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C S I R O



Annual Report
1998 ~ 99



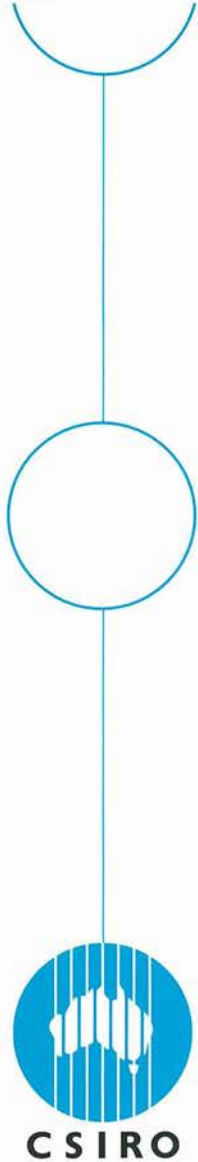
CSIRO

CSIRO — the Commonwealth Scientific and Industrial Research Organisation — is one of the largest and most diverse scientific institutions in the world. It has a staff of 6600 working in laboratories and field stations throughout Australia.

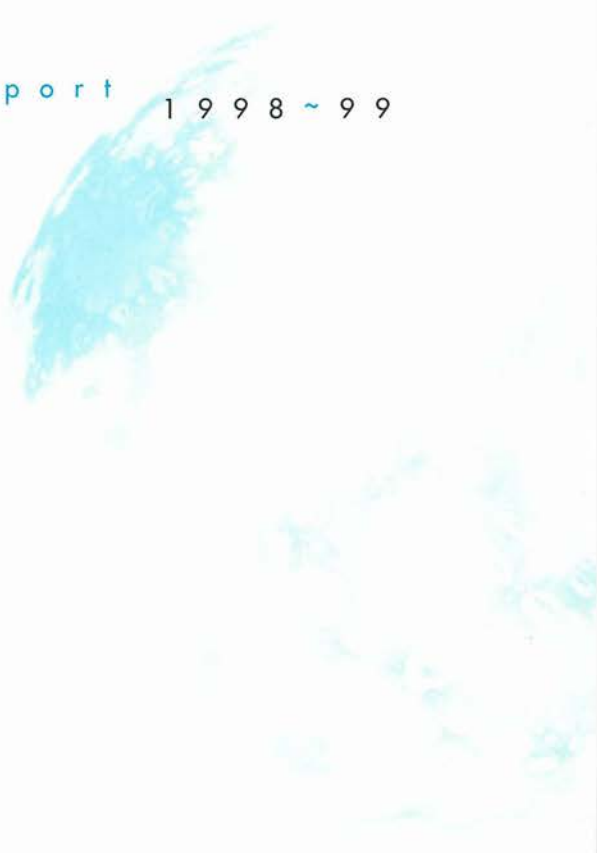
CSIRO is an independent statutory authority constituted and operating under the provisions of the *Science and Industry Research Act 1949*.

CSIRO'S VISION

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



Annual Report 1998 ~ 99



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Senator The Honourable Nick Minchin

Minister for Industry, Science and Resources

Parliament House

CANBERRA ACT 2600

We have pleasure in submitting to you, for presentation to Parliament, the fifty-first Annual Report of the Commonwealth Scientific and Industrial Research Organisation. This report has been prepared in compliance with the requirements of the *Commonwealth Authorities and Companies Act 1997* and the *Science and Industry Research Act 1949*.

We commend the Organisation's achievements to you.



D Charles K Allen, AO
(Chairman of the Board)

September 1999



Malcolm K McIntosh, AC
(Chief Executive)



Board resolution

The 1998-99 CSIRO Annual Report has been approved for presentation to the Minister for Science, Industry and Resources.

Signed at Canberra this 3rd day of September 1999 in accordance with a resolution of the Board Members.



D Charles K Allen, AO
(Chairman of the Board)



Colin M Adam
(Acting Chief Executive)

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FOREWORD

Research and commercialisation

We are pleased to record many significant research outputs and outcomes during the year. In particular, we are gratified that the 'flu drug RelenzaTM, developed by CSIRO and partners, has now been approved for use in the United States after an initial rejection earlier this year. The drug has also been approved for use in Australia, Sweden, Switzerland and the European Community.

Other new products for the manufacturing sector include improved sunscreens, developed with an industry partner, to protect skin against ultraviolet radiation, and our jointly-developed extended-wear contact lenses, which entered the global marketplace in mid-1999.

A company is constructing a \$1.8 million pilot plant to demonstrate the commercial viability of a new CSIRO process to produce flame retardant grade magnesium hydroxide, which will be used to make everyday plastic products with reduced fire risk.

Our Exelgram anti-counterfeiting technology has been used on a number of countries' high denomination banknotes and financial instruments.

In manufacturing systems, we have developed a product that should increase the ability of Australian-based firms to operate globally. It is a remote operating system that enables manufacturers in Australia to provide after-sales support anywhere in the world.

In the information technology area, we have developed an Internet Marketplace system, which is expected to deliver savings of around \$350 million over six years in Queensland alone.

To assist the minerals and energy industries, we have designed one of the world's most advanced airborne mineral exploration systems, TEMPEST, and it is now being offered as a commercial service.

FAMM, a CSIRO technology that measures the age of petroleum source rocks, is now being used internationally.

For agribusiness, we have developed several dairy ingredient manufacturing technologies to improve high-value products such as yoghurt and cappuccinos. The Australian dairy industry is enthusiastically adopting these technologies.

We have developed a new way to dye wool-cotton blends so they can stand up to machine washing and tumble drying.

In collaboration with Cooperative Research Centre and industry colleagues, we have developed a diet that triples the growth rate of oysters.

Our scientists played a major role in an international effort to stop the deadly Malaysian Nipah virus, which has killed over 100 people and up to a million pigs.

In the environmental area, our research on using forests as carbon stores is assisting the National Carbon Accounting System being developed by the Australian Greenhouse Office.

In addition several major commercial agreements have been negotiated during the year.

For example, CSIRO is to partner the Australian automotive industry in plans to build two radically new hybrid-electric cars for the 21st century. One will demonstrate 'parallel' hybrid technology which switches between the electric motor or the petrol motor; the other will demonstrate 'series' hybrid technology, whereby only the electric motor directly drives the wheels — the petrol motor is turned on and off as needed to recharge batteries and supercapacitors.

F H Faulding & Co Ltd has agreed to expand support for our research into a new drug delivery technology.

CSIRO, AWB Limited and the Grains Research and Development Corporation have formed Graingene, a joint venture that will support plant biotechnology research and generate commercialisation opportunities for Australian grain. The partners will be providing over \$20 million in total to support this venture.

We signed research agreements with Rio Tinto to identify areas of scientific research and development of mutual benefit to both organisations, and with British Aerospace Australia (worth up to \$20 million) to develop advanced materials and processes for the global aircraft industry of the early 21st century.

Major research initiatives

In January 1999 we announced plans to build a world-class sustainable energy research and demonstration centre for Australia in Newcastle, New South Wales. It will directly employ more than 100 research staff and, with an annual budget of around \$11 million, will make a significant economic contribution to the community.

CSIRO Energy Technology at North Ryde in Sydney will transfer to the Newcastle site to form the core of the new centre. The centre has received strong support from the New South Wales Government through the \$10 million Hunter Advantage Fund and from BHP Ltd.

1998 was the 'Year of the Oceans' so our marine research received special attention.

One key issue of concern is the growing number of introduced marine pests we are discovering, posing threats to our marine resources and the fishing industry. We have a research team addressing the problem of detection of these pests and methods for their control and eradication—seastars in southern waters and black striped mussels in Darwin Harbour were two pests that received particular attention this year.

A public awareness exercise for our marine research included media stories, special articles, talks, displays and visits by our research vessel *Franklin* to many ports.

Budgets, priorities and management

This year we undertook a major research planning exercise in close collaboration with our Sector Advisory Committees, in preparation for our next triennium of funding (following the May 1999 Budget, CSIRO's funding base for the 2001-2003 triennium will be maintained at current levels).

Key decisions from the Sector Planning Reviews signal some substantial changes to our research portfolio overall and reflect a move towards closer alignment of CSIRO's resources with major changes to the Australian economy.

There will be an expansion in real terms for the Food Processing, the Mineral Exploration and Mining, the Marine, the Petroleum and the Radio Astronomy Sectors.

This has been balanced by reductions in the Built Environment, the Meat, Dairy and Aquaculture and the Forestry, Wood and Paper Industries Sectors in response to insufficient adoption of research by industry.

Resources will be reduced in the Biodiversity Sector unless the Sector is able to refocus its projects to increase its attractiveness to commercial and Government land managers, as well as environmentally aware members of the community.

Two of our Deputy Chief Executives (DCEs) retired in June 1999, after outstanding service since 1996 as DCEs and, formerly, as Institute Directors. They are Dr Bob Frater (Manufacturing, Information Technology, Infrastructure and Services) and Dr John Radcliffe (Environment and Natural Resources).

Dr Frater was the key driver of the 1996 restructuring of CSIRO with the introduction of Sectors, and successfully led a significant high tech marketing push in Europe for CSIRO and its industry partners, through representation at the Hannover industry trade fair in both 1998 and 1999.

Dr Radcliffe's significant contribution was his advocacy of collaborative linkages across research organisations, including sharing sites and facilities. He made significant contributions to the development of the shared Waite Campus in Adelaide and the \$100 million Institute of Molecular Biosciences in Queensland. He also championed the development of the National Innovation Strategy for Agriculture during 1994-96.

Dr Ron Sandland (formerly Chief of CSIRO Mathematical and Information Sciences) is the new Deputy Chief Executive for Manufacturing, Information Technology, Infrastructure and Services. Dr Paul Wellings (formerly Head of the Innovation and Science Division, Department of Industry, Science and Resources and previously Chief, CSIRO Entomology) is the new Deputy Chief Executive for Environment and Natural Resources.

Gene technology

The debate on gene technology in Australia has increased over the last 18 months, with public concern rising following stories of possible harmful effects of the technology, emanating especially from Britain.

CSIRO undertakes gene technology research because we believe it will produce benefits for Australians and the Australian environment.

However, we are aware of the risks and unpredictable impacts that accompany the use of any new technology.

We have developed our own position statement on gene technology, reproduced in the box on page 7.

We believe it is essential for the Australian public to be aware of gene technology and be involved in discussions about its use. To that end we supported the Consensus Conference on Gene Technology in the Food Chain, held in Canberra in March 1999. We have also been contracted by the Federal Government's Biotechnology Australia Program to produce public information about gene technology, including a new web site.

CSIRO Position Statement on Gene Technology

CSIRO believes there is a window of great opportunity for Australia, its community and industries, based on research in gene technologies. It gives us the potential to improve our health, create a safer and more secure food supply, generate greater prosperity and attain a more sustainable environment. Our position on this issue is:

1. CSIRO is committed to playing a valuable, careful and ethical role in Australian and international efforts to develop beneficial new products and processes from gene technology.
2. CSIRO will help to provide a clean, safe food supply, novel materials and products and a sustainable environment for all Australians through the use of appropriate biotechnology, including gene technologies.
3. CSIRO recognises and respects public interest and concern on issues surrounding genetically modified organisms. We will consult with the community, listen to and recognise its concerns, and help to inform Australians about gene technology.
4. CSIRO will help Australia and its industries to be world competitive in biotechnology and gene technology. We will commercialise our activities in the most effective way and promote the growth of local biotechnology companies as appropriate. We will continue to conduct world class research and train our scientists to the highest standards.
5. CSIRO complies with all guidelines laid down by Government for the conduct of gene technology research. CSIRO recognises the issue of gene technology regulation is under active policy consideration by Federal and State Governments, and will comply with all new laws, regulations and requirements they determine.
6. CSIRO will address risks as well as benefits in its own gene technology research. To minimise risks nationally, CSIRO supports a national capability for environmental risk assessment and will participate as appropriate in establishing this capability.
7. CSIRO supports the stimulation of innovation through the protection of intellectual property rights in original gene technologies.

Board members

During the year Dr Eric Tan completed his term as a Board member and we thank him for his very enthusiastic participation and support for CSIRO. Three new Board members joined us: Mr John Gandel, Mr Donald F J McDonald and Professor Vicki Sara.

New reporting requirements

The format of our Annual Report has changed this year to comply with the new reporting requirements of the *Commonwealth Authorities and Companies Act*. Appendix 1 contains a summary of what is required under this Act.



D Charles K Allen, AO
(Chairman of the Board)



Malcolm K McIntosh, AC
(Chief Executive)

ABOUT CSIRO

Enabling legislation

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

Functions

In summary, CSIRO's primary functions are:

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

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

Powers

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

In particular it may:

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

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

CORPORATE VISION AND PURPOSE

Vision

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

Purpose

We serve the Australian community through outcomes which provide:

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

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

Values critical to our success

1. Satisfied customers and supportive stakeholders through application of our research

Operating principles

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

2. CSIRO - unity of purpose, diversity of means

Operating principles

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



3. Top people, top performance, integrity, trust and respect

Operating principles

We work together to create an organisation that:

- seeks to recruit the best and the brightest, provides a stimulating environment to encourage individuals to develop their full potential, and provides career opportunities which make CSIRO an attractive development base for future industry leaders;
- fosters adaptability and recognises exceptional performance with appropriate rewards;
- cares for the safety and well being of all employees with employment policies to support corporate goals;
- fosters creativity which underpins our performance and delivery;
- draws upon the breadth and depth of our skills to assemble excellent teams to tackle major challenges and uses networks of special skills inside and outside CSIRO;
- respects the unique skills, professionalism and knowledge of all our employees, and recognises that we are responsible for creating and maintaining our reputation.

4. First class science — because it helps Australia

Operating principles

- We maintain a world standard of scientific and engineering excellence in order to deliver agreed outcomes to our customers in industry, Government and the community, on time and within budget;
- The quality of our scientific research enhances Australia's international standing;
- We work 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.

RESPONSIBLE MINISTER

From 1 July 1998 to 3 October 1998, the Minister responsible for CSIRO was the Honourable John Moore, Minister for Industry, Science and Tourism. From 21 October 1998 to 30 June 1999, Senator the Honourable Nick Minchin, Minister for Industry, Science and Resources was the Minister responsible.

Under the *Science and Industry Research Act 1949*, the Minister has the power to:

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

The Ministers did not exercise any of these powers during 1998-99.

CORPORATE GOVERNANCE

Economic dependency

CSIRO is economically dependent on the Commonwealth Government, requiring appropriation of money by Parliament to carry out the majority of its activities.

Role of the CSIRO Board

The functions of the Board of CSIRO are contained in the *Science and Industry Research Act 1949* ('SIR Act') and the *Commonwealth Authorities and Companies Act 1997* ('CAC Act'). The SIR Act requires the Board to, amongst other duties:

- ensure the proper and efficient performance of the functions of the Organisation;
- determine the policy of the Organisation with respect to any matter; and
- give directions to the Chief Executive.

The CAC Act requires the Board to comply with certain accountability and corporate governance principles, including:

- the maintenance of the Audit Committee;
- specific financial and reporting provisions;
- disclosure of Board Member's personal interests;
- provision of indemnities and indemnity insurance in certain circumstances.

All the CAC Act requirements are currently being met.

The Board meets formally every second month for one or two days. Additional meetings may be scheduled as required. In accordance with the SIR Act, Board members, with the exception of the Chief Executive, are not involved in the day-to-day running of the Organisation.

The Board has a formal agenda for each meeting and receives regular papers from management on financial and business performance, and a range of specific issues relevant to the Organisation.

The Board has established a permanent Audit Committee and establishes other committees from time to time to assist in the execution of its duties and allow detailed consideration of complex issues.

The Audit Committee operates under written terms of reference (see page 12). All matters considered and determined by the Audit Committee are submitted to the Board for information and, where appropriate, ratification.

Board membership

Under the SIR Act, the CSIRO Board comprises the full-time Chief Executive, a part-time Chairman and up to eight other part-time members. All members, including the Chief Executive, are appointed by the Governor-General.

Each member brings complementary skills and experience to the Board. Details of the 1998-99 Board members, their qualifications and terms of appointment are shown at the end of this section. The Financial Statements contain details of remuneration of Board members and their attendance at Board and Audit Committee meetings.

Disclosure of interests

Section 21 of the CAC Act provides for the disclosure of material personal interests in a matter that is being considered by the Board and prohibits participation, deliberation and decision making by any member on such matters.

Board and Board Committee members' remuneration

The Remuneration Tribunal determines part-time Board members' remuneration and allowances.

Audit Committee

The Audit Committee, a formal sub-committee of the Board, meets at least four times a year. As at 30 June 1999 the Audit Committee comprised Mr D P Mercer (Chairman), Mr D C K Allen, Mr A E de N Rogers and Ms E Alexander (external advisor).

The Chief Executive and the Deputy Chief Executive responsible for Finance, together with the General Manager of CSIRO's Risk Assessment and Audit Unit, and representatives of the Australian National Audit Office, attend meetings at the invitation of the Audit Committee Chairman.

The Audit Committee's purpose as detailed in the Committee's Terms of Reference is:

'to assist Board members in fulfilling its responsibilities relating to corporate governance (particularly section 32 of the CAC Act 1997), accounting and reporting practices of the Organisation. The Committee oversees the Organisation's risk management policies, practices and controls in relation to:

- financial and commercial activities;
- legislative and regulatory conformance; and
- asset protection.'

The Committee has unlimited access to both the internal and external auditors and to senior management.

Other committees

There is a Board Remuneration Sub-Committee, which meets from time to time. Other sub-committees are established to address specific issues, such as the identification of a potential new Chief Executive; they are not permanent committees.

Risk management program

The Board has the responsibility for ensuring an appropriate risk management framework is in place to identify and manage high and significant risks to the Organisation.

To this extent, CSIRO undertakes a systematic program of Organisation-wide and Divisional risk assessments designed to identify, evaluate and prioritise risks and develop risk mitigation strategies. The Risk Assessment and Audit Unit facilitates this process with a three year rotation program, utilising a methodology consistent with the Australian Risk Management Standard AS/NZS-4360.

The Audit Committee reviews the Organisational high and significant risks and management's risk mitigation strategies through regular reports from the Risk Assessment and Audit Unit.

A risk management policy, and associated guidelines, was issued in July 1997.

It is the responsibility of the operational management of CSIRO to develop and implement risk mitigation strategies. In appropriate circumstances, insurance is used as a method to transfer the financial impact of risk.

Ethical standards

In September 1994 the CSIRO Board endorsed a Code of Conduct that applies to the Organisation's Board, management and staff. The Code provides a benchmark against which conduct can be assessed to ensure that the highest ethical standards are met.

Fraud control

The Organisation's Fraud Control Policy was issued with the Board's endorsement in April 1996. Since then a fraud risk assessment was conducted across CSIRO and will be reviewed during 1999. A detailed Fraud Control Plan has been developed in line with the guidelines set out by the Commonwealth Law Enforcement Board. The Audit Committee receives a regular six monthly fraud report from the Fraud Control Officer.

Independent professional advice

In the interests of their duties, Board members may seek independent professional advice at the Organisation's expense. However, the Chairman's prior approval is required in all instances.

Internal control

The Board is responsible for ensuring an appropriate internal control framework is in place and operating. Through the Audit Committee it reviews management's policies, procedures framework and internal compliance.

External audit

Under the CAC Act the Auditor General is the external auditor for CSIRO. The Audit Committee reviews the Australian National Audit Office audit plan and meets with the external auditor prior to recommending to the Board that the financial statements be signed.

Internal audit

The Risk Assessment and Audit Unit provides an independent review function in accordance with a formal charter endorsed by the Audit Committee.

The Audit Committee reviews the annual Risk Assessment and Internal Audit plan and receives regular reports on progress against that plan.

Year 2000 Compliance

The CSIRO has met the Government deadline of 30 June 1999 for readiness on all business critical systems. Other supporting or non-essential systems will be Y2K ready by 30 September 1999. The main effort now is concentrated on refining contingency plans for unexpected system failures.

CSIRO has received seed funding from the Commonwealth Government for its compliance work, and has reported regularly on its progress through the Office for Government Online.

External consultants have audited the Year 2000 project. This has resulted in improved process and performance benchmarking.

Status reports on the project are given regularly to senior management, the Audit Committee, the Board and to other Government agencies through the Office for Government Online.

Total expenditure for the Year 2000 project in CSIRO is projected to be less than \$10 million.

THE CSIRO BOARD (1998-99)



Chairman

Mr Charles Allen

AO MA MSc FTSE
Company Director
5 December 1996 — 14 December 2001

Members Current at 30 June 1999:



Dr Malcolm McIntosh

AC Kt BSc PhD FTSE FRAeS FIEAust CPEng
Chief Executive of CSIRO
3 January 1996 — 2 January 2001



Mr John Gandel

AO
Chairman, Gandel Group Pty Ltd
23 February 1999 — 22 February 2004



Mr Russell Higgins

BEd(Hons)
Secretary, Department of Industry, Science
and Resources
7 April 1997 — 30 June 2000



Mr Don McDonald

Grazier
15 July 1998 — 14 July 2003



Mr Don Mercer

BSc(Hons) MA(Econ)
Company Director
4 March 1998 — 3 March 2003



Professor Mary O'Kane

BSc PhD
Vice-Chancellor
University of Adelaide
28 May 1997 — 31 December 2000



Mr Norbury Rogers

BCom FCA
Senior Consultant
Ernst & Young
28 May 1997 — 31 December 2000



Professor Vicki Sara

BA(Hons) PhD DOC
Australian Research Council
15 July 1998 — 14 July 2003

Terms completed during year:



Dr Eric Tan

AM MBBS FRACS FACS
Company Director
12 December 1995 — 11 December 1998

CSIRO SERVICE CHARTER

Who we are

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is a statutory agency of the Government of Australia.

What we do

CSIRO serves the Australian community through outcomes which provide:

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

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

Our customers

Our customers include:

- business, including business associations and individual businesses;
- the Commonwealth and State Governments and their agencies;
- the Australian public.

Customer services

For organisations and individuals seeking scientific research expertise, we will:

- assist in clarifying the scientific expertise required to address the customer's needs;
- where CSIRO has the available expertise, develop a proposal for CSIRO to provide a service to the customer;
- negotiate a contract with the customer;
- conduct research or other scientific services as specified in the contract with the customer in a professional manner.

For Governments and their agencies, we will provide:

- strategic and applied research in support of national and regional economic, social and environmental objectives;
- submissions to inquiries and working parties where scientific and technical advice is required;
- delivery of scientific and technological inputs to foreign trade missions and overseas aid projects.



For people, companies and other organisations seeking information we will:

- provide up-to-date, accurate information about CSIRO and its activity;
- provide information and expert opinion on national and international developments in areas of science in which CSIRO has expertise;
- where the enquiry is outside CSIRO's expertise, direct the enquirer to organisations which may be able to provide the information.

Our service standards

Our performance can be measured against the following standards:

- in all activities the potential benefit to the Australian community will be identifiable;
- all scientific and commercial activity will be conducted with due professional care and skill;
- the Organisation will seek, through advisory committees, representing the sectors of the economy, and other means, the input of senior industry and Government officials in deciding its research priorities;
- the Organisation will seek and respond to feedback from the client for each major research project undertaken;
- the Organisation will utilise its scientific capability as effectively as possible when addressing the needs of its customers;
- advice given will be independent and based on appropriate expertise;
- CSIRO will listen to the community and recognise its concerns, and help to inform Australians about developments in science and its applications.

Staff conduct

The Staff Code of Conduct is based on four main principles:

- staff are expected to perform their duties with professionalism and integrity, and work efficiently to enable CSIRO to meet its research and corporate goals;
- fairness, honesty, equity and all legal requirements are to be observed by all CSIRO staff in the conduct of official duties and during interactions with clients and members of the public;
- real or apparent conflicts of interest are to be avoided on all occasions;
- intellectual property including confidential information will be properly protected during employment with CSIRO and afterwards, and appropriate business and commercial protocols will be strictly observed by staff.

Checking our performance

We will:

- evaluate our services against the standards we have set in this Charter, to see if we are meeting those standards;
- informally review the standards set out in this Charter during the year in response to ongoing changes;
- formally review the standards set out in this Charter at least once a year and adjust them in light of comments received, and include in the Annual Report, which is tabled in Parliament, the outcomes of the formal review and the adjustments made to the Charter as a result.

The Charter will be independently reviewed at least every three years. CSIRO invites comments from customers, stakeholders and staff as part of its monitoring and review procedures.

STRUCTURE, MANAGEMENT AND STAFF

The *Science and Industry Research Legislation Amendment Act 1986* established a ten-member Board responsible for determining policy and ensuring the efficient functioning of CSIRO.

The Chief Executive, who is a member of the Board, is responsible for the Organisation's activities. He is supported in this role by four Deputy Chief Executives, who together with the Chief Executive, constitute the Executive Committee that oversees CSIRO's operations.

CSIRO's research is planned and resourced on a Sectoral basis. The Organisation has defined 22 Sectors covering research in agribusiness; environment and natural resources; information technology, infrastructure and services; minerals and energy; and manufacturing. Each Deputy Chief Executive oversees a group of Sectors and a number of corporate functions.

Research is performed by the Divisions or business units of CSIRO. Divisions are largely organised by scientific discipline, and most contribute to more than one Sector.

Details of responsibilities and participation in this matrix structure are in the Organisation Charts following. (Chart 1: Corporate responsibilities; Chart 2: Sector responsibilities; Chart 3: Operational arrangements).

The locations of CSIRO's main sites are shown on the map that follows these charts.

CSIRO staff are employed under Section 32 of the *Science and Industry Research Act 1949*. Senior managers are listed following the charts and map.

At 30 June 1999 CSIRO had a total staff of 6636, which has an equivalent full-time value of 6324.89 units. The numbers employed in different job categories are shown below.

Staff by gender and principal functional area

	FEMALE	MALE	TOTAL
Administrative Support	670	231	901
Communication & Information	209	122	331
Corporate Management	7	61	68
General Services	78	71	149
Research Management	12	204	216
Research Projects	991	1669	2660
Research Scientist	173	1317	1490
Senior Specialist	2	32	34
Technical Services	113	674	787
TOTAL	2255	4381	6636

CHART 1
CORPORATE
RESPONSIBILITIES
AS AT 30 JUNE 1999

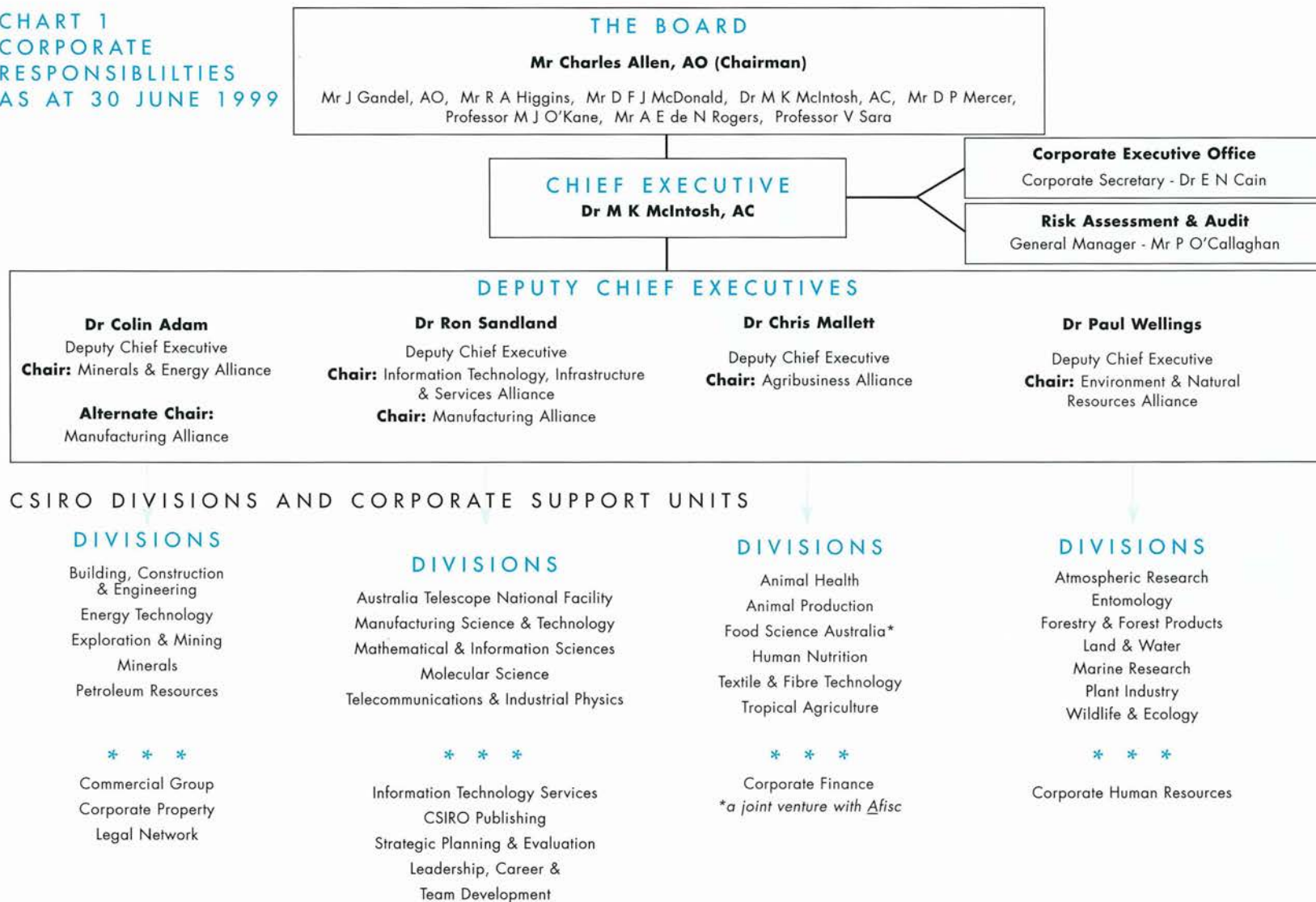


CHART 2

SECTOR RESPONSIBILITIES AS AT 30 JUNE 1999

Sector Coordinator

AGRIBUSINESS (Chair: Dr Chris Mallett)

Field Crops	Dr Jim Peacock <i>Plant Industry</i>
Food Processing	Professor Richard Head <i>Human Nutrition</i>
Forestry, Wood and Paper Industries	Dr Glen Kile <i>Forestry & Forest Products</i>
Horticulture	Dr Nigel Scott <i>Plant Industry</i>
Meat, Dairy and Aquaculture	Mr Shaun Coffey <i>Tropical Agriculture</i>
Textiles, Clothing and Footwear	Dr Peter Gordon <i>Textile & Fibre Technology</i>

ENVIRONMENT AND NATURAL RESOURCES (Chair: Dr Paul Wellings)

Biodiversity	Dr Brian Walker <i>Wildlife & Ecology</i>
Climate and Atmosphere	Dr Graeme Pearman <i>Atmospheric Research</i>
Land and Water	Dr Graham Harris <i>Land & Water</i>
Marine	Dr Nancy Bray <i>Marine Research</i>

INFORMATION TECHNOLOGY, INFRASTRUCTURE AND SERVICES (Chair: Dr Ron Sandland)

Built Environment	Mr Larry Little <i>Building, Construction & Engineering</i>
Information Technology and Telecommunications	Dr Dennis Cooper <i>Telecommunications & Industrial Physics</i>
Measurement Standards	Dr Barry Inglis <i>Telecommunications & Industrial Physics</i>
Radio Astronomy	Professor Ron Ekers <i>Australia Telescope National Facility</i>
Services	Dr Murray Cameron <i>Mathematical & Information Sciences</i>

MANUFACTURING (Chair: Dr Ron Sandland)


Chemicals and Plastics	Dr Albert Mau <i>Molecular Science</i>
Integrated Manufactured Products	Dr Ian Sare <i>Manufacturing Science & Technology</i>
Pharmaceuticals and Human Health	Dr Simon Carroll <i>Molecular Science</i>

MINERALS AND ENERGY (Chair: Dr Colin Adam)

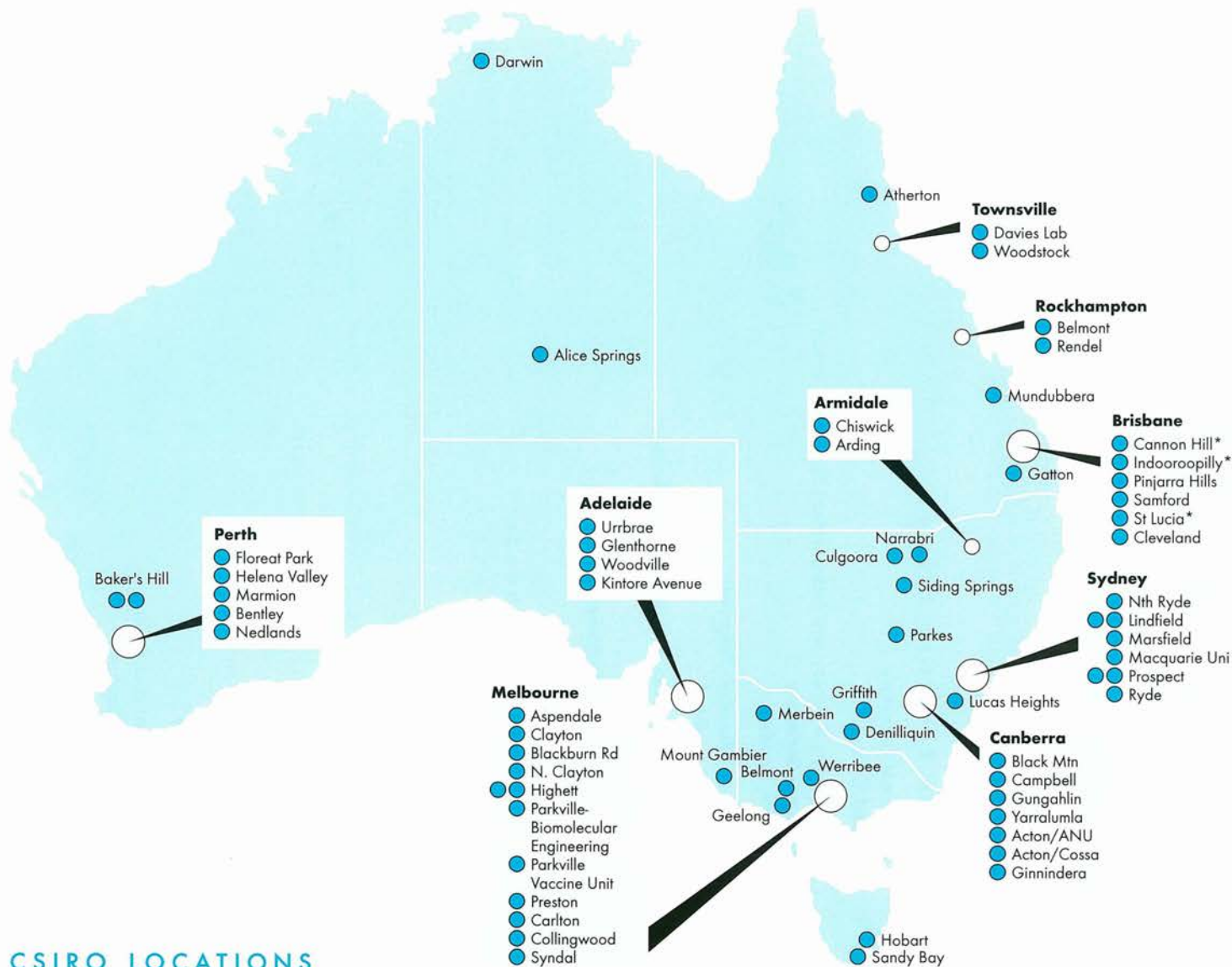
Energy	Dr John Wright <i>Energy Technology</i>
Mineral Exploration and Mining	Dr John Read <i>Exploration & Mining</i>
Mineral Processing and Metal Production	Dr Rod Hill <i>Minerals</i>
Petroleum	Dr Adrian Williams <i>Petroleum Resources</i>



CSIRO OPERATIONS AND REPORTING Chief Executive – Dr Malcolm McIntosh

 CSIRO	ALLIANCES and SECTORS																					
	Agribusiness						Environment & Natural Resources				Information Technology, Infrastructure & Services				Manufacturing		Minerals & Energy					
	Field Crops	Food Processing	Forestry, Wood & Paper Industries	Horticulture	Meat, Dairy & Aquaculture	Textiles, Clothing & Footwear	Biodiversity	Climate & Atmosphere	Land & Water	Marine	IT & Telecommunications	Built Environment	Measurement Standards	Radio Astronomy	Services	Chemicals & Plastics	Integrated Manufactured Products	Pharmaceuticals & Human Health	Energy	Mineral Exploration & Mining	Mineral Processing & Metal Production	Petroleum
Deputy Chief Executives																						
DIVISIONS																						
Dr Chris Mallett																						
Animal Health		●			●	●											●					
Animal Production					●	●		●		●												
Food Science Australia		●	●		●	●										●	●					
Human Nutrition		●	●		●													●				
Tropical Agriculture		●			●	●	●	●	●	●												
Textile & Fibre Technology						●																
Dr Paul Wellings*																						
Atmospheric Research								●														●
Entomology		●		●	●	●		●		●		●				●		●				
Forestry & Forest Products			●				●	●	●		●					●			●			
Land & Water		●		●	●	●	●	●	●		●								●	●	●	●
Marine Research					●		●	●		●												●
Plant Industry		●	●		●	●	●	●								●	●					
Wildlife & Ecology		●		●		●	●	●	●						●				●	●		
Dr Ron Sandland*																						
Australia Telescope National Facility														●								
Manufacturing Science & Technology										●		●			●	●	●		●	●	●	
Mathematical & Information Sciences		●	●	●	●	●	●	●	●	●	●		●	●			●	●		●	●	●
Molecular Science												●				●	●	●				●
Telecommunications & Industrial Physics						●		●			●	●	●		●	●	●		●	●		●
Dr Colin Adam																						
Building, Construction & Engineering												●				●	●				●	
Energy Technology								●	●	●									●	●	●	
Exploration & Mining										●									●	●	●	●
Minerals																			●		●	●
Petroleum Resources																			●	●		●

* Dr Paul Wellings and Dr Ron Sandland replaced Dr John Radcliffe and Dr Bob Frater on 28 June 1999.
As at 30 June 1999



* Part of South East QLD consolidation study.

CSIRO LOCATIONS

SENIOR STAFF AND ADDRESSES AS AT 30 JUNE 1999

CSIRO Corporate Centre - Canberra

PO Box 225, DICKSON, ACT 2602 Tel: (02) 6276 6766

Chief Executive

Dr Malcolm McIntosh, AC

Deputy Chief Executives

Dr Colin Adam

Dr Chris Mallett

Dr Ron Sandland

Dr Paul Wellings

Corporate Executive Office

Corporate Secretary

Dr Ted Cain

Government Business and International Scientific Liaison

Principal Secretary

Dr Beth Heyde

Manager Education Programs

Mr Ross Kingsland

Manager Ministerial and Government Business

Ms Marie Keir

Director National Awareness

Mr Julian Cribb

Corporate General Managers

Finance

Mr Bob Garrett

Human Resources

Mr Peter O'Keefe

Information Technology Services

Mr Jonathan Potter

Property

Mr George Harley

Publishing

Mr Paul Reekie

Risk Assessment and Audit

Mr Peter O'Callaghan

Strategic Planning and Evaluation

Dr Andrew Pik

Divisions

Animal Health

Chief: Dr Mike Rickard
Private Bag 24
GEELONG VIC 3220
Tel: (03) 5227 5000 Fax: (03) 5227 5555

Animal Production

Chief: Dr Oliver Mayo
Locked Bag No 1, Delivery Centre
BLACKTOWN NSW 2148
Tel: (02) 9840 2700 Fax: (02) 9840 2940

Atmospheric Research

Chief: Dr Graeme Pearman, AM
PMB 1
ASPENDALE VIC 3195
Tel: (03) 9239 4400 Fax: (03) 9239 4444

The Australia Telescope National Facility

Director: Professor Ron Ekers
PO Box 76
EPPING NSW 1710
Tel: (02) 9372 4100 Fax: (02) 9372 4310

Building, Construction & Engineering

Chief: Mr Larry Little
PO Box 56
HIGHETT VIC 3190
Tel: (03) 9252 6000 Fax: (03) 9252 6244

Energy Technology

Chief: Dr John Wright
PO Box 136
NORTH RYDE NSW 1670
Tel: (02) 9490 8666 Fax: (02) 9490 8909

Entomology

Chief: Dr Jim Cullen
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CANBERRA ACT 2601
Tel: (02) 6246 4001 Fax: (02) 6246 4000

Exploration & Mining

Chief: Dr Bruce Hobbs
Private Bag
WEMBLEY WA 6014
Tel: (08) 9333 6000 Fax: (08) 9387 6046

*Food Science Australia**

Chief Executive: Dr Michael Eyles

PO Box 52

NORTH RYDE NSW 1670

Tel: (02) 9490 8333 Fax: (02) 9490 8499

* Joint venture between Afisc and CSIRO Food Science & Technology

Forestry & Forest Products

Chief: Dr Glen Kile

PO Box E4008

KINGSTON ACT 2604

Tel: (02) 6281 8211 Fax: (02) 6281 8312

Human Nutrition

Chief: Professor Richard Head

PO Box 10041

ADELAIDE BC SA 5000

Tel: (08) 8303 8800 Fax: (08) 8303 8899

Land & Water

Chief: Dr Graham Harris

Private Bag 2

GLEN OSMOND SA 5064

Tel: (08) 8303 8400 Fax: (08) 8303 8555

Manufacturing Science & Technology

Chief: Dr Ian Sare

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CLAYTON SOUTH MDC VIC 3169

Tel: (03) 9545 2777 Fax: (03) 9545 1128

Marine Research

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HOBART TAS 7001

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Mathematical & Information Sciences

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Locked Bag 17

NORTH RYDE NSW 1670

Tel: (02) 9325 3100 Fax: (02) 9325 3200

Minerals

Chief: Dr Rod Hill

Box 312

CLAYTON SOUTH VIC 3169

Tel: (03) 9545 8500 Fax: (03) 9562 8919

Molecular Science

Acting Chief: Dr Albert Mau

Private Bag 10

CLAYTON SOUTH MDC VIC 3169

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Telecommunications & Industrial Physics

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Textile & Fibre Technology

Chief: Dr Brett Bateup
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Tropical Agriculture

Chief: Dr Elizabeth Heij
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ST LUCIA QLD 4067
Tel: (07) 3214 2200 Fax: (07) 3214 2288

Wildlife & Ecology

Chief: Dr Brian Walker
GPO Box 284
CANBERRA ACT 2601
Tel: (02) 6242 1600 Fax: (02) 6242 1555



Introduction

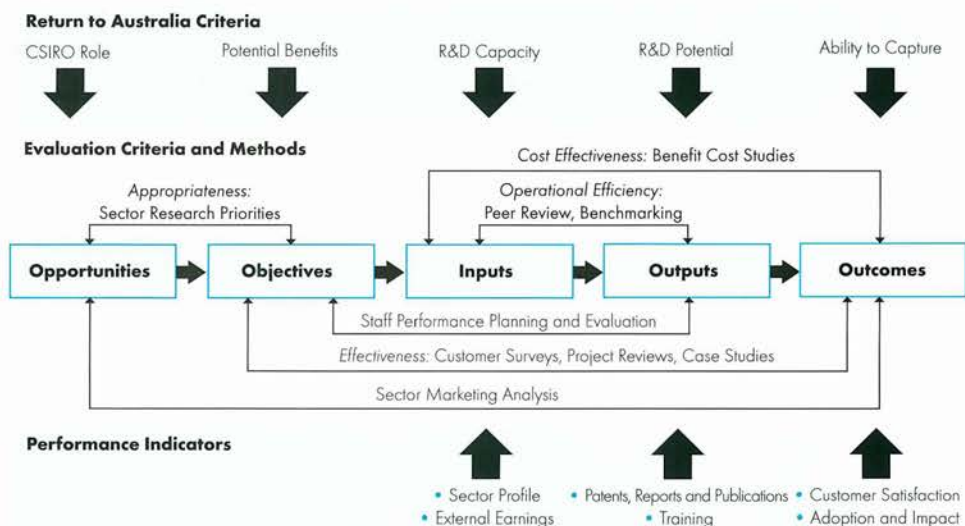
Performance evaluation in the past year has been dominated by the mid-term review of Sector Plans for the triennium 1997 to 2000. These reviews were carried out in association with CSIRO's 22 Sector Advisory Committees (SACs) in preparation for determining priorities and strategies for the 2000-03 triennium. The process culminated in a highly productive series of discussions between the CSIRO Executive and the Sector Advisory Committees and CSIRO staff. These discussions revealed:

- the immense value for CSIRO in having access to the diverse expertise of SAC members to enrich our evaluation and priority setting process;
- the great maturing in the relationship between CSIRO and the SACs since they were established three years ago;
- the very considerable progress that has already been made in refocussing of effort within a number of Sector portfolios and the work that remains to be done in some;
- the extent to which exciting demand-driven opportunities for CSIRO's research expertise swamp our capacity to deliver given our current level of resources;
- an increasing diversity of clients and research collaborators, stretching our business development skills as we work with them to develop mutually beneficial long-term relationships.

The performance evaluation and priority setting was conducted within the overall framework developed by CSIRO as shown in Figure 1.

Figure 1

CSIRO Planning and Evaluation Framework



The framework has evolved from CSIRO's priority setting methodology developed in 1990 and now incorporates the Government's Outcomes and Outputs accrual-based budgeting philosophy within the overall Opportunities-Objectives-Inputs-Outputs-

Outcomes context. Both the five priority criteria and the six performance indicators as negotiated with Government, are linked to the five elements of the framework, as are other evaluation processes undertaken in CSIRO.

The performance indicators are:

Input Indicators	Sector Profile External Earnings
Output Indicators	Publications, Reports and Patents Training
Outcome Indicators	Customer Satisfaction Adoption and Impact of Research and Advice

It is important to realise that CSIRO is but a part of the national innovation system for Australia. CSIRO's success in achieving benefits for Australia is dependent on business and community partnerships with CSIRO for the commercialisation of technology and uptake of research results and scientific advice. It is also dependent on a healthy and vigorous scientific base and continuing supply of high quality graduates from the university sector. See Box.

CSIRO's Role in the National Innovation System

CSIRO's linkages within the national innovation system are developed through:

- conducting mission-oriented, strategic research with commercial and public good benefits, mostly in collaboration with industry, universities and other public sector R&D providers;
- commercialisation of CSIRO developed technology, products and processes, including financial and legal aspects such as protection of intellectual property;
- assisting industry access Australian and overseas technology and fostering local and international scientific cooperation. Providing access to world class research facilities and specialist advice and technical services;
- building business networks with customers and the encouragement of continuing relationships;
- providing a nexus between policy makers, funders and other providers of research and contributing to public policy development;
- liaising with Commonwealth, State/Territory and Local Governments, industry, universities and other research users to identify research priorities and to coordinate the development of Australia's research infrastructure;
- managing national research facilities — the Australia Telescope, Australian Animal Health Laboratory, Oceanographic Research Vessel *Franklin* and the National Measurement Laboratory;
- conducting education, research training and science and technology awareness programs;
- promoting Australia's R&D capacities and the achievements of Australia's innovative companies.

INPUT INDICATORS

Sector Profile

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

CSIRO's research planning and priority setting is based on an assessment of the attractiveness and feasibility of research opportunities in twenty-two customer-focused Sectors. External Sector Advisory Committees (SACs) play a key role in advising CSIRO on priorities within Sectors.

Figure 2 shows the Sectoral distribution of total expenditure by CSIRO Divisions in 1998-99. Total expenditure includes expenditure from both appropriation and external income.

For comparison, the Figure also shows the planned level of investment in each Sector. The 'planned' investments incorporate approved changes to the levels that were determined prior to the start of the current triennium and published in the CSIRO Strategic Research Plan 1997-98 to 1999-2000 (SRP). It should also be noted that the chart reflects an estimate of CSIRO's operational activities in Food Science Australia (a joint venture with Afisc) which differ from the legal interest.

While the broad pattern of expenditure between Sectors is consistent with strategic investment decisions, actual expenditure varies from SRP estimates in individual Sectors for a number of reasons.

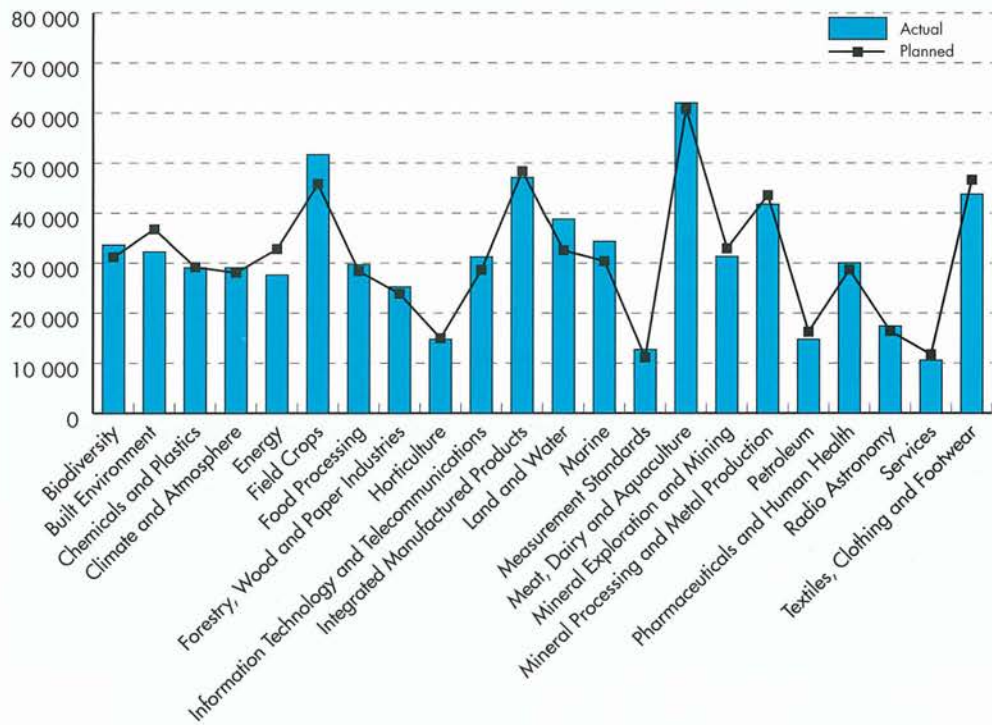
In some Sectors, economic and other circumstances have limited the capacity of firms and agencies to undertake and commission research. This affects CSIRO's external earnings and overall level of effort in these Sectors.

Actual expenditure also reflects cash management decisions taken by Divisions throughout the year — decisions that were not explicitly factored into SRP estimates of planned investment.

Most importantly, there has been a rapid maturing of the relationship between CSIRO and SACs in the period since preparation of the SRP, leading to some revisions to the initial plans — including redirection of effort both between and within Sectors.

Figure 2: CSIRO Expenditure by Sector, actual versus planned

CSIRO Expenditure by Sector, 1998-99: Actual versus planned, \$'000.
(Planned data include approved shifts from the original Strategic Research Plan).



External Earnings

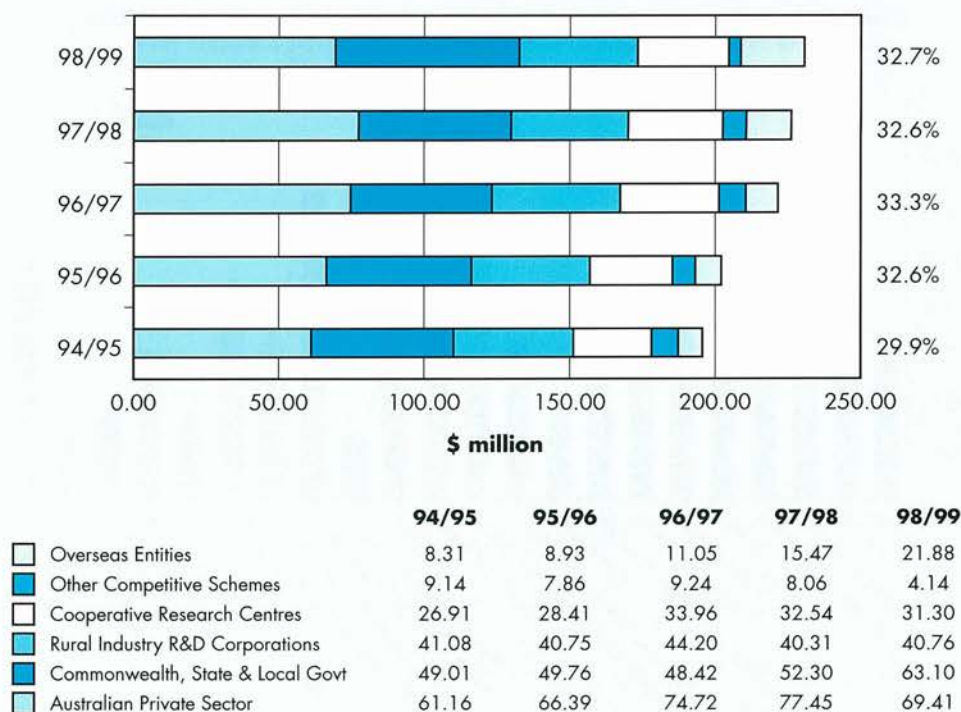
This indicator reflects the demand for CSIRO's research and services consistent with its mission.

CSIRO has again exceeded its 30 per cent external earnings target in 1998-99.

Earnings from research and services were \$231 million or 32.7 per cent of total income. This result compares with earnings of \$226 million or 32.6 per cent in 1997-98.

The sources and trends for the external income are shown in Figure 3.

Figure 3: Amounts and Sources of External Earnings



The data show that CSIRO's domestic private sector external earnings have been affected by the reported reduction in overall expenditure by business on R&D.

The reduction has been offset by increased earnings from overseas entities and Government sources (which include R&D spending by State Governments and Government owned trading enterprises).

Revenue from Cooperative Research Centres and the Rural Industry R&D Corporations is steady. Approximately 50 per cent (\$20 million) of R&D Corporation funds directed to CSIRO are contributed by the private sector through industry levies.

OUTPUT INDICATORS

Publications, Reports and Patents

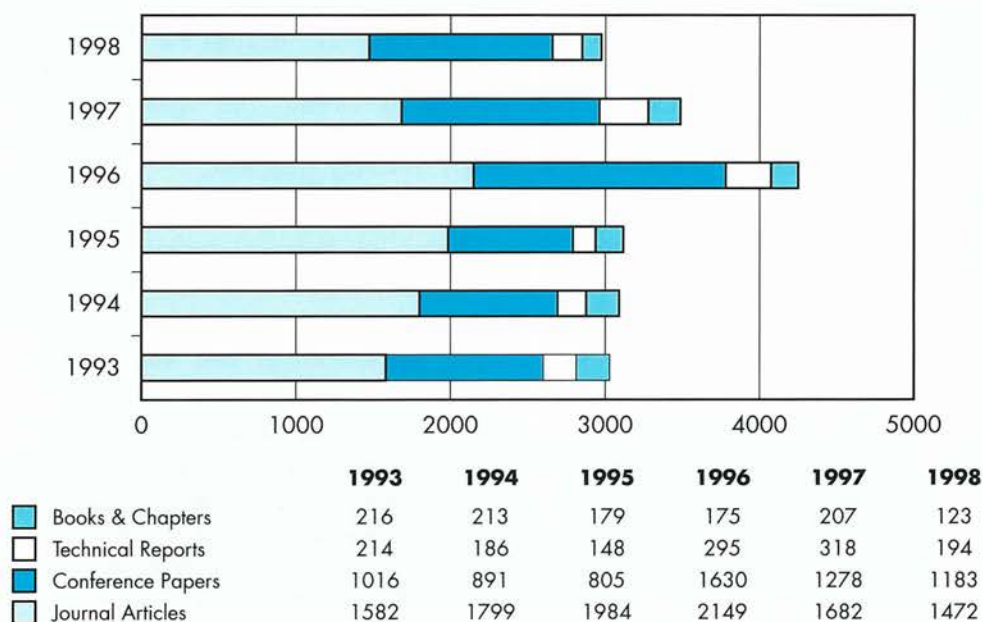
This indicator is used to assess primarily CSIRO's contribution to, and hence ability to access, the world's knowledge base.

Publications

The publications data are shown in Figure 4. As noted in last year's report, the method of collecting the data was changed in 1996-97. That change is thought to have accounted for a large part of the reported increase in the number of conference papers. There appears to be an overall decline in publication output across all categories to about 1993 levels.

Citation analysis of publications in refereed journals was undertaken in 1996 and will be repeated in 2001.

Figure 4: CSIRO publications



Reports

The number of client reports recorded rose to 8099 in 1998, up from 7095 in 1997 and 5076 in the previous year. Around half of the reports are from two Divisions and are reports resulting from providing testing and calibration services.

Patents

As at 30 June 1999 CSIRO had 84 Patent Cooperation Treaty applications in place, slightly up from 81 as at 30 June 1998, and on par with the average over the last five years. (International PCT applications are a 'temporary' phase in the patenting process and have a life span of 18 months. Hence the number reported here spans more than one year. In previous Annual Reports, only those applications initiated in the 12 months of the financial year were reported and averaged around 50).

The total number of Australian and foreign patents and applications (excluding PCTs) held as 30 June 1999 is 3179. The decision to file, prosecute and/or maintain a patent takes into account the technical considerations, patent attorney and legal advice, market conditions, and the wishes of commercial partners.

Income from the patent holding in 1998-99 amounted to \$7.0 million against an expenditure of \$5.3 million for legal and patent portfolio management costs.

Training

This indicator reflects CSIRO's contribution to the development of the skills base of Australia and its own staff.

In 1999 CSIRO supervised a total of 755 postgraduate students for universities throughout Australia, including 579 PhD students and 176 Masters or Honours students; 30 per cent of these students were supervised through the Organisation's involvement in the Cooperative Research Centres program. The overall figure represents a modest 1.6 per cent increase on 1998. This significant level of collaborative supervision of students with the universities contributes considerably to the overall breadth of training of Australia's university graduates.

In 1999 CSIRO is sponsoring 127 postgraduate students. This includes full scholarships for 27 PhD and three Masters or Honours students and partial scholarships to a further 76 PhD and 21 Masters or Honours students.

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

Internally, the CSIRO Leadership, Career and Team Development Program seeks to respond to those areas in which training and development of staff will make a major contribution to the achievement of the Organisation's goals. A group of Human Resources Managers and other specialist staff were accredited in facilitating the CSIRO-developed Research Team Effectiveness and Knowledge Team Effectiveness Questionnaires, used for assessing members' perceptions of the effectiveness of their work teams. The methodology is now widely used in CSIRO and in other research and knowledge-creating organisations as a diagnostic instrument for improving work performance.

Development began on two new programs, Team Leadership in CSIRO and Managing Complexity. The Team Leadership in CSIRO Program is aimed at developing the knowledge, skills and behaviours of leaders, managers, supervisors and coordinators of work teams. The Managing Complexity Program seeks to enhance the effectiveness of high potential individuals such as those staff managing highly complex, 'out of the box' projects and those staff making a significant role transition. These programs will be made available to staff during the coming year.

Under the World Bank Project to assist Lembaga Ilmu Pengetahuan Indonesia (LIPI), a Leadership Development Program modelled on the CSIRO Program was begun. Three workshops for 24 LIPI staff were conducted with themes including communication, negotiation, managing creativity and preparations for Action Learning Projects. In addition, three workshops were conducted for the LIPI Executive and CSIRO-LIPI staff.

The corporate training and development effort included some 3000 staff training/development days. In addition, Divisions conducted a range of training and development programs with the assistance of external training and development agencies.

CSIRO's Commercial Committee has overseen several specific staff training programs concerning the Organisation's commercial practice. Topics covered included business development, key account management and negotiation.

OUTCOME INDICATORS

Customer Satisfaction

This indicator relates to CSIRO's responsiveness to the needs of customers with whom the Organisation has a contractual arrangement. The indicator is assessed through a range of measures including repeat business, formal surveys, and joint project management. The analysis will therefore tend to exclude the provision of scientific advice to aid Government policy making.

The level of repeat business is high at around 75 per cent of all contracts on average across CSIRO. The variability between Divisions in the level of repeat business (50 - 95 per cent) reflects a range of factors such as the number and size of contracts and the maturity of the market.

Formal surveys are widely used, the response rate being variable: the average across CSIRO was 50 per cent. Project Committees or similar means of joint project management are used for about 50 per cent of contracts. Factors that determine whether or not such a strategy is employed are the size and duration of the project and the number of collaborators involved in the project.

The overall major finding for 1998-99 is that there is widespread satisfaction with customers' interaction with CSIRO. Specific comments from customers include:

'The research in this project has real substance. The excellent fundamental thistle and agent population dynamics work paves the way for an integrated control program which should ultimately result in the earlier and cheaper demise of nodding thistle.'

'Congratulations on the very worthwhile progress made with the project so far.'

'I would like to thank you and your associates for helping me on the batch stripper investigation to identify the poor efficiency. My customers have received your report and are pleased with the findings, and are in the process of implementing plant modifications. They have asked me to convey their appreciation.'

'I found the scientist pleasing to work with. He contributed ideas as well as listening to and incorporating our ideas.'

'The report was delivered on time and within budget and was of a high quality. Further explanatory work on the report was required and this was delivered in a useful and co-operative fashion.'

'The project was a first for Australia and hence provided a number of challenges for the project team. The final report for the project demonstrates the success of the project team in meeting these challenges and combines the input from the diverse segments of the project into a coherent document.'

The issue that stimulated the greatest proportion of adverse comments was failure to meet agreed milestones. Also significant, but to a lesser degree, was a perceived lack of focus by CSIRO on the outcomes required by the customer.

It is pleasing to note that an issue raised in past years by customers, that is lack of flexibility in contract negotiations, was not raised at all this year. It appears that the development of standard form agreements and the meeting of CSIRO's internal Commercial Network that focused on this matter have borne fruit.

Adoption and Impact of Research and Advice

This indicator assesses the significance or impact of CSIRO's work. The indicator looks at examples of CSIRO-developed practices, instruments/products, and processes adopted by users in industry, Government and the community, or changes in user practice in response to policy advice provided by CSIRO.

The research is reported by CSIRO Sectors, grouped into Alliances — Agribusiness; Environment and Natural Resources; Information Technology, Infrastructure and Services; Manufacturing; and Minerals and Energy.

In accord with the new reporting requirements under the CAC Act, we also report on factors and trends influencing each Sector, how they impact on research, and the strategies CSIRO has developed to optimise our contributions.

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Field Crops Sector

Industry Context

The prospects for growth in the Sector industries, both in commodity quantity and in product quality differentiation, are high. Currently, the Sector is in a healthy condition despite depressed commodity prices. Moreover, increasing demand for food and food products on a global scale and in particular in markets targeted by Australian agricultural and food industries, is assured.

However, a major problem facing the cropping industries is the existing and further potential loss of prime production land through increasing salinity and acidification. Research has paved the way for major improvements in management practices in all of the cropping industries to help solve this situation.

Industry has recognised that CSIRO's research is playing an increasingly important role in the Sector as in recent years the State Departments of Agriculture have progressively down-sized their research capacities and emphasised their roles in regulatory affairs. The CSIRO response has been to increase collaborative research programs with the State Departments, particularly in on-farm operations, and to increase collaborations with a growing number of elite farmer groups, ensuring rapid adoption of research into practice.

CSIRO's Strategic Response

Ecologically sustainable cropping systems research will have high priority in the Sector and is a major area of cross-Sectoral importance. Also of high priority is postharvest grain research.

Gene technologies will be of overriding importance for cropping industries of the future, but a key strategy in our research is to develop technologies that will bridge the transition between current conventional breeding and transgenic breeding of the future.

Gene technologies have opened the way for new approaches into the control of fungal pathogens in our crops, currently a limiting factor in the growth of the grain legume industries. Protein, starch and fatty acid composition of grains for the food chain can now be specific objectives in plant improvement programs.

There are new opportunities for the sugar and cotton cropping industries in 300 000 irrigated hectares of Western Australia, Northern Territory and Queensland. These expansions are strongly dependent on the high technology management and breeding research carried out by CSIRO.

Research Outcomes

Improved performance for grain storage. Trials carried out in collaboration with State Bulk Handling Companies in South Australia and Victoria have demonstrated that aeration can be used successfully in bunkers to store cereals and field peas. The two States have already implemented this technology.

Participative water use monitoring. A CSIRO/Coleambally Irrigation/Charles Sturt University project to monitor paddock water use successfully demonstrated a

participative process for involving the farming community in research. It led to community-driven attempts to acquire funding to expand and intensify the monitoring.

Simulation in farm management. Farmers in the northern cropping region are using CSIRO FARMSCAPE computer simulations to monitor crops and soils to improve farm management. Formal evaluation of FARMSCAPE showed major impacts on participating farmers and advisers, and significant market acceptance for simulation in commercial farm management.

Decision support for the cotton industry. CottonLOGIC, a decision support tool developed by CSIRO for the cotton industry, and launched in 1998 now has over 870 registered users. CottonLOGIC is available free to the industry to assist growers and their advisers in pest management, crop nutrition, insect species identification, plant mapping, growth regulation and management of INGARD cotton.

Winter wheat production. CSIRO plant breeders and AWB Limited have released to growers two new winter wheat varieties suitable for Australia's high rainfall zone. The new varieties, *Tennant* and *Brennan*, provide a further boost for the already fast expanding winter wheat production in Australia.

New soybeans. CSIRO scientists have developed a new soybean variety, high in isoflavone content. Developed to improve the culinary soybean industry in northern Australia, the variety, *Melrose*, is suited to a sub-tropical climate whilst providing a premium quality grain. *Melrose's* buff coloured coating ensures its quality for crushing or for processing into soy flour for bread products.

Food Processing Sector

Industry Context

The processed food industry is the largest manufacturing sector in Australia, with annual turnover of approximately \$44 billion. It comprises over 3500 firms of varying size and employs one in five of the manufacturing work force. It sources more than 90 per cent of its ingredients from the Australian agricultural sector and serves export and national markets, with export growth of approximately 11 per cent per annum for the last eight years.

The 'participation rate' by food companies in R&D has been low historically, but this is changing significantly in response to a market place in which innovation plays a key role. CSIRO continues to play lead roles for public and private R&D for the sector.

The primary R&D drivers for the sector in the medium term are:

- *globalisation of markets and R&D* - driving competitiveness in domestic and export markets;
- *consumerism* - increasing demands for sustainably produced, safe, wholesome, convenient and affordable quality food products with health benefit attributes;
- *technology domination/transfer* - advances in other disciplines (eg information technology, nutrition and health sciences) incorporated in food products and processes;
- *international and domestic regulation and policy* - affecting food composition, production and manufacturing systems and food labelling, for example health claims.

CSIRO's Strategic Response

CSIRO research will focus on:

- innovations to food product ingredients through developing new materials and improving their quality and functionality;
- developing efficient product manufacture and delivery systems;
- methods and strategies to improve the safety of food;
- identifying foods with specific health attributes and developing public information programs;
- understanding consumer demands and preferences for food products.

Research Outcomes

Community views on gene technology. A CSIRO national survey has been carried out to determine consumer attitudes towards biotechnology and in particular, genetic engineering in relation to the food supply. Results from the survey suggest that most Australians are willing to try gene modified foods provided they can see clear benefits. The survey findings send out a strong message that the community wants and needs more information on gene technology and its use in foods.

Novel ingredients for bowel health products. CSIRO and the Cooperative Research Centre for Food Industry Innovation have demonstrated that Himaize™ and a new high amylose maize starch are potent prebiotics, able to increase the populations of potentially beneficial bacteria in the colon. Separate CSIRO studies in animals have shown that the consumption of processed rice-based infant foods has a beneficial effect on large bowel physiology. If extrapolated to human infants, this could equate to an improvement in bowel health.

Breeding better barley. CSIRO has developed barley varieties for low-haze beer, using traditional breeding techniques. Lines of *Franklin*, *Tallon* and *Arapiles* have been produced and are currently being grown for seed increase and testing for agronomic and malting barley characteristics. Scientists have also developed transgenic barley lines with new genes for improvement of malting quality and virus resistance.

Reducing product spoilage in bulk containers. Export industry is implementing and evaluating new strategies developed by CSIRO to prevent container sweat and product spoilage through moulds in un-refrigerated bulk containers.

Using low value meat cuts. Technologies have been improved to convert pork shoulder meat and other low value meat cuts into a variety of convenience food products. A crucial part of the system has been the design and construction of a prototype machine to aid in the commercial production of meat products. This, and related processing innovations, has resulted in many inquiries from meat industry companies interested in taking up these technologies.

Improving plant profitability. An 'Integrated Process Systems' approach has demonstrated there is potential to achieve about 5 per cent savings on operating costs in food processing operations. This approach is currently being developed for implementation in one large food processing operation. Enabling technologies

needed for on-line control, such as the prediction of critical product quality properties through newly developed sensors and modelling, have also been developed.

New technologies for dairy industry. Several dairy ingredient manufacturing technologies were developed successfully to pilot scale in 1998-99 and are now being commercialised by Australian dairy companies, under licence from CSIRO. These include new and improved processes for the manufacture of whey protein isolates, cream powders, yoghurt base and an anti-cariogenic dental peptide.

World's best practice for mozzarella. Pizza cheese manufacturers are now better placed to satisfy customer requirements for the functional performance of cheese on pizza, following uptake of findings of CSIRO research and that of others. The Australian Cheese Technology Program extension program, supported by CSIRO and others, has developed a comprehensive course for mozzarella/pizza cheese manufacturers to encourage adoption of world's best practice.

A risk classification system for food premises. Following considerable research in the area of risk assessment, a Risk Classification System for all food premises has been formulated. This work has been conducted on behalf of the Australia New Zealand Food Authority and is in support of the recently developed Australian Food Safety Standards. The ranking of a food premises within the Risk Classification System will determine the frequency with which auditing of the premises will be conducted to determine compliance with the Australian Food Safety Standards. The risk ranking within this system will also determine the timeframe allowed for implementing the new food safety standards.

Forestry, Wood and Paper Industries Sector

Industry Context

The Forestry, Wood and Paper Industries Sector includes all stages of the value chain from sustainable management of native forests and plantations, to tree harvesting and log transportation, wood processing into building materials and furniture, pulp and paper and recycled fibre processing and products. It also embraces the environmental impact of forestry and processing operations. The Sector's significant contribution to Australia's sustainable development will be increasingly important in the future.

The Sector's 1 per cent share of National GDP increases to 4.5 per cent if the value of environmental services provided by Australia's commercial forests is included.

Some of the key factors influencing the Sector include:

- international policy to reduce deforestation and improvements in protection and management of natural forests for the sustained supply of commercial and environmental goods and services;
- declining access to native forests and expansion of plantations for wood supply;
- the role of forests in carbon sequestration and potential greenhouse gas emission trading;
- recognition of the capacity of new forests to supply environmental benefits such as amelioration of degraded land and management of catchment water balances;
- competition from wood substitutes and the need to continuously improve performance and quality of wood-based products and materials, especially in commodity markets;

- composites that maximize resource use and have predictable service performance;
- demand for high performance, light weight paper and board.

CSIRO's Strategic Response

CSIRO has the following strategic research objectives:

- sustainable management systems for native forests ;
- sustainable management and enhanced productivity of plantations;
- value enhancement in the forest;
- risk management – pathogens, pests, fire and drought;
- forest operations – their economic and environmental performance;
- wood processing and value added products;
- fibre quality, paper making and paper quality.

Research outcomes

Improved kiln operations. A graphical numerical model of the physical processes involved in the high-temperature drying of softwoods was developed for application in kiln design and operation in order to reduce stresses and deformities in pine board and increase performance and reliability. One company has already installed the model for refinement of kiln schedules.

Sewage boosts tree growth. Sewage sludge or 'biosolids' is boosting the growth of radiata pine plantations in the Wingello State Forest near Sydney. A single application of biosolids produced an increase in annual tree growth of about 35 per cent, which was sustained throughout a three year trial. Nutrients from the biosolids were not transported to either local streams or the watertable. Outcomes will be used by Sydney Water.

Preserving and colouring paling fences. Successful trials sponsored by the Timber Promotion Council, Victoria with two preservative treatments may lead to a revival in demand for traditional hardwood paling fencing in Australia's suburbs. The main drawbacks of paling fences are the risk of damage due to fungal decay and early fading to a dull grey colour. After three years of accelerated laboratory testing and field exposure of model fences, the treated fences are still sound, with no decay and no loss of colour.

Reconstituted products from Victorian eucalypts. Industry partners are now investigating commercial opportunities following a successful three year project that confirmed the potential for using sawmill waste and logs unsuited to sawing for a range of reconstituted hardwood products. Using experimental resins developed by CSIRO, the researchers produced laminated veneer lumber (LVL) and medium density fibreboard (MDF) with high levels of performance.

Gains from planting eucalypts and acacias together. Recent trials suggest that mixed plantings of eucalypts and acacias can offer production and environmental advantages over single-species plantations in both the tropics and southern Australia.

The trials showed that the acacias' contributions to soil nitrogen cycling gave a substantial early boost to growth of the eucalypts. Mixed plantings are now being more widely evaluated in Australia by state forest services and a private company.

Good prospects for drier-country eucalypt plantings. Sawing trials with eucalypts grown in plantations in the 580-750 millimetre rainfall zone of the Murray-Darling Basin have produced high recovery rates for top quality, appearance-grade wood. The best performer was spotted gum (*Corymbia maculata*), followed closely by sugar gum (*Eucalyptus cladocalyx*), with red ironbark (*Eucalyptus sideroxylon*) also showing promise. Farm foresters are now using this information to select and plant species with the greatest commercial potential.

Pruning for plantation sawlogs. Forestry Tasmania has modified its pruning regimes following CSIRO research showing that shining gum (*Eucalyptus nitens*), the most widely planted eucalypt in Tasmania, can be pruned to remove 55 per cent of leaf area at canopy closure without loss of height or diameter growth. Without pruning the trees develop large knotty cores that make them unsuitable for the production of sawn timber and veneer, a major objective for management of this species.

Predicting plantation productivity. A computer model (PROMOD), developed for prediction of plantation productivity is now being used by private forestry companies and was recently made available as a modified free-ware package to farm foresters.

Spatial soil data for forest management. A detailed soil and environmental study over 50 000 hectares of native eucalypt forest in southern New South Wales has produced a GIS-based Soil Information System available on CD-ROM. The system enables spatial predictions of key soil properties and land qualities important to forest management such as fertility, water holding capacity and erosion hazard; environmental coverages of climate, terrain, geology and vegetation that underpin the spatial models; text information and background data in the form of web (HTML) pages. The system is being used to improve forest management planning and operations.

Quantifying forest biomass for carbon storage. CSIRO work on using forests as a carbon store will underpin the National Carbon Accounting System being developed by the Australian Greenhouse Office. New methods of estimating forest biomass have been tested in the field and optimum strategies for sampling and prediction defined to suit various conditions. Effects of environmental conditions and species have been incorporated to allow generic application across regions and at varying scales.

Horticulture Sector

Industry Context

Australia's location, land and water resources and diverse range of climates make it possible to grow an extensive range of temperate, sub-tropical and tropical produce. Off-season horticultural products from Australia are increasingly meeting market opportunities in the Northern Hemisphere.

The following issues are important 'drivers', differentiating the horticulture sector from other agricultural production:

- most horticultural crops are highly perishable and are purchased (and often consumed) fresh. Quality of the produce is therefore highly dependent on good supply chain management;

- ultimate quality, whether fresh or further processed is largely determined 'on farm' and it is there that many value-added issues need to be addressed and solved;
- horticulture is at the intensive end of the crop production spectrum, requiring specialist attention to achieve ecological sustainability, and in many cases produce is grown close to or within urban areas with some resultant natural resource use and access conflicts; and
- demand for healthy, fresh, natural produce is growing with consumer incomes and health awareness.

CSIRO's Strategic Response

Increasingly, private companies and voluntary funding groups are co-investing with CSIRO and other agencies, and forming R&D partnerships with industry-based project steering committees. The key issues to be addressed by CSIRO research are:

- crop surety – paddock to plate (crop management). The two main drivers are increasing corporatisation in managing horticultural production as a business system and the market pull created by large retailers overseas and in Australia. This has led to a need for systems that can predict and manage both yield and quality. Projects in the Sector are addressing these issues by building on physiological and molecular studies of the structure, growth and nutrition of plants, the management of pests and diseases, postharvest packaging and processing and the soil-plant-product continuum;
- genetic advances (crop improvement). Molecular genetics is producing new plant varieties by direct (genetically modified organisms) and indirect (genetic mapping) means. Molecular studies are also casting new light on the physiology and management of the soil-plant environment interaction;
- market access and new incursions. Australia is facing increases in incursions of new pests and diseases to horticulture (such as papaya fruit fly, whitefly, banana fusarium wilt) from imports while there is increased pressure to ensure pest and disease free status of exports. CSIRO has considerable expertise in monitoring, detecting and identifying pest and disease species using molecular biological techniques or chemical signatures of the pests and diseases.

Research Outcomes

Effective control of silverleaf whitefly. The discovery of a highly effective native parasitoid of silverleaf whitefly has demonstrated the potential for integrated management of silverleaf whitefly in vegetable production.

More efficient irrigation. Farmers in the Griffith area of New South Wales have increased installation of micro-irrigation systems and on-farm drainage storage basins to help optimise water usage. This action follows transfer of the results of research to farmers through grower field days. CSIRO is also facilitating the formation of the National Irrigation Science Network, to enable better collaboration and communication between researchers and growers.

Cadmium contamination. Precautions and management guidelines for controlling cadmium contamination (through inadvertent addition in phosphate fertilisers) have been produced and adopted by vegetable growers throughout southern Australia.

Cashew growers handbook. A handbook has been produced for Northern Australian cashew growers. It provides background information for new growers and recommendations for selecting varieties, establishing an orchard, producing and marketing the crop. This handbook is the result of a four-year collaboration between the industry, CSIRO and state agencies.

Pest control. Adding to the success of CSIRO's management plan for the control of green vegetable bug (GVB), a major pest of pecan plantations, is the successful establishment of the GVB parasite *Trichopoda giacomellii*.

Development of fruitfly molecular markers. Molecular marker technology developed for species of fruitfly of high quarantine priority has been transferred to state and national agencies and successfully deployed for identification of quarantine intercepts.

Rapid test kits. New ELISA test kits for detecting chemical residues are being routinely used by the dried vine fruit industry to ensure the continued high quality and safety of Australian produce.

Meat, Dairy and Aquaculture Sector

Industry Context

Australia's meat, dairy and aquaculture industries produce more than \$13 billion of product each year and bring in \$6.5 billion in export earnings. This Sector encompasses red meat (beef and sheep), pigs, poultry, new animal industries, milk production and aquaculture of finfish, crustaceans and shellfish. Growth in this Sector will come from providing premium food products to increasingly affluent and discerning customers.

The major trends in science and technology underpinning the Sector are:

- the impact of molecular biology and gene technologies;
- understanding needs and demands of consumers;
- integrating socio-economic and ecological objectives into redesigned production systems;
- closer participation by stakeholders in R&D.

CSIRO's Strategic Response

To meet the needs of the Sector, CSIRO's main aims will be to assist efficient production, sustainable resource use, manufactured inputs and market and consumer issues. To achieve these aims, research will focus on:

- developing the technologies that will help the sector enhance international competitiveness and enterprise profitability and improve the efficiency of supply chains;
- developing the technology and systems for ecologically sustainable development;
- helping to maintain market access by reducing the risk of non-tariff barriers including disease status, food safety, nutrition and environmental concerns.

Research Outcomes

Baby oyster formula. CSIRO, the Cooperative Research Centre for Aquaculture and industry marine researchers have developed a more efficient, cost effective and naturally-sourced formula for seed oysters, using cultured algae and pastes of algal concentrates. With this diet, they have tripled the growth of oysters over a three-week period.

New Zealand adopts TB test. New Zealand's Chief Veterinary Officer has approved the use of BOVIGAM in New Zealand, following trials by its Animal Health Board. BOVIGAM is a gamma interferon test for bovine TB developed jointly by CSIRO and CSL Ltd.

Pondman 2 helps prawn farmers. CSIRO-developed Pondman 2 software is now commercially available for use by prawn farmers to improve their productivity. It enables them to assess farms for stock, feed usage, harvests and other conditions. One farmer involved in trials increased his average production to over 10 tonnes per hectare.

Sheep breeding consultancy. A new consulting agency, SELECT Breeding Services, was launched in August 1998, built upon CSIRO expertise in sheep breeding. It provides a personalised service, tailoring sheep genetics and wool technologies to the breeder's exact requirements.

Matching sheep on the Net. Following five years of research, CSIRO and NSW Agriculture scientists have launched a website that allows graziers to match the genetic abilities of individual rams from around Australia to the precise requirements of their ewes and farm enterprise, online.

Nemesis worm control program. Sheep breeders across Australia are adopting the Nemesis program developed by CSIRO, the University of New England and Agriculture WA as a vital weapon in the war on worms, according to a major nationwide survey of breeders, growers and wool industry advisers. The Nemesis program aims to breed worm resistant sheep.

High tech fish tags success. The Pop-up Satellite Tag developed by CSIRO to track fish has proved successful in trials completed in December 1998, when a tag disengaged from the fish at the programmed time, floated to the surface and transmitted information to a satellite revealing that the marlin had returned to within 40 nautical miles from where it was tagged and released.

Speedy disease diagnosis. An innovative test developed by CSIRO allowed the speedy diagnosis of the recent Newcastle disease outbreak at two poultry farms in New South Wales. Fast and accurate diagnoses are critical to the control of any disease outbreak.

Australians in Malaysian virus fight. CSIRO scientists played a major role in an international effort to stop the deadly Malaysian Nipah virus, which has killed over 100 people and up to a million pigs. The scientists helped design a national surveillance and eradication program for the disease in livestock. A new CSIRO serological test, developed to show if pigs have been exposed to the disease, is now being used in Malaysia and CSIRO has been asked to introduce the test in Thailand.

More environmentally friendly grazing. Management principles have been developed for grassy eucalypt woodlands to assist managers to incorporate native vegetation and wildlife habitat into commercial grazing systems. The principles are being taken up by a major northern pastoral company that is moving towards ISO 14000 accreditation.

Textiles, Clothing and Footwear Sector

Industry Context

The Australian textile, clothing, footwear and leather (TCF&L) industries have been undergoing restructuring in response to the significant changes occurring globally in production and processing, and the difficulty in competing with low labour cost countries. The changes have been driven by the 1987 Button Plan, which aimed to make the industries more competitive, externally focussed and export oriented. Though the response has been mixed, many enterprises are becoming world class and are innovative in product development, marketing and management. They are investing in new plant and equipment. Exports and value added production from the Australian TCF&L industries are increasing.

Australia is a major supplier of hides, skins and wet-blue leather to world markets and in the last few years the leather sector has outperformed other TCF sectors in export growth and value added products. The industry is presently suffering the consequences of the Asian economic downturn and the sluggish demand for leather goods in Europe. There remains considerable scope to process more hides and skins in this country.

In response to the 1997 Productivity Commissions Report on the TCF&L industries and to assist the industries prepare for proposed tariff reductions in 2005, the Federal Government has instituted the TCF 2000 Strategic Investment Program whereby some \$700 million will be available for investment in innovation, product development, and new plant and equipment. In concert with the Program, the Government has established an Action Agenda with the industries to determine their strategic directions through to 2010.

The fundamental challenges for research in the Sector are:

- to diversify the research portfolio to assist the Australian TCF&L industries address the strategic imperatives they face in order to become more innovative, productive and internationally competitive; and
- to retain a strong wool research portfolio for both on-farm and off-farm research. Though one of the key drivers for increasing the demand for wool will be the development of new products, be they new and novel wool yarns, fabrics or consumer products, an equally important driver is reducing the overall cost of wool production, marketing, distribution and processing.

CSIRO's Strategic Response

The Sector will:

- balance strategic research, innovation and technology transfer: ensure that research outcomes and commercial developments are regularly available for and taken up by the Australian wool producing and TCF&L industries;
- improve the marketing of CSIRO's research capabilities: identify target customers and expand the account management system;
- diversify the funding base: secure funding from a wider range of sources while continuing to work with The Woolmark Company.

Research Outcomes

Novel yarn structures. New spinning technology to produce yarns with structures that increase the security of fibres and consequently are less prone to producing pills is now being commercialised by a consortium consisting of CSIRO, WRONZ and The Woolmark Company.

Improved dyeing technology. The invention of the new fibre (OPTIM[®]) has required the development of new dyeing procedures for the new fibre, which have been trialled successfully on an industrial scale in Japan. Dyeing methods have also been established for Bulky Wool (OPTIM MAX[™]). Research has also produced a new way to dye wool-cotton blends so they can stand up to machine washing and tumble drying. This technology is being used by Rocklea Spinning Mills in its Colana[®] wool/cotton blend.

Environmentally sustainable processing. CSIRO research has led to the establishment of National Guidelines for wool scour effluent disposal, which are now in place, and the development of environmental risk assessment tools, which should be completed by December 1999.

Fibre bundle strength. A fast and accurate instrument to measure fibre bundle strength, and software to predict yarn and spinning performance have performed successfully in mill trials in Europe, Japan, China and India. The instrument is particularly useful for monitoring fibre damage due to dyeing. A number of mills are now routinely using the prediction package for quality control purposes.

Coloured lock sorter. This device helps to overcome the serious problem of contamination of the clip by coloured and stained wool. The technology, which allows the high speed detection of dark locks during the early stage processing of wool, is now being commercialised. It was displayed at the International Textile Machinery Association's (ITMA) exhibition in Paris in June 1999.

Rapid conditioning of fabrics. A new fabric conditioner that produces wool fabrics of enhanced quality is being commercialised. The equipment was also displayed at ITMA.

Sportwool. Sportwool, the new bilayer fabric consisting of wool and polyester, has been commercialised. Garments made from the fabric are ideal for active sports wear as the fabric allows the rapid dissipation of moisture when the wearer is undergoing high exertion. Most Australian athletes competing in the 1998 Commonwealth Games in Kuala Lumpur wore Sportwool.

Decision Support Systems for wool production. The genetic relationships of a number of wool traits have been identified and used in the construction of a prototype software package to assist fine-wool growers design breeding programs to maximise profit. In addition decision support software, which provides guidance for the production of fine wool in non-traditional areas, has been released to the wool industry.

Sheep parasite control. A Decision Support System for worm management using simulation models for the three important sheep parasites has been completed and integrated with the 'Grassgro' suite of Decision Support Tools for on-farm nutritional management.

Biodiversity Sector

Industry Context

With the demand for environmental solutions never stronger—driven by national policies and regulations and by substantial international factors, including trade—biodiversity is a key Sector in both public good and private benefit terms. Sustainability requirements identified by many Sectors require knowledge and skills with a biodiversity base.

There is a slowly growing recognition of the range of values and uses of biological resources. Economic benefit stems from direct use of species for their products, such as trees for timber, and indirect use of others that support ecosystem functions, such as micro-organisms cycling soil nutrients. Tourism is a major and growing economic asset that is substantially based on visitors experiencing Australia's biodiversity.

There is a considerable range of providers of biodiversity related research in Australia, but most are of a relatively small scale.

CSIRO's Strategic Response

CSIRO is active at the generic, regional and national levels, providing overviews and conceptual and organising frameworks that benefit from, and are complementary to, work in other organisations. CSIRO has an advantage in being able to integrate its research in this Sector with that in its other environment Sectors, its production Sectors, and with other research organisations, to give balanced ecological approaches.

The most significant areas for attention include:

- the role of biodiversity - ecosystem services and value;
- knowing our biodiversity, to contribute to the world's knowledge;
- using biodiversity, especially to create new industries based on native products;
- sustainable tourism;
- conserving biodiversity;
- pests, weeds and diseases;
- integrating biodiversity with other resource management.

Research Outcomes

Tools for conservation. Conservation management at regional and local levels is benefiting from substantial reports from CSIRO that reviewed existing and potential incentives for conserving biodiversity on private land and the role of local governments in conserving biodiversity. CSIRO is linking insights from science with management and infrastructural considerations and the outcome, working closely with others, is more robust responses to complex environmental needs.

Sustainable tourism. Against the backdrop of the tourism industry's heavy reliance on Australia's natural resource base, models integrating tourism into regional environment, society and economy considerations are being developed and put into use. A Tourism Futures Simulator developed with the Douglas Shire in northern Queensland is forming an important input into planning in that area and has generated interest from other local governments.

Pest management. A management strategy for control of Bitou bush was trialled in the Eurobodalla region of New South Wales. The strategy combined herbicides, fire, hand pulling and planting of competitive species. On the basis of the promising results and the field experience gathered, the approaches are now beginning to be more widely adopted.

Climate and Atmosphere Sector

Industry Context

The Sector covers the economic, social and environmental impact of weather and climate, as well as the effect of economic and social activities on climate and atmosphere. Issues include natural phenomena such as severe storms, tropical cyclones, and large-scale drought, and human impacts such as air pollution, ozone depletion and climate change.

The UN Framework Convention on Climate Change and the National Greenhouse Strategy are major drivers for this Sector. CSIRO works very closely with the Australian Greenhouse Office and with a growing range of State and private sector organisations demanding climate and greenhouse-related research.

Other drivers are the Montreal Protocol on Ozone Depleting Substances, the National Environment Protection Measure (NEPM) for Air, drought exceptional circumstances policy, and the need for solutions for sustainable management of Australia's environmental resources.

CSIRO is the largest provider of climate and atmosphere-related research in Australia (and the Southern Hemisphere). It works closely with and complements the research activity of the Bureau of Meteorology and work in Cooperative Research Centres and universities.

CSIRO's Strategic Response

CSIRO is tightly tied into the domestic and global policy development processes and with the major players in them. The Sector's strategy has the following key elements:

- capitalise on the last decade of investment in climate process and modelling research;
- further improve forecasting abilities;
- underpin Australia's position with respect to the Climate Change and Ozone Protocols, in particular seeking solutions in the biosphere for managing carbon emissions;
- provide air quality forecasts and seek to strengthen knowledge of the relationship between air quality and human health;
- provide scientific input to the development of public policy in this area;

- support the Australian Government in its negotiation of climate agreements bearing in mind their potential impact on Australia's economy and social situation;
- maximise the effectiveness of national expenditure on climate research by collaboration and communication with key stakeholders.

Research Outcomes

Outcomes for policy-makers. Scientists engaged in research on global atmospheric change have coordinated a range of differing research approaches by forming a 'Biosphere Working Group'. The Group deals with atmospheric observations and interpretations of increases in carbon dioxide, and with studies of the biospheric impacts and responses that affect the carbon dioxide uptake/release by vegetation and the land surface. The key outcome of this mechanism has been policies and programs with a more sound and comprehensive science basis, enabled through delivering coordinated scientific input to assessments by policy-makers. There have been over a dozen expert reports for use by the Australian Greenhouse Office and briefings to senior staff in both Government and industry. This Biosphere-related policy input adds further to the considerable and long-standing CSIRO science-based advice on climate and greenhouse matters.

Greenhouse science. Contract research for the Australian Greenhouse Office on 'core greenhouse science' has made significant contributions to national and international reviews of climate change science. This research program also underpins climate change scenario research, which in turn has been the subject of a number of contracts to deliver estimates of future climate change to State and Territory Governments.

Modelling Hong Kong's air quality. Experts from across CSIRO, in collaboration with the Victorian Environment Protection Agency and a major international consultancy firm, have compiled an inventory of all significant sources of air pollution in Hong Kong. They have also produced a model of current and future developments and their impact on the Hong Kong air environment. Hong Kong has gained important information and a sound methodological base for its air quality management. In the process, CSIRO scientists have gained valuable international experience and developed novel science applications that are now being applied in Australia and the surrounding region. One of these outcomes is a new project in collaboration with the Bureau of Meteorology and the Victorian and New South Wales Environment Protection Agencies to develop an air quality forecasting system for Australia's major cities.

Land and Water Sector

Industry Context

The Land and Water Sector is focused on the ecological, economic and social issues that underpin sustainable regional development and long-term management of the Australian landscape. The key focus is on delivery of large scale solutions to major national natural resource management problems.

The Sector's core agenda is to develop an in-depth understanding of natural and managed ecosystems across a range of scales and to determine the impact of terrestrial and aquatic management on systems function. The Sector has developed



strategic links to environmental policy units, local, State and Commonwealth Governments, agribusiness, water, mining and manufacturing industries, and community-based land management groups.

CSIRO's Strategic Response

The Sector's strategic direction is increasingly at a broad 'landscape' scale and directed to system-wide issues. There is a particular focus on capabilities for big, interdisciplinary studies at larger scales on complex issues. Research will be focused on:

- landscape scale systems understanding and the development of systems models to predict the impact of management practices on functioning, productivity and restoration of landscapes;
- water quality and quantity, the impact of climate variability on water management, and the impact of Council of Australian Governments (COAG) water reforms on water allocation and environmental flows;
- increased water use efficiency in irrigated agriculture;
- dryland and in-stream salinity management and rehabilitation of saline areas;
- land management impacts on river and storage water quality and coastal/estuarine environments;
- land atmosphere interactions, carbon cycling;
- contaminant behaviour in groundwater, aquatic and terrestrial environments: risk assessment, ecotoxicity, remediation/rehabilitation;
- socio-economic impacts of environmental management practices;
- design of environmentally benign agricultural production/management systems.

Research Outcomes

The Murray-Darling Basin Soil Information Strategy. The Murray-Darling Basin Soil Information Strategy has created a large new spatially referenced database of soil and geological resources. Through cooperation between State and Federal agencies, the database, and new lithology and soil-landforms maps of the Basin, represent major advances in natural resources information. Unlike the initial format of the *Atlas of Australian Soils*, the information is ready to be re-interpreted for a variety of regional planning purposes. The Strategy was a three-year collaborative project between CSIRO as the lead agency and the Bureau of Rural Sciences, and was funded by the Murray-Darling Basin Commission.

Impacts on landscapes. A CSIRO team working in several catchments has found signs that European settlement unleashed an episode of erosion, sediment deposition and change in river systems orders of magnitude greater than assumed to date. New ways to identify and date flood deposits in Eastern Australian river catchments are building a picture of a landscape in dramatic transition over years or decades, rather than centuries. This understanding will be vital in devising the best strategies for farmers, foresters and land managers to combat future large scale erosion and deposition events and improve water quality and sustainability.

Design and management of effluent-irrigated plantations. National guidelines on the design and management of effluent-irrigated plantations have been published as a book (*Sustainable Effluent-Irrigated Plantations: An Australian Guideline*) and supporting CD-ROM. These products are the core outcome of seven years' research by CSIRO in test plantations near Wagga Wagga in New South Wales.

Dynamic rainforests. CSIRO research has shown that Australia's northern tropical rainforest, previously thought to have been fairly static during the last few millennia, has undergone a massive five-fold expansion in area since the end of the last ice age. This information is now being incorporated in planning strategies for managing these areas.

Remediation. CSIRO has demonstrated the power of natural attenuation processes, using naturally occurring soil ingredients (microbes, chemicals etc) to degrade contaminants into harmless substances. These processes have also accelerated remediation. Companies, such as BP Oil, are now using these processes in remediating sites.

\$130 million boost for health of Port Phillip Bay. Melbourne Water has launched a bold and innovative two-pronged project that will improve the health of Port Phillip Bay by reducing nitrogen outflows from the Western Treatment Plant and stormwater run-off. This follows the Victorian State Government's \$12 million CSIRO Port Phillip Bay Environmental Study, which found that the Bay was in generally good condition, but recommended that it would benefit from reduced nitrogen loads. The 'Healthy Bay Initiative' will create opportunities to reuse treated effluent in water recycling schemes and agriculture and improve the water quality of the Bay.

Marine Sector

Industry Context

Research in the Marine Sector is relevant to economic and environmental activity in Australia's marine territory, one of the world's largest marine jurisdictions. We have an obligation to understand, preserve and utilise the vast potential wealth of our ocean territory in a responsible and sustainable manner.

Our oceans are a public domain, with many activities competing for access. Pressures on the ocean from land and offshore activities are considerable, and increasing. Economic, environmental and public good considerations can only be balanced through a combination of fundamental research into ocean processes and ecosystems, and development of robust techniques for assessing and mitigating the risks to ecological integrity that stem from human use.

Australia's Ocean Policy (issued in December 1998) is premised on an ecosystem approach to planning for multiple uses of the marine environment. The associated Marine Science and Technology Plan (released in June 1999) identifies national research priorities and forms the basis of an integrated national marine research strategy. Both will be strong drivers of work in the CSIRO Marine Sector in the next year and the next triennium.

CSIRO's Strategic Response

Given the recent, strongly articulated Australia's Oceans Policy, the Sector's strategic response is to focus on the research required to meet those national goals, which are both environmental and economic. The Marine Sector has identified the following as priority areas for the next four years:

- exploring the Exclusive Economic Zone and supporting multiple-use marine management, specifically around south eastern Australia as part of Oceans Policy implementation, and on the Northwest Shelf in collaboration with the Western Australian State Government;
- catchment-to-coastal zone integrated research, specifically in the context of the newly-created Cooperative Research Centre for Coastal Zone, Estuary and Waterway Management;
- climate impacts in the marine environment, responding to a growing demand for detailed regional application of the climate predictive capability developed by CSIRO and the Bureau of Meteorology over the last few years.

The challenges we face as custodians of the world's largest and most diverse Exclusive Economic Zone are daunting in scope. Collaboration and co-investment are key elements of our strategic response. This Sector is the largest provider of marine research in Australia and in the Southern Hemisphere. In that leadership role, we work from the conviction that Australia needs all of its (widely distributed) players to work together if we are to have any hope of making a dent in those challenges. We also play a crucial international role as the regional leader for international programs.

We co-invest in research with industry and Government, in order to get to more effective and comprehensive outcomes than a straight purchaser-provider arrangement allows, and to remove major roadblocks in the path to adoption. The newly-identified priorities push us into areas where co-investment has been grudging or absent in the past, but where needs and opportunities have been identified.

Research Outcomes

Policy developments. CSIRO made very strong contributions to the development of Australia's Oceans Policy and the Marine Science and Technology Plan. We helped to ensure that these were developed on a sound scientific basis, within a context of multiple-use and regional marine planning. Our close involvement with the implementation of Oceans Policy results from a decade-long track record: a decade of research about and advice to Environment Australia on marine biodiversity, ecosystem function and an ecosystem basis for marine resource and conservation management. This culminated in authorship of the three science-based Oceans Policy Issues Papers (out of a total of seven), significant influence on the content of Oceans Policy, and flow through into a major, ongoing role in its implementation.

Better fisheries management. CSIRO research has provided scientific support for new management processes adopted by the fishing industry and fishing authorities. These processes relate to catch management aimed at long-term sustainability. One major outcome was a set of recommendations for mitigating the effects of trawling on the Great Barrier Reef, based on a five-year research program jointly funded by CSIRO and other Commonwealth agencies. An exciting new development in this area is research into the feasibility of 'stock enhancement': augmenting wild fisheries with larvae raised in aquaculture hatcheries.

Marine pest control. CSIRO's Centre for Research on Introduced Marine Pests (CRIMP) discovered large numbers of black striped mussel in March 1999, during a survey of Darwin Harbour, undertaken with the Northern Territory Museum. This pest

is a relative of the mussel that has invaded the Great Lakes in North America, incurring millions of dollars of expense each year in fouling of intakes and other structures. CRIMP provided scientific support to the Northern Territory Government, assessed the incursion and developed treatment options and protocols. If, as believed, the mussels have been eradicated, it will be the world's first successful elimination of an introduced marine pest.

Managing effluents. In a follow-on to the CSIRO-managed study of Melbourne's Port Philip Bay, we have been working with the Victorian Government to reduce nutrient loads entering the Bay, and with the Water Services Association of Australia have developed effluent management guidelines, which have been adopted by industry. Similar advice was adopted by the Tasmanian State Government, on the basis of a study of nutrient pathways in an estuary with intensive aquaculture (the Huon River in Tasmania). As a result of these and other regional projects, there is steadily growing recognition by Government and industry of the need for a 'catchment to ocean' approach to solving coastal zone impact problems.

Seamounts. Research undertaken by CSIRO led to Australia's first exclusively deep-sea marine reserve, 170 kilometres south of Hobart. The reserve is intended to protect unique and vulnerable seamount plants and animals, including orange roughy habitat, within an area of about 370 square kilometres. The Commonwealth Government sees the Tasmanian Seamounts Marine Reserve as a commitment to developing a nationally representative system of marine protected areas in Commonwealth waters.

INFORMATION TECHNOLOGY, INFRASTRUCTURE AND SERVICES

Built Environment Sector

Industry Context

The Built Environment is the nation's largest asset. Built Environment industries—construction, transport, utilities—generate 17 per cent of the nation's economic output, employ 15 per cent of the nation's workforce and contribute 7 per cent in exports.

Some key issues shaping Australia's built environment are:

- the environmental deterioration of human settlements (poor air and water quality, transport congestion and end use energy inefficiency);
- national water supply is facing severe population and environmental pressure;
- increasing cost of national infrastructure is creating demand for increasingly sophisticated tools for planning and management;
- poor information flow in the construction industry is producing operating inefficiency, errors and waste;
- low built environmental efficiency and productivity, reflected in a large sector balance of trade deficit, indicates a need for greater application of IT and automation;
- pollution and high energy consumption in indoor environments;

- environmental sustainability is driving the construction industry to increase recycling of construction material and reduce waste;
- performance-based design codes and standards are critical to innovation in building design and materials.

CSIRO's Strategic Response

The Sector's strategic direction is focused on key global drivers for Australia over the next decade. These are global competitiveness and integration, applying information and communications technologies, and environmental sustainability. From these and extensive consultation with industry in 1999, CSIRO has developed a new research portfolio for 2000-03. The portfolio has 13 strategic objectives as follows:

- improving the performance of windows and facades: to deliver new technologies and new methods for controlling heat, noise, security and strength functions into the building façade;
- fire science and technology for the built environment: to reduce fire protection and prevention costs and enhance human safety in design and construction through development of advanced fire engineering methods and new fire safe materials. With the introduction of performance based fire codes in Australia (a world first), fire engineering is playing an increasingly important role in the design and construction of large, complex buildings;
- improving service life performance of buildings and infrastructure: to develop innovative products and systems and accurate service-life prediction tools to ensure more durable and reliable infrastructure. The cost to maintain Australia's infrastructure assets is about \$25 billion per annum;
- integrated design and construction support systems: to reduce design and construction errors, costs and times for buildings and facilities through the development of precise component (object) representations plus mathematical optimisation and visualisation models for information, materials, labour and equipment use. Up to 7 per cent of total project costs are due to errors and rework; labour and equipment operational efficiency is currently only 40-60 per cent;
- environment engineering for human productivity: to improve the quality of indoor and personal environments by developing new software, processes and products. Improved technologies can provide savings of about \$5 billion annually. Lost productivity and illness due to poor indoor environment costs \$10 billion annually in Australia;
- efficient use of electricity distribution assets: to develop technologies that improve the efficiency of power transfer and ensure reliability, stability and quality of supply in the electricity transmission and distribution industries;
- optimising infrastructure network performance: to improve the efficiency and resilience of key network infrastructures by developing an improved performance capability for complex network systems that can be applied across different types of network and operator to meet their designated performance requirements;
- intelligent transport systems: to reduce congestion, and improve the safety of Australia's transport systems through Intelligent Transport System information and

control system technology, and contribute to the Australian industries' international competitiveness. Benefits of proposed research to Australia via direct saving of costs through reduced travel time, an increase in road safety, reduced carbon dioxide emissions and the overall improvement in road fleet efficiency is estimated at \$3 billion per year;

- advanced technologies for integrated urban water management: to reduce the economic and environmental cost of managing urban water, wastewater and stormwater and improve the quality of water services by developing a range of technologies and systems. Maintenance and replacement costs for the Australian urban water industry will approximately double during the next 20 years while the industry will face increasing social and environmental pressures to achieve more efficient water use, protect public health and prevent long term environmental damage;
- solid waste reactivation for construction: to minimise waste by reactivating solid wastes for use as alternative materials and products for construction. CSIRO research will deliver waste reactivation technologies suitable for 75 per cent of all solid waste from industrial, construction and mining sources. This will also provide entry into the \$300 billion fast growing global waste management market;
- low energy accelerated processing: to reduce environmental emissions and improve cement product performance by developing new process technologies for the cement and concrete products industry. Accelerated curing of concrete and ceramic products can achieve energy savings of \$100 million annually, reduce environmental emissions, and improve product consistency;
- new generation building materials: to develop a new generation of polymer-based building materials with enhanced performance and recyclability. The built environment uses almost 20 per cent of plastics produced, but the range of applications for plastics are limited by deficiencies in performance and recyclability;
- sustainable smart coatings technologies: to develop new coatings technologies with improved durability, performance and environmental sustainability.

Research Outcomes

SICOR. CSIRO has developed a novel process for surface treatment to improve adhesion to plastics. A license agreement has been signed with an Australian automotive manufacturer and SICOR-treated polypropylene components are now being used on current car models.

FASE/CellSim. Frequency Assignment by Stochastic Evolution software, developed by CSIRO in conjunction with the Telstra Research Laboratories, has enabled Telstra Mobilenet to greatly improve its mobile customer capacity.

Safe-T-Cam. The automated vision-based monitoring system developed by CSIRO and the New South Wales Roads and Traffic Authority (RTA) has been so successful that the RTA is expanding Safe-T-Cam to cover all main transport routes in New South Wales. The system takes pictures of heavy vehicles, then locates and deciphers their registration plates. This information is used to identify heavy vehicles that are travelling beyond prescribed hours or at excessive average speed.

Align 3D. Leighton Contractors Pty Ltd will use CSIRO's Align3D software to select a 'best' route for the proposed \$3.7 billion Canberra-to-Sydney Very High Speed Train Project. Align3D has also saved millions of dollars on the routing of the Bruce Highway at Gympie and the Second Range Crossing at Toowoomba, both in Queensland.

Super-conducting tapes. MM Cables has established a pilot-scale manufacturing facility in Australia for high-temperature super-conducting electrical tapes. This is a result of a collaborative R&D program involving CSIRO and the University of Wollongong. The tape will be 1-10 per cent more efficient than conventional conductors, giving an annual saving in power transformers alone of at least 1000 gigawatts per hour or \$100 million and a consequent reduction in carbon dioxide emissions of 1 million tonnes per year.

Natural and mixed-mode ventilation. CSIRO tools for analysing thermal, air-flow, pollutant dispersion, particle deposition and difficult ventilation problems in buildings were used to develop: a system for natural cooling for a library/arts block at Birrong Girls High School; a natural ventilation system for Worsley Alumina; an air distribution system in a pharmaceutical serum storage facility for Hooker Cockram; and design of natural and mixed-mode ventilation systems in several new Westfield shopping centres. These studies have demonstrated that energy-efficient ventilation systems offer cheap, environmentally friendly solutions, which deliver improved indoor air quality, thermal comfort and freedom of control by users.

Yarra Valley pilot water treatment plant. CSIRO's novel processes for the removal of nitrogen and phosphorus from sewage without the need for chemical addition or effluent filtration have now been tested by Yarra Valley Water in Victoria. The test produced a reduction of nitrogen and phosphorus below current Environmental Protection Authority requirements. This research will benefit the aquatic environment and may result in the production of a high-value fertiliser by-product.

CDS Technologies pilot plants. As part of a Start Project, CSIRO has developed new techniques for rapid removal of particles from stormwater and sewer overflow streams. Particles in wastewater reduce the efficiency of UV disinfection, requiring the alternative method of chlorination, with its associated problems of cost and chlorination by-products. CSIRO's techniques will allow sufficient reduction in solids loading, allowing disinfection to be readily achieved using conventional UV irradiation.

Urban Water Program. CSIRO's expertise in urban water use has led to a complete review of Australia's urban water use in conjunction with the Council of Australian Governments and the Water Services Association of Australia. The program has commenced with a Domestic Water Use Study using smart water meters. The study is surveying 600 households in Perth, to analyse water use patterns in Australian households as part of a reappraisal of urban water, wastewater and stormwater services in Australia.

International Alliance for Interoperability. A CSIRO initiative saw the establishment of the Australian Chapter of the International Alliance for Interoperability. This is part of a global effort by 12 nations towards developing tools for the seamless transfer of information across the Architecture, Engineering and Construction industry to deal with inefficiencies caused by fragmented knowledge bases, inaccurate documentation and lack of standards in information structures and flows. Savings of over 20 per cent are expected as a result of new interoperable systems for information sharing.

Information Technology and Telecommunications Sector

Industry Context

The Information Technology and Telecommunications (IT&T) Sector encompasses electronic commerce, telecommunications and computer networking, mobile communications and electronic media systems.

The Sector continues to be one of the fastest growing in the Australian economy with a sustained growth rate of 12 per cent over the last five years. Senator Richard Alston, Minister for Communications, Information Technology and the Arts said in his December 1998 speech entitled "A Strategic Framework for the Information Economy": "The information economy is generating opportunities across all sectors — it is a new source of jobs for regional and city-based Australians, it provides opportunities for Australian business, wealth creation through ready access to a global marketplace, and reductions in the cost of transactions."

Apart from the direct benefits of revenue and employment, the successful implementation of IT&T hardware and software is a critical factor for business and one of growing importance in the success of many industries. IT&T products and services have substantial impact on productivity in all industries and in particular the service industries. This trend is expected to continue.

The IT&T industry is driven by the explosion in networks, especially Internet/intranet services, access and its adoption by business. A huge range of new application areas are opening up as companies move towards systems integration and customisation to improve performance and save on costs. This reflects a major shift from 'one size fits all' to solutions tailored to each individual business.

Very short product lead times, as short as three months, and life-cycles (one to two years) influenced by global alliances are a feature of the Sector. Deregulation of telecommunications services continues to have a major impact.

Australia's IT&T equipment manufacturers are world competitive—exporting one-third of production and undertaking high levels of R&D. Major telecommunications equipment suppliers are moving into Australia because Australia offers them an ideal cost-effective geographical location supported by a significant source of innovation.

CSIRO's Strategic Response

The response to this rapidly changing industry sector includes the following strategic goals:

- to create the new wireless infrastructure technologies needed for Australia to compete in global markets for the information economy;
- to enable full Australian participation in the global information economy by developing optimised adaptive networks that are cost competitive and provide the requisite quality of service;
- to increase the effectiveness and efficiency of organisations by creating systems to capture, keep, locate and show necessary documents for all time;
- to achieve electronic delivery of personalised and enhanced services by developing service trading systems around an 'honest broker' service;

- to enable the early deployment of new and improved service delivery via the Internet by integrating information systems operated by very many business units;
- to improve the effectiveness of information systems by designing and implementing fully engaging, fit-for-purpose intuitive interfaces;
- to reduce the risks and costs associated with the creation of scalable distributed information systems by increasing design and implementation productivity;
- to increase mobile access to on-line information systems by adapting and enhancing existing technologies for use in both rural and commercial areas;
- to underpin the local development of advanced microwave system technologies for 'dual use' civilian and military applications;
- to enable the creation of new and better information services by automatically tailoring and synthesising documents and multi-media information.

Research Outcomes

Internet Marketplace. An Internet Marketplace is a community of service providers and customers who share infrastructure and services enabling integrated service delivery across organisations. CSIRO has developed an Internet Marketplace system for the Queensland Government, which will enable savings of around \$350 million over six years in Queensland alone.

Microchip modem for USA market. Australian company, Radiata Communications Pty Ltd, is using CSIRO technology to develop a single chip modem for use in wireless local area networks markets in the USA, Europe and Japan. The modem and an associated 5 Gigahertz radio chip will play an important role in giving computer users mobility and greater bandwidths indoors to enable the use of rich multimedia applications within buildings without using cables.

Archiving electronic records. The Victorian Electronic Record Strategy team, comprising CSIRO, Ernst & Young and the Public Record Office of Victoria, has created a complete approach to archiving electronic documents. The solution enables records and associated documents to be automatically archived and then retrieved and displayed forever, exactly as they appeared when created. As a result of this work, the Victorian Government has committed \$5 million towards implementing the system, with CSIRO's help, within one of its agencies.

Radio communications test facility. CSIRO's unique, multi-purpose, high-speed wireless communications testbed has been used by Ericsson GmbH, Tadiran Microwave Networks Australia and Vodafone Australia. This multi-purpose facility has been used for both system design studies and propagation measurements. New digital communications systems have been designed by evaluating the performance of different coding and modulation schemes over real environments. Propagation measurements have contributed to the development of new international standards for in-building wireless and mobile communications.

Broadband wireless access. High frequency broadband integrated radio systems will enable the wireless delivery of broadband services to business and the home. CSIRO has signed a \$3 million contract with Tadiran Microwave Networks Australia Pty Ltd for the development of broadband point-to-point full duplex radio systems.

Measurement Standards Sector

Industry Context

The Measurement Standards Sector is concerned with physical standards of measurement. Measurement standards are an infrastructural component of the economy: physical standards underpin the national standards and conformance infrastructure that provides the technical basis for orderly commerce, national and international trade, technical harmony between manufacturers and Governmental regulatory activities. CSIRO's work for this sector is undertaken in the National Measurement Laboratory – National Facility (NML).

Standards are of increasing importance in international trade. A Global Mutual Recognition Agreement is being established between National Measurement Institutes to provide mutual recognition of national measurement standards and calibration certificates. Parties to this agreement will have to demonstrate the equivalence of their national standards through participation in a program of 'key comparisons' and the integrity of their calibration services through accreditation of those services to ISO Guide 25 (soon to be ISO 17025).

APEC has recognised the importance of measurement standards in promoting trade. This has led to significant work for the NML in assisting the development of measurement infrastructure in Asia Pacific countries.

CSIRO's Strategic Response

CSIRO aims to provide value to Australia through activities in nine key areas:

- standards and calibration services - to provide an effective calibration service to underpin testing, quality and product development in Australia;
- national measurement system - to provide leadership in measurement and support for other elements of Australia's standards and conformance infrastructure to ensure a coherent national system;
- international recognition - to ensure that Australia's measurement standards are recognised internationally, are equivalent to those of its major trading partners and do not represent a technical barrier to Australian trade and trade agreements;
- primary standards R&D - to undertake leading-edge R&D in trapped ion frequency standards and production of silicon spheres for the atom-based kilogram project to maintain international credibility for Australian measurement standards;
- accreditation of calibration services - to gain accreditation to ISO 17025 in support of Australia's entry into the Global Mutual Recognition Agreement on standards and calibration certificates;
- technology transfer and Asia Pacific cooperation - to capitalise on the NML's expertise in metrology for the benefit of Australian industry and Australia's regional interests;
- gas mixture standards - to establish gas mixture standards for carbon-based gases in support of environmental measurements and Australia's position in international carbon trading;
- high flow standards - to extend the range of standards for gas flow measurement to provide legal traceability of utility metering in gas distribution;

- metrology in medicine and health - to develop new standards and techniques to increase accuracy and reliability of medical diagnosis and therapy.

Research Outcomes

Atomic-based kilogram. CSIRO is producing near-perfect rounded silicon spheres for standards laboratories in Australia, Germany and Italy. These spheres will be used to help determine more precisely the kilogram and Avogadro's constant—a fundamental scientific constant. The first sphere was completed in June 1999.

Trapped-ion frequency standards. CSIRO's trapped-ion clocks have achieved stability in excess of 100 times greater than that of conventional caesium beam frequency standards. The work has received international recognition, resulting in an invited review of the state-of-the-art for Progress in Physics.

Electromagnetic immunity testing. A new calibration service for some electromagnetic immunity test equipment has been established at CSIRO's National Measurement Laboratory. Information technology and other electrical equipment must comply with national and international electromagnetic immunity standards. With such a testing capability, Australia adds another element to the test documentation that it can provide to support the acceptance of electrical products in overseas markets, particularly those in Europe, and can protect its own markets from the dumping of sub-standard products.

High voltage impulse testing. CSIRO's National Measurement Laboratory has developed a new impulse testing system to allow power transmission lines and equipment to be tested for withstanding lightning strikes. The system fulfils new international guidelines and is being used as a model for developing and testing similar national testing facilities in other Asia-Pacific economies.

International trade. To trade with confidence, economies need to know that their measurement standards, which underpin all test results and product certifications, are comparable. In 1998-99, CSIRO's National Measurement Laboratory made major contributions to the drafting of a Mutual Recognition Agreement between national metrology institutes. The Agreement will be acceded to by at least 39 national metrology institutes in October 1999.

Regional development. CSIRO's National Measurement Laboratory is strongly supporting the Australian Government's APEC goals for development of standards and conformance infrastructure in the Asia-Pacific. In 1998-99 NML continued its work on seven projects funded variously by Australian Government APEC funds, through AusAID and the Department of Industry, Science and Resources, and by the World Bank. Bilateral projects were undertaken to develop or demonstrate capabilities in national metrology institutes in the Philippines, Indonesia, Thailand, Vietnam and Malaysia. For the third year, NML also provided the secretariat for the Asia-Pacific Metrology Programme involving 23 nations and, in this capacity, has provided representation at most meetings of the APEC Sub-Committee on Standards and Conformance to advise on regional technical development of measurement systems.

Radio Astronomy Sector

Context

CSIRO's effort in this Sector centres on the Australia Telescope National Facility (ATNF), which has 'advancement of knowledge' as its primary goal. International linkages for Australian science and technology spin-offs are two significant consequences of activity in this Sector.

Continual upgrading of the Facility is essential if it is to remain world-class. The current Major National Research Facilities Program funded upgrades will provide state-of-the-art millimetre-wave receivers and extend the Australian network of telescopes used for Very Long Baseline Interferometry. These upgrades will be complete by 2001. Operations and science will then be dominated by the impact of the new facilities.

Internationally, radio astronomy is dominated by National Facilities, supporting university-based users. International facilities will become increasingly important over the next decade.

Two major radio astronomy developments being planned now (the Large Millimetre Array (ALMA) and the Square Kilometre Array (SKA)) will enable key questions such as the evolution of the early Universe to be attacked. To maintain our position in radio astronomy Australia needs to be involved in these projects.

The SKA is an international billion-dollar project to build the next-generation radio telescope. Construction is expected to begin in 2008. Australia is well-positioned to play a key role in the development of the SKA. It is possible that the SKA will be located in Australia. The technology development required will have wide industrial application and construction will involve significant industrial contracts.

CSIRO's Strategy

The critical overall objective of the ATNF is to remain at the forefront of world radio astronomy. As a National Research Facility, the ATNF enables its users — 80 per cent of whom are from outside CSIRO — to carry out leading-edge radio astronomy.

The ATNF has identified five strategic objectives to enable its users to remain at the forefront of this science. They are to:

- operate the National Facility for radio astronomy research;
- maintain the ATNF's forefront position by extending the Facility through continuing introduction of state-of-the-art equipment and instrumentation;
- exploit the upgraded Facility (particularly its millimetre-wave capabilities) to make new astronomical discoveries;
- position Australia for participation in future major international facilities, particularly the Square-Kilometre Array project;
- conduct an effective outreach program to increase public awareness of Australia's achievements in astronomy and conduct other educational activities to attract young people to a career in science.



Research Outcomes

'Mirage' used to measure age of Universe. A team using CSIRO's Australia Telescope has measured how fast the Universe is expanding and has found it to be both older and larger than previously thought. Measuring the expansion of the Universe has been a key problem in astronomy for most of this century. The Australia Telescope's measurement puts the age of the Universe at 15 billion years. The team used a new method that avoids the built-in uncertainties in older methods: it involves looking at a distant quasar (the bright centre of a distant galaxy) whose image has been doubled by the gravity of a nearer galaxy.

'Impossible' pulsar found. CSIRO's Parkes radio telescope has found an object that theory says should not exist: a pulsar that 'pulses' only once every eight seconds. A pulsar is a small spinning star that emits a beam of radio waves. As the star spins, the beam sweeps over the Earth and we see a radio 'blip'. At eight seconds, the new pulsar's rotational period is by far the longest of any known.

Cosmic collision revises evolution of Universe. Two of the biggest structures in the Universe, galaxy clusters, are colliding, according to new evidence from the Australia Telescope and the University of Sydney. This changes our picture of the Universe's history. Astronomers had thought clusters (giant swarms of galaxies) had formed early in the life of the Universe then changed little since. But collisions between them must have transformed the clusters themselves and affected the development of their constituent galaxies. These cosmic traffic accidents are the most energetic events in the Universe since the initial Big Bang, releasing most of their energy as X-rays.

New instrument finds 'hidden' galaxies. In the past year multibeam surveys at Parkes have:

- shown that our galaxy's gravity has torn material from two small nearby galaxies, the Magellanic Clouds, settling a long-standing controversy;
- mapped the galaxies behind the Milky Way in a region that was suspected to harbour a great concentration of mass; 33 new galaxies have been found in this region, but not enough to confirm previous predictions;
- established that neutral hydrogen gas contributes fairly little to the total density of matter in the Universe, thus helping to discriminate between different models of how galaxies form.

The multibeam receiver system is also being used to hunt for pulsars. By June this year 396 new ones had been found, and more are expected. Only 750 pulsars had been found in the previous three decades by all other surveys world-wide.

Start of high-frequency upgrade. The Australia Telescope Compact Array at Narrabri is being upgraded to observe at millimetre-wavelengths — radio frequencies ten times higher than those it can handle at present. When this upgrade is complete it will give astronomers their first chance to image radio emission from the cosmic molecules that act as markers to many astrophysical processes in the southern sky. The upgrade is being funded by the Commonwealth Government's Major National Research Facilities program and CSIRO's Capital Investment Plan program.

Service Sector

Industry Context

The Service Sector encompasses services such as wholesale and retail trade; finance and insurance; business services; health services; education; and travel and tourism. It is not R&D intensive in general, although overall business expenditure on R&D is substantial (\$340 million). The most R&D intensive areas are wholesale trade, finance and insurance and business services.

Information technology and telecommunications (IT&T) provides the main technology base for the Service Sector. IT&T systems integration and customisation is a key factor in improving productivity in service firms. A huge range of new application areas within service firms is opening up because of the Internet and continuing trends in performance/cost of IT&T components. Examples are data mining, personalised services and electronic service delivery.

Any industry usually approaches new technology in the sequence adopt – adapt – invent. Australian service firms are beginning to move from the ‘adapt’ to the ‘invent’ stage. R&D intensity is significantly higher in the USA than in Australia: this indicates the direction in which Australian firms will have to move to remain competitive.

Globalisation is a major issue for service industries worldwide. This is apparent in the substantial and growing world trade in commercial services. The Internet and on-line services are having an enormous impact on globalisation.

Australian service firms can be both world-scale and competitive: service firms are the only Australian firms in *Forbes’* global best 400 large firms, and there are four Service Sector firms in *Fortune’s* Global 500.

CSIRO’s Strategic Response

Substantial progress has been made over the past three years in clarifying how research in general, and CSIRO in particular, can contribute to the development of the Australian service industries.

Our research is directed to helping Australian industry achieve the following goals:

- to improve the effectiveness of decision making in uncertain business environments, through new techniques and software implementations for modelling, measuring and assessing risk;
- to improve productivity and competitiveness, through an integrated approach to gathering, analysing and using information;
- to increase the cost effectiveness of health care delivery and outcomes through integrated health care and health service delivery systems;
- to improve the access, quality and efficiency of health care for Australia’s aging and remote population through telehealth technology;
- to improve the quality and cost effectiveness of diagnosis and treatment through computer-aided decision support and clinical advisory systems;
- to facilitate cost efficiencies and new business opportunities, based on personalised and enhanced service delivery in electronic commerce;

- to improve delivery of goods and services at reduced cost through improvements in supply chain management;
- to achieve secure and cost effective protection of physical, human and electronic assets through use of intelligent vision systems;
- to improve significantly the efficiency and effectiveness of asset monitoring through use of advanced monitoring technologies.

Research Outcomes

RoadCrack®. Commercialisation negotiations of the automated road pavement crack detection and classification system (*RoadCrack®*) reported on last year have begun, with keen interest in the system from the United States and Europe. *RoadCrack®* is a fully automated machine vision system that detects and classifies road pavement cracks. The New South Wales Roads and Traffic Authority has been using the *RoadCrack®* prototype for two years to help manage the Australian road network. The system saves tens of millions of dollars in maintenance annually by detecting pavement deterioration at an early stage, when repairs are cheaper to do.

Measuring up businesses. The Organisational Performance Measurement (OPM®) system, launched in June 1999, is designed to help business of all sizes and kinds become more sustainable by analysing their performance and helping with future planning. The system is endorsed by the Australian Quality Council. Marksman Homes, a homebuilding company that trialled an early version of the system, won the 1997 and 1998 NSW Quality Builder of the Year awards.

The door that knows your face. New technology being developed by CSIRO and the security products company Banque-Tec will mean that an entry door to a security building will reject anyone who presents an access card, but does not have the matching face. The system, using CSIRO-developed face recognition and image compression technology, is capable of rapidly matching a face to an image stored either on a smartcard or in a database. Already there has been very strong interest in the technology in Asia and Europe.

MANUFACTURING

Chemicals and Plastics Sector

Industry Context

The Chemicals and Plastics Sector encompasses commodity chemicals; bioactives (pesticides and herbicides, for example); surfactants and cosmetics; paint and ink; other speciality chemicals (dyes and explosives, for example); plastic resins; rubber and plastic products; and synthetic fibres. It is a significant provider of materials for manufacturing, mining and agriculture as well as supplying products directly to consumers.

The chemicals and plastics industry in Australia is characterised by a few large local companies, a few large foreign multi-national companies and a large and growing

number (around 2500) of small-to-medium sized companies employing fewer than 50 staff each. Australian industrial operations are not large on a world scale and local companies are generally better able to compete internationally in specialty or commodity niche areas. (Specialty chemicals have a product focus and generally involve lower capital cost processes.)

There are three vital strategic factors for the Sector:

- sustainability (economic viability, environmental sustainability and social responsibility);
- the nature and pace of technical change;
- the impact of biotechnology.

The chemical industry worldwide is going through a period of very substantial change with a marked trend towards biotechnology development and life science initiatives. A feature of the industry, both in Australia and overseas, is major restructuring into traditional chemical firms and vertically integrated life science companies. Biotechnology is expected to have a major impact in the more 'traditional' chemical production and processing activities. The chemical industry worldwide is a mature industry and the trend to life sciences heralds a marked shift in R&D.

CSIRO's Strategic Response

The change in the industry is being mirrored in significant change within CSIRO away from traditional approaches to crop protection products toward biotechnology-based approaches to bioactive molecule discovery and a bioprocessing initiative involving scale-up and downstream processing; protein purification and engineering; and large scale cell cultivation. Bioprocessing routes to industrial chemicals fit well with the specialty chemicals focus of the Australian chemical industry.

Our research is directed to helping Australian industry achieve the following goals:

- rapid expansion of bioprocessing as a core capability;
- manufacture of new and improved polymer-based products (for example coatings, fibres, elastomers, tooth fillings, optical lenses, sensing devices);
- use of packaging that is biodegradable or recyclable; secure (for authentication and identification of high value products); or enhances the quality of fresh and processed food;
- use of socially, ecologically and economically acceptable crop protection products well suited to integrated production systems in Australia;
- improvement and control of adhesion, permeability, surface conductivity and radiation attenuation for polymer products;
- design and formulate high-added value specialty chemical products or processes;
- retain Australia's market advantage for export grain by maintaining its ability to produce, store and sell clean, dry, insect-free grain;
- environmentally aware manufacture of non-commodity chemicals, in which all steps, from selection of raw materials to disposal of effluent, are integrated;
- improve service life of polymer coatings, composites and engineering polymers.

Research Outcomes

Engineered resins. The CSIRO - Du Pont Strategic Alliance team has devised, patented and largely developed the most effective, versatile and convenient method of controlling free radical polymerisation that is currently available. The new technology will have a substantial impact on the polymer industry world wide. Du Pont is currently applying the technology to the development of higher performance and more environmentally benign automotive paints. A number of companies have approached Du Pont and CSIRO for licences in such broad application areas as: rubber processing and tyres of lower rolling resistance; polyelectrolytes for rechargeable lithium batteries; flocculants for water purification; dental composite materials; more biocompatible biomaterials; pigment dispersants for high performance inks; and compatibilising agents for blends of engineered plastics.

Polymer banknotes. (UCB) Union Chemie Belge, UK has invested \$43 million in a manufacturing plant at Craigieburn, Victoria to produce specialty films, including the substrate for polymer banknotes. This investment flows from the development by Note Printing Australia and CSIRO of the world's first non-fibrous polymer banknote. Polymer notes have been produced for several countries and Taiwan has recently agreed to use the polymer substrate produced by UCB.

MIEX. Orica Watercare, CSIRO and the South Australian Water Corporation have developed the MIEX DOC Process for cost-effective management of dissolved organic carbon (DOC) in potable water—one of the key challenges facing today's water treatment industry. Orica has committed \$10 million for a new MIEX resins manufacturing plant in Melbourne. The plant will come on-line in late 1999 with a capacity of around 300 tonnes per year.

Sunscreens. With Micronisers Pty Ltd and its customers, CSIRO has developed methods to improve sunscreen effectiveness. UV-radiation absorbing metal oxides have been converted into transparent, ultrafine particles with improved UV absorbing capability. These sunscreen additives are in commercial production and are expected to replace 40-60 per cent of the metal oxides used as sunscreen additives in the 2000 summer season in Australia, as well as achieving substantial export sales and use in the general cosmetics market.

Biopesticides. A registration package for the product, BioCaneTM (BioCare Technology Pty Ltd, Sydney), has been produced and submitted in collaboration with the Bureaux of Sugar Experimental Stations. Some 9 tonnes of this granular product have been produced over the past two seasons for commercial trials, mainly in the Burdekin region in Queensland.

Insect-killing nematodes. CSIRO has reached the stage of commercially producing nematode products using technologies it has developed and patented over many years. These products are now being used to control various insect pests, both in Australia and overseas, including fungus gnats and black vine weevils in ornamentals, banana weevils, and most recently termites in houses and scarabs in amenity turf and berryfruit.

Natural Products Library. In a joint venture with BioDiscovery Ltd, CSIRO has developed a unique library of extracts made from Australian insects to allow systematic screening for novel agrochemical and pharmaceutical leads. This taps into the rich biodiversity present in Australia, as well as CSIRO's knowhow in working with Australian invertebrates. Rhône Poulenc, recognising the continuing potential of natural products to lead to new agrochemicals, has sub-licensed CSIRO's Insect

Extract Library from BioDiscovery Ltd and has commenced screening it for novel insecticides, fungicides and weedkillers.

Industry problem solving. The Polymer Service Life Group at CSIRO Molecular Science carried out over 100 individual, contracted R&D projects with Australian industry during the year. In a number of cases the companies involved (particularly defence and aerospace) indicated that results have provided substantial financial benefit, saved international contracts, and averted production line stoppages or closures.

Integrated Manufactured Products Sector

Industry Context

The Integrated Manufactured Products Sector covers machinery and equipment (especially transport equipment), instruments (especially measuring and testing instruments), methods for metal-based manufacturing (die casting, welding, coatings, alloys, forging and casting), manufacturing processes (including design and rapid prototyping) and the operation of distributed manufacturing enterprises.

Some significant aspects of the environment for manufacturing are:

- product development lead time and product life cycle are now almost half what they were ten years ago. This narrows the window of market opportunity;
- customers demand products that are customised to their needs and local conditions;
- there is a continuing need for differentiated products, often to fill niche markets;
- tools are required for facilitating globally-distributed manufacturing;
- adaptable/reconfigurable manufacturing systems, information and communication technologies, and modelling and simulation are key to manufacturing capabilities;
- manufacturing processes that minimise waste and energy consumption will be necessary to respond to increasingly stringent community expectations and environmental regulation. Use of environmentally acceptable processes could well become a prerequisite to being able to export into particular markets.

CSIRO's Strategic Response

CSIRO's current customer base is diverse and primarily small and medium enterprises (SMEs). The majority of Australian manufacturers, and SMEs in particular, are primarily interested in incremental improvements in products and processes.

Our research is directed to helping Australian industry achieve the following goals:

- lower energy use and waste to both reduce cost and maintain licence-to-operate in an increasingly constrained environmental framework;
- weight reduction and improved energy efficiency in transport equipment;
- improve quality and productivity by developing measurement, inspection and quality assurance tools;
- creation and growth of businesses based on sensing and monitoring;



- creation of a vertically integrated minerals-metal production-manufacturing chain based on magnesium and titanium alloys;
- improve productivity, quality and cost-effectiveness in manufacturing processes;
- to be world competitive in customised and niche-volume production;
- to operate in dynamic, global supply chains through effective distributed manufacturing systems;
- creation and growth of businesses based on biomimetic, nanoscale manufacturing;
- to reduce costs of existing micromanufactured products and develop new, differentiated high-value products based upon small-scale physical system manufacturing.

Research Outcomes

Anti-counterfeiting technology succeeds overseas. CSIRO's Exelgram anti-counterfeiting technology has been used in a number of countries' high-denomination banknotes and financial instruments.

Aluminium diecasting. A collaborative project with Nissan Casting has solved some long standing problems in diecasting. Understanding the effect of molten metal quality has eliminated costly plant-wide casting porosity outbreaks. Understanding the mechanisms of soldering has extended the life of some die components by orders of magnitude. A new process monitoring system has improved process understanding significantly. Overall the results have reduced Nissan's production costs by many thousands of dollars a year.

Arc welding of train tracks. CSIRO has developed special techniques and consumables for the joining of rails of dissimilar materials by direct arc welding for its industrial collaborators ANI Engineering and Edgar Allen Engineering, UK. The companies intend to market the technology locally and overseas — the market is estimated to be US\$30 million per annum.

Arc Deposition System. An industrial prototype of the filtered Arc Deposition System developed by CSIRO is about to be installed in the Suttons plant in Melbourne.

Cast-bonded bimetallic products. A novel technique for producing wear resistant and corrosion resistant bimetallic products has been developed. Two newly-formed Australian companies, Cast Bonding Australia Pty Ltd in Ballarat, Victoria and Cast Clad Pty Ltd in Birchgrove, New South Wales, have adopted the technology for the manufacture of bimetallic products for the mining and allied industries.

Remote operation support systems. In conjunction with Farley Cuttings Systems, CSIRO has developed a remote operating system that enables the provision of after-sales support anywhere in the world from Australia. The Internet is used to capture a wide range of information from the end user's installation and feed this back into process and service databases. Farley estimates that the system will enable them to increase sales of machines in new markets and in existing markets where customers are prepared to upgrade their machines to get better service.

Pharmaceuticals and Human Health Sector

Industry Context

The Pharmaceuticals and Human Health Sector focuses on health outcomes realised primarily through the pharmaceutical industry. It encompasses pharmaceuticals, diagnostics, nutritional products, *in-vivo* medical devices and other health care products.

The global pharmaceutical industry is large (\$300 billion per annum) with large companies, each of which has less than 4 per cent of the global market. Recent science and technology trends (high throughput screening, combinatorial chemistry, an explosion of genetic information) provide a new era of molecular discovery and design. Biotechnological approaches are now fundamental and many large, diversified companies are moving towards a 'life sciences' focus. Numerous small biotechnology companies provide drug development opportunities. R&D underpins the industry and firms invest substantial amounts in R&D.

Key drivers are:

- time and cost to market - cost from discovery to drug registration averages \$150 million; development times are increasing and product life cycle times decreasing;
- innovation deficit - a global shortfall in product development;
- genomics, natural products and biotechnology processes;
- changing patterns of disease;
- cost of health care.

There are over 140 companies in the Australian pharmaceutical industry, including a number of significant majority Australian-owned companies. Ninety per cent of these firms engage in R&D activity, often at significant levels. The ability to capture the benefits of R&D has been hampered in the past by the absence of a culture of pharmaceutical development to translate research outputs to products. Government policy stemming from the Pharmaceutical Development Plan of 1990 has assisted in redressing this impediment.

CSIRO's Strategic Response

CSIRO research will be aimed at adding value to the industry in the following areas:

- anti-infective agents for the control of selected infectious diseases;
- capitalising on Australia's unique biodiversity for the discovery and development of bioactive molecules for pharmaceuticals and nutraceuticals;
- biomaterials for ophthalmic, cardiovascular, orthopaedic and wound-healing products;
- agents and strategies for the prevention, diagnosis and treatment of prostate and colon cancers;
- improved therapeutic effectiveness and reduced side-effects through targeted delivery of new and existing drugs, genes and gene modifiers;
- therapeutic agents for diabetes through rational drug design;



- innovative technology for diagnostic reagents;
- enhanced growth and repair of human and animal tissues using growth factor agents.

Research Outcomes

RelenzaTM. RelenzaTM, the world's first anti-influenza virus drug, developed with Biota from CSIRO's pioneering protein crystallography effort in the 1980s, has been approved in Australia and is available now by prescription. It has also been approved for use in the European Union and the United States of America. Worldwide sales of at least \$500 million are anticipated with substantial impact on health and productivity of 'flu sufferers. GlaxoWellcome has commissioned a manufacturing plant for RelenzaTM in Boronia, Victoria.

'Extended-wear' contact lenses. CIBA Vision started selling 'extended-wear' contact lenses in May 1999. The lenses, developed by CSIRO and commercialised through the Cooperative Research Centre for Eye Research and Technology, are made of a new polymeric material capable of transmitting up to six times more oxygen to the eye than ordinary soft lenses. This allows extended wear for up to 30 days and nights.

NucoloxTM. Collaborative research between CSIRO and Sigma Pharmaceuticals led to the Australian release of the laxative drink product NucoloxTM in August 1998. This product eases laxation and improves bowel health. It is suitable for people who cannot consume a high fibre diet for a variety of reasons including food allergies.

Novel chemicals and processes. Specialty chemicals and processes have been developed that can be used to screen drug targets for new bioactive molecules. They will also reduce costs for and wastage from large-scale chemical plants. Technology transfer and evaluation agreements have been negotiated with Aldrich Chemical Company, which will market the chemicals worldwide.

MINERALS AND ENERGY

Energy Sector

Industry Context

This Sector encompasses the use, production and supply of all energy resources except petroleum and natural gas.

The energy industry arrangements that have existed in Australia for a number of decades are rapidly changing in the face of fundamental and far-reaching market reform in the energy supply industry, affecting production, distribution and delivery of electricity and gas; major rationalisation and increased productivity of the coal industry in light of price pressures and international competitive pressures; the emergence of a range of new power generation, storage, distribution systems; and the impact of the Kyoto conference and pressures to contain carbon dioxide emissions.

The two key drivers for the Sector are downward cost pressures to keep energy prices at competitive international levels, and greenhouse gas concerns. Other factors are:

- coal projected to continue as Australia's leading commodity export with continuing pressure to increase productivity and lower cost;
- gas projected to increase from 18 per cent of primary energy to 28 per cent by 2010, and power and cogeneration applications rising from 9 per cent to 21 per cent;
- power industry to increase capacity by 2010;
- renewable energy, assisted by green power schemes, will receive considerable investment, but clean coal technologies will remain the major basis, and gas the commercial choice for new supply;
- energy efficiency and conservation measures will be adopted across industry, transport, and the domestic sectors, with considerable scope for 'new' and 'future' practice and associated R&D;
- exports of mining and energy equipment and services will grow with opportunities, flowing from the Kyoto protocol, for technologies in the clean coal, renewable, end use efficiency, and environmental areas.

CSIRO's Strategic Response

The Energy Sector has refocused its effort considerably during the triennium, and reflects the recent decision by CSIRO and New South Wales Government to establish a world class sustainable energy R&D centre at Newcastle. The Sector research plans also respond to the Government's commitment to the Kyoto protocol as well as minimising the growth of greenhouse gas emissions.

The strategic objectives for the Sector are:

- prediction of future energy trends and technology innovation;
- enhanced cost competitiveness of coal production;
- improved environmental, health and safety aspects of coal production;
- cleaner, more efficient power generation from fossil fuels with lower greenhouse emissions;
- development and use of distributed energy generation;
- development of high efficiency, cost effective energy storage;
- development and utilisation of renewable energy;
- direct mitigation of greenhouse gas emissions;
- enhanced energy end use efficiency.

Research Outcomes

Microseismic monitoring. CSIRO's microseismic monitoring system, used in eight coal mines, is now widely accepted across Australia's underground coal mining industry.



The results from monitoring have provided information that has enabled mines to address production delays and reduce safety incidents.

Mine planning and scheduling. Predictive geological models and longwall geomechanics provided to industry are leading to improvements in mine planning and scheduling. The benefits realised in minimising stoppages and increased safety are estimated at \$600 000 per day for a typical underground longwall mine.

Improved underground roadways. A systematic approach to the planning and construction of underground roadways has resulted in 20-25 per cent improvements in the speed of roadway development and a 20 per cent decrease in construction costs. These savings total \$7.9 million a year for one mine, with potential for widespread adoption in other underground longwall mines.

In-seam drill guidance tool. A radiometric/radar geo-steering tool for in-seam drill guidance is being commercialised through Sibra Pty Ltd.

Briquette coal trials. Value-added coal products (briquettes) are at demonstration stage. A 10-12 tonnes/hour plant in Western Australia is producing 16 000 tonnes of binderless briquette coal and this work is now flowing onto a feasibility study for a commercial plant.

Measuring flow rate of coal. CSIRO has developed and successfully plant tested an ultrasonic technique for the on-line measurement of mass flow rates of coal in pulverised coal-fired power stations. These measurements are needed for optimising plant performance. Commercialisation is scheduled for the end of 1999.

Oxygen sensor commercialisation. Ceramic Oxide Fabricators Pty Ltd has been licensed for electrode technology for oxygen sensors. Negotiations are in progress with another company to start a collaborative program for the development of oxygen separation devices for gas calibration.

Mineral Exploration and Mining Sector

Industry Context

The Sector is concerned with the exploration for, and mining of, economically viable, naturally occurring, solid, inorganic mineral deposits. Environmental impacts of mining, minesite rehabilitation and occupational health and safety considerations are also included.

A number of Australian mining and exploration companies are prominent at a global level; some 42 per cent of total exploration budget of Australian-based companies is expended overseas and about 20 per cent of the world's exploration budget is spent here. Two key industry organisations are AMIRA (which includes some 88 Australian exploration companies) and AUSTMINE (which comprises some 137 service and manufacturing companies with exports of mining equipment and services over \$1 billion per year).

The minerals industry is now in a deep cyclical low in mineral prices and has intensified its focus on cost reduction and diversified markets. Spending for future growth has been severely curtailed, with particular impact on exploration and R&D. The associated growth in outsourcing provides opportunities for CSIRO. Smaller companies also play an important and increasing role in the Australian industry by providing niche products and contract services.

CSIRO's Strategic Response

CSIRO's Sector activities have been reshaped around two concepts:

The Glass Earth—to discover the next generation of giant ore deposits in Australia by making the top one kilometre of the Australian continent, and the processes operating within it, transparent.

Objectives of the research are to:

- develop geological concepts that deliver validated area selection criteria to industry;
- provide innovative technologies to recognise ore-bearing systems and locate ore deposits;
- provide specialised concepts and technologies for exploration within and through the Australian regolith.

The Accessible Earth—to optimise the efficiency, safety and cost effectiveness of mining systems by making fully accessible new types of mineral deposits as well as deposits that are currently sub-economic.

The objectives for this concept are to:

- improve ore body delineation, rock mass characterisation and mine design reliability;
- optimise mine operations and product quality;
- develop innovation mining and extraction systems;
- develop technologies that improve mine safety and health;
- develop technologies that protect the environment;
- optimise exploration to market systems.

Research Outcomes

Gold exploration. The CSIRO calcrete geochemistry exploration technology, which improves detection of buried gold deposits, has been used in the Gawler Craton in South Australia. Numerous gold deposits have been identified there. In response to this success the Federal Government has provided funding to encourage a coordinated regional approach to infrastructure and other developments in this region.

TEMPEST. One of the world's most advanced airborne mineral exploration systems, TEMPEST, developed by CSIRO, is now being offered as a commercial service by World Geoscience Corporation. It is also being used to detect underground water and groundwater salinity.

Microseismic monitoring. CSIRO's microseismic monitoring system, used in eight coal mines, is now widely accepted across Australia's underground coal mining industry. The results from monitoring have provided information that has enabled mines to address production delays and reduce safety incidents.

SIROSIZE. Continuous monitoring to ensure consistent size distribution of material on a conveyor has been made possible with the commercialisation of SIROSIZE by Adept Electronic Solutions. Continuous monitoring can provide up to date information on



size distributions without the disruption to operations caused by manual sampling and sizing methods.

Auslog borehole logging techniques. The SIROLOG family of spectrometric borehole logging tools developed by CSIRO is now produced and marketed by Scintrex/Auslog Pty Ltd. The technology opens up new possibilities for improved control in exploration, mine planning, development and production stages and for mineral processing.

Cleaning up the dust challenge. One of the biggest environmental challenges for the Australian surface mining industry has been how to reduce the amount of dust produced in the mining process. A recent achievement has been the development and implementation of a Decision Support Dust Management System for a major open pit gold mine in Western Australia. This Support System provides strategies and methods for control and monitoring of dust emissions and has been used as a case study example for the Australian Protection Authorities' *Best Practice in Environmental Planning and Management in Mining* series.

Indicators of ecosystem rehabilitation. The critical phase of rehabilitation of minesites has now been made more reliable with the discovery of the indicators of ecosystem rehabilitation. These indicators will predict the success or failure of rehabilitation on minesites by examining the soil surface condition, vegetation development and the complexity of the habitat. Following successful tests of this Ecosystem Function Analysis in a coal mine in Queensland, staff from a number of mineral mines are now being trained in its use.

Mineral Processing and Metal Production Sector

Industry Context

This Sector transforms as-mined, mineral ores to mineral products, chemically processed minerals, and refined and unrefined metal.

The Sector has demonstrated a high appetite for technology, and Australian industry over the years has been a receptive developer and adaptor of technologies. It currently operates against a backdrop of increasing globalisation, erosion of technical capability, and the need to process more complex, often lower-grade ore bodies in the face of declining commodity prices and lower profitability. Pressure for 'sustainable' processing will continue to grow with implications for greenhouse gas reduction, recycling and zero waste processes and the social impacts of mining and processing.

Commodity prices are depressed, in part due to the Asian economic crisis, and this is placing pressure on companies to use new technologies to reduce operating costs and to maximise return on assets in the short to medium term. Demand will pick up as the global economy improves, but real prices are predicted to decline over the longer term, underpinning the call for continuing innovation. Price cycles and slowness will combine to kill weak firms and there is opportunity for a market share increase for Australia. Amalgamations and take-overs have produced a small number of large trans-nationals although a large number of medium sized smaller processing companies are poised to play an increasing role in the future.

The technology needs for this Sector are:

- process intensification, simplification and optimisation;
- increasing the degree of asset utilisation to lower capital and operating costs;
- strategies and practices that will lead to sustainable mineral processing, including increased recovery of valuable components and reduced waste and greenhouse emissions;
- processing lower grade, complex, impure and difficult-to-treat deposits;
- integrated 'manufacturing-style' systems to optimise the flow of materials to market.

CSIRO's Strategic Response

In response to these identified needs, CSIRO research is focusing on:

- strategies and technologies for sustainability, to assist industry meet economic, environmental and social expectations;
- technologies for process improvement;
- techniques to increase asset utilisation, including monitoring and control;
- techniques for difficult-to-treat ores;
- technologies for mining and mineral processing in 2010;
- technologies for differentiating Australia's commodities to increase export competitiveness;
- establishment of new light metal industries based on aluminium, magnesium and titanium;
- development of enabling technologies in chemical, biochemical, physical, mathematical and engineering disciplines for access by industry.

Research Outcomes

Adding value to Australia's magnesite. Flamemag International GIE is constructing a \$1.8 million pilot plant at Clayton, Victoria, to demonstrate the commercial viability of a new CSIRO process to produce flame retardant grade magnesium hydroxide for use in plastics.

Support for the emerging magnesium metal industry. Through secondments, CSIRO assisted the Australian Magnesium Corporation to carry out a feasibility evaluation of the magnesium metal demonstration plant at Gladstone, Queensland and provided assistance with the feasibility study for a full-scale commercial plant. CSIRO researchers also contributed to critical technology areas during the commissioning phase of the demonstration plant.

On-line analysis for cement. CSIRO has worked with Adelaide Brighton Management Ltd to develop and implement two key on-line analysis systems: an on-conveyor belt bulk elemental analyser for the raw materials, and an analyser for determining the composition and phases in cement.

Savings for gold producers. Gold producers in Western Australia have now confirmed CSIRO research indicating that most lime consumption is related to high magnesium content of their hypersaline water. By minimising the amount of magnesium entering the system through better water management, and by carefully adjusting the leach pH to lower, but still safe values, companies can save millions of dollars in lime reagent costs.

*International marketing of QEM*SEM.* CSIRO has licensed LEO Electron Microscopy Ltd, UK, to commercialise its new generation QEM*SEM system, the most advanced quantitative image analysis system for characterising ores and similar materials. The system is being marketed internationally as the LEO QEMSCAN and, to date, systems have been sold in South Africa, Canada and Australia.

Improved heat transfer in mixing tanks. Modelling by CSIRO's computational fluid dynamics (CFD) team has identified a new stirred tank reactor configuration that reduces batch times and so increases plant productivity. CSIRO applied CFD modelling to improve the design of a reactor that is planned for Orica's new chlor-alkali plant.

Checking new refinery design. CSIRO's computational fluid dynamics research has been successfully used by Caltex Australia at its Brisbane refinery to manage the technical risk of unconventional design improvements to the reactor system of the fluid catalytic cracker.

Petroleum Sector

Industry Context

The oil and gas sector accounts for production of more than half of Australia's energy needs and therefore has a direct influence on the competitiveness of industry and on the community. Australia is gas rich, though most is remote from markets; gas will grow to 28 per cent of total energy needs by 2010. Oil is set to decline from 80 per cent of self-sufficiency in the absence of further significant discoveries. Oil and gas prices are projected to rise slightly from current low levels in coming years. Petroleum exploration remains high, despite downturn in other parts of industry expenditure.

The key drivers for the industry are:

- to improve the Australian exploration performance. Increased resources and competitive finding costs are pre-requisites for the long-term performance of the petroleum industry;
- to improve the financial viability of the Australian petroleum industry through technology improvements. There is a focus on increased productivity from investments, especially drilling and offshore facilities, in the face of a flat price outlook and with operations in increasingly deeper water further offshore;
- to minimise the impact on Australia's marine environment;
- to maximise value to Australia from its oil and gas resources. This requires capture of the value of natural gas resources (with the associated opportunity of a growing gas industry), and increasing the fraction of the total oil-in-place that can be economically produced.

The focus of the industry is on offshore north-west Australia and this is anticipated to continue for several decades.

CSIRO's Strategic Response

R&D aimed at meeting the challenges of the key industry drivers is aimed at:

- increasing petroleum reserves and the success rates of exploration;
- increasing the quality of appraisal and field development of reserves;
- cutting costs and increasing returns from drilling;
- developing better data integration, risk and uncertainty technologies to improve business decisions taken in an uncertain environment;
- extracting increased value from gas production and processing;
- enabling economic flow rates from 'tight'/low permeability reservoirs;
- developing options for storage or disposal of carbon dioxide produced by gas production and processing;
- enabling sustainable disposal of drilling and production waste;
- predicting extreme ocean conditions as input to the design of offshore facilities.

Research Outcomes

New oil exploration technique. CSIRO has developed and patented GOI (grains containing oil inclusions) technology that helps determine oil migration pathways through rock zones. This technology has been used with success in exploration in the Tenacious Field (Cultus), Laminaria Field (Woodside), and Laminaria East and ZOCA fields (Broken Hill Petroleum Pty Ltd).

Old oil. CSIRO has established a global reputation concerning the analysis of fluid inclusions. The technology was used in the discovery of the world's oldest oil, preserved as microscopic inclusions within the mineral grains of Archaean sandstones that are up to three billion years old. This discovery extends the known age range of petroleum generation and migration and has important implications for understanding the organic evolution of the earth.

FAMM goes international. Fluorescence alteration of multiple macerals, more widely known as FAMM, is a technology developed in CSIRO to provide more robust measurements of the thermal maturity of potential petroleum source rocks. After an initial focus on Australian basins, the technology has been exported to the China National Petroleum Corporation as part of a plan to establish FAMM as a standard exploration technique used worldwide.

Isotope stratigraphy. Stratigraphic correlation using the isotopic composition of strontium extracted from limestones is now common exploration practice in the highlands of Papua New Guinea. Ongoing research sponsored by Chevron, Esso and Santos has resulted in the establishment of an excellent correlation between the isotope stratigraphy, and more conventional schemes based on the distribution of fossils. Establishing a firm link with the biostratigraphy reinforces the view that isotope stratigraphy can be used with great confidence for mapping and structural modelling.

Reservoir modelling. CSIRO has led the process of applying computer-based modelling to the prediction of in-situ conditions using sparse data made available



during exploration. A powerful new technique has been developed to combine low-resolution seismic information that has good spatial coverage with fine detail from boreholes that have poor coverage. The software is being made available to the industry on a widely used computer platform.

Drill cost reduction. Software that captures drilling knowledge has been built to assist petroleum engineers make better use of drilling data and experience during the planning and operating phases of well design. The process supports all major decisions that affect the final cost of the well, including risk and uncertainty. The software was released for commercial use in December 1998 and is currently on trial in two major oil fields.

Wellbore stability. Operating companies such as Woodside, Apache Energy and BHP Petroleum have adopted CSIRO technology that enables them to determine the time-dependent stability of oil wells. This enables improved well design, optimal drilling fluid design and helps avoid problems like failure of the borehole wall that may lead to additional costs of between \$150 000 and \$400 000 a day. A full scale field trial of the technology is currently being carried out in the South China Sea in collaboration with Petronas Research & Scientific Services.

New drilling fluids. CSIRO is collaborating with Baroid Drilling Fluids, Inc, a leading supplier of drilling fluid products worldwide, in the development of environmentally friendly water-based drilling fluids, which will perform essentially like oil-based drilling fluids in mitigating wellbore instability in shales. In the first year of the project, a number of promising compounds have been developed.

Gravity currents. CSIRO research has found that gravity currents can reduce the effectiveness of hydraulic fractures designed to extract oil and gas from wells. The resultant modelling of this effect is now incorporated into two-thirds of the world's commercial models for hydraulic fracture design.

RESEARCH AWARDS

Outstanding performance in research is also recognised by various national award schemes. Two schemes operated by CSIRO are reported on below.

The Chairman's Medal

The 1998 Chairman's Medal and CSIRO Medals were presented on 3 December, 1998 by Professor Peter Doherty, Nobel Laureate.

The winners of the Chairman's Medal were Dr Ahmed Bhoyro, Dr John Cook, Dr David King, Dr Gary O'Loughlin, Dr David Phillips, Dr John Rippon, Mr Keith Thomas and Dr John Warner for the development of innovative new wool fibres.

CSIRO Medals

The CSIRO Medals for 1998 for CSIRO staff were awarded to:

- Dr Robert Leicester for scientific contributions to knowledge of timber structural properties;
- Dr Lister Staveley-Smith, Dr Trevor Bird, Mr Malcolm Sinclair and Dr Warwick Wilson, for the Parkes 21-cm Multibeam System;
- Dr Stephen Wilkins, Dr Dachao Gao, Dr Tim Gureyev, Dr Andrew Pogany, Dr Andrew Stevenson, and Dr Tim Davis, for developments in hard X-ray phase contrast imaging.

The external CSIRO Medal winner was:

- Professor David Boger from the University of Melbourne, for his work on viscoelastic fluid mechanics.

Sir Ian McLennan Achievement for Industry Award

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

The 1998 Award was presented on 17 November, 1998 by Mr Hugh Morgan, AO, Managing Director, Western Mining Corporation Ltd. The winner was Dr Mary Ann Augustin of Food Science Australia for her research for the dairy industry over the last ten years, which has helped generate millions of dollars in sales of specialised dairy products.



Chairman's Medal:

From left to right are Dr John Warner, Dr David King, CSIRO Chairman, Mr Charles Allen, AO, Dr David Phillips, Dr John Cook, Dr John Rippon, Dr Ahmed Bhoyro, Mr Keith Thomas, Dr Gary O'Loughlin and guest of honour Professor Peter Doherty.

Photo: Mark Fergus



CSIRO Medallists:

From left to right are CSIRO Chief Executive, Dr Malcolm McIntosh, AC, Dr Lister Staveley-Smith, Dr Steve Wilkins, CSIRO Chairman, Mr Charles Allen, AO, Dr David Phillips, guest of honour Professor Peter Doherty, Dr Robert Leicester and Professor David Boger.

Photo: Mark Fergus



Sir Ian McLennan Award

From left to right are Sir Peter Derham, winner Dr Mary Ann Augustin, and Mr Hugh Morgan, AO.

Photo: Mark Fergus

RESEARCH SUPPORT

Education Programs

CSIRO Education Programs operates a range of projects to raise awareness of the value of scientific research and to encourage students to take up science careers.

The group lost one of its major sponsors – BHP – after ten years of generous support. The challenge is to replace this sponsorship. This issue is being addressed through approaches to corporations.

Scientriffic, a junior version of the successful *Helix* magazine was launched in May. It is supported by a range of sponsors. Early indications are that the rate of paid subscriptions will exceed the predicted level and that the budget for this project will balance.

A new weekly science television program for children was developed with Network Ten. The program has been successful and it is planned to continue it indefinitely.

Energy Services

Energy Services assesses and recommends methods to reduce CSIRO's overall energy usage in line with CSIRO policies and Government annual reduction targets and when relevant provide staff awareness and training programs.

A cost-effective bulk electricity supply contract for Victoria, New South Wales and Australian Capital Territory was negotiated in November 1998. 'Smart' metering of energy uses at most individual sites has been effected, facilitating more effective monitoring, reporting and forecasting.

Finance

The Organisation has prepared a full accrual budget for the next triennium to support the Commonwealth Government's new Accrual Information Management System and the new Outputs and Outcomes framework.

Implementation of Phases 2 and 3 of the Project Support System has delivered functionality enhancements in response to Divisional and corporate requirements. As part of preparations for the Year 2000, all financial reporting and operations, including cheque production, were consolidated onto the Y2K-compliant Unibis financial system.

A new travel contract was negotiated with Ansett for domestic travel and Qantas and Carlson Wagonlit Travel for international travel. The contract provides improved service and price.

In line with a Commonwealth directive, all CSIRO general insurance policies have been transferred to the Government's Comcover scheme, resulting in an overall reduction in premium costs.

Human Resources

A major focus of Human Resources activity has been the implementation of the initiatives introduced in the Enterprise Agreement that was certified in June 1998 and, in particular, the introduction of flexible remuneration packaging and commencement of reviews of CSIRO's performance management and salary and classification systems.

An Environmental Management System (EMS) based on the international standard ISO 14000 has been developed to assist CSIRO meet its environmental obligations. A phased introduction of the EMS by Research Divisions is planned over several years.

Information Technology Services

One of the challenges is to match the growth in demand for network capacity across a geographically diverse organisation. The strategies to overcome these issues relate to building a quality and scalable network environment. This starts at the basic cabling, with the Organisation's cable upgrade program, includes flexible LAN switches and extends to flexible Wide Area Networking utilising the most appropriate Telstra, Optus or AARNet service.

CSIRO's World Wide Web site was redesigned and the quality of presentations and content dramatically improved. The service takes advantage of modern database technology.

Following a trial, an agreement was negotiated with Elsevier Science BV to provide scientific journals online to reduce dependence on paper journals and reduce the overall cost of libraries while increasing the amount of available information.

National Awareness

Service to politicians. Two major outcomes of trial information services to politicians have been the extension of National Science Briefings to all State Parliaments and the establishment of the Parliamentary Information Initiative, aimed at providing Federal politicians with regular information about CSIRO research, tailored to their own special requirements.

Corporate reputation. Outcomes of public awareness activities have been measured by media analysis and a public opinion survey. Analysis of print media during 1998 showed that CSIRO continues to receive very favourable print media. A public opinion survey in May 1999 showed awareness of CSIRO by the public continues to be high and our work is held in high regard.

Property

CSIRO's property assets are being efficiently and effectively managed, using the CSIRO Property Management Plan 2000 as a base for principles and strategies. Rationalisation and consolidation of resources continues in line with research requirements and budgetary parameters. The Internal Leasing Scheme provides the most appropriate means for generating funds for allocation to the maintenance and replacement of CSIRO's highly specialised assets.

A repairs and maintenance survey conducted over the past two years is enabling funds for the maintenance of assets to be directed more effectively to areas of specific need. This will permit the life of assets to be extended and for the long-term cost of repairing and maintaining assets to be minimised.

CSIRO's property portfolio is also continuing to change to meet the needs of research and science. Projects recently completed include the Discovery centre at Black Mountain (Australian Capital Territory), and new facilities at Floreat Park (Western Australia) and Werribee (Victoria). New projects include facilities at North Ryde (New South Wales) and Clayton (Victoria) and joint venture facilities at Bentley

(Western Australia) – Western Australian Government; St Lucia (Queensland) – University of Queensland and Pinjarra Hills (Queensland) – Queensland Government.

In hand with the development of necessary new facilities is the disposal of older complexes that have serviced CSIRO scientists for several decades. These include Helena Valley (Western Australia), Armidale Longford, (New South Wales), and Adelaide Glenithorne, (South Australia). Future disposals will include Syndal (Victoria), Preston (Victoria), Ryde (New South Wales), and a portion of North Ryde (New South Wales).

Risk Assessment and Audit

A key element in CSIRO's corporate governance framework is the Board and Senior Management's understanding of the risks facing the Organisation.

To assist this understanding the Unit provided the Board Audit Committee with a summary of the high and significant risks at the CSIRO organisational level. These risks had been identified using the ongoing risk assessment process, which follows the Australian/New Zealand standard on risk management (4360:1999). Management provided an overview of the strategies it has in place to mitigate each of these risks.

A further important outcome is the provision of regular audit reports to Senior Management and Board Audit Committee, which provide assurance that internal controls are in place and operating effectively.

DEVELOPMENTS SINCE 30 JUNE 1999

The *Commonwealth Authorities and Companies Act 1997* requires CSIRO to report developments since the end of the financial year, giving particulars of any matter or circumstance that has arisen and has significantly affected or may significantly affect:

- (i) the authority's operations in future financial years; or
- (ii) the results of those operations in future years; or
- (iii) the authority's state of affairs in future financial years.

Since 30 June 1999 no developments have arisen that have significantly affected or may significantly affect CSIRO's operations or state of affairs.



INDEPENDENT AUDIT REPORT

To the Minister for Industry, Science and Resources

Scope

I have audited the financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1999. The financial statements comprise:

- Statement by Board Members
- Operating Statement
- Statement of Assets and Liabilities
- Statement of Cash Flows
- Schedule of Commitments
- Schedule of Contingencies, and
- Notes to and forming part of the Financial Statements.

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

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 as to whether, in all material respects, the financial statements are presented fairly in accordance with Australian Accounting Standards, other mandatory professional reporting requirements and statutory requirements so as to present a view of the entity which is consistent with my understanding of its financial position, the results of its operation and its cash flows.

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

Audit Opinion

In my opinion,

- (i) the financial statements have been prepared in accordance with Schedule 2 of the Finance Minister's Orders; and
- (ii) the financial statements give a true and fair view, in accordance with applicable Accounting Standards, other mandatory professional reporting requirements and Schedule 2 of the Finance Minister's Orders, of the financial position of the Commonwealth, Scientific and Industrial Research Organisation as at 30 June 1999 and the results of its operations and its cash flows for the year then ended.

Australian National Audit Office

David C McKean

Executive Director

Delegate of the Auditor-General

Canberra

6 September 1999

GPO Box 707 CANBERRA ACT 2601
Centenary House 19 National Circuit
BARTON ACT
Phone (02) 6203 7300 Fax (02) 6203 7777

In our opinion, the attached 1998/99 financial statements give a true and fair view of the matters required by Schedule 2 of the Finance Minister's Orders made under the *Commonwealth Authorities and Companies Act 1997*.

Signed at Melbourne this 3rd day of September 1999 in accordance with a resolution of the Board Members.



D Charles K Allen, AO
(Chairman of the Board)



Colin M Adam
(Acting Chief Executive and
Board Member)

OPERATING STATEMENT

For the year ended 30 June 1999

	Notes	1999 \$'000	1998 \$'000
NET COST OF SERVICES			
Operating expenses			
<i>Business Units</i>			
Animal Health (incl. Australian Animal Health Laboratory)		23 283	21 416
Animal Production		20 699	19 666
Atmospheric Research		15 952	14 885
Australia Telescope National Facility		17 541	14 963
Building, Construction & Engineering		29 059	26 739
Discovery Centre		105	98
Energy Technology		18 898	19 764
Entomology		31 619	29 679
Exploration & Mining		35 046	32 348
Food Science & Technology		15 088	10 053
Food Science Australia Joint Venture	4(a), 21	4 253	9 684
Forestry & Forest Products		29 188	30 767
Human Nutrition		9 204	8 395
Land & Water		44 850	43 914
Magnesium Project		1 966	3 733
Manufacturing Science & Technology		42 584	40 894
Marine Research		36 737	35 486
Mathematical & Information Sciences		32 484	28 812
Mediterranean Agricultural Research		1 122	66
Minerals		33 748	34 479
Molecular Science		42 640	35 701
ORV Franklin National Facility		5 518	4 964
Petroleum Resources		11 682	9 856
Plant Industry		53 203	46 226
Publishing		6 297	5 180
Telecommunications & Industrial Physics (incl. National Measurement Laboratory)		56 550	51 554
Textile & Fibre Technology		23 591	25 264
Tropical Agriculture		34 559	33 811
Wildlife & Ecology		22 222	22 358
Corporate Activities	4 (b)	48 034	41 797
Total operating expenses	4 (a)	747 722	702 552
Operating revenues from independent sources			
Revenue from research activities and user charges		217 616	219 048
Other revenue	5	35 336	30 574
Total operating revenues from independent sources		252 952	249 622
Net cost of services		494 770	452 930
REVENUES FROM GOVERNMENT			
Parliamentary appropriations received	6	475 390	466 837
Surplus/(deficit) of revenues from Government over net cost of services		(19 380)	13 907
Accumulated surpluses at beginning of reporting period		597 340	613 433
		577 960	627 340
Revenue measure – payment to Government	7	–	(30 000)
Accumulated surpluses at end of reporting period		577 960	597 340

The accompanying notes form part of these financial statements

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION
STATEMENT OF ASSETS AND LIABILITIES
As at 30 June 1999

	Notes	1999 \$'000	1998 \$'000
DEBT			
Leases	8	19 804	19 534
Deposits – Trust monies	13	16 296	13 096
Total debt		36 100	32 630
PROVISIONS AND PAYABLES			
Employees	9	145 889	139 027
Suppliers	10	25 839	18 112
Other	11	132 937	129 058
Total provisions and payables		304 665	286 197
Total liabilities		340 765	318 827
EQUITY			
Reserves		397 824	252 407
Accumulated surpluses		577 960	597 340
Total equity	12	975 784	849 747
Total liabilities and equity		1 316 549	1 168 574
FINANCIAL ASSETS			
Cash	13	53 611	28 042
Receivables	14	32 289	44 580
Investments	15	99 280	94 245
Total financial assets		185 180	166 867
NON-FINANCIAL ASSETS			
Land and buildings	16	859 927	817 522
Plant and equipment	17	250 561	165 597
Inventories	18	549	876
Other	19	20 332	17 712
Total non-financial assets		1 131 369	1 001 707
Total assets		1 316 549	1 168 574
 Current liabilities		 157 364	 127 961
Non-current liabilities		183 401	190 866
 Current assets		 123 781	 93 641
Non-current assets		1 192 768	1 074 933

The accompanying notes form part of these financial statements

STATEMENT OF CASH FLOWS

For the year ended 30 June 1999

	Notes	1999 \$'000	1998 \$'000
OPERATING ACTIVITIES			
Cash received			
Appropriations		475 390	466 837
Sales of goods and services		248 293	239 879
Interest		1 701	2 153
Other		3 200	497
		728 584	709 366
Cash used			
Employees		411 872	408 304
Suppliers		244 946	230 122
Interest and other financing costs		417	1 276
		657 235	639 702
Net cash provided by operating activities	20	71 349	69 664
INVESTING ACTIVITIES			
Cash received			
Proceeds from sale of property, plant and equipment		31 988	22 737
Proceeds from sale of equity instruments		19	156
		32 007	22 893
Cash used			
Purchase of property, plant and equipment		70 969	68 672
Purchase of equity investment		1 841	829
		72 810	69 501
Net cash used by investing activities		(40 803)	(46 608)
FINANCING ACTIVITIES			
Cash received			
Proceeds from debt		—	5
Cash used			
Revenue measure – payment to Government		—	30 000
Net cash used by financing activities		—	(29 995)
Net increase/(decrease) in cash held		30 546	(6 939)
Cash at 1 July		121 348	128 287
Cash at 30 June		151 894	121 348
For the purpose of the Statement of Cash Flows, cash is represented by:			
Cash at bank and on hand	13	37 065	14 770
Cash at bank – trust monies	13	16 296	13 096
Deposits – at call	13	250	176
Short term bank bills	15	—	2 539
R&D Syndicate deposits – under contract	15	98 283	90 767
		151 894	121 348

The accompanying notes form part of these financial statements.

SCHEDULE OF COMMITMENTS

As at 30 June 1999

	1999 \$'000	1998 \$'000
By Type		
Commitments payable		
Capital commitments		
Land and buildings	10 122	16 630
Plant and equipment	3 441	11 468
Total capital commitments	13 563	28 098
Other commitments		
Operating leases	18 372	12 277
Research and development commitments	269 412	252 454
Other commitments	17 770	2 249
Total other commitments	305 554	266 980
Total commitments payable	319 117	295 078
Commitments receivable		
Research and development commitments	239 668	233 193
Other receivables	4 266	11 978
Total commitments receivable	243 934	245 171
Net commitments	75 183	49 907
By Maturity		
All net commitments		
One year or less	32 641	37 573
From one to two years	17 615	4 334
From two to five years	16 981	4 909
Over five years	7 946	3 091
Net commitments	75 183	49 907
Operating lease commitments		
One year or less	6 935	3 866
From one to two years	5 457	4 202
From two to five years	3 753	2 535
Over five years	2 227	1 674
Total operating lease commitments	18 372	12 277

The accompanying notes form part of these financial statements.

SCHEDULE OF CONTINGENCIES

As at 30 June 1999

	1999 \$'000	1998 \$'000
Contingent losses		
Estimated legal claims arising from employment, motor vehicle accidents and contractual disputes. These matters are being fully defended.	2 105	700
Estimated cost of clean up of asbestos and chemical contaminations of sites at Lindfield and Samford should CSIRO decide to sell the land.	2 000 4 105	— 700
Contingent gains		
Legal claims expected to succeed from recovery of debts.	(259)	(259)
	3 846	441

SCHEDULE OF UNQUANTIFIABLE CONTINGENCIES

As at 30 June 1999

The Commonwealth of Australia and CSIRO are defendants in legal proceedings brought by three plaintiffs in relation to the escape of Rabbit Calicivirus Disease in 1995. The defendants have denied legal liability and will respond to the legal proceedings accordingly. At this stage, there is insufficient information to assess CSIRO's potential financial exposure to such claims.

CSIRO is the defendant in legal proceedings brought by Charter Pacific Corporation Limited in relation to the exploitation of CSIRO's Exelgram technology and a Deed of Settlement entered into between the parties in September 1994. The proceedings are being vigorously contested by CSIRO and CSIRO has filed a counter claim against Charter Pacific Corporation Limited.

Preliminary investigation by the CSIRO Environmental Management Committee identified a range of potential environmental risks associated with storage of low level radioactive waste at Woomera, SA, and low level contamination of a number of sites with asbestos or other hazardous substances. The costs associated with the clean up of these sites have not been quantified.

The accompanying notes form part of these financial statements

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION
NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS
For the year ended 30 June 1999

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Note 1 Summary of significant accounting policies

1.1 Basis of Accounting

The financial statements are a general purpose financial report.

They have been prepared in accordance with Schedule 2 of the Orders issued by the Finance Minister under the *Commonwealth Authorities and Companies Act 1997*.

The financial statements have been prepared:

- in accordance with the Australian Accounting Standards, other authoritative pronouncements of the Accounting Standards Board (Accounting Guidance Releases) and the Consensus Views of Urgent Issues Group, and
- have regard to Statements of Accounting Concepts.

The financial statements have been prepared on an accrual basis and are in accordance with the historical cost convention, except for certain assets which, as noted, are at valuation. Except where stated, no allowance is made for the effect of changing prices on the results or on the financial position.

1.2 Rounding

Amounts are rounded to the nearest \$1 000 except in relation to:

- remuneration of Board Members;
- remuneration of Officers; and
- remuneration of auditors.

1.3 Consolidation

There is no consolidation of related entities in CSIRO's financial statements. CSIRO has provided in-kind contributions to these related entities, Biomolecular Research Institute Limited and Ceramic Fuel Cells Limited. These contributions have been accounted for in CSIRO's Operating Statement and disclosed in Note 22.

1.4 Taxation

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

1.5 Foreign Currency Transactions

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

Hedging is undertaken in order to avoid or minimise possible adverse financial effects of movements in exchange rates. Where a purchase or sale is specifically hedged, exchange differences arising up to the date of purchase or sale, and costs, premiums and discounts relative to the hedging transaction, are included with the measurement of purchase or sale.

1.6 Insurance

As part of its risk management strategy, CSIRO has in place insurance cover with the Commonwealth Government's Managed Fund (Comcover), for a range of risks including industrial special risks, professional indemnity, public and product liability, directors and officers liability/company reimbursement, travel and motor vehicles. The insurance cover is designed to protect CSIRO from catastrophic losses. Deductibles on the above insurances are up to \$600 000.

1.7 Revenue Recognition

Parliamentary appropriation revenue is recognised at the time CSIRO becomes entitled to receive the revenue.

Revenue from contract research activities is recognised by reference to the stage of completion of contracts. The stage of completion is determined according to the costs incurred to date after taking into account the total contract values and the estimated total costs. The balances of contract research activities in progress are accounted as either contract research work in progress (Note 19) or contract research revenue received in advance (Note 11) in the Statement of Assets and Liabilities. Where necessary, a surplus or deficit is recognised progressively for each research activity.

Revenue from sale of goods and other services is recognised upon delivery of goods and services performed.

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.

Resources received free of charge are recognised as revenues and expenses in the Operating Statement when received/used and their fair value can be reliably measured.

1.8 Inventories Held for Resale

Inventories held represent books, CD-ROMs and videos. They are held for resale and valued at the lower of cost and net realisable value in accordance with AAS2 on Inventories.

1.9 Consumable Stores

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

1.10 Leases

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

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

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

1.11 Bad and Doubtful Debts

Bad debts are written off in the year in which they are identified. A provision is raised for doubtful debts based on a review of all outstanding receivables at year end.

1.12 Investments

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

Investments in associate companies which operate in R&D and high technology industries are carried at lower of cost or Board valuation, and not in excess of the recoverable amount. They are not material and CSIRO has, in accordance with Australian Accounting Standards AAS14, elected not to account for them using the equity method. An associate is an entity in which CSIRO exercises significant influence but not control.

1.13 Research and Development Expenditure and Intellectual Property

All research and development costs, including costs associated with protecting intellectual property (eg. patents and trademarks) are expensed as incurred, except where benefits are expected, beyond any reasonable doubt, to equal or exceed those costs. As at 30 June 1999 no research and development costs or intellectual property have been capitalised in the Statement of Assets and Liabilities.

1.14 Cooperative Research Centres

The activities attributable to the interests of CSIRO in Cooperative Research Centres have been expensed consistent with Note 1.13. CSIRO's interests in Cooperative Research Centres are disclosed in Note 27.

1.15 Property

The Finance Minister's Orders require property, plant and equipment to be revalued by 1 July 1999 and in accordance with the 'deprival' method of valuation as set out in the *Commonwealth Government Accounting Guidelines "A1. Asset Valuation"* and thereafter every three years.

All land, buildings and leasehold improvements were inspected, floor space of buildings remeasured, the remaining life reassessed and revalued in June 1999 using methods which comply with the *Guidelines*.

Land which will continue to be used for research activity was valued by CSIRO's registered valuer, Ross Stevens FAPI at "existing use value". Existing use contemplates the continued use of the asset for the same application as at the date of valuation, having regard to the asset's capacity to continue contributing to the value of the entity but ignoring alternative uses.

Land designated for possible sale was valued at market value by registered external valuers, Paul McBurnie FAPI(Val) and (Econ), and Malcolm Collins AAPI(Val).

Buildings and leasehold improvements, which will continue to be used for research activities, were valued at depreciated replacement cost using current building prices to arrive at current gross replacement cost less accumulated depreciation having regard to the age and condition.

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

1.16 Plant and Equipment

As required by the Finance Minister's Orders, all plant and equipment was revalued as at 1 July 1998 in accordance with the 'deprival' method of valuation and thereafter every three years.

The Australian Valuation Office conducted the valuation using the "deprival" method for plant and equipment with historical costs of \$75 000 and over. Other plant and equipment under that \$75 000 threshold was valued in house at their depreciated replacement cost. Any assets, which would not be replaced, or are surplus to requirements, were valued at net realisable value.

All plant and equipment acquired after the revaluation date is valued at historical cost. The capitalisation threshold limit is \$3 000. The \$3 000 threshold was selected because it facilitates efficient asset management and reporting without materially affecting asset values recognised. 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 the control and subsequent 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 24).

1.17 Depreciation and Amortisation

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

1.17 Depreciation and Amortisation (cont'd)

An annual review of the economic useful life or depreciation rates and method for plant and equipment was carried out in July 1998 and necessary adjustments recognised in the current and future reporting periods as appropriate.

Depreciation and amortisation rates applying to each class of depreciable assets are as follows:

• Building on freehold land	40 to 50 years
• Leasehold improvements	Lease term
• Passenger vehicles	5 years
• Agricultural and transport equipment	3 to 15 years
• Computing, scientific, workshop, furniture and office equipment	2 to 25 years
• Research Vessels	25 years
• Australia Telescope	12 to 45 years

The aggregate amount of depreciation and amortisation for the year is disclosed in Note 4(a). The change in depreciation rates and revaluation of plant and equipment on 1 July 1998 has increased depreciation charges and the operating deficit this year by \$5.4m.

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

1.18 Liability for Employee Entitlements

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

The provision for annual leave reflects the value of total annual leave entitlements of all employees at 30 June 1999 and is recognised at its nominal value.

The liability for long service leave is recognised and measured at the present value of the estimated future cash flows to be made in respect of all employees at 30 June 1999. In determining the present value of the liability, attrition rates and pay increases through promotion and inflation have been taken into account.

On 17 June 1998, CSIRO's Enterprise Agreement was certified. From that date, officers employed continuously on a term basis for more than one year will receive, on termination, a severance payment of one week's salary per completed six months' service. As at 30 June 1999, a provision for severance pay in respect of term staff was recognised at its nominal value.

1.19 Superannuation

CSIRO discharges its liability for indefinite employees' superannuation by contributing to the Commonwealth Superannuation (CSS) and the Public Sector (PSS) superannuation schemes, which provide retirement, death and disability benefits to employees. Contributions to the schemes are at rates calculated to cover existing and emerging obligations. Current contribution rates are 20% of salary (CSS) and 10.2% of salary (PSS). These contribution rates are determined by regular actuarial review. In addition a 3% employer productivity benefit is contributed for CSS and PSS members. For term employees who have chosen not to join CSS or PSS, a 7% employer productivity benefit is contributed to Australian Government Employees Superannuation Trust (AGEST) or other eligible superannuation funds.

1.20 Workers' Compensation

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

1.21 Cash

For the purpose of the Statement of Cash Flows, cash includes cash at bank and on hand, deposits at call, trust monies and R&D Syndication deposits under contract. They are readily convertible to cash.

1.22 Financial Instruments

Accounting policies and other matters in relation to financial instruments are disclosed in Note 32.

1.23 Joint Venture

CSIRO's 50% interest in the joint venture, Food Science Australia (FSA), has been accounted for in the financial statements using the equity method and in accordance with Australian Accounting Standard AAS19. Details of the joint venture and the effect of the change in the method of accounting for the joint venture in 1998/99 are disclosed in Note 4 and 21.

1.24 Contingencies

A material contingency, which has been quantified and not recognised as an expense or revenue, is disclosed in the Schedule of Contingencies unless the possible loss or gain is remote. Where a material contingency could not be reasonably quantified it is disclosed in the Schedule of Unquantifiable Contingencies.

1.25 Changes in Accounting Policies

Changes in accounting policy have been identified in this note under their appropriate headings.

1.26 Comparative Figures

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

Note 2 Economic dependency

CSIRO receives approximately two thirds of its funding from Commonwealth Parliamentary appropriations and it has no borrowing powers under its *Science and Industry Research Act 1949*.

Note 3 Segment reporting

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

	1999 \$'000	1998 \$'000
Note 4 (a) Operating expenses		
Goods and services expenses:		
Employee expenses		
Remuneration for services provided	413 887	405 431
Separation and redundancy	6 921	6 438
	420 808	411 869
Suppliers' expenses		
Supply of goods and services	242 181	221 969
Operating lease rental	5 324	2 938
	247 505	224 907
Depreciation and amortisation		
Depreciation and amortisation of property, plant and equipment	67 600	61 241
Amortisation of finance leased assets	592	548
	68 192	61 789
Net foreign exchange losses		
Non-speculative	-	202
Net losses from sale of assets		
Property, plant and equipment	4 779	751
	4 779	953

Note 4 (a) Operating expenses (cont'd)	Notes	1999 \$'000	1998 \$'000
Write-down of financial assets			
Receivable for goods and services		296	239
Investment – associate companies		1 769	829
		2 065	1 068
Interest and other expenses:			
Finance lease charges – current year		417	601
Finance lease charges – prior years' adjustment		–	1 207
Refit expense/(provision written back) for research vessels		(297)	158
		120	1 966
Abnormal item:			
Change in method of accounting for joint venture, Food Science Australia	21	4 253	–
Total operating expenses		747 722	702 552

Note 4 (b) Corporate activities – operating expenses

Corporate Business	1 839	2 040
Corporate Executive Office	6 795	6 443
Corporate Finance	2 408	2 156
Corporate Human Resources	4 320	4 212
Corporate Property	3 426	2 895
Corporate Training	1 516	1 164
Executive	7 384	6 771
Information Technology Services	8 828	7 687
MSS – LIPI Consultancy Project	3 354	2 116
Risk Assessment & Audit	1 316	1 251
Strategic Planning	364	430
Other	6 484	4 632
	48 034	41 797

Note 5 Other revenue from independent sources

Agriculture, Fisheries and Forestry – Australia's contribution to the operation of the Australian Animal Health Laboratory National Facility	6 129	6 090
Interest	1 701	2 154
Royalties and license fees	6 499	5 262
Sale of produce and livestock	7 714	4 735
Fees for provision of services	8 795	9 547
Rental proceeds	2 740	2 292
Net foreign exchange gains – non speculative	119	–
Net gains from sale of shares	5	66
Miscellaneous	1 634	428
Total other revenue from independent sources	35 336	30 574

Note 6 Revenue from Government	Notes	1999 \$'000	1998 \$'000
Parliamentary appropriations received:			
Appropriation Acts Nos. 1 and 3		447 345	439 433
Appropriation Acts Nos. 2 and 4		28 045	27 404
Total revenue from Government		475 390	466 837

Note 7 Revenue measure – payment to Government

In agreeing to CSIRO's appropriation budget for the current triennium (1997/98 to 1999/2000), the Government imposed a revenue measure requiring CSIRO to provide savings through efficiency gains, asset rationalisation and other measures totalling \$60m to be paid periodically to the Government over three years. As CSIRO had paid the full amount due by 30 June 1998 (\$30m) in 1997/98, no payment was made in 1998/99. The balance of the revenue measure would be paid in 1999/2000.

Note 8 Finance lease liabilities

Lease liabilities recognised in the Statement of Assets and Liabilities:

Current	738	296
Non-Current	19 066	19 238
Total finance lease liabilities	19 804	19 534

Finance lease liabilities at the reporting date and related finance charges are payable as follows:

Within one year	1 222	971
Within one to two years	1 230	992
Within two to five years	3 598	3 054
More than five years	17 821	22 725
	23 871	27 742
Service and maintenance charges	(1)	(1)
Minimum lease charges	23 870	27 741
Future finance charges	(4 066)	(8 207)
Total finance lease liabilities	19 804	19 534

Note 9 Liabilities to employees

Accrued wages and salaries		8 365	6 651
Provision for recreation leave	1.18	45 245	42 696
Provision for long service leave	1.18	90 698	89 680
Provision for severance pay	1.18	1 581	–
Total liabilities to employees		145 889	139 027

Note 10 Liabilities to suppliers

Trade creditors		25 839	18 112
Total liabilities to suppliers		25 839	18 112

Note 11 Other liabilities

Contract research revenue received in advance	1.7	32 404	37 624
R&D Syndicates – under contract	23	98 434	90 917
Other creditors		2 099	517
Total other liabilities		132 937	129 058

Note 12 Equity - movement summary 1998/99

Description	Accumulated Surpluses		Asset Revaluation Reserve		Total Equity	
	1999 \$'000	1998 \$'000	1999 \$'000	1998 \$'000	1999 \$'000	1998 \$'000
Balance as at 1 July	597 340	613 433	252 407	252 407	849 747	865 840
Surplus/(Deficit)	(19 380)	13 907	–	–	(19 380)	13 907
Revenue measure –						
payment to Government	–	(30 000)	–	–	–	(30 000)
Net revaluation increase	–	–	145 417	–	145 417	–
Balance as at 30 June	577 960	597 340	397 824	252 407	975 784	849 747

The net revaluation increase in the asset revaluation reserve comprises:

Revaluation increase/(decrease)		
– land	(1 741)	–
– buildings and leasehold improvements	54 132	–
– plant and equipment	93 026	–
	145 417	–

Note 13 Cash

	1999 \$'000	1998 \$'000
Cash at bank and on hand	37 065	14 770
Cash at bank – trust monies	16 296	13 096
Deposits – at call	250	176
Total cash	53 611	28 042

Note 14 Receivables

Goods and services	26 906	23 461
Provision for doubtful debts	(634)	(473)
	26 272	22 988
Property sales	520	15 722
Other	5 497	5 870
Total receivables	32 289	44 580

Receivables overdue by:

Less than 30 days	5 013	4 247
Between 30 and 60 days	1 503	1 229
Between 60 and 90 days	297	677
Greater than 90 days	858	1 066
Total receivables overdue	7 671	7 219

Note 15 Investments	Notes	1999 \$'000	1998 \$'000
R&D Syndicate deposits – under contract	23	98 283	90 767
Short term bank bills		–	2 539
		98 283	93 306
Shares – at valuation	% CSIRO interest		
Unlisted associate companies			
Dunlena Pty Ltd	47.0	5	5
Gene Shears Pty Ltd	50.0	580	580
Gropep Pty Ltd	34.4	545	101
Preston Group Ltd	34.0	1 984	784
X-Ray Technologies Pty Ltd	37.5	875	750
		3 989	2 220
Provision for diminution in value		(3 989)	(2 220)
		–	–
Shares – at cost			
Other companies			
Listed companies		989	928
Unlisted companies		8	8
Debentures and unsecured notes		–	3
		997	939
Total investments		99 280	94 245

CSIRO has shares in a listed company, Queensland Metals Corporation NL. As at 30 June 1999 the market value was \$962 793 (1998 \$1 352 239).

In addition, CSIRO has a 26.3% and 30.2% beneficial interest in unlisted R&D companies, PolyU Pty Ltd and Ceramic Fuel Cells Ltd respectively. Their valuation was less than \$1 000 and not listed above. These also have been fully provided for diminution in value.

Note 16 Land and buildings

Land

At cost	–	978
At June 1996 valuation	–	170 914
At June 1999 valuation	165 500	–
	165 500	171 892

Buildings

At cost	–	55 058
At June 1996 net valuation	–	564 239
At June 1999 gross valuation	1 233 425	–
	1 233 425	619 297
Accumulated depreciation	(603 960)	(46 113)
	629 465	573 184
Capital works in progress – at cost	8 347	10 488
	637 812	583 672

Leasehold improvements

At cost	–	4 263
At June 1996 net valuation	–	42 217
At June 1999 gross valuation	77 125	–
	77 125	46 480
Accumulated amortisation	(38 072)	(3 511)
	39 053	42 969

Note 16 Land and buildings (cont'd)

	1999 \$'000	1998 \$'000
Buildings under finance lease		
At June 1996 net valuation	–	20 052
At June 1999 gross valuation	20 827	–
	20 827	20 052
Accumulated amortisation	(3 265)	(1 063)
	17 562	18 989
Total land and buildings	859 927	817 522

Note 17 Plant and equipment

Plant and equipment		
At cost	46 991	409 188
At July 1998 gross valuation	473 027	–
	520 018	409 188
Accumulated depreciation	(294 955)	(259 271)
	225 063	149 917
Research vessels		
At cost	275	32 361
At July 1998 gross valuation	46 444	–
	46 719	32 361
Accumulated depreciation	(22 180)	(16 210)
Provision for refit	–	(560)
	24 539	15 591
Plant and equipment under finance lease		
At cost	904	108
At July 1998 gross valuation	100	–
	1 004	108
Accumulated amortisation	(45)	(19)
	959	89
Total plant and equipment	250 561	165 597

(a) Analysis of property, plant and equipment

Movement summary 1998/99 for all assets irrespective of valuation basis.

Description	Land \$'000	Buildings \$'000	Total Land & Buildings \$'000	Plant and Equipment \$'000	Total \$'000
Gross value as at 1.7.98	171 892	696 316	868 208	441 657	1 309 865
Additions	4 111	22 288	26 399	45 034	71 433
Revaluation increase/(decrease)	(1 742)	622 749	621 007	128 041	749 048
Disposals	(8 761)	(1 629)	(10 390)	(46 991)	(57 381)
Gross value as at 30.6.99	165 500	1 339 724	1 505 224	567 741	2 072 965
Accumulated depreciation/ amortisation as at 1.7.98	–	50 686	50 686	276 060	326 746
Depreciation/amortisation	–	26 013	26 013	42 179	68 192
Adjustment for revaluations	–	568 616	568 616	35 015	603 631
Adjustment for disposals	–	(18)	(18)	(36 074)	(36 092)
Accumulated depreciation/ amortisation as at 30.6.99	–	645 297	645 297	317 180	962 477
Net book value as at 30.6.99	165 500	694 427	859 927	250 561	1 110 488
Net book value as at 30.6.98	171 892	645 630	817 522	165 597	983 119

Note 17 Plant and equipment (cont'd)

(b) Total property, plant and equipment classified by title, specific uses and zoning

Description	Land \$'000	Buildings \$'000	Plant and Equipment \$'000	Total 1999 \$'000	Total 1998 \$'000
Freehold	141 270	569 705	–	710 975	485 733
Commonwealth Crown Leases	10 730	192 413	–	203 143	122 507
Leasehold	–	77 125	–	77 125	46 480
National Facilities	9 000	468 772	195 885	673 657	263 451
Deed of Grant	–	2 535	–	2 535	623
Finance Lease	4 500	20 827	1 004	26 331	21 952
Capital Works in Progress	–	8 347	–	8 347	10 488
	165 500	1 339 724	196 889	1 702 113	951 234
Plant and Equipment	–	–	370 852	370 852	358 631
	165 500	1 339 724	567 741	2 072 965	1 309 865
Accumulated depreciation/ amortisation	–	(645 297)	(317 180)	(962 477)	(326 746)
Total property, plant and equipment	165 500	694 427	250 561	1 110 488	983 119

Freehold	–	Held in Fee Simple - however, the majority of freehold properties are zoned "Public Purpose Commonwealth" which restricts sale potential.
Commonwealth Crown Leases	–	Represents ACT sites that are held on 99 year leases with a restricted purpose clause "Scientific Research Purposes".
Leasehold	–	Property covered by various lease arrangements with Universities, State Governments and other entities.
National Facilities	–	Represents Australian Animal Health Laboratory, Australia Telescope, National Measurement Laboratory and the Oceanographic Research Vessel <i>Franklin</i> managed by CSIRO on behalf of the Commonwealth (Note 17(c)).
Deed of Grant	–	Covers property that reverts to the State Government when vacated by CSIRO.
Finance Leases	–	Represents land and buildings subject to finance lease arrangements with State Governments.
Capital Works in Progress	–	Relates to building works currently under construction.

The specialised nature of CSIRO's buildings and the zoning restrictions on land use, and the consequent low levels of demand for such properties, mean that the market values of the properties may be significantly lower than the "existing use value" to CSIRO.

(c) National Facilities

The Australian Animal Health Laboratory (AAHL), the Australia Telescope (AT), the Oceanographic Research Vessel (ORV) *Franklin* and the National Measurement Laboratory (NML) have been established by the Commonwealth Government as National Facilities to satisfy an identified national research need. The term 'National Facility' denotes substantial instrumentation, equipment and costs of such magnitude that the expense can only be justified on the basis of shared use by researchers from several organisations. The primary criteria require that the facilities are specifically designated for national use and that they are made available to scientists according to the merit of their proposals. These facilities are controlled and administered by CSIRO on behalf of the Commonwealth Government.

Note 17 Plant and equipment (cont'd)

Details of National Facilities included in the above totals of Land and Buildings and Plant and Equipment are as follows:

	AAHL \$'000	AT \$'000	ORV Franklin \$'000	NML \$'000	Total \$'000
Land	9 000	–	–	–	9 000
Buildings	424 154	–	–	44 618	468 772
Accumulated depreciation	(177 750)	–	–	(19 892)	(197 642)
	246 404	–	–	24 726	271 130
Plant and equipment	8 830	149 284	29 445	8 326	195 885
Accumulated depreciation	(5 742)	(75 898)	(16 148)	(3 685)	(101 473)
	3 088	73 386	13 297	4 641	94 412
Net book value as at 30.6.99	258 492	73 386	13 297	29 367	374 542
Net book value as at 30.6.98	148 252	41 068	5 422	25 753	220 495

The operating expenses for the above named National Facilities for the financial year amounted to \$48 862 135 (1998 \$44 407 478) and they have been included in CSIRO's Operating Statement.

Note 18	Inventories held for resale	Notes	1999 \$'000	1998 \$'000
Books and media products – at lower of cost and net realisable value		1.8	549	695
Properties held for resale – at cost			–	181
Total inventories held for resale			549	876

Note 19	Other non-financial assets			
Prepaid property rentals			992	1 284
Other prepayments			95	1 265
Contract research work in progress – at cost		1.7	19 245	15 163
Total other non-financial assets			20 332	17 712

Note 20 Statement of cash flows - cash flow reconciliation

Net cost of services		(494 770)	(452 930)
Revenue from Government	6	475 390	466 837
Operating surplus/(deficit)		(19 380)	13 907
Depreciation and amortisation of property, plant and equipment	4	68 192	61 789
Increase/(decrease) in provision for refit	17	(560)	(190)
Increase/(decrease) in provision for diminution in value	15	1 769	829
(Profit)/loss on disposal of property, plant and equipment	4	4 779	751
(Profit)/loss on disposal of shares	5	(5)	(66)
(Increase)/decrease in receivables	14	(2 910)	(1 867)
(Increase)/decrease in inventories	18	146	(695)
(Increase)/decrease in other non-financial assets	19	(2 620)	(4 523)
Increase/(decrease) in employee liabilities	9	6 862	3 388
Increase/(decrease) in liability to suppliers	10	7 727	(3 921)
Increase/(decrease) in debt and other liabilities	8 & 11	7 349	262
Net cash provided by operating activities		71 349	69 664

Note 21 Joint venture

On 1 December 1997 CSIRO entered into a joint venture with a Victorian State Government agency, Australian Food Industry Science Centre (Afisc) to provide food industry clients with complete, integrated research, technical training and commercial product and process development services. The joint venture trades under the business name Food Science Australia (FSA) as an unincorporated joint venture.

In 1997/98 CSIRO's 50% interest in the assets, liabilities and operating results of the joint venture were based on FSA's unaudited financial statements for the period 1 December 1997 to 30 June 1998. However, the decision of the joint venturers, after the preparation of CSIRO's financial statements, to account the initial contributions as loans instead of revenue, resulted in the following abnormal adjustments to be made in 1998/99:

	1999 \$'000	1998 \$'000
Share of FSA's 1998/99 operating surplus/(deficit)	(1 047)	3 669
Reversal of share in FSA's 1997/98 operating surplus	(3 669)	-
Change in accounting treatment of CSIRO's net contribution to FSA as loan	1 470	-
Share of FSA's 1997/98 operating deficit as a result of a change in accounting treatment of CSIRO's initial net contribution	(1 007)	-
Abnormal item - Net gain/(loss) due to change in method of accounting for FSA	(4 253)	3 669*

During the year FSA made an operating deficit of \$2 095 693 (1998 \$2 013 312). In accordance with the joint venture agreement the operating deficit is shared equally between the joint venture parties.

* CSIRO share of FSA's 1997/98 operating surplus was not included as an abnormal item that year.

Note 22 Related entities (Note 1.3)

During the financial year CSIRO provided actual in-kind contributions in the form of scientific staff and research facilities totalling \$2 745 459 (1998 \$3 136 159) to Biomolecular Research Institute Limited (BRI) and \$1 410 622 (1998 \$1 866 737) to Ceramic Fuel Cells Limited. The contributions were in accordance with formal agreements between CSIRO and the related entities and have been accounted for as expenses in CSIRO's Operating Statement.

Ceramic Fuel Cells Limited's (CFC) principal activity is the research and development of ceramic fuel cell technology. During 1998/99 CFC was restructured from a company limited by guarantee to a company limited by shares. CSIRO was allocated 32.2% beneficial interest in the company's issued shareholdings that reflects its total in-kind contributions of \$14.1m to June 1999.

Biomolecular Research Institute Limited (BRI) is principally a research and development company involved in the development of pharmaceutical and biological products. It is a company limited by guarantee. As at 30 June 1999 CSIRO has a 40% beneficial interest in the company and its in-kind contributions to June 1999 amounted to \$28.5m.

Note 23 Research and Development Syndicates

CSIRO is a party to three agreements whereby the Research and Development Syndicates have purchased intellectual properties, with an option to sell back to CSIRO at a guaranteed price, and provided funds to CSIRO to undertake further research and development to advance the intellectual properties to commercialisation.

All research and development work is now complete. The balances of deposits (Note 15) are held as security to meet CSIRO's obligations (Note 11) to purchase the intellectual property held by each Syndicate, at the guaranteed option price, should the investors elect to sell.

Note 24 Resources made available to CSIRO and not included in the Statement of Assets and Liabilities

	Land \$'000	Buildings \$'000	Plant and equipment \$'000	Total \$'000
At valuation or cost	21 016	61 112	40 425	122 553
Accumulated depreciation	–	(36 213)	(36 447)	(72 660)
Net value as at 30.6.99	21 016	24 899	3 978	49 893
Net value as at 30.6.98	17 630	25 079	5 809	48 518

The above assets are made available to CSIRO at little or no cost in accordance with formal agreements with contributors. They have either been purchased out of contract research monies and expensed in the year of purchase in accordance with the accounting policy Note 1.16, or made available to CSIRO at little or no cost.

These assets are controlled and accounted for in the contributors' books and any proceeds from their disposal are refundable to the contributors in accordance with formal agreements on equity share. The fair value of the in-kind contributions of these assets could not be reliably determined and therefore not brought to account in the Operating Statement. Although a valuable resource, these assets can be a constraint to management decision making in that they must be operated in accordance with the terms of their provision to CSIRO.

The major contributors of the above assets are The Woolmark Company and Meat and Livestock Australia Ltd.

Note 25 Monies held in trust

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

	1999 \$'000	1998 \$'000
Investments		
Commonwealth Bank of Australia	2 541	2 599
St George Bank	227	216
M F Cash Management Fund	713	875
Potter Warburg Cash Management Ltd	165	–
One Eleven Nominees Pty Ltd	347	–
Members Australia Credit Union Ltd	531	–
	4 524	3 690
Cash at bank	261	132
	4 785	3 822
(a) The components of trust funds are as follows:		
William McIlrath Trust Fund	214	235
David Rivett Memorial Lecture Fund	105	100
FD McMaster Bequest	2 354	2 389
Sir Ian McLennan Achievement for Industry Award	107	100
The Ken and Yasuko Myer Plant Science Research Fund	962	998
The Elwood and Hannah Zimmerman Trust Fund	1 043	–
	4 785	3 822

William McIlrath Trust Fund	Established to appoint and fund postgraduate students in Animal Husbandry at the McMaster Laboratory, Prospect.
David Rivett Memorial Lecture Fund	Established to bring eminent overseas scientists to present the David Rivett Memorial Lecture.
FD McMaster Bequest	Established to award fellowships for research in agriculture or veterinary science in CSIRO Divisions.
Sir Ian McLennan Achievement for Industry Award	Established to award outstanding contributions by CSIRO scientists to national development.
The Ken and Yasuko Myer Plant Science Research Fund	Established to fund plant science research.
The Elwood and Hannah Zimmerman Research Trust Fund	Established to fund weevil research and the curation of the Australian National Insect Collection (ANIC) weevil collection.

Note 25 Monies held in trust (cont'd)

(b) Movements of trust funds summary

	Myer \$'000	McLennan \$'000	McMaster \$'000	McIlraith \$'000	Rivett \$'000	Zimmerman \$'000	Total 1999 \$'000	Total 1998 \$'000
Balance at 1 July	1 006	100	2 389	235	100	805	4 635	3 776
Receipts during year	-	-	-	-	-	252	252	-
Interest and dividends	111	7	115	10	5	36	284	351
Expenditure	(155)	-	(150)	(31)	-	(50)	(386)	(305)
Balance at 30 June	962	107	2 354	214	105	1 043	4 785	3 822

Note 26 Remuneration of auditors

	1999 \$	1998 \$
Remuneration to the Auditor-General for:		
Auditing the financial statements for the reporting period	205 000	225 000

The Auditor-General received no remuneration for other services during the reporting period.

Note 27 Cooperative Research Centres (CRCs)

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

During the financial year, CSIRO's total actual 'in kind' and cash contributions to CRCs amounted to \$110m. As the CRC agreements include a twelve month termination clause, this amount approximates CSIRO's forward commitment for 1999/2000.

At 30 June 1999, CSIRO is a participant in 53 CRCs and CSIRO's interest in each of the CRCs is determined by the individual CRC agreement. These are:

Names of Cooperative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
AGRICULTURE AND RURAL BASED MANUFACTURING	
Aquaculture	12
Cattle and Beef Industry (Meat Quality)	29
Food Industry Innovation	16
Hardwood Fibre and Paper Science	48
Legumes in Mediterranean Agriculture	18
Plant Science	64
Premium Quality Wool	42
Quality Wheat Products and Processes	24
Sustainable Cotton Production	28
Sustainable Production Forestry	32
Sustainable Rice Production	16
Sustainable Sugar Production	19
Tropical Pest Management	33
Tropical Plant Pathology	27
Viticulture	21

Names of Cooperative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
ENVIRONMENT	
Antarctica and the Southern Ocean	15
Biological Control of Vertebrate Pest Populations	65
Catchment Hydrology	29
Freshwater Ecology	16
Soil and Land Management	45
Southern Hemisphere Meteorology	27
Sustainable Development of Tropical Savannas	10
Tropical Rainforest Ecology and Management	38
Waste Management and Pollution Control	8
Water Quality and Treatment	13
Weed Management Systems	31
INFORMATION AND COMMUNICATION TECHNOLOGY	
Advanced Computational Systems	34
Australian Photonics	4
Distributed Systems Technology	3
Research Data Network	33
Satellite Systems	28
MANUFACTURING TECHNOLOGY	
Alloy and Solidification Technology	49
Industrial Plant Biopolymers	27
Intelligent Manufacturing Systems and Technologies	14
International Food Manufacture and Packaging Science	31
Materials Welding and Joining	49
Molecular Engineering and Technology:	
Sensing and Diagnostic Technologies	43
Polymers	28
MEDICAL SCIENCE AND TECHNOLOGY	
Cardiac Technology	22
Cellular Growth Factors	4
Diagnostic Technologies	18
Eye Research and Technology	21
Tissue Growth and Repair	24
Vaccine Technology	26
MINING AND ENERGY	
A J Parker CRC for Hydrometallurgy	50
Australian Geodynamics CRC	32
Australian Mineral Exploration Technologies	43
Australian Petroleum CRC	50
Black Coal Utilisation	14
G K Williams CRC for Extractive Metallurgy	56
Landscape Evolution and Mineral Exploration	44
Mining Technology and Equipment	19
New Technologies for Power Generation from Low Rank Coal	10

Note 28 Remuneration of Board Members

	1999 \$	1998 \$
Remuneration and superannuation benefits received or due and receivable by full-time and part-time Board Members were:		
Board Members' remuneration	461 778	451 784
Payments to superannuation funds for Board Members	61 466	59 629
	523 244	511 413

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

\$	1999 Number	1998 Number
Nil - 10 000	4	3
10 001 - 20 000	-	1
20 001 - 30 000	4	4
50 001 - 60 000	1	1
350 001 - 360 000	1	1

Note 29 Meetings of Board Members and Audit Committee

During the financial year, six Board Meetings and five Audit Committee Meetings were held. The number of meetings attended by each of the Board and Audit Committee members was as follows:

	Board Members' Meetings		Audit Committee Meetings	
	No. eligible to attend	No. attended	No. eligible to attend	No. attended
D C K Allen (Chairman)	6	6	5	4
A J Gandel (appointed 23/2/99)	2	2	-	-
R Higgins	6	5	-	-
D P Mercer	6	6	5	5
D F J McDonald (appointed 15/7/98)	6	6	-	-
M K McIntosh	6	6	5	2
M J O'Kane	6	4	-	-
A E de N Rogers	6	6	5	5
V R Sara (appointed 15/7/98)	6	4	-	-
E G C Tan (completed term 11/12/98)	3	2	-	-

The members of the Audit Committee are Mr D P Mercer (Chairman), Mr A E de N Rogers and Ms E Alexander (independent adviser and non Board Member). Ms E Alexander attended all Audit Committee meetings held for the year.

The Chairman of the Board is an ex officio member of the Audit Committee and the Chief Executive is invited to attend meetings of the Audit Committee.

Note 30 Remuneration of Officers

	1999 \$	1998 \$
Remuneration received or due and receivable by Officers	1 274 295	1 210 601

The number of Officers included in these figures is shown below in the relevant income bands:

\$	1999 Number	1998 Number
Nil - 100 000	2	-
180 001 - 190 000	-	1
200 001 - 210 000	-	2
210 001 - 220 000	2	-
230 001 - 240 000	1	-
240 001 - 250 000	1	-
260 001 - 270 000	-	1
350 001 - 360 000	1	1

The Officers' remuneration includes the Chief Executive and the Deputy Chief Executives concerned with, or taking part in, the management of CSIRO.

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

D C K Allen (Chairman)	M K McIntosh
A J Gandel	M J O’Kane
R Higgins	A E de N Rogers
D P Mercer	V R Sara
D F McDonald	E G C Tan

Remuneration – Information on remuneration of Board Members is disclosed in Note 28.

Board Members’ interests in contracts

Since 1 July 1998 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 28 by reason of a contract made by CSIRO with the Board Member or with a firm of which the Board Member is a member or with a company in which the Board Member has a substantial financial interest.

Other transactions of Board Members — related entities

Mr R Higgins is the Chief Executive Officer and Secretary of the Department of Industry, Science and Resources (DISR). During the financial year a number of grants and consultancy contracts were entered into between DISR, on behalf of the Commonwealth of Australia, and CSIRO. The contracts are based on normal terms and conditions for such arrangements. Mr R Higgins is also a Board Member of Austrade, Export Finance Insurance Corporation, Australian Industry Development Corporation, Australian Tourist Commission, Rossun Pty Ltd and the Australian Sports Commission. Transactions with these entities, if any, are based on normal terms and conditions.

Dr M K McIntosh was a Director of an associated company of CSIRO, Gene Shears Pty Ltd. It has a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions. Dr M K McIntosh resigned as a Director of Gene Shears Pty Ltd on 10 July 1998.

Mr D P Mercer is the Director of Orica Ltd, North Ltd and Australian Prudential Regulation Authority, Chairman of Australia Pacific Airports Ltd and Australian Information Economy Advisory Council, Chancellor of Royal Melbourne Institute of Technology (RMIT). RMIT is involved in a number of Cooperative Research Centres in which CSIRO is a participant. CSIRO’s transactions in the field of research and development with any of these entities are based on normal commercial terms and conditions.

Professor M J O’Kane is the Vice Chancellor of the University of Adelaide. There are transactions and other arrangements between CSIRO and the University of Adelaide. CSIRO has a number of buildings on the University campus, which are used by CSIRO for research and development. The University and CSIRO are partners in a number of Cooperative Research Centres. CSIRO is a tenant on various campuses of the University. In addition, Professor O’Kane is a Director of FH Faulding & Co Limited. This entity has a number of contractual relationships with CSIRO in the field of research and development based on normal commercial terms and conditions.

Mr A E de N Rogers is Chairman of Uniquest Limited, Chairman of Australian Institute of Marine Science, a Director of the Ports Corporation of Queensland and a member of the Senate of the University of Queensland. These entities have a number of contractual relationships with CSIRO in the field of research and development. The University of Queensland is also a participant in a number of Cooperative Research Centres in which CSIRO is a participant. All contracts are based on normal commercial terms and conditions.

Professor V R Sara is a Commonwealth Statutory Officer and a Chair of the Australian Research Council. She is also a member of the Prime Minister’s Science Council, Engineering and Innovation Council, the Anglo-Australian Telescope Board, the Korea-Australia Foundation Board, and several other Government Committees. The transactions with these entities, if any, are based on commercial terms and conditions.

(a) Terms, conditions and accounting policies			
Financial instrument <i>Financial assets</i>	Notes	Accounting policies and methods Financial assets are recognised when control over future economic benefits is established and the amount of the benefit can be reliably measured.	Nature of underlying instrument
Cash at bank and deposits at call	13	Cash at bank and deposits are recognised at their nominal amounts. Interest is credited to revenue as it accrues.	Balance of cash at bank is mainly from contract research monies received in advance and held in the Organisation's current bank account. Interest is earned on the daily balance at the prevailing daily 30-day bank bill rate less fees and is paid at month end. Deposits at call mainly relate to foreign currencies temporarily held for overseas operations. Interest is earned on the daily balance at the prevailing commercial bank interest rate for money on call and is paid at month end.
Cash at bank – trust monies	13	Cash at bank is recognised at its nominal amount. Interest is brought to account as it accrues.	Monies held in trust for third parties.
Receivables for goods and services and other receivables	14	These receivables are recognised at the nominal amounts due less any provision for doubtful debts. Provisions are made when collection of the debt is judged to be less rather than more likely.	Credit terms are net 30 days.
Receivables for property sales	14	These receivables are recognised at the nominal amount when contracts of sale have been executed.	All these receivables will be settled by 31 October 1999.
Short term bank bills	15	Bank bills are recognised at cost. Interest is accrued as it is earned.	In 1997/98 the bank bills matured between 30 to 90 days and earned an effective interest rate of 5% pa payable on maturity.
R&D Syndicate deposits – under contract	15	These deposits are recognised at their nominal amounts. Interest is brought to account as it accrues in accordance with R&D Syndicate agreements (Notes 11 and 23).	These deposits are held as security to meet CSIRO's obligations to buy back the intellectual property held by each syndicate, at the guaranteed option price should the investor elect to sell on or before the contracted date.
Listed and unlisted shares	15	These are carried at the lower of cost or recoverable amounts. No dividends have been declared or paid by the investee.	

(a) Terms, conditions and accounting policies

Financial instrument Financial liabilities	Notes	Accounting policies and methods Financial liabilities are recognised when a present obligation to another party is entered into and the amount of the liability can be reliably measured.	Nature of underlying instrument
Finance lease liabilities	8	Liabilities are recognised at the present value of the minimum lease payments at the beginning of the lease. The discount rates used are estimates of the interest rates implicit in the leases.	At reporting date, CSIRO had finance leases with terms averaging 17 years and a maximum term of 25 years. The interest rate implicit in the leases averaged 3.7% (1997/98: 5.1%). The lease liabilities are secured by the lease assets and disclosed in Notes 16 and 17.
Trade creditors and other creditors	10	Creditors and accruals are recognised at their nominal amounts, being the amounts at which the liabilities will be settled. Liabilities are recognised to the extent that the goods or services have been received (irrespective of having been invoiced).	Settlement is usually made net 30 days.
R&D Syndicate – under contract	11	These liabilities are recognised at their nominal amounts. Interest is brought to account as it accrues in accordance with R&D Syndicate agreements (Notes 11 and 23).	As above for R&D Syndicate deposits. They are held as security to meet CSIRO's obligations under the R&D Syndicate agreements, which can be exercised on or before the contracted date.
Research revenue received in advance	11	Revenue from contract research activities is recognised when work is performed. Revenue is deferred to the extent that CSIRO has not performed its contractual obligations as at 30 June 1999.	Research revenue received in advance is not recognised as revenue until work is performed.
Trust monies	11	As above in cash at bank – trust monies.	Being monies held in trust for third parties. They are payable on demand.

Note 32 Financial instruments (cont'd)**(b) Interest rate risk**

Financial Instrument	Notes	Floating Interest Rate		Fixed Interest Rate								Non Interest Bearing		Total		Weighted Average Effective Interest Rate	
		1999 \$'000	1998 \$'000	1 year or less	1 to 2 years	2 to 5 years	> 5 years	1999 \$'000	1998 \$'000	1999 \$'000	1998 \$'000	1999 \$'000	1998 \$'000	1999 \$'000	1998 \$'000	1999 %	1998 %
Financial Assets (recognised)																	
Cash at bank and cash on hand	13	37 065	14 770											37 065	14 770	4.6	4.8
Cash at bank – trust monies	13	16 296	13 096											16 296	13 096	4.6	4.8
Deposits – at call	13	250	176											250	176	4.6	4.9
Short term bank bills	15	–	2 539											–	2 539	–	5.0
Receivables for goods and services	14											26 272	22 988	26 272	22 988	n/a	n/a
Receivables for property sales	14											520	15 722	520	15 722	n/a	n/a
Other receivables	14											5 497	5 870	5 497	5 870	n/a	n/a
R&D Syndicate deposits	15									81 283	73 767	17 000	17 000	98 283	90 767	9.8	9.8
Shares	15											997	939	997	939	n/a	n/a
Total financial assets (recognised)		53 611	30 581							81 283	73 767	50 286	62 519	185 180	166 867		
Total Assets														1 316 549	1 168 574		
Financial liabilities (recognised)																	
Finance lease liabilities	8			13 901	14 264			5 903	5 270					19 804	19 534	3.7	5.1
Trade creditors	10											25 839	18 112	25 839	18 112	n/a	n/a
Research revenue received in advance	11											32 404	37 624	32 404	37 624	n/a	n/a
R&D syndicates – under contract	11									81 284	73 767	17 150	17 150	98 434	90 917	9.8	9.8
Trust monies	11	16 296	13 096											16 296	13 096	4.6	4.8
Other creditors	11											2 099	517	2 099	517	n/a	n/a
Total financial liabilities (recognised)		16 296	13 096	13 901	14 264			5 903	5 270	81 284	73 767	77 492	73 403	194 876	179 800		
Total Liabilities														340 765	318 827		
Legal claims												2 105	700	2 105	700	n/a	n/a
Total financial liabilities (unrecognised)												2 105	700	2 105	700		

(c) Net fair values of financial assets and liabilities

		1999		1998	
	Notes	Total carrying amount \$'000	Aggregate net fair value \$'000	Total carrying amount \$'000	Aggregate net fair value \$'000
Financial assets					
Cash at bank and on hand	13	37 065	37 065	14 770	14 770
Cash at bank – trust monies	13	16 296	16 296	13 096	13 096
Deposits at call	13	250	250	176	176
Short term bank bills	15	–	–	2 539	2 539
Receivables for goods and services	14	26 272	26 272	22 988	22 988
Receivables for property sales	14	520	520	15 722	15 722
Other receivables	14	5 497	5 497	5 870	5 870
R&D Syndicate deposits – under contract	15	98 283	98 283	90 767	90 767
Shares	15	997	971	939	1 360
		185 180	185 154	166 867	167 288
Financial liabilities (recognised)					
Finance lease liabilities	8	19 804	19 804	19 534	19 534
Trade creditors	10	25 839	25 839	18 112	18 112
Research revenue received in advance	11	32 404	32 404	37 624	37 624
R&D Syndicate – under contract	11	98 434	98 434	90 917	90 917
Trust monies	11	16 296	16 296	13 096	13 096
Other creditors	11	2 099	2 099	517	517
		194 876	194 876	179 800	179 800
Financial liabilities (unrecognised)					
Legal claims	Schedule of Contingencies	2 105	2 105	700	700

Financial assets

The net fair values of cash, deposits at call, short term bank bills, trade debtors for sale of properties, goods and services and R&D syndicate deposits approximate their carrying amounts.

The net fair values for listed equity investments is the quoted market price at reporting date, adjusted for the transaction costs necessary for realisation.

The net fair values for unlisted equity investments in associated companies have been assessed by the Board Members based on the underlying business of the investees in R&D and high technology industries.

Other than for listed financial assets, none of the classes of financial assets are readily traded on organised markets in standardised form.

Financial liabilities

The net fair values of finance leases are based on discounted cash flows using current interest rates for liabilities with similar risk profiles.

The net fair values for trade creditors, contract monies received in advance, R&D syndicate under contract and trust monies are approximated by their carrying amounts.

(d) Credit risk exposures

CSIRO's maximum exposures to credit risk at reporting date in relation to each class of recognised financial assets is the carrying amount of those assets as indicated in the Statement of Assets and Liabilities.

The economic entity has no significant exposures to any concentrations of credit risk.

APPENDIX 1. STATUTORY REPORTING REQUIREMENTS

Commonwealth Authorities and Companies Act 1997

The *Commonwealth Authorities and Companies Act 1997* (Cth) (the 'CAC Act') imposes core reporting requirements on Commonwealth authorities.

It replaces Part XI of the Audit Act 1901 (Cth) under which CSIRO previously had reporting obligations and can be found on the Internet at http://www.austlii.edu.au/au/legis/cth/consol_act/caaca1997387/

Section 9 of the CAC Act requires directors of a Commonwealth Authority to prepare an annual report in accordance with Schedule 1 of the CAC Act for each financial year and give this to the responsible Minister by 15 October each year (unless another date is approved). Schedule 1 of the CAC Act requires the annual report of a Commonwealth Authority to contain:

1. a report of operations prepared in accordance with the *Commonwealth Authorities and Companies Order 1998* (otherwise known as the Finance Ministers Orders or FMOs).
2. financial statements prepared in accordance with the FMOs which give a true and fair view of the matters dealt with in the Orders; and
3. a report by the Auditor-General's Report on those financial statements in which the Auditor-General must provide his opinion as to whether the financial statements have been prepared in accordance with the FMOs and give a true and fair view of the matters required by those Orders.

The FMOs are located at http://www.dofa.gov.au/pubs/fmab/fmos_cacs.pdf

1. Report of Operations

The Board Members of CSIRO are also responsible under s. 9 of the CAC Act for the preparation and content of the report of operations in accordance with FMOs. Schedule 1 of the FMOs specifies the requirements for the report of operations required to be prepared. The report of operations must include:

Reporting Requirements under Schedule 1, FMOs	Page
Resolution of report of operations by Directors (that is, Board Members).	2
State CSIRO's enabling legislation and CSIRO's objectives and function as set out in that legislation, and include the name of CSIRO's Minister(s) during the relevant reporting period, including the current Minister.	8-10
Outline the organisational structure and location of major activities and functions.	15-29
Review operations and future prospects.	30-88

Provide particulars of judicial decisions or reviews by outside bodies which may have a significant impact on the operations of CSIRO.	NA
Report on the effects of Ministerial directions or general policies of the Government by the Minister, and any reason for non-compliance.	NA
Details of Board Members, number of Board meetings and attendance record.	15-16 113
Details of the Audit Committee, number of Audit Committee meetings and attendance record.	12-14 113
Details of indemnities and insurance for officers.	100
Include any other matters required to be included in the Annual Report by the <i>Science and Industry Research Act 1949 (SIR Act)</i> or other legislation.	See below

Section 51 *SIR Act* specifies that the Annual Report must set out the following:Reporting Requirements under the *SIR Act*

Page

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.	4-7 39-87
A description of any developments in those policies that occurred during the year.	4-7 39-87
Any determination made by the Minister during the year which deal with a specific function of the Organisation to carry out scientific research for reasons other than those listed in s. 9(1)(a)(i) - (iii) <i>SIR Act</i> .	10
Any written direction or guideline given by the Minister to the Board dealing with the functions and powers of the Board.	10

2. Financial Statements

The *Commonwealth Authorities and Companies Orders (Amendment) 1998* amends the FMOs by inserting a new Order 5. Order 5 provides:

Schedule 2 of these Orders specifies the requirements for the financial statements required to be prepared by the directors of a Commonwealth Authority and included in its annual report under clause 1 of Schedule 1 of the CAC Act.

The amendment to the FMOs is located at:

http://www.dofa.gov.au/pubs/finstate/commonwealth_authorities_and_companies.pdf

The *Guidelines for the Forms of Financial Statements for Commonwealth Authorities* was released by the Commonwealth in July 1998, and sets out the format to be adopted for each of the above statements. These guidelines are located at: http://www.dofa.gov.au/pubs/finstate/cac_guidelines.pdf

Schedule 2 requires the following information to be included in CSIRO's financial statements:

Reporting Requirements under Schedule 2, FMOs	Page
Statement of financial position	90-118
Operating statement	91
Statement of assets and liabilities	92
Statement of cashflows	93
Schedule of commitments	94
Schedule of contingencies	95

3. Auditor-General's Report

The Auditor-General's Report on CSIRO's financial statements is on page 89.

Functions of the Organisation

(1) The functions of the Organisation are:

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

(2) The Organisation shall:

- (a) treat the functions referred to in paragraphs (1) (a) and (b) as its primary functions; and
- (b) treat the other functions referred to in sub-section (1) as its secondary functions.

Powers of the Organisation

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

- (a) arrange for scientific research or other work to be undertaken, on behalf of the Organisation, by any person or body;
- (b) join in the formation of a partnership or company;
- (c) make available to a person, on such conditions and on payment of such fees or royalties, or otherwise, as the Chief Executive determines, a discovery, invention or improvement to the property of the Organisation;
- (d) pay to officers, or to persons undertaking work on behalf of the Organisation, such bonuses as the Chief Executive, with the approval of the Minister, determines in respect of discoveries or inventions made by them; and
- (e) charge such fees, and agree to such conditions, as the Chief Executive determines for research and other services carried out or facilities made available by the Organisation at the request of any person.

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

(3) An approval under sub-section (2):

- (a) may be of general application or may relate to a particular company or proposed company; and
- (b) may be given subject to conditions or restrictions set out in the instrument of approval;

(4) Where the Organisation commences to hold a controlling interest in a company, the Minister shall:

- (a) cause to be prepared a statement setting out particulars of, and the reasons for, the holding of that controlling interest; and
- (b) cause a copy of the statement to be laid before each House of the Parliament within 15 sitting days of that House after:
 - (i) the Organisation commenced to hold that controlling interest; or
 - (ii) if the Minister is of the opinion that the disclosure of the holding of the controlling interest would affect adversely the commercial interests of the Organisation, the Minister ceases to be of that opinion.

- (5) Nothing is invalid on the ground that the Organisation has failed to comply with sub-section (2).
- (6) Where the Organisation holds a controlling interest in a company, the Organisation shall ensure that the company does not do any act or thing that, if done by the Organisation, would not be within the functions of the Organisation.

APPENDIX 3. LEGAL REQUIREMENTS

Freedom of information

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

In the year to 30 June 1999, CSIRO received 27 requests under the Act.

Section 8 Statement

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

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

CSIRO's function and powers

Refer to Appendix 2 of this Annual Report.

Consultative procedures

Valuable input from industry and other users and stakeholders into the identification of strategic research needs and the formulation of policy and administration is obtained through formal advisory and consultative committees as well through receipt of representations from industry, scientific and employee groups. Membership of Sector Advisory Committees is listed in Appendix 6.

Categories of documents

CSIRO holds the following categories of documents:

- (1) Corporate records: containing information of corporate and residual value such as financial management and administration, buildings and property, personnel and industrial relations and scientific and industrial research.
- (2) Work group records: these are records generated within a work group such as research records and materials created in the course of scientific and technical investigations including:
 - raw data;
 - project databases;
 - observational and experimental data; and
 - field and laboratory notebooks.

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

The following CSIRO documents are available for purchase by the public by contacting CSIRO, Limestone Avenue, Campbell, ACT 2602 or CSIRO Publishing 150 Oxford Street, Collingwood, VIC 3066: Scientific and technical publications including magazines, journals and books as well as CSIRO administrative manuals. A list of administrative manuals is available from the Freedom of Information (FOI) Coordinator.

Archives and disposal arrangements for documents

CSIRO maintains an archives collection in Canberra that has records dating from the establishment in 1926 of the Council for Science and Industrial Research, the original predecessor of CSIRO. Certain Australian Archives Regional Offices 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.

FOI procedures and initial contact points

A central Freedom of Information (FOI) Coordinator is responsible for the receipt of requests, identification of relevant CSIRO documents, consultation with CSIRO authors and officers, determining access to the documents and arranging internal review. Initial enquiries should be made to:

FOI Coordinator
CSIRO
Limestone Avenue
CAMPBELL ACT 2601

or

PO Box 225
DICKSON ACT 2602

Tel: (02) 6276 6123

In accordance with the *Freedom of Information Act 1982*, formal requests to CSIRO should be addressed to the Chief Executive of CSIRO.

Privacy

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

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

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

During 1998-99 the Privacy Commissioner did not undertake any investigations under s.36 of the *Privacy Act* 1988 in relation to CSIRO.

Privacy Procedures and Initial Contact Points

A central Privacy Coordinator manages CSIRO's privacy responsibilities.

Initial enquiries should be made to:

Privacy Coordinator
CSIRO
Limestone Avenue
CAMPBELL ACT 2601

or

PO Box 225
DICKSON ACT 2602
Tel: (02) 6276 6123

The Administrative Decisions (Judicial Review) Act

The *Administrative Decisions (Judicial Review) Act* 1977 ('AD(JR) Act') enables a person aggrieved by certain classes of administrative decisions or actions taken by Commonwealth agencies including CSIRO to challenge these decisions in the Federal Court.

Section 13 of the AD(JR) Act gives a person aggrieved by a decision the right to obtain a statement of the reasons for the decision. This right exists independently of the right to apply for a review of a decision.

The statement of reasons is to be in writing and is to set out the findings on material questions of fact, referring to the evidence or the material on which those findings were based and giving the reasons for the decision.

In the year to 30 June 1999, CSIRO received no requests for statements of reason under the AD(JR) Act.

APPENDIX 4. TRUST FUNDS

William McIlraith Fellowship Trust Fund

In 1996 Ms Jennifer MacDiarmid was appointed as a postgraduate student for three years to conduct research on cloning, gene expression and analysis of immune responses in sheep to excretory/secretory antigens from an important nematode parasite.

Excretory/secretory antigens from the larval stage of an important nematode parasite of sheep have been isolated and the genes encoding six of these antigens have been cloned using a novel, rapid cloning system. Ms MacDiarmid has also generated a novel ovine anti-immunoglobulin E (IgE) monoclonal antibody, which has been used to identify parasite antigens that elicit an IgE antibody response in sheep. Such antigens are currently thought to be critical for vaccine development. Amino acid and DNA sequence analysis has characterised the antigen genes, which are currently being cloned into an attenuated *Salmonella* delivery vector. In a pilot study sheep mounted a strong immune response to these parasite antigens.

Ms MacDiarmid is expected to submit her PhD thesis by late 1999.

Sir Ian McLennan Achievement for Industry Award

Established in 1985 the Sir Ian McLennan Achievement for Industry Award recognises outstanding contributions by CSIRO scientists and engineers to national development. The winning scientist/engineer 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.

This year's winner was Dr Mary Ann Augustin, of Food Science Australia (a joint venture between CSIRO and Afisc) (see p 83).

FD McMaster Bequest Trust Fund

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

From this fund, seven Fellowships were awarded in 1998-99, totalling \$123 000. They were given to support eminent overseas scientists selected to work for a period in CSIRO Divisions.

Four Research Fellowships and three Visiting Fellowships were awarded. For the former, the Fellow is actively involved in a CSIRO research project for three to twelve 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 Ken and Yasuko Myer Plant Science Research Fund

In June 1994 CSIRO Plant Industry received a bequest of \$1 million from the estate of the late Kenneth Myer to establish a trust fund for plant science research. The Board of Trustees established to manage the Fund includes representatives from the Myer Family, industry and CSIRO.

The Ken and Yasuko Myer Plant Science Research Fund supports postdoctoral fellowships within CSIRO Plant Industry. Current fellowships include research projects directed towards the natural production of indigo cotton using gene technology and innovative uses of lucerne to manage water and nutrients in cropping systems in wet landscapes. The Trustees have approved a new fellowship on genes to control flowering.

The David Rivett Memorial Fund

The David Rivett Memorial Fund was established in 1961 to commemorate the life and work of the late Sir David Rivett, formerly Chief Executive Officer and subsequently Chairman of CSIR. The Fund is used to finance a public lecture by a suitably distinguished overseas scientist on current and significant new research. No lecture was organised during 1998-99.

Science and Industry Endowment Fund

The Fund was established under the *Science and Industry Endowment Act 1926* with the Trustee of the Fund being the CSIRO Chief Executive. Applications to the fund were received from a range of sources and grants were approved totalling \$17 091.

Elwood and Hannah Zimmerman Research Fund Trust

The Trust was established in 1995 following a donation of \$400 000 from Elwood and Hannah Zimmerman. This initial donation has since been matched dollar for dollar by CSIRO. Elwood and Hannah Zimmerman also contribute around \$10 000 per year to the Trust. In addition, \$40 000 bequested to CSIRO from the Estate of the late Mr Alan Cox was made available to the Zimmerman Trust during the 1998-99 financial year; this contribution was also matched by CSIRO.

The Governors of the Australian National Insect Collection (ANIC) Fund, together with Dr Elwood Zimmerman, are the Trustees of the Elwood and Hannah Zimmerman Research Fund Trust.

During 1998-99 research on the systematics of the Australian weevils was conducted, relating directly to the completion of the remaining volumes of the series *Australian Weevils*, begun by Dr Zimmerman in 1991, and also involving other studies of the Australian weevil fauna. Some fieldwork was undertaken in northern Queensland and the Canberra and Bateman's Bay areas to collect weevils and information about their biology. The curation, re-sorting and re-labelling of the ANIC weevil collection was commenced, and numerous papers and reprints were added to the collection of weevil literature in the ANIC.

APPENDIX 5. CSIRO RESEARCH

During 1996-97 Sector Research Plans were developed for the 1997-98 to 1999-2000 funding triennium. The components of each Sector Plan are listed below.

AGRIBUSINESS

Field Crops

- High-Value Food Products
- Feed Grains and Industrial Raw Materials
- Gene Technologies for Breaking Yield Barriers
- Post-Harvest Technologies
- Genetic Engineering for Pest and Disease Management
- Integrated Biological Management Strategies
- Crop Water and Nutrient Use
- Strategic Cropping Options
- Sustainable Resource Management

Food Processing

- Biotechnology for Food Quality
- Food Ingredients
- Food Processing Technology
- Value-Added Processing for Meat Industries
- Cheese and Cultured Foods
- Packaging and Transport Technologies
- Basis of Consumer Food Preference
- Strategies to Ensure Food Safety
- Health Potential of Processed Food

Forestry, Wood and Paper Industries

- Industrial Plantations
- New Plantations (Farm Forestry)
- Native Forests
- Harvesting, Rooding and Transport
- Solid Wood
- Composites
- Pulp and Paper
- Recycling
- Furniture and Other Appearance Products

Horticulture

- Crop Improvement
- Crop Management
- Postharvest Quality
- Crop Protection
- Water, Nutrients and Sustainability

Meat, Dairy and Aquaculture

- National Animal Disease Advice and Control
- Animal Health and Trade
- Aquaculture
- Livestock Improvement
- Intensive Livestock - Pigs and Poultry
- Nutrition for Cattle and Sheep
- Pasture Improvement
- Pesticide Reduction and Parasite Control
- Sustainable Resource Management
- Biological Control
- Pre-Processing and Consumer Issues
- Dairy Production
- Manufactured Inputs
- Biometrics

Textiles, Clothing and Footwear

- Product Innovation
- Colouration and Finishing
- Fibre Structure and Function
- Topmaking and Spinning
- Wool Scouring and Environment
- Leather Research
- Quality Control and Instrumentation
- Parasite Control
- Wool Genetic Improvement
- Quality and Productivity Through Nutrition
- Resource Management for Wool Producers
- Market Access and Protection

ENVIRONMENT AND NATURAL RESOURCES

Biodiversity

- Knowing our Biodiversity
- The Functional Role of Biodiversity
- Using Biodiversity
- Sustainable Tourism
- Conserving and Monitoring Biodiversity
- Integrating Biodiversity with Resource Management
- Managing Environmental Pests, Weeds and Diseases

Climate and Atmosphere

- Air Quality
- Atmospheric Composition
- Climate Processes
- Climate Modelling
- Climate Impact

Land and Water

- Catchment Management, Assessment and Monitoring
- Sediment, Nutrient and Pollutant Transport in Catchments
- Surface Water Management
- Groundwater Management
- Land Resource Inventory and Evaluation
- Land Degradation Processes, Management and Restoration
- Land and Water Contamination
- Remediation
- Waste Utilisation
- Integrated Resource Use and Society

Marine

- Multi-Use of EEZ
- Marine Living Resources: Northern
- Marine Living Resources: Southern
- Marine Living Resources: International
- Conservation Management
- Products and Biotechnology
- Estuarine and Coastal
- ORV *Franklin*

INFORMATION TECHNOLOGY, INFRASTRUCTURE AND SERVICES

Built Environment

- Energy Conservation and Improved Indoor Air Quality
- Management and Re-Use of Urban Waters
- Water Treatment Processes
- Waste Minimisation and Recycling Technologies in Construction
- Condition Monitoring and Rehabilitation
- Construction Elements with Enhanced Service Lives
- Sustainable Use of Timber
- Performance Criteria for the Built Environment
- Advanced Construction Systems Delivery
- Infrastructure Optimisation
- Integrated Design Technologies
- Intelligent Transport Systems

Information Technology and Telecommunications

- Wireless Access
- Millimetre-Wave Communications
- Mobile Communications Networks
- Antennas
- Interactive Media System and Environments
- Spatial Information Infrastructures, Systems and Services
- Electronic Documents and Commerce
- Software Engineering Initiative
- Advanced Telecommunications Networks and Services

Measurement Standards

- National Measurement System
- Standards Research and Development
- International Metrology
- Asia-Pacific Activities

Radio Astronomy

- National Facility Operation

- Astrophysics
- Engineering Development

Services

- Health Services
- Security Systems
- Decision Support for Service Process Improvement
- Data Mining
- Imaging

MANUFACTURING

Chemicals and Plastics

- Polymers and Composites
- Engineered Packaging, Membranes and Inorganic Materials
- Specialty Designer Chemicals
- Crop Protection Products
- Chemical Processing, Cleaner Production and Disposal

Integrated Manufactured Products

- Light Metals - Automotive
- Shipbuilding and Aerospace
- Industrial Instruments
- Medical Instruments
- Scientific Instruments
- Electric Motors
- Forging and Casting
- Non-Ferrous Materials
- Joining Technologies
- Ceramics and Composites
- Automation
- Manufacturing Systems
- Micromanufacturing

Pharmaceuticals and Human Health

- Antivirals
- Cancer
- Cardiovascular Disease
- Diabetes
- Tissue Growth and Repair
- Generic Pharma Discovery
- Diagnostics
- Biomaterials

MINERALS AND ENERGY

Energy

- Coal Exploration and Mining
- Environmental Impacts of Mining
- Coal Preparation
- Clean Utilisation Technologies
- Fuel Cells and Gas
- Renewables and Energy Storage

Mineral Exploration and Mining

- Ore Deposit Formation
- Mineral Mapping Technologies
- Exploration Geology and Geochemistry in the Regolith
- Exploration Geophysics
- Mine-Scale Geophysics
- Mine Design and Operations
- Mining Equipment and Automation
- New Mining Methods
- Environmental Impacts of Mining
- Water Issues for Mining
- Occupational Health and Safety

Mineral Processing and Metal Production

- Alumina Production
- Non-Ferrous Mineral Processing
- Iron Ore Processing
- Industrial Minerals
- Base Metal Hydrometallurgy
- Light Metal Production
- Base Metal Pyrometallurgy
- Ferrous Metal Pyrometallurgy
- Precious Metal Processing
- Environment, Health and Safety Systems
- Process Design and Optimisation
- Process Mineralogy
- Materials and Equipment

Petroleum

- Environment and Safety
- Exploration and Appraisal
- Drilling and Completions
- Development and Production
- Facilities
- Coal Seam Methane
- Capability Gaps



APPENDIX 6. SECTOR ADVISORY COMMITTEES, AS AT 30 JUNE 1999

To ensure the continuing effectiveness of research and development for each Sector, CSIRO has appointed Sector Advisory Committees with members representing its stakeholders and customers. These Committees assist in the planning of research portfolios for each Sector, providing valuable information about the strategic research needs of industry and society. The Committees also help in the uptake of research results by industry.

AGRIBUSINESS

Field Crops Sector

Chairman

Mr Trevor Flugge
Chairman
Australian Wheat Board

Members

Mr Harry Bonanno
Chairman
Australian Cane Growers

Dr Tony Gregson
Consultant

Mr John Grellman
Board Member
Cotton Seed Distributors Ltd

Mr Mike Hedditch
Executive Director
Rice Growers Association
of Australia

Mr Chris Henderson
Farmer, seed producer, feed grain supplier

Dr Chris Hudson
Goodman Fielder Ltd

Professor John Lovett
Managing Director
Grains R&D Corporation

Professor Don Marshall
Dept of Crop Science
University of Sydney

Mr Doug Rathbone
Chief Executive Officer
Nufarm Pty Ltd

Mr Brendan Stewart
President
Grains Council of Australia

Food Processing Sector

Chairman

Mr Steve Marshall
Group Director Corporate Technology
Goodman Fielder Ltd

Members

Dr Geoff Annison
Scientific and Technical Director,
Australian Food Council

Dr Simon Brooke-Taylor
Program Manager
Australian & New Zealand Food Authority

Professor Ken Buckle
Dept Food Science & Technology
University of New
South Wales

Dr Paul Donnelly
Managing Director
Dairy R&D Corporation

Dr Alan Grant, Vice President
Technology Asia/Pacific
Kraft Foods Ltd

Dr Roger MacBean
R&D Technical Manager
QUF Industries Ltd

Dr Jan Mahoney, Program Manager
Agriculture Industries
Dept of Natural Resources, Vic

Mr Hans Sidler
General Manager, National Food Buying
Woolworths Supermarkets

Mr Dan Southee
Scientific Liaison Officer
Nestle Australia Ltd

Mr Peter Wallace
Chief Executive Officer
National Heart Foundation

Dr Peter White
Executive Director
Rural Industries Export
Development Unit
Queensland Dept of Primary Industries

Dr Robert Wotzak
Technical Development Director
Arnotts Biscuits Ltd

Forestry, Wood and Paper Industries Sector

Chairman

Mr Angus Pollock
General Manager
Forest Resources
Australian Paper

Members

Mr Ron Adams
Managing Director
Bunnings Forest Products

Dr Tony Flowers
Development Manager (Australia)
Fletcher Challenge Paper

Mr Allan Jamieson
Manager
North Eucalypt Technologies

Mr Peter Law
General Manager, Engineering
Boral Timber Industries Ltd

Mr Kevin Lyngcoln
Chief Executive Officer
Plywood Association of Australia

Mr Richard Rawson
Deputy Secretary, Operations
Dept of Natural Resources
& Environment, Vic

Mr Mark Thomas
Chief Executive
Greening Australia

Mr Peter Yuile
First Assistant Secretary
Forests Division
Dept of Agriculture, Forestry & Fisheries

Horticulture Sector

Chairman

Mr David Pullar
David Pullar & Associates

Members

Mr Laurence Ah Toy
Director
Koolpinyah Station Pty Ltd

Mr Tony Biggs
Director & Horticultural Consultant
Cardinal Horticultural Services Pty Ltd

Mr Phillip Laffer
Director of Viticulture & Winemaking
Orlando-Wyndham Pty Ltd

Mr Brian Newman
Executive Director
Ausveg Board

Mr Peter Pokorny
National Merchandising Manager,
Produce Woolworths Ltd

Mr Paul Ziebarth
Member
Queensland Fruit & Vegetable Growers
Board

Meat, Dairy and Aquaculture Sector

Chairman

Dr John Keniry
Chairman
Ridley Corporation Limited

Members

Dr Ted Christie
Barrister & Environmental Lawyer

Mr Gordon French
Queensland Dairy Farmers Organisation

Mr Robin Hart
Chairman
Kerwee Pastoral Company

Mr Pheroze Jungalwalla
Manager R&D Tassal Ltd

Ms Wendy Lapointe
Veterinarian & beef producer

Dr Gardner Murray
Consultant

Mr Michael O'Keeffe
Chief Manager, Agribusiness
Rabo Australia Ltd

Mr Ervin Vidor
Director & Chairman
Sea Farms Ltd

Mr Shane Walsh
Beef Producer

Mr Tony Wharton
Chief Executive Officer
Q-Meat

*Textiles, Clothing and
Footwear Sector*

Chairman

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Textile & Garment Consultant

Members

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Managing Director
COOGL Australia Pty Ltd

Mr Trevor Dawson
Managing Director
Rocklea Spinning Mills Pty Ltd

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Dept of Industry Science & Resources

Mr Guy Fitzhardinge
Livestock Producer
Thring Pastoral Company

Ms Margaret Moroney
Margaret Moroney Pty Ltd

Mr Lindsay Packer
Managing Director
Packer Tanning

Mr Colin Sleep
Portfolio Manager (Rural)
National Mutual Funds Management

Mr Brian van Rooyen
Managing Director
Australian Country Spinners

Mr Andrew Vizard
Veterinary Clinical Centre
University of Melbourne

Mr David Ward
Managing Director
Australian Wool Testing Authority Ltd

**ENVIRONMENT AND NATURAL
RESOURCES**

Biodiversity Sector

Chairman

Ms Robyn Kruk
Executive Director, Director General's Unit
NSW Premiers Department

Members

Dr Des Griffin
Consultant

Mr Stephen Hunter
Head - Biodiversity
Environment Australia

Mr Ian Kennedy
Director
Ian Kennedy and Associates

Professor Pauline Ladiges
Head, School of Botany
University of Melbourne

Dr Ray Nias
Director of Conservation
World Wide Fund for Nature

Professor Henry Nix
Centre for Resource & Environmental
Studies
Australian National University

Mr Graeme O'Neill
Freelance science writer

Climate and Atmosphere Sector

Chairman

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Manager Environmental Affairs
Santos Ltd

Members

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Executive Manager Greenhouse Policy Group
Environment Australia

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Director, Environmental Health
NSW Health Department

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Deputy Director (Research & Systems)
Bureau of Meteorology

Mr Mark McKenzie
Engineering & Environment
National Roads & Motorists Association

Mr Michael Rae
Program Leader, Resource Conservation
World Wide Fund for Nature

Dr Peter Scaife
Director, Centre for Sustainable Technology
University of Newcastle

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Principal Consultant
Taplin Ecoconsulting

Mr Frank van Schagen
Executive Director
Dept of Natural Resources, Qld

Land and Water Sector

Chairman

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Executive Director
Water Services Association

Members

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Chief Executive
Murray-Darling Basin Commission

Mr Andrew Campbell
Assistant Secretary, Sustainable Landscapes
Branch
Environment Australia

Mr Murray Chapman
General Manager
Indigenous Land Corporation

Mr John Corrigan
Chief Executive Officer
Dames and Moore

Dr Wendy Craik
Executive Director
National Farmers Federation

Mr Jock Douglas AO
Pastoralist

Mr Denis Flett
Chief Executive
Goulburn-Murray Water

Dr Phil Price
Executive Director
Land & Water Resources
R&D Corporation

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Chief Executive Officer
Agriculture WA

Ms Kathryn Tayles
General Manager Environmental Policy
Rio Tinto Ltd

Marine Sector

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Vice Chair, IUCN Commission on
National Parks and Protected Areas

Members

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Chairman
Environment Protection Authority WA

Mr Peter Cochrane
Deputy Executive Director
Australian Petroleum Production &
Exploration Association

Mr Ron Eagle
Deputy Director General
NSW Public Works

Ms Mary Harwood
Assistant Secretary, Parliamentary &
Communication Unit
Dept of Agriculture Forestry & Fisheries

Mr Ted Loveday
President
Queensland Commercial Fishermens
Organisation

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Professor of Environmental Science
James Cook University

Dr Peter O'Clery
Director
O'Clery & Associates

Dr Conall O'Connell
First Assistant Secretary, Marine Group
Environment Australia

Dr Russell Reichelt
Director
Australian Institute of Marine Studies

Dr Nicholas John Schofield
Program Manager, Water Resources,
Land & Water Resources
R&D Corporation

INFORMATION TECHNOLOGY, INFRASTRUCTURE AND SERVICES

Built Environment Sector

Chairman

Mr Alan Castleman
Chairman
Australian Unity

Members

Mr Richard Dinham
Managing Director
SJPH Design Partnership

Mr Alan Evans
First Assistant Secretary, Industry Division A
Dept of Industry, Science & Resources

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Government Property Office (WA)

Mr Vincent O'Rourke
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Queensland Rail

Dr Michael Sargent
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Transfield Power Systems

Mr Bill Service
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Saltcoats Consulting Pty Ltd

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General Manager
Boral Recycling Pty Ltd

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Roads & Traffic Authority (NSW)

Ms Yvonne von Hartel
Senior Partner
Robert Peck von Hartel Trethowan

Information Technology and Telecommunications Sector

Chairman

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Company Director
Ernst & Young

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Consultant
Allan & Buckeridge Pty Ltd

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Director Electronics Surveillance Research
Defence Scientific Technology Organisation

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Deputy Executive Director
Australian Information Industry Association

Mr John Kranenburg
Executive Director
Fujitsu Australia Ltd

Mr David Laidlaw
General Manager Solutions Development
ISSC Australia

Mr David Merson
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Mr Peter Rule
Director Strategic Development
Ericsson Australia Pty Ltd

Dr Ockert van Zyl
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Manufacturing
Siemens Ltd

Measurement Standards Sector

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Director
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Southern Pathology

Mr John Birch, AM
Executive Director
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Branch
Dept of Industry Science & Resources

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Australian Telecommunications Authority

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School of Physics
University of Sydney

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Gerard Industries Pty Ltd

Mr John Gilmour
Chief Executive
National Association of Testing Authorities
Australia

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General Manager
Australian Government Analytical
Laboratories

Mr John Hulbert
Executive Director
Joint Accreditation System of Australia and
New Zealand

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Principal Consultant Testing & Measurement
Testing & Certification Australia

Mr Chris Nesbitt-Hawes
Consultant

Sqd Ldr Bob Phillips
Department of Defence

Mr Ross Wraight
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Standards Australia

Radio Astronomy Sector

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Anglo-Australian Observatory

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European Southern Observatory, Germany

Dr Brian Boyle
Director
Anglo-Australian Observatory

Dr Dennis Cooper
Sector Coordinator
CSIRO Telecommunications & Industrial Physics

Dr Bob Frater AO
Deputy Chief Executive
CSIRO

Professor Paul Goldsmith
Director
Cornell University, USA

Professor Kwok-Yung Lo
Academia Sinica

Professor Peter McCulloch
Director, Physics Department
University of Tasmania

Professor Jeremy Mould
Director

Mount Stromlo & Siding Springs
Observatories

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News Ltd

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Officer in Charge
Australia Telescope National Facility

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University of New South Wales

Dr Rachel Webster
School of Physics
University of Melbourne

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Australian Coalition of Service Industries

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Services
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Managing Director
Logica

Mr Michael Mannington
Director
ID Tours

Mr Roger Nairn
National Australia Bank

Mr Peter O'Grady
Quality consultant

Dr John Primrose
Senior Medical Advisor, Pharmaceutical
Benefits
Dept of Health & Family Services

Mr Victor Skladnev
Managing Director
Polartech

Mr Seong Woh Choo
Head of Research
National Roads & Motorists Association

MANUFACTURING

Chemicals & Plastics Sector

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Orica Ltd

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Analchem Bioassay

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Avcare

Mr Leo Hyde
R&D Manager
Du Pont Australia Ltd

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Innovative Technology & Licensing Australia
(Chemicals)

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History & Philosophy of Science
University of Melbourne

Mr Doug Rathbone
Chief Executive Officer
Nufarm Pty Ltd

Dr Nicole Williams
Chief Executive Officer
Plastics & Chemicals Industries Association

Integrated Manufactured Products Sector

Chairman

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Company Director

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Dyneke Pty Ltd

Mr Frank Cunningham
Manager Business
Development
BHP Research Laboratories

Mr Keith Daniel
Chief Executive Officer
AMBRI Pty Ltd

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Industry Specialist - Defence & Aerospace
Dept of State Development, Victoria

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General Manager
ANI Engineering Technology Group

Mr Stuart Romm
Chief Executive
H.P.M. Industries Pty Ltd

Mr Antony Simpson
Company Director

Pharmaceuticals & Human Health Sector

Chairman

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Director
Baker Medical Research Institute

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Archer Consulting Group

Dr John Flack
Director
Pharmaceutical R&D
AMRAD Operations Pty Ltd

Professor Ian Gust
Director of Research & Development
CSL Ltd

Ms Patricia Kelly
Assistant Secretary, Purchasing,
Pharmaceutical & Environmental
Industries Branch
Dept of Industry, Science & Resources

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Foursight Associates Pty Ltd

Dr Hugh Niall
Chief Executive Officer
Biota Holdings Ltd

Dr Ian Pitman
Innovation Director
FH Faulding & Co Ltd

Mr Graham Thurston
Secretary
Australian Diagnostic Manufacturers
Association

Dr Denis Wade
Chairman & Managing Director
Johnson & Johnson Research Pty Ltd

Dr Des Williams,
Group Manager, Research and
Development
Sigma Pharmaceuticals Pty Ltd

Professor John Zalcborg
Director
Division of Haematology & Med Oncology
Peter MacCallum Cancer Institute

MINERALS AND ENERGY

Energy Sector

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Managing Director
Electricity Supply Association of Australia

Members

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Principal
Benchmark Economics

Mr Robin Bryant
General Manager, Energy Minerals Branch
Dept of Industry Science & Resources

Mr David Cain
General Manager
Energy Technology Technical Group
Rio Tinto

Dr Ted Campbell
Deputy Director General
Dept of Mines & Energy

Mr George Edwards
George Edwards Consulting Services Pty Ltd

Mr Philip Harrington
Executive Manager
Sustainable Energy Group
Australian Greenhouse Office

Mr Bruce Robertson
Consulting Mining Engineer
Shell Coal Australia Ltd

Dr John Sligar
Director
Sligar & Associates Pty Ltd

Mr Jack Taylor
Director Marketing
The Green Energy Corporation Ltd

Dr George Webb
Research Manager
Australian Gas Association

Dr John Zillman
Director
Bureau of Meteorology

Mineral Exploration & Mining Sector

Chairman

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Executive General Manager
WMC Resources Ltd

Members

Mr Alan Broome
Chairman
AUSTMINE-ACIRL

Mr Alan Castleman
Chairman
Australian Unity

Mr Mark Cutifani
Group Executive Mining
Normandy Ltd

Mr Dick Davies
Chief Executive Officer
Australian Mineral Industries Research
Association

Dr Geoff Dickie
Executive Director, Resource Development
Division
Dept of Mines & Energy, Qld

Mr Jeff Harris
Assistant Secretary
Dept of Agriculture Forestry & Fisheries

Dr Neil Phillips
General Manager Geology
Great Central Mines Ltd

Mr Lee Ranford
Director General
Dept of Mines & Energy WA

Dr Tom Whiting
General Manager Australia & South Asia
BHP Minerals Discovery

Mr Mark Woffenden
General Manager Mine Planning &
Technology
Hamersley Iron Pty Ltd

*Mineral Processing & Metal
Production Sector*

Chairman

Mr Dick Davies
Chief Executive Officer
Australian Mineral Industries Research
Association

Members

Mr Roy Ames
Consultant

Dr Robin Batterham
Vice President Research & Technology
Rio Tinto Ltd

Dr John Burgess
Corporate General Manager
BHP

Mr Craig Burns
General Manager
Minerals Development Branch
Dept of Industry Science & Resources

Mr John den Dryver
Executive General Manager Technical
Normandy Mining Limited

Dr Bruce Kelley
General Manager
Rio Tinto Technology Development

Mr Ian Lawrence
Lawrence Consultants Pty Ltd

Mr Malcolm Richmond
Managing Director, Development
Hamersley Iron Pty Ltd

Dr John Tilley
Assistant Secretary
Minerals Branch
Dept of Agriculture Forestry & Fisheries

Mr John Winckel
Executive General Manager
Metals Pasma Limited

Petroleum Sector

Chairman

Dr Agu Kantsler
General Manager
New Ventures
Woodside Offshore Petroleum Pty Ltd

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Agostini Consulting Pty Ltd

Mr Charles Balnaves
Group Manager Petroleum Engineering
BHP Petroleum Pty Ltd

Mr Peter Cochrane
Deputy Executive Director
Australian Petroleum Production &
Exploration Association

Mr Michael Frost
General Manager, Exploration
Santos Ltd

Dr Rodney Halyburton
Vice President
Special Projects
BHP Petroleum Pty Ltd

Mr John Hartwell
Head of Division
Dept of Industry Science & Resources

Mr John Hebbberger
Manager, Exploration & Earth Science
West Australian Petroleum Pty Ltd

Mr Doug Hodson
Well Construction Manager
Woodside Energy Ltd

Mr Leif Larsen
General Manager
Schlumberger Oilfield Australia Pty Ltd

Mr Rob Male
Alliance Contract Manager
Woodside Offshore Petroleum Pty Ltd

Mr Kees Van Gelder
Principal Development Engineer,
Technology,
Woodside Offshore Petroleum Pty Ltd

Dr Robert Willink
General Manager - Oil & Gas Exploration
Boral Energy Resources Ltd

APPENDIX 7. COOPERATIVE RESEARCH CENTRES PROGRAM

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

At 30 June 1999 CSIRO was involved in 53 of the 67 current CRCs. On that date five CRCs in which CSIRO took part completed their operation. They were Plant Science, Soil and Land Management, Tropical Pest Management, Cardiac Technology and the Research Data Network.

CSIRO took part in 21 of the 26 successful 6th round CRCs, which were announced on 16 April 1999 and which should begin operation in July and August 1999. Of these successful proposals, four were new and the rest were fresh applications from existing Centres.

COOPERATIVE RESEARCH CENTRES IN WHICH CSIRO IS A PARTICIPANT

MANUFACTURING TECHNOLOGY

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

INFORMATION AND COMMUNICATION TECHNOLOGY

- Advanced Computational Systems
- Australian Photonics
- Distributed Systems Technology
- Research Data Network
- Satellite Systems

MINING AND ENERGY

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

AGRICULTURE AND RURAL BASED MANUFACTURING

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

ENVIRONMENT

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

MEDICAL SCIENCE AND TECHNOLOGY

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

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