia and the Australian Wool Research and Promotion Organisation have reached agreement to commercialise two new processes that will reduce adverse impacts on the environment while reducing the costs of wool processing (see page 30);
 - A genetically engineered vaccine against cattle tick, developed in conjunction with Biotech Australia, was released (see page 21).
 - Digital Exploration Ltd, a leader in petroleum and mineral exploration, relocated its Australian operations to CSIRO's Queensland Centre for Advanced Technologies in Brisbane (see page 26).
 - SIROGAS, a computer program that simulates and investigates gas flows, is to be installed in South Korea (see page 27).
 - The NSW Road Traffic Authority is to buy a further 20 SAFE-T-CAM units, which help in efforts to eliminate speeding and unsafe heavy vehicles from roads (see page 32).
 - CSIRO has won contracts to supply its award-winning optical technology to the US and Chinese Mints (see page 33).
 - The Smart Test Battery Analyser has won nationwide distribution and several orders from the USA, Europe and Malaysia (see page 33).
- CSIRO entered into a number of major agreements including:
- with other consortium participants, a contract with a US company, Georgia-Pacific, to develop Scrimber high quality reconstituted timber technology;

- a consultancy with the Australian Institute of Petroleum to provide information on the volume of petrol sold into and from Australian service stations at different temperatures;
- an agreement setting up the Australian Housing and Urban Research Institute, which will carry out a program of housing and related urban research and provide education and training into housing and urban issues.

SMALL-TO-MEDIUM SIZED ENTERPRISES (SMEs)

In June 1994, all Divisions in CSIRO were surveyed to assess the levels of interaction with SMEs. Although it is difficult to make comparisons with the figures found in the CSIRO/McKinsey report on CSIRO's interaction with SMEs, it appears that the number of contracts between CSIRO and these enterprises rose by 23 per cent in the past financial year. The level of funds received by CSIRO from SMEs rose by 27 per cent.

These figures appear to demonstrate that CSIRO is currently meeting its commitment to double the level of interaction with SMEs within five years.

It is clear that, by some measures, the level of interaction is high and rising. However, in other areas, such as secondments of CSIRO staff to industry and vice versa, and the level of subcontracting of research to private industry, the level of interaction is still low.

The following are examples of progress being made in collaborative research projects with SMEs:

- nickel exploration, with Forrestania Gold NL;
- mine design and planning

- software, with Fractal Graphics;
- stored grain research, with Grainco, Graincorp and others;
- fruit ripening research, with Pacific Seeds Pty Ltd;
- pharmaceutical drug research, with AMRAD Corporation;
- advanced microwave systems engineering, with Microwave Networks Australia.

SERVICE EXPORTS

In August 1993, CSIRO joined Austrade and others in a study of service exports from Australia. The study, involving ten organisations, resulted in a survey database covering more than 1350 exporters in 27 industry sectors including education, information technology, wholesale and retail trade, technical services, finance and transport. The study also analysed best practice in ten other countries. CSIRO's focus in participating in the study, which is due for completion in 1994–95, was on innovation processes, R&D expenditure and competitive advantages.

CORPORATE BUSINESS

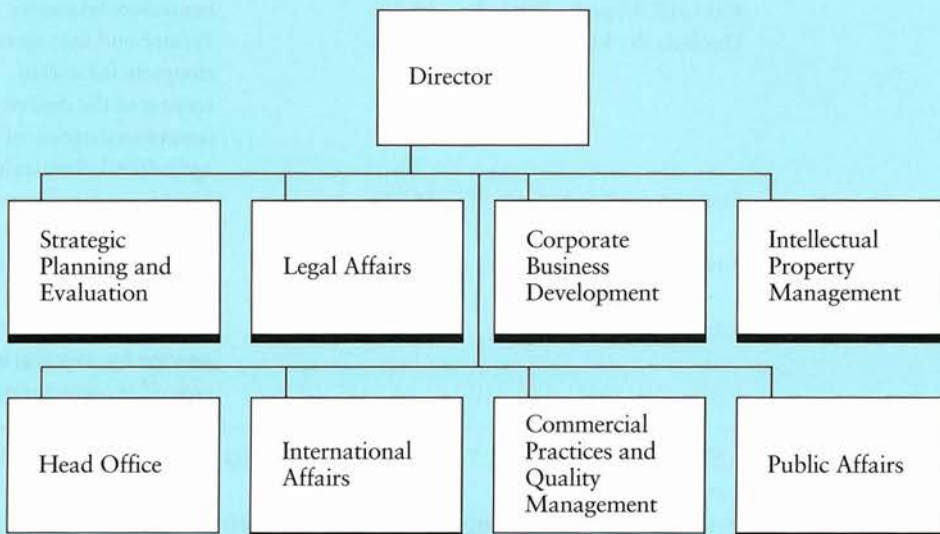
During this year, Mr Peter Bradfield was appointed as Director, Corporate Business. Mr Bradfield came to CSIRO from the resources industry, where he was Chief Executive of Energy Resources of Australia Ltd and Managing Director of the Elders Mining Group of companies. He is also a foundation director of the Australian Minerals and Energy Foundation.

The range of responsibilities of the Director, Corporate Business is shown in the chart below.

The Corporate Business Department acts as a resource for CSIRO Institutes and Divisions, enabling them to draw on a range of commercialisation and management skills that help them deal with business and industry.

A focus of activities for the year involved the restructure of some of these groups, affecting in particular the strategic planning and evaluation function (see p 56) and

Corporate Business
Department structure



the legal affairs function. Legal staff are now located in some Institute offices to speed the contract negotiation and approvals processes. More legal staff have been appointed to deal with the increasing number and variety of contracts between CSIRO and industry and to reduce the costs incurred by using external legal services.

INTELLECTUAL PROPERTY

Following the closure of Sirotech (CSIRO's former technology transfer company), management of the Organisation's patent portfolio was contracted to Intellectual Property Management Ltd. This has been a successful arrangement, but the long term management issues are currently being reviewed with a view to maximising the returns to CSIRO, effectively controlling costs and ensuring international best

practice in intellectual property management.

LEGAL ISSUES

One of CSIRO's technologies remained the subject of litigation. Another litigation case was settled out of court in September 1993 following mediation. The details of the settlement remain confidential under the terms of the Deed of Settlement, although exceptions to those provisions have enabled reporting to the Minister and an agreed press release was issued shortly after settlement.

COMMERCIAL PRACTICE MANUAL

A major development has been the introduction of the *CSIRO Commercial Practice Manual*, a result of the work of the Commercialisation Task Force (see

INTERESTS IN COMPANIES

The companies in which CSIRO had a commercial interest as at 30 June 1994 are as follows:

Name of Company	CSIRO's interest (%)	Principal activity
Bio-Coal Briquette Pty Ltd	17.2%	Smokeless briquettes
Dunlena Pty Ltd	47.0%	Trustee and management company for a joint venture in the discovery to commercialisation of agricultural chemicals
Gene Shears Pty Ltd	34.7%	Modifying the effects of unwanted genes
Gropep Pty Ltd	35.1%	R&D of growth factors and related peptides
Preston Group Ltd	16.1%	Simulation and scheduling systems for aviation and ground transportation

CSIRO also has less than 5 per cent equity holdings in the following listed companies:

- Queensland Metals Corp Ltd: magnesite processing
- Mineral Control Instrumentation Ltd: scientific and industrial instruments

last year's Annual Report). Regional workshops in five capital cities ensured that all senior staff in CSIRO understood the concepts which underpin the contents of the manual. These workshops brought together for the first time a range of staff to discuss commercial practices in CSIRO. They were successful in alerting staff to the issues they must consider when entering into negotiation with other organisations. Further work is now being done in Institutes and Divisions to ensure that all research staff have an understanding of the key commercial practice issues.

INTERNATIONAL

The CSIRO Chief Executive, Dr John Stocker, and the Director of Corporate Business, Mr Peter Bradfield, visited Japan in April to explore the potential for expanding links between CSIRO and a number of Japanese companies, departments and institutions. Of special note were Dr Stocker's useful discussions with Shimadzu Corporation which is building a factory in Victoria.

Following the signing during the previous year of cooperation agreements with institutions in Vietnam, Thailand, Malaysia and Indonesia, some joint projects have now begun. For example, the CSIRO Division of Building, Construction and Engineering, the University of Melbourne and LEMTEK at the University of Indonesia have established a Joint Centre for Sustainable Urban and Regional Development which was opened officially in June 1994 by the Deputy Prime Minister and Minister for Housing and Regional Development, the Honourable Brian Howe, MP, and his counterpart, Mr

Akbar Tanjung, the Indonesian State Minister for Public Housing.

As a result of Dr Stocker's personal intervention following his visit to China in 1992, the Australian company Memtec Ltd was introduced to the China National Lanxing Chemical Cleaning Company. The two companies signed an agreement in December 1993 to form a joint venture company in China to manufacture membrane filters for water treatment.

Dr J B Clark, President of the Republic of South Africa's CSIR, visited CSIRO during the year. The two organisations signed an agreement establishing a framework for cooperation on joint research projects, the exchange of management systems and commercial business activities. A CSIRO delegation visited CSIR in July 1994 to develop this relationship.

CSIRO hosted the United Nations Industrial Development Organization (UNIDO) international conference 'Economic Growth with Clean Production' in February. Amongst those attending this most successful conference were the Indonesian Minister for the Environment; the German Minister for the Environment, Nature Conservation and Nuclear Safety; the US Deputy Director and Chief of Staff, White House Office on Environmental Policy; and the Director General of UNIDO. Financial support provided by the Commonwealth Environmental Protection Authority, AIDAB and Austrade enabled participants from a number of developing countries to attend. Some 500 people attended the Conference, including

participants from Australia and 24 other countries.

In March, as part of CSIRO's continuing exchange program with the Chinese Academy of Sciences, a delegation of eminent biotechnologists visited CSIRO Divisions, biotechnology companies, universities and other institutions to gain an appreciation of Australia's research capacity with a view to establishing further collaborative activities.

FUNDING

34.6% of CSIRO's revenue came from external sources

1993-94 year was the third year of the Organisation's second triennium appropriation budget. The additional capital infrastructure funding announced by the Government in 1991-92 (\$20.72 million) was followed by the 1992-93 Budget announcement of a further \$12 million in each of the second and third years of the triennium (1992-93 and 1993-94).

This support has enabled CSIRO to continue to carry out its capital investment program without the

FUNDING

reductions to the overall levels of research activity which would otherwise have been necessary.

The employment of 200 youth trainees throughout CSIRO in 1993-94 has also been made possible through the additional funding.

The Organisation's external revenue was \$241.6 million, which represented 34.6 per cent of its total revenue. Expenditure of these external earnings by source of funds is shown in the following table.

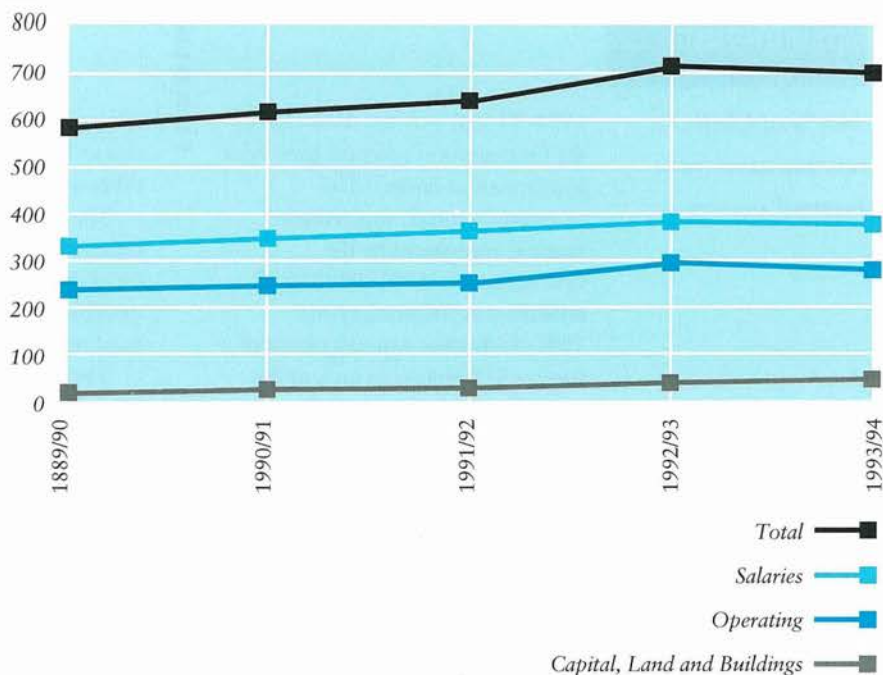
EXPENDITURE OF EXTERNAL EARNINGS BY SOURCE 1993-94

	\$m	
Rural Industry R&D Corporations/Councils*	48.564	19.7%
NERDDC/ERDC	1.681	0.7%
Other Competitive Funding Schemes	8.589	3.5%
Commonwealth and State Governments	44.532	18.1%
Co-operative Research Centres	19.876	8.1%
Private Sector (Direct)*	63.276	25.7%
Overseas Bodies	9.210	3.7%
Miscellaneous Bodies	10.892	4.4%
Earned Revenue	39.430	16.0%
Total expenditure of external earnings	246.049	100%

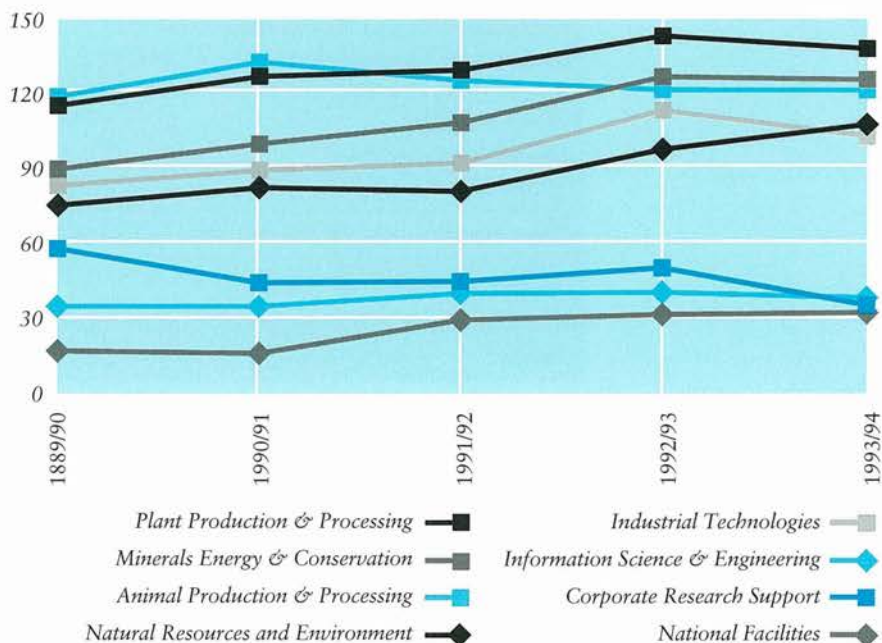
These are CSIRO ledger figures

* Approximately half of the RIRDC funding comes from the private sector as levies

CSIRO Expenditure
by Category
1993 Dollars*

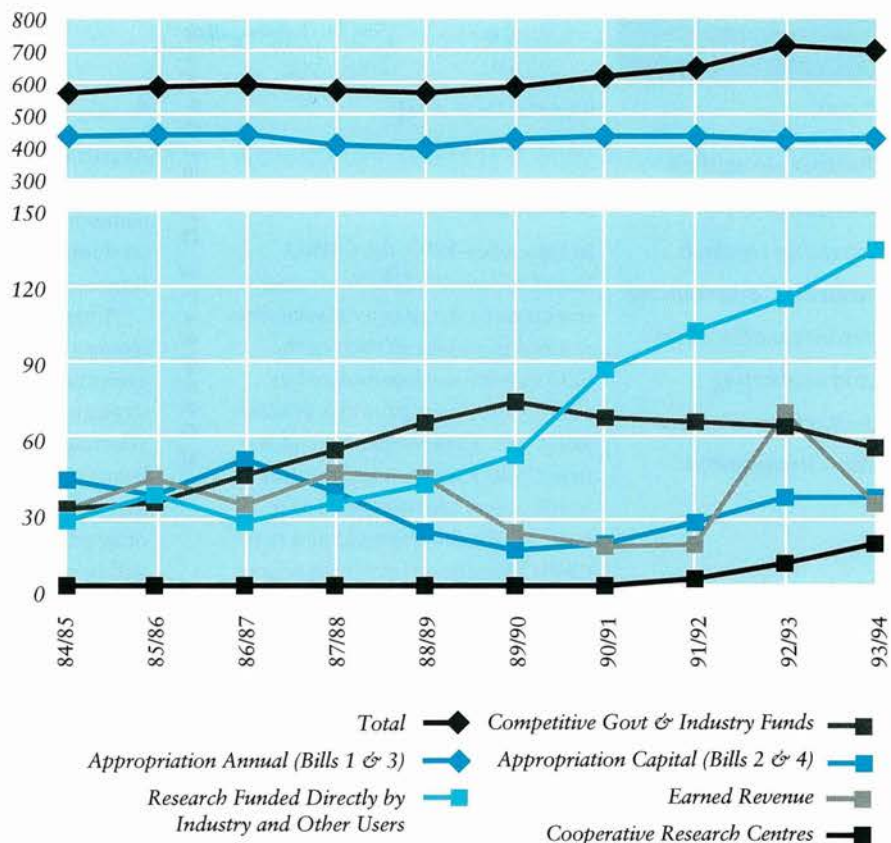


CSIRO Expenditure
by Institute
1993 Dollars*

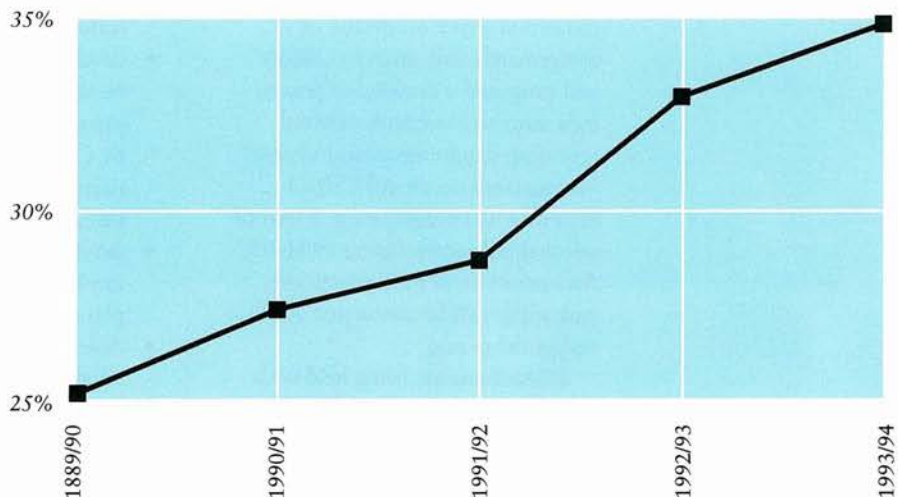


* Figures prior to 1992-93 are calculated on a cash basis. From 1992-93, CSIRO has used accrual accounting, which affects comparability between years. Figures exclude provision for employee entitlements and depreciation of buildings. Equipment depreciation is included in place of asset purchases, and in the Institute table, Institutes' internal leasing (use of buildings) charge is included. Twenty-seven pay periods were counted in 1992-93.

CSIRO Expenditure
by Source of Funds
1993 Dollars*



CSIRO Externally-
Funded Cash
Expenditure as a
Proportion of Total



GOAL

Further strengthen mechanisms for assessing research priorities, determining resources allocation and evaluating performance across the Organisation

PLANNING AND
EVALUATION

Strategic planning

In December 1993, the CSIRO Board endorsed CSIRO's strategic responses to the priority assessments reached in respect of each of the SEO sub-divisions considered in CSIRO's research priorities process (see p xx). These responses and the new CSIRO vision statement (see inside cover) are being used as a basis for the development of a new CSIRO Strategic Plan which is now being prepared.

In February 1994, the CSIRO Board requested a report of progress against each of the planned outcomes set out in the CSIRO Strategic Plan 1991-92 to 1995-96. The report will be presented to the Board in August 1994.

Performance indicators

A steering group recently prepared a discussion paper on the use of performance indicators in CSIRO and proposed a draft set of generic indicators to meet both external reporting requirements and internal management needs. All CSIRO Institutes will participate in a trial of selected indicators during 1994-95. An evaluation of their practicality and utility will be conducted at the end of the period.

Discussions are being held with the Australian Nuclear Science and Technology Organisation (ANSTO), the Australian Institute of Marine Science (AIMS) and the Department of Industry, Science and Technology on developing a set of indicators that can be reported in a common manner.

Planning and evaluation review

As part of a review of the corporate planning function, a strategic planning and evaluation group was established within the Corporate Business Department.

A major component of CSIRO's strategy is to strengthen CSIRO's assessment and evaluation of strategic issues and opportunities affecting the Organisation and its business development. It is also vital that CSIRO improves the evaluation of its performance. The new section will be important in providing help to line managers in meeting their planning and evaluation responsibilities and in coordinating CSIRO-wide activities where necessary.

A project control group was established to:

- provide management direction for the strategic planning and evaluation section;
- oversee the production of statutory planning documents;
- develop a strategy for implementing effective strategic planning and evaluation for use by CSIRO line managers, with particular emphasis in the business development of CSIRO;
- develop staffing plans to implement and manage the planning and evaluation strategy;
- develop terms of reference for an ongoing Strategic Planning and Evaluation Committee to replace the project control group in September 1994.

GOAL

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

CONTINUOUS IMPROVEMENT

Infrastructure

Following an external consultant's review and benchmarking of research support services in Divisions at CSIRO's Clayton(Vic) site, an exercise has begun streamline the delivery of research support services at CSIRO's sites. The objective is to reduce significantly infrastructure costs to ensure that CSIRO can maximise the proportion of its budget allocated to its core business of research and technology development.

Internal audit

A comprehensive review has been completed of CSIRO's internal audit function. This has led to a significant refocusing of the function to embrace risk assessment, to upgrade the frequency and relevance of internal audit activities, and to outsource a substantial proportion of routine audit activity.

Risk management

As part of CSIRO's continuing enhancement of general management practices, a major upgrade of risk management has begun. Structured reports on risk issues from senior line managers have been introduced. A pilot exercise has begun to develop a comprehensive risk profile for two Divisions, at the conclusion of which consideration will be given to the implications of these pilot profiles for the Organisation as a whole.

FINANCE

This year consolidated the implementation of the commercial accounting package, Unibis, with the current release being provided to more than 50 sites throughout Australia.

The land and buildings asset registers were transferred into the Unibis asset register system to enhance control and reporting.

CSIRO's management has endorsed a move to full accrual accounting and management reporting from 1 July 1995. To facilitate this decision, plans for the implementation of Unibis as a central general ledger have been prepared. This project will be undertaken during 1994-95. The planning for the implementation of a project management and information system has also started to facilitate the move to full accrual-based management reporting.

In December, Bank of America was appointed to provide facilities to enable the production of overseas bank drafts and allow the telegraphic transfer of funds. This has been well received by Divisions due to the overall reduction in costs and the general operation efficiencies that have been obtained.

A number of submissions were made during the year to enable the Federal Government to consider the funding requirements of CSIRO for the 1994-97 triennium.

INTERNAL AUDIT

The internal audit program is supervised by an Audit sub-committee of the CSIRO Board. During 1993-94 this committee consisted of two non-executive Board members supplemented by an audit partner of a major accounting firm. Late in the year the Board decided to strengthen this committee and the Chairman of the CSIRO Board is now also a member of this committee.

The internal audit program consists of three types of formal review: cyclic review of management units, risk-based review of information systems and risk-based review of Corporate functions. These reviews are complemented by a program of continuous monitoring of the financial transactions of the Organisation.

During 1993-94 nine Divisions were reviewed and reviews of a number of corporate systems or functions were completed, including The Australian Government Credit Card and Travel Expenditure within CSIRO.

Audit reports contain not only audit findings and recommendations but also commitments to action on the part of responsible managers. Thus at the time of reporting, CSIRO is satisfied that necessary remedial action will take place. A quarterly follow-up process tracks all commitments until agreed action has been completed and any deficiency resolved.

A series of project reports draws from the detailed findings of individual reports. These address strategic themes and are directed to the management of the Organisation.

From time to time, information papers are issued that include best practice statements for corporate activities. Such best practice statements are issued to all administrative units and are used as a benchmark in future audits of these functions.

INFORMATION TECHNOLOGY SERVICES

CSIRO's Information Technology Steering Committee (ITSC) has continued to address policy issues in relation to corporate Information Technology (IT) services. A significant task has been the development of the draft Corporate IT Strategic Plan for CSIRO which prescribes the strategic directions for corporate IT over the next three to five years.

Other significant issues addressed by the ITSC included developing a framework for effective IT management within CSIRO by allocating responsibilities, outlining effective IT planning and providing job descriptions for a variety of IT managers.

During the year tenders were called for UNIX equipment to replace the existing Fujitsu mainframe. The project to transfer the corporate mainframe systems to the new UNIX corporate servers is well advanced and full-year savings of \$800,000 will be realised when the replacement is completed in August 1994. In addition the replacement is in accord with the strategy to move to UNIX for all corporate application servers, both central and local.

The CSIRO telecommunications network remains the backbone of the IT program and provides the capacity for corporate IT products to be delivered in flexible and efficient ways. The X.25 network has been migrated to the Australian Academic Research Network (AARNet), and AARNet now provides the majority of CSIRO's network services. Virtually all CSIRO sites are now connected to

AARNet and, provided that correct software is installed at local sites, access is possible for the majority of CSIRO researchers to E-mail, corporate administrative systems, and information and resource discovery services.

In 1993, the Australian National Audit Office reviewed the security of a number of CSIRO scientific computers. At the same time an internal group, the Network Security Task Force, reviewed CSIRO's network security. Both groups found shortcomings in current practice. A document outlining policy, standards and guidelines for computer and network security was produced and promulgated throughout the Organisation. Implementation of policy has proceeded continuously in 1994 and a comprehensive risk assessment exercise is being undertaken now by all Divisions and units. An IT Security Officer is being appointed.

Under the PABX replacement program, ten fourth generation PABXs were installed for the integration of voice and data and access to high quality digital services (ISDN). The use of least cost routing has been expanded and this, together with other network services, now reduces STD costs by more than \$800,000 a year.

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

to summary financial and resource data.

Tenders were also called for a new library system to replace the ageing GEAC system. Ferntree was the successful tenderer with the Voyager library system and the Structured Information Manager product.

PROPERTY

Project administration

CSIRO's \$105 million Capital Investment Plan for the 1991–94 triennium proceeded within budget. The urgent need to upgrade some facilities to meet research requirements necessitated that some 1994–97 triennium projects were brought forward.

Following a rigorous priority-setting process, a revised Capital Investment Plan of \$240 million for the 1994–97 and 1997–2000 triennia was prepared and submitted to the CSIRO Board for approval. At its June 1994 meeting the Board agreed to a four-phase, six-year implementation of this Plan.

Work on the North Ryde Redevelopment Project progressed during 1993–94. Extensive road and other infrastructure works were undertaken and a new Fire Technology building was completed as part of Stage 1 of the project. Stage 2 of the internal roadworks has been completed also and tenders have gone out for Stages 3 and 4.

Major works completed during the year included:-

- a controlled environment facility for the Division of Tropical Crops and Pastures at St Lucia, Queensland;
- refurbished facilities for the Division of Fisheries at Cleveland, Queensland;
- the Division of Atmospheric Research building at Aspendale, Victoria;
- a seawater system for the Division of Fisheries at Marmion, Western Australia;
- transgenic glasshouses for the Division of Plant Industry at Black Mountain, ACT;

- tripartite facilities (CSIRO, the South Australian Research and Development Institute and the University of Adelaide) at the Division of Soils, Adelaide;
- two new extensions at the Queensland Centre for Advanced Technologies facility at Pinjarra Hills, Queensland.

Major works presently in progress include those at:

- the Division of Biomolecular Engineering at Parkville, Victoria;
- construction of the McMaster Laboratory at Prospect, NSW;
- the Animal Health Laboratory at Parkville, Victoria;
- the Division of Radiophysics, Epping, NSW;
- the Division of Information Technology building at the ANU Campus, ACT;
- the Division of Building Construction and Engineering, Highett, Victoria;
- the Division of Mineral Process Engineering at Clayton, Victoria;
- the Herbarium extension for the Division of Plant Industry at Black Mountain, ACT;
- refurbishment of the Division of Entomology at Black Mountain, ACT;
- the Division of Horticulture, Merbein, South Australia;
- a Childcare Centre at Urrbrae, South Australia.

Property acquisitions/disposal

During 1993–94 a total of six properties were disposed of and one major acquisition occurred (an addition to the Clayton site). The acquisition and disposal of staff residences on transfer continued under the Compulsory Transferees Home Purchase scheme.

GOAL

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

STRATEGIC DEVELOPMENT

Consistent with Government initiatives, CSIRO has used enterprise bargaining to promote the development of a workplace culture of continuous improvement through revised management and work practices, including enhanced participative processes.

The CSIRO Enterprise Agreement was certified in December 1993. The Agreement provided for immediate salary increases and a framework for the continuing reform of CSIRO using the cooperative approach adopted previously during structural efficiency negotiations. In addition to a two per cent salary increase and a single payment equivalent to one per cent of salary it also allows for pay increases of up to an additional three per cent for initiatives which could be negotiated as a basis for improving productivity efficiency and flexibility in CSIRO. A management-union bargaining unit has been established to progress the productivity/efficiency matters.

Key issues being proposed include:

- improved inefficiency procedures providing for independent assessment of performance against specified performance indicators;
- introducing streamlined travel processing arrangements and substituting the current travel allowance with reimbursement of reasonable costs;
- abolishing remuneration or classification appeals for staff above CSOF4;
- removing the payment of district allowances.

The Duty at Sea Enterprise Agreement continued the process of

award restructuring whereby common conditions were determined for all staff performing duty at sea. In close association with the Divisions of Oceanography and Fisheries negotiations with the Public Sector Union were completed and a comprehensive Enterprise Agreement was ratified in November 1993.

CONSULTATIVE COUNCIL

The Consultative Council is the central forum for consultation between management and staff (unions) of CSIRO. Two subcommittees of Council (Human Resources Policy, and Organisational Policy and Communication) meet to consider and progress issues between meetings of Council. Council usually meets twice per year, although when the need arises additional meetings are held.

Issues that have been considered or monitored by Council in the past year are: the CSIRO budget; the competency review; provision of superannuation to staff; strategic human resources planning; development of redeployment and redundancy guidelines; consideration of impediments to redeployment; deployments between Divisions; devolution of the organisational counselling service; evaluation of data available from the CSIRO Human Resources Information System (CHRIS); finalisation of Code of Conduct and arrangements for its introduction to the Organisation; conditions for staff seconded to Cooperative Research centres; provision of childcare; Aboriginal and Torres Strait Islander Strategy implementation; staff training and development.

REVIEWS

A review of the human resource management (HRM) function in CSIRO is being carried out. The review is examining the strategic and operational HRM needs at both corporate and business unit level. Models appropriate for multi-disciplinary R&D organisations are being analysed and benchmarking against best practice organisations both in Australia and overseas has been undertaken.

A comprehensive review and analysis of travel expenditure patterns and arrangements in CSIRO has been carried out. A staff attitude survey was included to identify travel and family-related issues which needed to be taken into account in any revision of travel entitlements. The resultant findings have formed the basis for streamlining of travel administration and proposals to move to a more commercial model of travel cost reimbursement. The latter is being negotiated through the enterprise bargaining process.

OCCUPATIONAL HEALTH AND SAFETY

Occupational Health and Safety is managed corporately in CSIRO through a network of health and safety advisers strategically located in the major regions of research intensity throughout Australia. The corporate focus is mainly on coordinating, monitoring and reporting. The network focus is on all aspects of accident prevention integrated with a smaller, but no less important, focus on rehabilitation.

As part of the accident prevention program, CSIRO Divisions now have all of the structural arrangements contained in the *Occupational Health and Safety (Commonwealth*

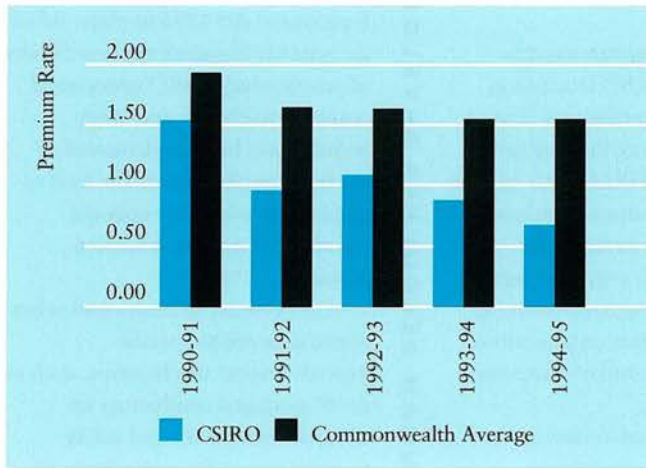
Employees) Act 1991 in place. All of the relevant Comcare approved codes of practice and CSIRO operational occupational health and safety policies have been implemented or are being implemented. The level of compliance with these codes of practice and policies is audited annually.

The network of health and safety advisers develops specific procedures and mechanisms, such as developing and conducting an occupational health and safety training course for supervisors, to further strengthen the accident prevention process.

The present balance of workplace consultative processes, the provision of professional occupational health and safety advisers in the workplace combined with a stated commitment to line management responsibility for occupational health and safety is approaching the ideal structure for managing the Organisation's accident and injury risk. The final measure of this risk management performance is the continuing downward trend in the direct cost of injuries which make up the compensation premium (see following chart).

The 1994-95 premium rate, which determines the CSIRO compensation premium as a percentage of total annual salary, is 0.72 per cent, which reflects the compensation management performance during 1993-94. This has been reduced from the actual 1993-94 rate of 0.87 per cent for 1992-93 performance.

CSIRO is continuing to develop cost effective procedures and mechanisms to further reduce the number and severity of work accidents.



CSIRO Occupational Health & Safety Premium Performance in Relation to the Commonwealth Average 1990-1995

STAFF APPRAISAL AND MANAGEMENT

The competency-based classification system introduced into CSIRO during Award Restructuring in 1991 is being refined to enable better application to recruitment, reward and training/development processes. A major sampling of 'job families' has been undertaken to provide key result area, key task and performance indicator data. This is being consolidated into benchmark statements for each job family and will be validated against sample positions and CSIRO's arbitrated work level standards. Tools including 'on the job behaviour' statements will then be available for line managers to use for the various staffing and performance management activities.

RECRUITMENT

Work was undertaken to improve the quality of selection techniques

and processes. The work involved the use of assessment centres, psychometric testing and informal group assessment by team members.

Comprehensive market surveys covering research, professional/technical support and administrative staff were published. This analysis enables CSIRO to set realistic commencement pay rates for employees as well as providing an external assessment of CSIRO's employment attractiveness.

New separation questionnaires were introduced to provide a better analysis of reasons why staff leave, parting views about the Organisation and the destinations of ex-employees.

REDEPLOYMENT AND REDUNDANCY

Pressure on resources and changing research priorities continue to force Divisions to restructure their work areas.

The number of forced retrenchments was minimised by workforce planning principles with early involvement of the unions, and through the use of skills analysis, substitution and staff retraining.

However, the number of retrenchments increased significantly during the past year, with the majority of retrenched staff choosing to separate under lump sum benefit provisions. The table left shows the trend over the past three years.

DEVELOPMENT AND LEADERSHIP PROGRAMS

Several CSIRO training and development policies were clarified during the year. Guidelines were issued on provision of assistance to CSIRO staff undertaking external

Retrenchments	91/92	92/93	93/94
Total	108	112	206
– with lump sum benefit	103	108	198
– after retention period or with income maintenance	5	4	8

studies and employment and management of trainees and apprentices.

Coordination of training and development activities throughout the Organisation was the focus of intense discussion during 1993–94. A revised training architecture was developed as a basis for wider internal consultation.

Overseas study awards were revised and recast as the Chief Executive's Study Awards in late 1993 to raise their profile and have them recognised as an important personal development opportunity for non-research staff.

In March 1994, the Chief Executive conducted a workshop with a cross section of 30 younger CSIRO staff from Divisions and Units throughout Australia. An open exchange of views typified discussions throughout the two days, providing direct feedback to the Chief Executive.

An internal CSIRO training and development newsletter was launched in July 1993. It features contributions from Divisions and Units discussing problems, providing suggestions, and offering information about local best practice.

More recently, the release of a self-paced workbook on career planning created very high levels of interest. A similar document on teamwork is under development.

CSIRO continued to run its Research Management Program (RMP) during 1993–94 with two intakes (RMP 10 and 11). The RMP is structured into two five-day modules, which are separated by a five month period. The program content includes sessions dealing with personal effectiveness, team

management, leadership, financial management, commercialisation practices, individual/organisational learning and marketing research and development. Between the two modules each participant also undertakes an action learning assignment negotiated with his/her supervisor. RMP 10 had 32 participants, which included four females, while RMP 11 had 28 participants, all male.

The course has been a successful and high profile program since its inception in 1988, with 277 staff (259 males, 18 females) having completed the course. It is currently under review, with a view to strengthening the action learning component and some of the content to be covered.

The Leadership Development Program (LDP) is CSIRO's premier executive development program. It is an individually tailored two year program, focused on the 'high fliers' within CSIRO who are considered to have potential to be future leaders in CSIRO. Unlike other CSIRO management development programs, selections are made by the Executive Committee. Since its inception in 1990, a total of 60 senior managers have participated in the three intakes of LDP. LDP 3 which began in November 1993, has 20 participants, who will graduate in June 1995.

The LDP was recently evaluated. Details of the evaluation are contained in the report *Out of the Rock Pool, Into the Ocean*. The evaluation confirmed that the program has resulted in real and sustained improvements in the leadership and management performance of its participants. The

LDP is seen as having assisted the participants' readiness to assume a future senior management/leadership role. The LDP will be enhanced with a wider program focus on potential participants, an improved selection and nomination process, and an increased corporate and international focus, allowing some non-CSIRO participants on the program and increasing the links with the tertiary education and business sectors.

Funding was made available in this year's budget for the development and delivery of a pilot program for CSIRO's project leaders. The program aimed to provide newly appointed and emerging project leaders with the skills, knowledge and orientation they require to manage research projects effectively. In the event, a significant proportion of the participants already had many years of project leader experience, but, in most cases, had never received training for that role. The pilot course was conducted in November 1993 with six subsequent courses. A total of 130 people have been through the program.

HUMAN RESOURCES INFORMATION SYSTEMS

CSIRO has continued to maintain a comprehensive suite of human resource information systems that support pay, employment data, performance management, workforce planning and training and development.

An assessment of more user-friendly software packages has been undertaken and proposals prepared for eventual update of the current systems.

A consolidated HR statistics handbook is published annually.

EQUAL EMPLOYMENT OPPORTUNITY

CSIRO has continued to implement strategies under the EEO Program that was launched in October 1991. In addition, the Human Resource Policy Subcommittee of the Consultative Council has supported projects such as child care, the Aboriginal and Torres Strait Islander Strategy and the further introduction of flexible work practices that help staff balance their work, family and other commitments.

The EEO Program makes provision for Divisions and Business Units to develop their own EEO Plans. The Program recognises the ongoing need for the development and implementation of policies and practices that promote equitable staff management in CSIRO. Over the past two years there has been a move for Divisions and Business Units to incorporate EEO objectives into their Human Resource and/or Business Plans.

The day to day responsibility for EEO rests with each line manager and supervisor. An EEO Unit within the Corporate Services Department provides specialist advice to managers and staff and is responsible for policy development. The Unit supports an EEO network of contact officers and human resource managers within Divisions and Business Units. The senior executive responsible for EEO is the Director Corporate Services.

Over the past year initiatives have included:

- the promotion and development

of CSIRO's Aboriginal and Torres Strait Islander Recruitment and Career Development Strategy, that aims to increase the representation of Aboriginal and Torres Strait Islander staff across all levels. As at April 1994 CSIRO employed eight staff who identified as Aboriginal or Torres Strait Islander on the data base. This is an increased rate of identified employment of 60 per cent from the 1992-1993 period. However Aboriginal and Torres Strait Islander staff only represent 0.11 per cent of the total staff in CSIRO.

CSIRO continues to target school children through its Double Helix Science Club and scholarship programs to encourage Aboriginal and Torres Strait Islander children to consider careers in science.

- the continued development of work based child care initiatives;
- input into the implementation of the CSIRO Enterprise Agreement with special emphasis on flexible work practices to help staff to more appropriately balance work, family and other external commitments;
- a review of EEO policies and structures within CSIRO to ensure their relevance to CSIRO's current requirements and that the policies are incorporated into the relevant human resource manuals;
- the promotion of EEO principles and practices through the Research Development Program and facilitating the attendance of EEO Contact Officers and other staff at regional training programs;

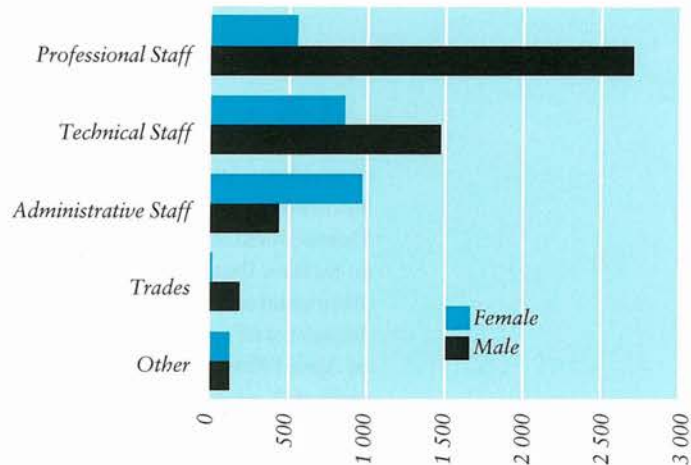
- the Code of Conduct, which was initiated from the EEO Unit, was further developed through the Commercialisation Task Force and is in press. The Code outlines appropriate work place behaviour and management and staff responsibilities (including EEO).

The proportion of women in CSIRO increased from 27 per cent in 1986 to 33.41 per cent in 1994. This figure represents a slight increase since 1993 and continues an upward trend since 1986.

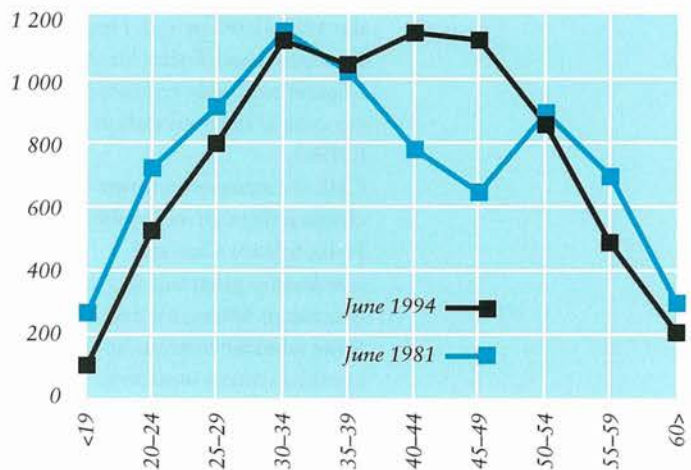
An examination of the work profile for the Organisation as at April 1994 in the research group (representing 41 per cent of total staff) showed a gender split of 85 per cent male and 15 per cent female. This proportion has changed very little since 1990. In the Technical, Administrative and Support groups (representing 57 per cent of total staff), the gender ratio in 1990 was 56 per cent male and 44 per cent female. In 1994 the ratio is 54 per cent male and 46 per cent female. Whilst the gender ratios appear to be reaching a more even split in the Technical/ Administrative area, the number of female research staff has not significantly grown in the past four years.

A major initiative for the 1994-1995 financial year will be the Human Resources Census which will include the updating of data captured by the EEO Census of 1987. In addition, priority will be given to the developing mechanisms to collect meaningful and accurate ongoing data through the Human Resources Information System for people with disabilities and staff from non-English speaking backgrounds.

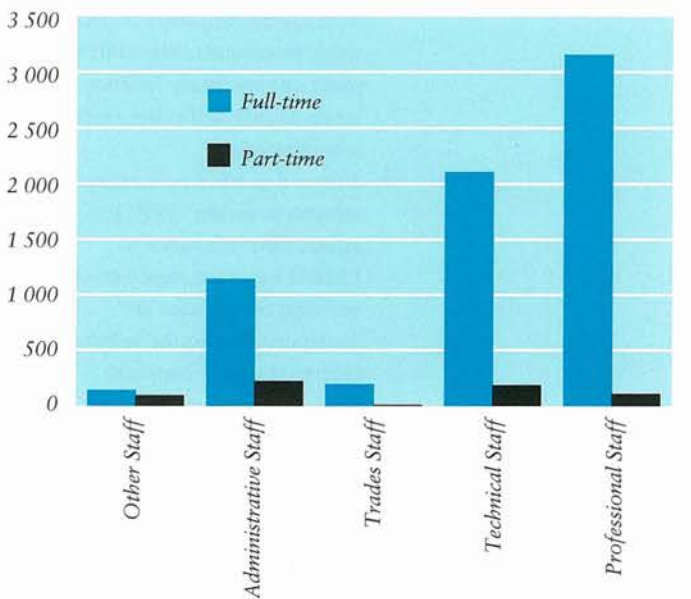
CSIRO Staff by Staff Group by Gender as at June 1994



CSIRO Age Structure of Staff at June 1981 and June 1994



CSIRO Full Time and Part Time Staff as at June 1994



GOAL

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

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

PUBLIC RELATIONS

CSIRO's communication strategy seeks to maximise direct interaction between CSIRO staff, stakeholders and the community, and to back these interactions with a strong presence in the Australian media.

CSIRO brought issues and developments in science and technology before the general community through a variety of public events. A travelling interactive exhibition on minerals exploration and processing continued its progress around the country. Development of two other travelling displays — one on all CSIRO research, intended to travel to regional areas, and one on the nutrition and safety aspects of food — is well advanced.

Planning also began for an interactive education display featuring CSIRO work on tropical rainforests, to be located in far north Queensland.

The Organisation maintained its presence at agricultural shows, this year in Darwin, Adelaide, Perth and a number of major rural centres, and at science expos for students and the general community in Sydney, Brisbane and Melbourne. A number of CSIRO Divisions contributed to the staging of the Australian Science Festival in Canberra in April.

Initiatives to develop CSIRO's links with industry and the business community included publication of the debut edition of *Research Results*, a magazine that demonstrates to industry the benefits of collaboration with CSIRO. The magazine offered a prize of \$25,000 for the company that submitted the best proposal for such collaboration. Interest has been strong.

CSIRO also arranged publication of a range of features and articles in trade and specialist magazines, including a four-page insert in the *Business Council Bulletin*, the official organ of the Business Council of Australia. The insert described a number of case studies showing how industry and the community benefit from CSIRO research. Publication of a monthly four-page insert in *Business Review Weekly* continued during the year. A new monthly column on R&D began in *Australian Business Monthly*.

Also in association with *Business Review Weekly*, CSIRO organised a series of industry breakfast forums for the construction, energy and minerals industries.

Publication continued of CSIRO's magazines, *Ecos* (on science and the environment) and *Rural Research*. An independent survey, commissioned by the Cooperative Research Centre for Soil and Land Management, investigated how agricultural advisers become aware of and receive research results. It showed that *Rural Research* topped the list of such publications used regularly by this important target audience.

Internationally, CSIRO supported the Government's promotion of Australia's trade, culture and sport in the 'Australia Today Indonesia' exhibition in Jakarta in May. The portrayal of the diversity of CSIRO's research and its relevance to the South East Asian region aroused great interest in the 'Visions for Australia' pavilion. A large display on CSIRO environmental management technology was prepared for the UNIDO Clean Production Conference in Melbourne.

Two CSIRO science communication managers were co-leaders of a team that made a successful bid for the right to host the 1996 international Public Communication of Science and Technology conference in Melbourne. The bid was made at this year's conference in Montreal, where the communicators also presented two papers on communication of science and technology.

CSIRO research continued to be widely covered in the print and electronic media. Forty eight scientists benefited during the year from a home-grown media skills training program, and another 36 participated in a program designed to enhance their presentation skills.

An experimental series of 'CSIRO Technology Updates' was produced for the video programs shown in airport departure lounges. CSIRO also gave support to the highly rating ABC television program on innovation, *Great Ideas*, shown from June to August 1994.

The CSIRO Information Network handled more than 38,000 enquiries on science and technology topics, an increase of 11 per cent over the previous year.

INFORMATION SERVICES

CSIRO provides scientific and technical information to clients within the Organisation and to external clients in the research, business and academic sectors.

Key outcomes for 1993-94 were:

- achievement of \$4.2 million revenue target from sales of journals, books and electronic information products and services;
- collaboration with CSIRO

information technology personnel, librarians and user groups to specify and select the Voyager library system and SIM text retrieval system which will be implemented throughout CSIRO in 1994-95;

- implementation of the Service Quality program with a significant investment in training, and commencement of SQ projects in publication sales and finances;
- development of a detailed strategic plan for the next three years, based on a ten-year scenario analysis of the scientific information industry worldwide;
- development of business and marketing plans for 1994-95, based on profitability analysis and market analysis for all products and services.

CSIRO Clients

CSIRO's commercialisation initiatives, led by the Chief Executive and the Director, Corporate Business, were supported by publication of the Organisation's Commercial Practice Manual and by the appointment of staff to advise on corporate records management policies and practices.

Publication continued of the magazines *Ecos* and *Rural Research*, and of the 'CSIRO Business' pages in *Business Review Weekly*. The video, *Caterpillars and Cotton*, produced for the Visions for the Future exhibition in Indonesia, was awarded a major prize in the USA International Film and Video festival.

The quality of the combined CSIRO library catalogue was upgraded, and the purchase coordinated of over 11,000 journal

subscriptions valued in excess of \$6 million for the CSIRO library network.

A major commitment was made in planning the implementation of the new Voyager library system and the SIM text retrieval system, including negotiation for CSIRO-wide access to the Current Contents database to commence late 1994.

External Clients

For 1993–94 more than 40 per cent of budget came from sales to external customers, including export earnings of more than \$2 million. This represents a significant export of value-added scientific products, and places CSIRO as Australia's premier publisher of scientific research. Sales of the *Australian Journals of Scientific Research* generated most of the export earnings.

Books published reached record sales of \$0.8 million. Three new books, *Sharks and Rays of Australia*, *Gardening Down-under*, and *Australian Tropical Rain Forest Trees* were major revenue earners.

Sales of the SAGE database on

CD-ROM continued to increase and the new multimedia CD-ROM, *Insects — a World of Diversity*, was released in June 1994 and has attracted significant media attention.

Publishing and database production services for the Standing Committee on Agricultural Resource Management (SCARM-ANZ) were renegotiated and effectively maintained, although the database services will be subject to further review and redefinition in 1994–95. In collaboration with the Energy R&D Corporation, CSIRO investigated prospects for producing a database of Australian energy research publications.

The decision was taken to close the CSIRO AUSTRALIS online information retrieval service and to move the databases to the National Library of Australia's OZLINE service, effective July 1994. Users will have the benefit of single point access to the combined range of databases with minimal need for retraining, and CSIRO will achieve significant financial savings.

EDUCATION PROGRAMS

CSIRO's Double Helix Science Club continued its growth, reaching 23,000 members. An audited circulation of 25,850 was achieved for the Club's magazine, *The Helix*. The national experiment for members in 1994 involved the genetic mapping of fruit flies to assist research into fruit fly control. Over 1600 members of the Club took part.

BHP continued its sponsorship of the Club. A merchandise operation for the Club was successfully established offering members experiment kits, books and Club clothing.

Kathryn Barker examines a fruit fly caught as part of the Double Helix Science Club's national experiment



The network of CSIRO Science Education Centres (CSIROSECs) grew to nine with Centres operating in Townsville and Canberra. There are now CSIROSECs in every capital city (plus Townsville) all demonstrating the contribution of scientific research to the 60,000 school students and teachers who visit annually.

The Townsville centre, called the North Queensland Science Education Centre or NQSEC, is a joint project of CSIRO, the Queensland Department of Education and James Cook University of North Queensland. It was officially opened in May.

The Canberra Centre, called The Green Machine, is yet to be officially opened as negotiations continue to find more suitable accommodation than currently available. The centre is a joint initiative of CSIRO, the Plant Science Centre and the ACT Department of Education and Training.

Each CSIROSEC also travelled to regional centres. The Science and Technology Awareness Program of the Department of Industry, Science and Technology continued to support this travelling CSIROSEC program in 1994.

The CSIRO Student Research Scheme placed a record 590 senior secondary students under the supervision of practising scientists. The Scheme was again assisted by the Institution of Engineers, Australia and the Science and Technology Awareness program of the Department of Industry, Science and Technology.

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

The student section, in which students undertake an independent research project, received a record number of entries. The teacher awards continued to attract high standards.

Initial funding was approved from the Department of Employment, Education and Training to support the introduction of a new project, CREST, in late 1994. CREST stands for Creativity in Science and Technology. This program provides support for teachers to include research projects in the curriculum of science and technology classes in junior secondary school.

CONTRIBUTION TO PUBLIC POLICY

CSIRO provides information to the Minister for Industry, Science and Technology on matters related to his portfolio, and to the relevant Department. The Organisation's funding for the 1994-97 triennium was considered as part of the Government's statement on industry and employment policies and programs, 'Working Nation'.

CSIRO's position in the community and expertise in science and technology frequently require it to contribute to Government consideration and public debate on a wide range of issues. Similarly, given its size and multi-disciplinary nature, the Organisation attracts considerable public scrutiny of its direction and mode of operation.

Consequently, CSIRO participates in or responds to a large number of Commonwealth and State Government and Parliamentary inquiries and reviews. Its officers are members of national councils, authorities and standing

committees, such as the Prime Minister's Science and Engineering Council, the Australian Science and Technology Council (ASTEC), and the Standing Committee on Agriculture and Resource Management.

CSIRO Submissions to Inquiries and Reviews

During the year submissions were made to:

- Senate and House of Representative Standing Committee inquiries into the national strategy for conservation of Australia's biodiversity, adequacy of Commonwealth Fisheries Legislation; waste disposal; landcare policies and programs; patterns of urban settlement; Australia's population carrying capacity; environmental policies which stimulate economic growth; disaster management; efficiency dividend arrangements for Commonwealth Departments; and Australia's international relations;
- Australian Science and Technology Council (ASTEC) inquiries into Future Directions for Energy Research and Technology; Research and Technology for Tropical Australia; Research Data Networks; and the Operation of the External Earnings Requirement for Commonwealth Government Research Agencies;
- Industry Commission inquiries into Environmental Waste Management Equipment, Systems and Services; Meat Processing; and Research and Development in Australia;
- The McKinnon Review of

Marine Science and Fisheries Research;

- The Taskforce on Regional Development, chaired by Mr Bill Kelty;
- The Commonwealth Department of Primary Industries and Energy Review of Rural Research; and the Review of the Model of the R&D Corporations;
- The Bureau of Industry Economics Review of the Multi-function Polis (MFP);
- The external Review of the National Health and Medical Research Council;
- The Commonwealth Commission of Inquiry into the Shoalwater Bay Area;
- The Western Australian Select Committee on Science and Technology;
- The NSW Legislative Assembly Select Committee on Bushfires.

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–x, 1–2, 48–73, 87);
- any determinations made by the Minister under sub-paragraph 9(1)(a)(iv) of the Act during the year;
- any directions or guidelines given by the Minister under section 13 of the Act during the year;
- any policies notified by the Minister under section 14 of the Act during the year;
- financial statements for the reporting year in a form approved by the Minister for Finance (see pages 89–114);
- the Auditor-General’s report on these statements (see page 88).

The Minister 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:	p. 3
Responsible Minister:	p. 3
Powers, functions and objects:	pp 3, 75–76
Membership and staff:	pp 4–11
Financial statements:	pp 89–114
Activities and reports:	pp 11–73
Interest in companies:	pp 50, 101

3: FUNCTIONS AND POWERS OF CSIRO

Functions of the Organisation

1. The functions of the Organisation are:
 - (a) to carry out scientific research for any of the following purposes:
 - (i) assisting Australian industry;
 - (ii) furthering the interests of the Australian community;
 - (iii) contributing to the achievement of Australian national objectives or the performance of the national and international responsibilities of the Commonwealth;
 - (iv) any other purpose determined by the Minister;
 - (b) to encourage or facilitate the application or utilisation of the results of such research;
 - (ba) to encourage or facilitate the application or utilisation of the results of any other scientific research;
 - (bb) to carry out services, and make available facilities, in relation to science;
 - (c) to act as a means of liaison between Australia and other countries in matters connected with scientific research;
 - (d) to train, and to assist in the training of, research workers in the field of science and to co-operate with tertiary-education institutions in relation to education in that field;
 - (e) to establish and award fellowships and studentships for research, and to make grants in aid of research, for a purpose referred to in paragraph (a);
 - (f) to recognise associations of persons engaged in industry for the purpose of carrying out industrial scientific research and to co-operate with, and make grants to, such associations;
 - (g) to establish, develop and maintain standards of measurement of physical quantities, and in relation to those standards
 - (i) to promote their use;
 - (ii) to promote, and participate in, the development of calibration with respect to them; and
 - (iii) to take any other action with respect to them that the Chief Executive determines;
 - (h) to collect, interpret and disseminate information relating to scientific and technical matters; and
 - (j) to publish scientific and technical reports, periodicals and papers.
2. The Organisation shall:
 - (a) treat the functions referred to in paragraphs (1) (a) and (b) as its primary functions; and (b) treat the other functions referred to in sub-section (1) as its secondary functions.

Powers of the Organisation

1. The Organisation has power to do all things necessary or convenient to be done for or in connection with the performance of its functions and, in particular, may
 - (a) arrange for scientific research or other work to be undertaken, on behalf of the Organisation, by any person or body;

- (b) join in the formation of a partnership or company;
 - (c) make available to a person, on such conditions and on payment of such fees or royalties, or otherwise, as the Chief Executive determines, a discovery, invention or improvement the property of the Organisation;
 - (d) pay to officers, or to persons undertaking work on behalf of the Organisation, such bonuses as the Chief Executive, with the approval of the Minister, determines in respect of discoveries or inventions made by them; and
 - (e) charge such fees, and agree to such conditions, as the Chief Executive determines for research and other services carried out or facilities made available by the Organisation at the request of any person.
2. The Organisation shall not, without the written approval of the Minister, hold a controlling interest in a company.
 3. An approval under subsection (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 subsection (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 following information is presented in accordance with the requirements of section 8 of the *Freedom of Information Act* 1982 (the *Act*)

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

In the year to 30 June 1994, CSIRO received 18 requests under the *Act*.

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

In the year to 30 June 1994, CSIRO received one request from an officer of CSIRO for access to their own personnel records.

Categories of documents

CSIRO holds documents under the following headings:

- Financial Management and Administration
- Buildings and Property
- Personnel and Industrial Relations
- Scientific and Industrial Research

The following CSIRO documents are customarily made available to the public free of charge: policy circulars; information circulars; staff circulars; *CoResearch* (staff newspaper); film catalogue; list of saleable publications; information service leaflets issued by Divisions on a wide range of technical subjects attracting frequent inquiries from the general public; conditions of CSIRO post-doctoral awards; press releases; information on careers in CSIRO; and school project material.

ARCHIVES AND DISPOSAL ARRANGEMENTS FOR DOCUMENTS

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

FACILITIES FOR ACCESS

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

FOI PROCEDURES AND INITIAL CONTACT POINTS

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

FOI Co-ordinator
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*, formal requests

to CSIRO should be addressed to the Chief Executive of CSIRO.

PRIVACY

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

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

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

During 1993–94 the Privacy Commissioner did not undertake any investigations under s. 36 of the *Privacy Act 1988* in relation to CSIRO.

PRIVACY PROCEDURES AND INITIAL CONTACT POINTS

A central Privacy co-ordinator manages CSIRO's privacy responsibilities. Initial enquiries should be made to:

Privacy Co-ordinator
CSIRO
Limetone Avenue
CAMPBELL ACT 2601
or
PO Box 225
DICKSON ACT 2602
Tel: (06) 276 6123

5. TRUST FUNDS SCIENCE AND INDUSTRY ENDOWMENT FUND

In 1993–94, nine grants totalling \$17,453 were provided from this Fund, which was established under the *Science and Industry Endowment Act of 1926*. Recipients of the grants ranged from retired professional scientists to science teachers' associations. This was in keeping with the intention of the Act to promote interest in scientific and industrial research and to provide support to worthy individuals who have no institutional support.

The Science Grants come from the annual return on the £A100 000 originally allocated to the Fund by the Act.

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

F D MCMASTER BEQUEST TRUST FUND

From this fund, six Fellowships were awarded in 1993–94, totalling \$116,860. They were given to support eminent overseas scientists selected to work for a period in CSIRO Divisions.

Four Research Fellowships and two 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 NSW grazier,

bequeathed in his will a substantial proportion of shares in his pastoral company to CSIRO on the condition that the proceeds from their sale be used to undertake research in agriculture or veterinary science.

SIR IAN MCLENNAN ACHIEVEMENT FOR INDUSTRY AWARD

Established in 1985, the Sir Ian McLennan Achievement 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 p47.

6. CSIRO RESEARCH PROGRAMS 1993-94 MULTI-DIVISIONAL PROGRAMS

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

1. Gene Shears
2. Novel Management Techniques for Plant and Plant Product Pests
3. Fibre Utilisation
4. Alumina Production
5. Aluminium Production
6. Heavy Mineral Processing
7. Integrated Geological, Geophysical, Mine Design Visualisation
8. Iron Ore Processing
9. Magnesium Alloys
10. Magnesium Production
12. Active Packaging
13. Biomaterials and Medical Devices
14. Boeing-CSIRO Joint Research Effort
15. Process and Maintenance Optimisation in Manufacturing
16. Urban Water Systems
17. Climate Change
18. Conserving Biodiversity for Australia's Future
19. Data Acquisition and Utilisation
20. Algal Research Program
21. Coastal Zone Program
23. Management of Marine Living Resources
24. Minesite Rehabilitation
25. Improving Forestry
26. Gene Mapping
27. Biosensors
28. Smart Manufacturing
29. Climate Variability and Impacts
30. Air Quality

31. Management of Eucalypt Forests
32. Dryland Farming for Catchment Care
The programs Energy Storage (11) and Land and Water Care (22) expired during the year.

INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING Animal Health

- Control of Bacterial Diseases
- Control of Parasitic Infections
- Plant Associated Toxins
- Avian Diseases
- International Projects and Consulting
- Effective Vaccine Development

Animal Production

- Sustainable Grazing Systems and Livestock Production
- Breeding for Improved Wool Quality and Production Efficiency
- Manipulating Skin Function for Quality Wool
- Livestock Growth and Meat Quality

Australian Animal Health Laboratory

- Diagnosis and Epidemiology of Exotic Diseases
- New Approaches to Disease Diagnosis
- Molecular Virology and Vaccine Development

Biometrics Unit

- Statistics for Animal Science
- Statistics for Food Science

Food Science and Technology

- Process Technology
- Meat Quality
- Value-Added Processing
- Energy Management
- Microbial Technology
- Protein Products
- New Dairy Products
- Food Safety and Food Components
- Food Processing and Packaging
- Sensory Studies

Human Nutrition

- Tissue Growth and Repair
- Social Nutrition, Epidemiology and Food Policy
- Nutrition Control of Cardiovascular Disease
- Nutrition and Cancer
- Nutritional Pharmacology
- Carbohydrates and Nutrition

Tropical Animal Production

- Animal Health and Vaccine Technologies
- Livestock Improvement
- Efficient and Sustainable Production

Wool Technology

- Raw Wool Specification
- Scouring and Effluent Treatment
- Mill and Testing
- Physical Processing
- Instrumentation and Computing
- Dyeing, Finishing and Chemical Processing
- Fabric Quality
- Fibre Structure and Function
- Novel Products
- Comfort
- Hides, Skins and Leather

INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Applied Physics

Electrotechnology
Applied Electricity and Magnetism
Plasmas, Ozone, Mass and Temperature
Acoustics and Surface Mechanics
Optical Technology

Biomolecular Engineering

Protein Engineering
Gene Therapeutics
Receptors and Cytokines
Biomaterials
Protein Structure*
Virus Replication and Assembly *

* programs of the Biomolecular Research Institute

Chemicals and Polymers

Fine Chemicals
Industrial Chemicals
Polymers
Water and Wastewater Treatment
Pharmaceutical Chemicals

Manufacturing Technology

Casting and Solidification
High Energy Processing
Industrial Automation
Joining and Surfacing
Manufacturing Management Systems

Materials Science and Technology

Alloys Research & Development
Ceramics & Refractories
Photonics
Particle, Fibre & Film Technologies
Electronic Beam Lithography

INSTITUTE OF INFORMATION SCIENCE AND ENGINEERING

Australia Telescope National Facility

National Facility Operation
Astrophysics
Instrumentation
Computing Support
Astronomy Education Centres

Information Technology

Knowledge-based Systems
Spatial Decision Support Systems
Human-Computer Interfaces and Visualisation
Distributed Systems
Software Engineering
Supercomputing Support Group

Mathematics and Statistics

Applied and Industrial Mathematics
Applied and Industrial Statistics
Signal and Image Analysis
Computing, Software and Networks

Radiophysics

Radio-frequency Systems
Digital Systems
Mobile Communications
Electromagnetics and Antennas
mm-wave IC (integrated circuit)
Design and Test
GaAs IC Prototyping Facility
Signal and Imaging Technology
Medical and Ultrasonic Imaging

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

Building Construction and Engineering

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

Coal and Energy Technology

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

Petroleum Resources

Petroleum Exploration Technologies
Reservoir Characterisation
Drilling and Wellbore Engineering
Reservoir Testing and Stimulation

Exploration and Mining

Area Selection
Area Evaluation
Deposit Delineation
Coal Mining
Metalliferous Mining
Mining Environmental Management
* Australian Geodynamics CRC
* CRC for Australian Mineral
Exploration Technologies

*included as programs in the Divisional structure

Mineral and Process Engineering

Mineral Processing
Pyrometallurgy
Process Modelling and Development
Process Instrumentation

Mineral Products

Energy Storage
Alumina Production
Heavy Mineral Processing
Magnesite Processing
Gold Production
Magnesium Production

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT

Atmospheric Research

Atmospheric Pollution
Atmospheric Processes
Global Atmospheric Change
Climate Modelling

Centre for Environmental Mechanics

Atmosphere and Plant Processes
Soil and Plant Processes
Aquatic Processes

Fisheries

Tropical Fisheries Resources
Pelagic Fisheries Resources
Mariculture
Temperate and Deepwater Fisheries
Resources
Marine Environment Resources

Oceanography

Climate
Marine Environment
Environmental Prediction
Marine Resources and Pollution

Wildlife and Ecology

National Rangelands
Ecology and Conservation
Management of Tropical Forests
and Savannas
Conservation Biology and Ecology
Biology of Australia's Vertebrate
Fauna: Applications and Pest
Control
Assessment and Management of
Natural Resource Systems

Water Resources

Catchment Management for Water
Quality Protection
Urban Water Management
Groundwater and Site Remediation
Rivers and Wetlands
Irrigation Systems and Dryland
Salinity Management

CSIRO Office of Space Science and Applications (COSSA)

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

INSTITUTE OF PLANT
PRODUCTION AND PROCESSING
Entomology

Pests of Humans and Livestock
Pests of Crops and Timber
Biological Control of Weeds
Taxonomy and Australian National
Insect Collection
Biotechnology
Stored Grain

Forestry

Softwood Plantations
Australian Tree Resources
Regrowth Forest Management
Hardwood Plantations

Forest Products

Pulp and Paper Products
Biodeterioration and Preservation
Composites and Chemical Products
Wood Science and Technology

Horticulture

Crop Management
Crop Improvement

Plant Industry

Sustainable Agricultural Systems
Gene Expression and Plant
Development
Australian Flora Resources and
Management
Molecular Approaches to Improved
Plant Productivity, Protection
and Nutritive Value
Wheat Germplasm and Grain
Quality
Improvement of Rainfed Crops and
Pastures
Cotton Management and
Production

Soils

Soils and Environmental Quality
Soils and Rural Production
Soils and Land Resources

Tropical Crops and Pastures

Tropical Crops
Land Management and Agricultural
Systems
Tropical Forages

7. INSTITUTE/SECTOR ADVISORY COMMITTEES

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

CSIRO AGRICULTURAL SECTOR ADVISORY COMMITTEE

This Committee covers the Institute of Animal Production and Processing and the Institute of Plant Production and Processing

Chair

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

Members

Mrs Marion Becker
Grazier, Central Queensland
Mr Keith Campbell
Grazier, southern NSW; commercial
grazing consultant; Committee
member, Wool Council of Australia
and General Council & Wool
Committee of NSW Farmers'
Federation
Mr Julian Cribb
Agricultural journalist
Dr Brian Fisher
Director, Australian Bureau of
Agricultural and Resource
Economics

Dr John Keniry
Ridley Corporation Limited
Mr John Mackenzie
Treasurer, National Farmers'
Federation, several NFF committees;
Chairman of Directors, Farmwide

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

Professor Harold Woolhouse
Director, Waite Agricultural
Research Institute

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT ADVISORY COMMITTEE

Chair

Mr Neil Inall
Media Consultant, Cox, Inall
Communications

Members

Mr David Buckingham
Executive Director, Environment,
Strategies Directorate, Department
of Environment, Sport and
Territories

Mr Alex Campbell
General President, The Western
Australian Farmers' Federation

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

Mr Brian Hill
Executive Director, Agriculture and
Forestry Group, Department of
Primary Industries and Energy

Mr George Littlewood
Vice President, External Affairs,
CRA Ltd

Mr Michael Rae
World Wide Fund for Nature

Mr Bob Wilson
Wilson Corporate and
Environmental Services Pty Ltd

**INSTITUTE OF INFORMATION
SCIENCE AND ENGINEERING
ADVISORY COMMITTEE**
Chair

Mr Ian J Kowalick
Consultant

Members

Professor Tony Cantoni
Director, Australian
Telecommunications Research
Institute

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

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

Dr Peter Robinson
Chief, CSIRO Division of
Manufacturing Technology

Mr Mel Ward
Consultant

Mr Michael Williams
General Manager, Technology and
Quality, AWA

Mr David Wills
General Manager, MIS Division,
Woolworths

**INSTITUTE OF MINERALS,
ENERGY AND CONSTRUCTION
ADVISORY COMMITTEE**
Chair

Dr I Gould
Group Executive, CRA Ltd

Members

Mr D Chandler
Pioneer Property

Mr P Favretto
Director, Projects Finance Group

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

Mr J J Linden
General Manager (Marketing),
Gwalia Consolidated Ltd

Dr S M Richards
Chairman, Aberfoyle Ltd

**CSIRO MANUFACTURING
ADVISORY BOARD**
Chair

Sir Russel Madigan
Chairman, Remproc Ltd

Members

Dr Colin Adam
Director, CSIRO Institute of
Industrial Technologies

Dr John Burgess
General Manager, Research, BHP
Limited

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

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

Mr Noel Godfrey
Electrical Engineering Manager,
BHP Engineering Pty Ltd

Mr John Innes
Group Executive, Technical
Resources, CRA Limited

Mr John Spasojevic
Deputy Secretary, Department of
Industry, Science and Technology

Dr Don Williams
Chairman, Australian National

Dr John White
Chief Executive, Transfield
Shipbuilding Pty Ltd

Mr Ken Windle
Managing Director, Glaxo
Australia Ltd

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 Information Services (314 Albert Street, East Melbourne, Vic. 3002) or through the National Library's OZLINE database service.

Corporate publications during the year have included:

- *CSIRO Annual Report 1992-93*
- *CSIRO data book 1994*
- *Ecos* environmental magazine (quarterly);
- *Rural Research* magazine (quarterly insert to *Australian Farm Journal*);
- *CSIRO Business* (monthly insert to *Business Review Weekly*);
- *The Helix* (quarterly magazine for Double Helix Club members);
- *Research Results* (magazine demonstrating benefits to industry of collaboration with CSIRO)
- *CSIRO: the pay-off* (four-page insert in the May 1994 edition of *Business Council Bulletin*)

9. THE CARE AND USE OF ANIMALS IN CSIRO

In February 1994, the CSIRO Board endorsed the following policy statement. The Organisation's first such statement appeared in the 1982–83 *CSIRO Annual Report*.

THE CARE AND USE OF ANIMALS IN CSIRO

CSIRO is committed to the conduct of research for the benefit of Australia. It believes that animal-based scientific procedures, when carried out humanely and with full public accountability, are a legitimate activity in support of human health, the well-being of the livestock industries, the management of Australia's native and introduced fauna, and the welfare of animals.

There is no Commonwealth legislation to regulate the conduct of animal-based scientific procedures by Commonwealth officers. Nevertheless, CSIRO insists that its officers familiarise themselves with and comply with the spirit of relevant State/Territory legislation.

CSIRO also insists that its experimental animals be treated in accordance with the standards set out in the *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*, a code to which the Organisation is a signatory.

CSIRO is continually investigating and, where possible, adopting techniques that make it possible to reduce or replace the need for animals in research, and to refine such use.

CSIRO remains committed to ensuring that at all levels within the Organisation, community sensitivities and expectations about

the care and use of animals for scientific purposes continue to be understood and appropriate attitudes developed.



Australian National Audit Office
Centenary House
19 National Crt
Barton ACT 2600

INDEPENDENT AUDIT REPORT

To the Minister for Industry, Science and Technology

Scope

I have audited the financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1994. The statements comprise:

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

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

The audit has been conducted in accordance with 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 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 and applicable Accounting Standards the financial transactions and cash flows for the year ended 30 June 1994 and the state of affairs of the Organisation as at that date
- (iii) the receipt, expenditure and investment of moneys, and the acquisition and disposal of assets, by the Organisation during the year have been in accordance with the *Science and Industry Research Act 1949*, and
- (iv) the statements are in accordance with the Guidelines for Financial Statements of Public Authorities and Commercial Activities.

D S Lennie
Executive Director
Australian National Audit Office
Melbourne
30 September 1994

**COMMONWEALTH SCIENTIFIC AND
INDUSTRIAL RESEARCH ORGANISATION**

OPERATING STATEMENT

FOR THE YEAR ENDED 30 JUNE 1994

	Notes	1994 \$'000	1993 \$'000
COST OF SERVICES			
Operating expenses	2		
Research Programs			
Animal Production and Processing		135 390	134 118
Industrial Technologies		100 642	103 847
Information Science and Engineering		41 909	35 356
Minerals, Energy and Construction		122 097	114 068
Natural Resources and Environment		102 862	103 110
Plant Production and Processing		127 907	128 047
National Facilities		16 561	18 550
Research Support		47 670	47 993
Total operating expenses		695 038	685 089
 Operating revenues from independent sources			
Revenue from research activities and user charges		221 626	194 690
Other revenue	3	19 973	30 496
Total operating revenues from independent sources		241 599	225 186
 Net cost of services		(453 439)	(459 903)
REVENUE FROM GOVERNMENT			
Parliamentary appropriations received	2	456 089	454 251
 Operating results (deficits) before abnormal items		2 650	(5 652)
Abnormal items	4	—	(176)
 Operating results (deficits)		2 650	(5 828)
Accumulated results of operations at beginning of financial year		647 584	653 412
Accumulated results of operations at end of financial year		650 234	647 584

The accompanying notes form part of these statements.

STATEMENT OF FINANCIAL POSITION

AS AT 30 JUNE 1994

	Notes	1994 \$'000	1993 \$'000
Current assets			
Cash	5	11 320	22 571
Receivables	6	20 553	14 800
Investments	7	62 352	78 597
Other	8	18 465	32 767
		<u>112 690</u>	<u>148 735</u>
Non-current assets			
Investments	7	68 773	65 748
Property, plant and equipment	9	977 392	953 789
		<u>1 046 165</u>	<u>1 019 537</u>
Total assets		<u>1 158 855</u>	<u>1 168 272</u>
Current liabilities			
Creditors and borrowings	10	14 990	9 910
Leases	13	2 622	2 658
Provisions	11	55 563	61 304
Other	12	68 737	85 940
		<u>141 912</u>	<u>159 812</u>
Non-current liabilities			
Creditors and borrowings	10	10 220	5 064
Leases	13	19 703	22 346
Provisions	11	70 207	70 263
Other	12	66 848	63 472
		<u>166 978</u>	<u>161 145</u>
Total liabilities		<u>308 890</u>	<u>320 957</u>
Net assets		<u>849 965</u>	<u>847 315</u>
Equity			
Accumulated results of operations		650 234	647 584
Asset revaluation reserve		199 731	199 731
Total equity		<u>849 965</u>	<u>847 315</u>

The accompanying notes form part of these statements.

**COMMONWEALTH SCIENTIFIC AND
INDUSTRIAL RESEARCH ORGANISATION**

**STATEMENT OF CASH FLOWS
FOR THE YEAR ENDED 30 JUNE 1994**

	Notes	1994 \$'000	1993 \$'000
Cash flows from operating activities			
Parliamentary appropriations	2	456 089	454 251
Receipts from research activities and user charges		228 686	252 215
Interest received	2	2 054	11 052
Dividends received	3	24	7 655
Payments to suppliers and employees		(636 248)	(614 611)
Finance charges on finance lease paid	2	(484)	(682)
Net cash flows used by operating activities	14(b)	<u>50 121</u>	<u>109 880</u>
Cash flows from investing activities			
Payments for property, plant and equipment		(87 522)	(76 802)
Payments for investments		-	(324)
Proceeds from sale of property, plant and equipment		9 488	5 974
Proceeds from sale of investment		<u>1 316</u>	<u>1 549</u>
Net cash flows used by investing activities		<u>(76 718)</u>	<u>(69 603)</u>
Cash flows from financing activities			
Loan from the Commonwealth	10	5 156	2 064
Principal repayment under finance lease		<u>(2 679)</u>	<u>(2 146)</u>
Net cash flows used by financing activities		<u>2 477</u>	<u>(82)</u>
Net increase/(decrease) in cash held		<u>(24 120)</u>	<u>40 195</u>
Cash at beginning of financial year		<u>164 640</u>	<u>124 445</u>
Cash at end of financial year	14(a)	<u><u>140 520</u></u>	<u><u>164 640</u></u>

The accompanying notes form part of these statements.

NOTES TO AND FORMING PART OF
THE FINANCIAL STATEMENTS

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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

NOTE 1 SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

1.1 Significant Accounting Policies

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

1.2 Basis of Accounting

As required by sub-section 57(1)(a) of the *Science and Industry Research Act* 1949, the financial statements are prepared in accordance with the Guidelines for Financial Statements of Public Authorities and Commercial Activities approved by the Minister for Finance which incorporate the Australian Accounting Standards and Statements of Accounting Concepts. The financial statements are prepared on an accrual basis and in accordance with the historical costs convention, except for certain assets which are at valuation.

1.3 Principles of Consolidation

During the year, CSIRO's only fully owned subsidiary company, Sirotech Ltd, did not trade and was officially wound up by members' voluntary liquidation prior to 30 June 1994.

As at 30 June 1994, CSIRO's in-kind contributions provided 54% of the Biomolecular Research Institute Limited's resources. CSIRO does not have the capacity to control BRI's Board or its financial and operating policies. Having considered this matter and its immaterial effect on CSIRO's financial statements, CSIRO has, in accordance with Australian Accounting Standard AAS24, elected not to consolidate its accounts (Note 15).

1.4 Economic Dependency

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

1.5 Foreign Currency

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

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

1.5 Foreign Currency (continued)

Hedges

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

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

1.6 Income Tax

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

1.7 Insurance

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

1.8 Reporting by Segments

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

1.9 Revenue Recognition

Parliamentary appropriations are recognised as revenue in the year of receipt in accordance with the Minister for Finance's Guidelines for Financial Statements of Public Authorities and Commercial Activities.

Revenue from contract research activities is recognised in the Operating Statement when work is performed; the balances of research activities in progress are accounted as either research work in progress or contract research moneys received in advance in the Statement of Financial Position. A surplus/deficit is recognised on completion of each research activity. However, where a deficit is anticipated over the life of the research activity then it is brought to account when first recognised.

1.9 Revenue Recognition (continued)

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

1.10 Consumable Stores

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

1.11 Finance and Operating Leases

CSIRO accounts for and discloses finance and operating leases in accordance with AAS17 (Note 13). Assets acquired under finance leases are included in property, plant and equipment (Note 9).

Finance leases effectively transfer from the lessor to the lessee substantially all the risks and benefits incidental to the ownership of the leased assets.

Where assets are acquired by means of finance leases, the present value of the minimum lease payments is recognised as an asset at the beginning of the lease term and amortised on a straight line basis over the expected useful life of the leased asset. A corresponding lease liability is also established and each lease payment is allocated between the liability and finance charge.

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

1.12 Receivables

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

1.13 Investments

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

Controlled Entities

Sirotech Ltd was wound up during the year. There are no other controlled entities.

1.13 Investments (continued)

Associated Companies

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

Other Companies

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

Managed Funds

Managed funds comprise government, semi-government and bank endorsed securities which are valued at market values on 30 June 1994.

1.14 Research and Development and Intellectual Property

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

1.15 Co-operative Research Centres

The activities attributable to the interests of CSIRO in Co-operative Research Centres have been expensed consistent with Note 1.14. CSIRO's interests in Co-operative Research Centres are disclosed in Note 23.

1.16 Property

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

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

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

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

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

1.16 Property (continued)

Property under construction

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

1.17 Plant and Equipment

All plant and equipment are valued at historical cost. The capitalisation threshold limit is \$3,000. Assets costing less than the threshold limit are expensed in the year of purchase. Computer software, scientific glassware, experimental prototype equipment, and library monographs and serials are not capitalised as non-current assets owing to either their uncertain useful lives or the uncertainty of benefits to be derived from their development. Property, plant and equipment which are purchased from contract research funds and where their sale proceeds are refunded to the contributors under the terms of the agreements, are expensed during the year of purchase. Separate records for these assets are maintained (Note 19).

1.18 Depreciation and Amortisation

Depreciation is calculated on a straight line basis so as to write off the net cost or revalued amount of each item of building, plant and equipment over its expected useful life.

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

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

1.19 Employee Entitlements

Provisions for employee entitlements are calculated based on the expected amounts to be paid for recreation and long service leave at current pay rates. Long service leave is provided for those employees with five or more years service. Entitlements which are expected to be paid within the next twelve months are disclosed as current liabilities.

1.20 Superannuation

CSIRO is an approved authority for the purposes of the *Superannuation Act* 1976 and the *Superannuation Act* 1990 and is required to meet the employer's share of the cost of benefits payable pursuant to those Acts to employees in accordance with Government policy. CSIRO discharges this liability by periodic payments to the Commonwealth of amounts, expressed as a percentage of the salary for superannuation purposes of eligible employees, estimated by the Commonwealth to be sufficient to meet CSIRO's share of the full accruing cost both of pensions granted on the retirement or death of such employees and any subsequent pension increases. CSIRO meets its liability for the productivity superannuation benefit on a pay-as-you-earn basis to the Commonwealth Public Sector Superannuation Scheme (PSS) and Commonwealth Superannuation Scheme (CSS) and other approved superannuation schemes and no further accrual is required.

1.21 Workers' Compensation

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

1.22 Cash Flows

For the purpose of the statement of cash flows, cash includes cash at bank and on hand, deposits at call and investments in money market instruments which are readily convertible to cash.

1.23 Comparative Figures

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

	1994	1993
	\$'000	\$'000

NOTE 2 OPERATING RESULTS

Operating results have been determined:

After crediting as revenues:

Interest received or due and receivable	2 054	11 052
Parliamentary appropriations		
— annual (Bill 1)	424 034	414 993
— capital (Bill 2)	32 055	39 258

After charging as expenses:

Foreign exchange losses	—	544
Interest on finance leases	484	682
Loss on sale of property, plant and equipment	—	1 706
Loss on sale of land and buildings	565	—
Wages and salaries related payments	293 587	287 859
Superannuation (including productivity benefits)	49 673	50 112
Provision for legal settlements	2 012	9 500
Provision for long service leave	7 753	9 987
Provision for recreation leave	28 340	26 299
Provision for doubtful debts	246	524
Provision for diminution in value of shares	—	979
Provision for refit of research vessels	200	200
Intellectual property written-off	—	8 201
Depreciation and amortisation	55 315	49 540
Bad debts written-off	566	6

NOTE 3 OTHER REVENUE

Department of Primary Industries and

Energy's contribution to the cost of the

Australian Animal Health Laboratory

Dividends	5 818	6 055
Interest	24	7 655
Royalties	1 061	7 259
Sale of produce and livestock	2 533	2 314
Profit on sale of investments	859	1 008
Fees for provision of services	966	751
Rental proceeds	3 928	3 995
Net foreign exchange gains	988	557
Profit on sale of plant and equipment	315	—
Miscellaneous	1 648	—
	1 833	902

Total other revenue

19 973 30 496

	Notes	1994 \$'000	1993 \$'000
NOTE 4 ABNORMAL ITEMS			
Prior period net gains/(losses) relating to non-current assets		—	(176)
Total abnormal items		—	(176)
NOTE 5 CASH			
Cash at bank and on hand		9 057	14 437
Deposits — at call		489	481
Managed funds — at call		1 774	7 653
Total cash		11 320	22 571
NOTE 6 RECEIVABLES			
Trade debtors		21 354	15 376
Advances		319	298
		21 673	15 674
Provision for doubtful debts		(1 120)	(874)
Total receivables		20 553	14 800
NOTE 7 INVESTMENTS (NOTE 1.13)			
Current			
Managed funds			
Government and semi-government stocks and bonds		30 600	60 401
Bank endorsed bills and government guaranteed promissory notes		19 019	6 468
Negotiable certificate of deposits		8 996	5 315
		58 615	72 184
R&D Syndicate deposits			
Term deposits — under contract	18	3 737	6 413
		62 352	78 597
Non-current			
R&D Syndicate deposits			
Term deposits — under contract	18	66 848	63 472

		1994 \$'000	1993 \$'000
	Notes		
NOTE 7 INVESTMENTS (continued)			
Shares — at valuation			
	% CSIRO interest		
Associated companies			
Bio-Coal Briquette Pty Ltd	17.2	88	88
Dunlena Pty Ltd	47.0	5	5
Gene Shears Pty Ltd	34.7	501	501
Gropep Pty Ltd	35.1	101	101
Preston Group Ltd	16.1	784	784
		<u>1 479</u>	<u>1 479</u>
Provision for diminution in value		<u>(1 479)</u>	<u>(1 479)</u>
		<u>—</u>	<u>—</u>
Shares — at cost			
Listed companies			
Mineral Control Instrumentation Ltd		260	260
Queensland Metals Corporation NL		1 655	2 005
Unlisted companies			
Other corporations		7	8
Debentures and unsecured notes - at cost		<u>3</u>	<u>3</u>
		<u>1 925</u>	<u>2 276</u>
		<u>68 773</u>	<u>65 748</u>
Total investments		<u>131 125</u>	<u>144 345</u>

Mineral Control Instrumentation Ltd and Queensland Metals Corporation N.L. are public listed companies. As at 30 June 1994 the total market values of these quoted shares were \$240 000 and \$3 626 492 respectively. CSIRO is a minority shareholder (less than 5%) in these listed companies.

NOTE 8 OTHER ASSETS

Current			
Prepayments		1 097	14 510
Property held for resale — at acquisition cost		720	479
Research work in progress — at cost	1.9	<u>16 648</u>	<u>17 778</u>
Total other assets		<u>18 465</u>	<u>32 767</u>

1994	1993
\$'000	\$'000

NOTE 9 PROPERTY, PLANT AND EQUIPMENT
(NOTES 1.16, 1.17 AND 1.18)

Land (a)

At cost	4 159	—
At valuation	178 767	180 001
	<u>182 926</u>	<u>180 001</u>

Buildings

At cost	7 363	—
At valuation	524 906	525 918
	<u>532 269</u>	<u>525 918</u>

Accumulated depreciation	(17 904)	—
	<u>514 365</u>	<u>525 918</u>

Capital works in progress — at cost	54 342	25 831
	<u>568 707</u>	<u>551 749</u>

Leasehold improvements

At cost	2 545	—
At valuation	31 702	31 757
	<u>34 247</u>	<u>31 757</u>

Accumulated amortisation	(1 503)	—
	<u>32 744</u>	<u>31 757</u>

Plant and equipment

Equipment — at cost	300 591	277 653
Research vessel 'Southern Surveyor' - at cost	16 753	16 776
	<u>317 344</u>	<u>294 429</u>

Accumulated depreciation	(195 127)	(179 037)
Provision for refit of research vessel	(200)	(100)
	<u>122 017</u>	<u>115 292</u>

National facilities

Oceanographic research vessel 'Franklin' — at cost	15 288	15 132
Australia Telescope — at cost	48 707	48 856
	<u>63 995</u>	<u>63 988</u>

Accumulated depreciation	(16 316)	(14 242)
Provision for refit of research vessel	(200)	(100)
	<u>47 479</u>	<u>49 646</u>

	1994 \$'000	1993 \$'000
NOTE 9 (Continued)		
Buildings and equipment under finance lease		
Buildings	20 094	20 150
Equipment	6 455	6 456
	<u>26 549</u>	<u>26 606</u>
Accumulated amortisation	(3 030)	(1 262)
	<u>23 519</u>	<u>25 344</u>
Total property, plant and equipment	<u>977 392</u>	<u>953 789</u>

(a) Includes Crown land and land held in Commonwealth title totalling \$2 610 000 (1993 \$2 610 000). Negotiations are continuing between CSIRO, the Commonwealth Government and ACT Government to have leases issued in CSIRO's name.

Total property, plant and equipment (Summary)		
At cost	476 297	410 854
At valuation	735 375	737 676
	<u>1 211 672</u>	<u>1 148 530</u>
Accumulated depreciation and amortisation	(233 880)	(194 541)
Provision for refit of research vessels	(400)	(200)
Total property, plant and equipment	<u>977 392</u>	<u>953 789</u>

NOTE 10 CREDITORS AND BORROWINGS

Current

Trade creditors	13 576	9 069
Other creditors	1 414	415
Amounts payable to Sirotech Ltd	—	426
	<u>14 990</u>	<u>9 910</u>

Non-current

Loan from the Commonwealth (a)	10 220	5 064
Total creditors and borrowings	<u>25 210</u>	<u>14 974</u>

(a) The loan of \$10 220 000 (1993 \$5 064 000) 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 has been fully drawn down as at 30 June 1994. Interest is paid annually and the principal will be repaid in full on 1 October 1997. Interest totalling \$486 462 (1993 \$321 089) has been capitalised on the North Ryde Redevelopment Project.

	Notes	1994 \$'000	1993 \$'000
NOTE 11 PROVISIONS			
Current			
Provision for recreation leave	1.19	43 978	42 223
Provision for long service leave	1.19	9 573	9 581
Provision for legal settlements		2 012	9 500
		<u>55 563</u>	<u>61 304</u>
Non-current			
Provision for long service leave	1.19	<u>70 207</u>	<u>70 263</u>
Total provisions		<u><u>125 770</u></u>	<u><u>131 567</u></u>

NOTE 12 OTHER LIABILITIES

Current			
Accrued expenses		2 826	13 866
Research revenue received in advance	1.9	57 478	57 958
Unearned revenue – “R&D Syndicates”	18	3 887	6 563
Trust monies		4 546	7 553
		<u>68 737</u>	<u>85 940</u>
Non current			
Unearned revenue – “R&D Syndicates”	18	<u>66 848</u>	<u>63 472</u>
Total other liabilities		<u><u>135 585</u></u>	<u><u>149 412</u></u>

NOTE 13 LEASE COMMITMENTS (NOTE 1.11)

Total operating and finance lease rentals			
contracted for at balance date:			
Payable no later than one year		5 504	5 706
Payable later than one year, but no later than two years		2 781	5 628
Payable later than two years, but no later than five years		6 498	6 942
Payable later than five years		<u>26 690</u>	<u>29 374</u>
Total lease commitments		<u><u>41 473</u></u>	<u><u>47 650</u></u>
Representing:			
Non-cancellable operating leases		11 381	14 126
Finance leases		<u>30 092</u>	<u>33 524</u>
Total lease commitments		<u><u>41 473</u></u>	<u><u>47 650</u></u>

	1994	1993
	\$'000	\$'000

NOTE 13 LEASE COMMITMENTS (continued)

Non-cancellable operating lease commitments contracted for at balance date and not provided for in the accounts:

Payable no later than one year	1 826	1 829
Payable later than one year, but no later than two years	1 580	1 744
Payable later than two years, but no later than five years	3 885	3 980
Payable later than five years	4 090	6 573
	<u>11 381</u>	<u>14 126</u>

Finance lease commitments:

Payable no later than one year	3 678	3 877
Payable later than one year, but no later than two years	1 201	3 884
Payable later than two years, but no later than five years	2 613	2 962
Payable later than five years	22 600	22 801
	<u>30 092</u>	<u>33 524</u>

Deduct, future lease expenditure not provided for in the accounts:

Maintenance charges	(477)	(878)
Future finance charges	<u>(7 290)</u>	<u>(7 642)</u>

Total lease liabilities provided for in the accounts

<u>22 325</u>	<u>25 004</u>
---------------	---------------

(a) Representing lease liabilities

Current	2 622	2 658
Non-current	19 703	22 346
	<u>22 325</u>	<u>25 004</u>

(b) The lease liabilities are allocated between current and non-current elements.

The principal component of the lease payment due for the year ending 30 June 1995 is shown as current and the remainder of the liability as non-current.

	Notes	1994 \$'000	1993 \$'000
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NOTE 14 STATEMENT OF CASH FLOWS (NOTE 1.22)**(a) Reconciliation of cash**

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

Cash at bank and on hand	5	9 057	14 437
Deposits – at call	5	489	481
Managed funds	5&7	60 389	79 837
Term deposits – under contract	7	70 585	69 885
		<u>140 520</u>	<u>164 640</u>

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

Operating results (deficits)		2 650	(5 828)
Non cash flows in operating results			
Depreciation and amortisation	2	55 315	49 540
Net loss/(profit) on disposal of property, plant and equipment	2&3	(1 083)	1 706
Profit on disposal of investment	3	(966)	(751)
Increase in provision for doubtful debts	6	246	524
Increase in provision for diminution in value	7	–	979
Increase in provision for employee entitlements	11	1 691	4 727
Increase in provision for refit of research vessel	9	200	200
Increase/(decrease) in provision for legal settlements	11	(7 488)	9 500
Abnormal items	4	–	(374)
Changes in assets and liabilities			
(Increase)/decrease in receivables	6	(5 999)	(12 519)
(Increase)/decrease in other assets	8	14 302	1 357
Increase/(decrease) in creditors	10	5 080	122
Increase/(decrease) in other current and non-current liabilities	12	(13 827)	60 697
Net cash outflows from operating activities		<u>50 121</u>	<u>109 880</u>

Non-cash financing activities

CSIRO has finance leases for property, plant and equipment with an aggregate fair value of \$26 549 853. There were no new finance leases during the year. These are not reflected in the Statements of Cash Flows.

NOTE 15 BIOMOLECULAR RESEARCH INSTITUTE LIMITED (BRI)

As at 30 June 1994, CSIRO's in-kind contributions provided 54% of the Biomolecular Research Institute Limited's resources. BRI was established in October 1990 by CSIRO and a Victorian Government agency. It is a research and development company involved in the development of pharmaceutical and biological products.

During the year CSIRO has provided in-kind contributions in the form of scientific staff and accommodation to the value of \$3 330 000 (1993 \$3 503 000) and they have been reflected in CSIRO's Operating Statements. Its net assets as at 30 June 1994 were \$6 027 579 (1993 \$5 230 108).

	1994 \$'000	1993 \$'000
--	----------------	----------------

NOTE 16 CAPITAL EXPENDITURE COMMITMENTS

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

Payable no later than one year	19 914	17 528
Payable later than one year, but no later than two years	722	203
Total capital expenditure commitments	20 636	17 731

NOTE 17 AGREEMENTS EQUALLY PROPORTIONALLY UNPERFORMED

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

	1994 \$'000	1994 \$'000
	Income	Expenditure
Receivable/payable no later than one year	104 524	116 982
Receivable/payable later than one year, but no later than two years	51 647	52 778
Receivable/payable later than two years, but no later than five years	40 303	41 010
Receivable/payable later than five years	3 728	3 659
	200 202	214 429

This year the above disclosure is a new requirement under the Guidelines for Financial Statements of Public Authorities and Commercial Activities. As a result there are no comparative figures available.

NOTE 18 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 are drawn upon in accordance with the terms of those agreements to meet CSIRO's research contract obligations. The balance of deposits represents an amount held as security for CSIRO's obligations under put options.

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

NOTE 19 RESOURCES PROVIDED FREE OF CHARGE AND NOT INCLUDED IN THE STATEMENT OF FINANCIAL POSITION

	Land(a) \$'000	Buildings \$'000	Plant and equipment \$'000	Total 1994 \$'000	Total 1993 \$'000
At valuation or cost	18 621	31 361	38 619	88 601	88 059
Accumulated depreciation	—	(1 178)	(29 125)	(30 303)	(31 061)
	<u>18 621</u>	<u>30 183</u>	<u>9 494</u>	<u>58 298</u>	<u>56 998</u>

(a) Includes land \$12 090 000 (1993 \$12 090 000) which has been previously purchased out of contract research monies and are in CSIRO titles. In accordance with the contract research agreements, any sales proceeds from disposal of these assets shall be refunded to the contributors.

NOTE 20 MONIES HELD IN TRUST

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

	1994 \$'000	1993 \$'000
Investments		
Advance Bank	94	89
Commonwealth Bank of Australia	2 475	2 659
State Electricity Commission of Victoria	—	12
St George Bank	128	122
M F Cash Management Fund	1 002	—
	<u>3 699</u>	<u>2 882</u>
Cash at bank	<u>228</u>	<u>78</u>
Total monies held in trust	<u><u>3 927</u></u>	<u><u>2 960</u></u>

NOTE 20 MONIES HELD IN TRUST (continued)

	1994 \$'000	1993 \$'000
The components of trust funds are as follows:		
William McIlrath Trust Fund	235	221
David Rivett Memorial Lecture Fund	85	82
FD McMaster Bequest	2 450	2 514
Sir Ian McLennan Achievement for Industry Award	155	143
The Ken and Yasuko Myer Plant Science Research Fund	1 002	—
Total monies held in trust	3 927	2 960

NOTE 21 CONTINGENT LIABILITIES

Contingent liabilities for which no provision has been made in the accounts as at 30 June 1994 were:

Performance guarantee	184	184
Estimated personal injury and workers compensation claims pre 1988 which are being defended	1 000	1 500
Total contingent liabilities	1 184	1 684

NOTE 22 AUDITOR'S REMUNERATION

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

Auditing the accounts	260	290
(No other services were provided by the auditors)		

NOTE 23 CO-OPERATIVE RESEARCH CENTRES (CRC)

The Co-operative Research Centres Program, launched in May 1990 by the Commonwealth, was established to assist two or more collaborators to carry out research contributing to the development of internationally competitive industry sectors. The Program supports long-term, high-quality research, improved links between research and application, and stimulation of education and training. At 30 June 1994 CSIRO is a participant in 43 CRCs, CSIRO's interest in each is listed as follows :

Names of Co-operative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
Legumes in Mediterranean Agriculture	18
Plant Science	67
Tropical Plant Pathology	29
Temperate Hardwood Forestry	45
Hardwood Fibre and Paper Science	54
Viticulture	21
Waste Management and Pollution Control	9
Vaccine Technology	26
Tissue Growth and Repair	35
Cellular Growth Factors	19
Cardiac Technology	19
Intelligent Manufacturing Systems and Technology	30
Alloy and Solidification Technology	32
Materials Welding & Joining	39
Polymer Blends	34
Molecular Engineering & Technology	44
Industrial Plant Biopolymers	25
Intelligent Decision Systems	7
Robust & Adaptive Systems	22
Australian Photonics	2
G K Williams CRC for Extractive Metallurgy	52
Australian Petroleum	61
Sustainable Cotton Production	28
Southern Hemisphere Meteorology	19
Freshwater Ecology	14
The Cattle & Beef Industry (meat quality)	30
Biological Control of Vertebrate Pest Population	67
Tropical Rain forest Ecology & Management	37
Eye Research and Technology	21
Food Industry Innovation	15
Premium Quality Wool	46
Soil and Land Management	57
New Technologies for Power Generation from Low Rank Coal	10

NOTE 23 CO-OPERATIVE RESEARCH CENTRES (CRC) (Continued)

Names of Co-operative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
Catchment Hydrology	25
A J Parker CRC for Hydrometallurgy	49
Tropical Pest Management	44
The Antarctic and Southern Ocean Environment	14
Australian Mineral Exploration Technologies	48
Mining Technology and Equipment	73
Aquaculture	10
Research Data Network (not yet approved)	16
Advanced Computational Systems	35
Australian Geodynamics	40

The 1992/93 audited accounts are available for 27 of the above CRCs. A review of these accounts revealed that 14 CRCs have audit reports with minor technical breaches of the CRC Agreements between the Commonwealth and participants. These have no material effect on the statements of CSIRO or the CRCs concerned.

NOTE 24 BOARD MEMBERS' REMUNERATION AND SUPERANNUATION BENEFITS

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

	1994 \$'000	1993 \$'000
Board Members' remuneration	383	352
Payments to superannuation funds for Board Members	37	33
Total Board Members' remuneration and superannuation benefits	420	385

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

\$	1994 Number	1993 Number
1 - 10 000	2	-
10 001 - 20 000	7	8
30 001 - 40 000	1	1
210 001 - 220 000	-	1
230 001 - 240 000	1	-

1994	1993
\$'000	\$'000

NOTE 25 EXECUTIVES' REMUNERATION

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

1 534	1 268
-------	-------

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

\$	1994 Number	1993 Number
120 001 – 130 000	–	1
130 001 – 140 000	1	1
150 001 – 160 000	2	4
160 001 – 170 000	3	–
170 001 – 180 000	1	1
180 001 – 190 000	1	–
210 001 – 220 000	–	1
230 001 – 240 000	1	–

NOTE 26 RELATED PARTY INFORMATION**Board Members**

The Board Members of CSIRO during the financial year were:

A E Clarke	D S Shears
J W Stocker	N C Stokes
J R de Laeter	C R Ward-Ambler
A K Gregson	L N R Carmichael (resigned during 1993/94)
Sir Gustav Nossal	M G Forshaw (resigned during 1993/94)
S M Richards	

Remuneration

Information on remuneration of Board Members is disclosed in Note 24.

Board Members' interests in contracts

Since 1 July 1993 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 24 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.

NOTE 26 RELATED PARTY INFORMATION (continued)

Other transactions of Board Member-related entities

The Chairman of the Board, Professor A E Clarke, is a Director of Alcoa of Australia Limited, Biosupplies Pty Ltd and BioPolymers Pty Ltd and is a Board Member in two Co-operative Research Centres. These companies and 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.

A Board Member and Chief Executive, Dr J W Stocker, is a Board Member of Gene Shears Pty Ltd, MFP Development Corporation, Strategic Industry Research Foundation Limited (resigned 14 June 1994) and a consultant to AMRAD Corporation Ltd. These companies have a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions.

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

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

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

A Board Member, Dr A K Gregson is a Director of the Grains Research and Development Corporation and a Board Member of ANSTO. CSIRO receives research and development grants from the Corporation. ANSTO has a number of contractual relationships with CSIRO in the field of research and development. These grants and contracts are based on normal commercial terms and conditions.

A Board Member, Mr N C Stokes, is a Director of Continental Venture Capital Limited and is employed as a Vice President of Bankers Trust Australia Limited (BT). Continental Venture Capital Limited or its subsidiaries may have dealings with CSIRO. The contracts are based on normal commercial terms and conditions. BT manages some of CSIRO's funds. CSIRO pays normal commercial fees to BT for the fund management.

BOARD MEMBERS' STATEMENT

In our opinion, the accompanying statements of the Commonwealth Scientific and Industrial Research Organisation show fairly:

- the state of affairs as at 30 June 1994
- the operating result for the year ended 30 June 1994; and
- the cash flows for the year ended 30 June 1994.

The statements have been prepared in accordance with the Guidelines for Financial Statements of Public Authorities and Commercial Activities which incorporate the Australian Accounting Standards and Statements of Accounting Concepts.

Signed at Melbourne this 30th day of September 1994 in accordance with a resolution of the Board Members.



Adrienne E Clarke
Chairman



John W Stocker
Chief Executive and Board Member

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