

CSIRO Annual Report 1997 - 1998



CSIRO

a n n u a l
r e p o r t

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*.

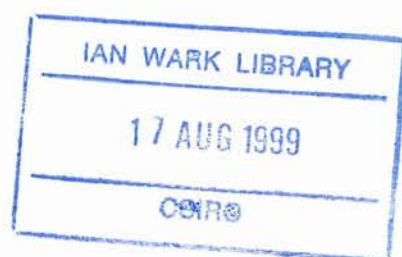
CSIRO's Vision

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



CSIRO

ANNUAL REPORT
1997-98



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MOLECULAR SCIENCE



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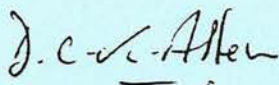
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The Honourable John Moore MP
Minister for Industry, Science & Tourism
Parliament House
CANBERRA ACT 2600

We have pleasure in submitting to you, for presentation to Parliament, the fiftieth Annual Report of the Commonwealth Scientific and Industrial Research Organisation.

We commend the Organisation's achievements to you.



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



Malcolm K McIntosh
(Chief Executive)

September 1998

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1 9 9 7 - 9 8 A T A G L A N C E

- Research highlights:
 - a major new undersea gold deposit was found in the Bismarck sea by an international team aboard the CSIRO research vessel *Franklin*;
 - an automated system for detecting road pavement cracks from a moving vehicle has completed field trials;
 - genes have been identified to enable plants to produce raw materials needed to make industrial chemicals and polymers;
 - a new vaccine has been developed to protect cattle from bovine respiratory disease (shipping fever);
 - one of the lightest magnesium car seat frames in the world has been developed in collaboration with an industry partner;
 - a new modelling technique has enabled CSIRO to pinpoint areas with the most potential for producing wind energy; and
 - the 3-D structure of part of the Insulin-like Growth Factor receptor protein has been determined for the first time.
- Commercialisation highlights:
 - OptimTM technology for producing thinner, longer and stronger wool fibres has been licensed to an Australian company;
 - Bioclip technology for the biological harvesting of wool is to be commercialised in late 1998;
 - a \$16 million ten-year licence agreement has been signed with a US company for the commercialisation of SICOR, a new process for bonding adhesives and paints to plastics;
 - the RACOD meter, for on-line measurement of biochemical oxygen demand in sewerage treatment works, has been licensed to two companies prior to an international launch;
 - grapeVINE software jointly developed by CSIRO and industry to manage information overload is to be included in a new product from Netscape Communications;
 - American Express has adopted CSIRO's Exelgram anti-counterfeiting technology for its new travellers cheques; and
 - CSIRO and Sigma Pharmaceuticals have commercialised a novel bowel health product that incorporates resistant starch.
- CSIRO Divisions and industrial partners enjoyed considerable commercial success at their first appearance in the Hannover Trade Fair.
- A new Enterprise Bargaining Agreement was ratified in June 1998, delivering a 10 per cent pay rise over three years in exchange for more flexible working arrangements.
- The first phase of a Project Support System was introduced to improve financial accounting, resource allocation and reporting.
- A staff survey revealed that CSIRO is a high performing organisation with staff having considerable satisfaction and pride in their work.

Research and commercialisation

This has been an exciting year for CSIRO research, with several outcomes of importance to Australia and of international significance.

In December 1997 newspapers around the world carried the story of the world's richest undersea gold strike in the Bismarck Sea off New Britain. The series of deposits was found by an international team aboard the CSIRO research vessel *Franklin*.

CSIRO has patented a process to improve the recovery of fine nickel particles from their ores.

A new modelling technique has enabled CSIRO to pinpoint areas with the most potential for producing wind energy.

Working with international colleagues, our scientists have found a way to enable crop plants to produce the raw materials needed to make industrial chemicals and polymers.

CSIRO and industry developed one of the lightest magnesium car-seat frames in the world.

CSIRO, through a CRC, has produced a continuous-wear contact lens.

The SICOR process has been developed to enable adhesives and paints to be bonded to plastics in a cheaper, more environmentally friendly process than the ones currently used.

An automated system for detecting road pavement cracks from a moving vehicle has completed field trials.

Software developed jointly by CSIRO and industry will form part of a new product from US Internet software giant Netscape.

Draft guidelines have been developed for the design and management of forest plantations irrigated by effluent.

After many years' research we have brought our biological wool harvesting technology to the market in the form of Bioclip technology.

A new vaccine has been developed to protect cattle from shipping fever, which can cause losses of \$50 million a year.

CSIRO scientists have developed national Indoor Air Quality Guidelines for the Sydney Olympics that aim to achieve world's best practice standard for all Games facilities.

Our research has had a significant impact on proposals to use management agreements to conserve native vegetation outside reserves.

International research collaboration has resulted in a better understanding of the sources and impacts of atmospheric haze over Australia and Asia.

CSIRO has provided research input into national projects to develop strategies for monitoring the state of the marine environment and for the sustainable management of several of Australia's major fisheries.

Scientific excellence

Our success in research and its adoption by users is founded on CSIRO's excellence in science and engineering. A citation survey carried out for us by the Australian National University, published in September 1997, clearly showed that CSIRO's scientific performance remains very high.

Our presence in the scientific literature has remained steady, and improved in areas where it is particularly strong (such as agricultural sciences, earth sciences, applied sciences, engineering and biotechnology) despite an overall decline in publication rates for Australia.

Looking to the future

To ensure that the Organisation continues to achieve success in relevant fields of science, the Executive has taken initiatives in funding a number of innovative projects.

In December 1997 we announced a series of special research and demonstration projects to be undertaken by multidisciplinary teams at CSIRO with the goal of building a better future for Australia. We called for the most imaginative and far-sighted proposals our scientists could come up with, and sought

the help of our Sector Advisory Committees in the process.

This produced a list of 41 projects, all of which were worth pursuing. From this list the CSIRO Executive selected the eight most promising, based on their scientific potential, the benefit to Australia and the ability to deliver results in a relatively short time.

More than \$20 million, generated from the sale of assets and internal savings, has been allocated to these projects, which include a new solar/fossil fuel hybrid energy system, a hybrid electric/petrol car, sustainable city water systems, feral pest control and leading-edge gene technologies. Several other projects from the list of 41 are also being pursued with other funding.

Management arrangements

Management arrangements to foster delivery of the best possible outcomes for Australia are also essential for CSIRO. A central feature in our research planning and prioritisation process is to focus on Sectors, with each of the 22 Sectors representing an industry group, market or natural resource of national significance.

Each Sector has a Sector Advisory Committee to provide external user input to assist with the identification of priority needs and opportunities. The Sector Advisory Committees are now well established and their advice gives CSIRO a good perspective of the priorities of the marketplace.

In all, we now have a more unified organisation with a stronger customer and stakeholder focus, striving to make a bigger impact for Australia's future well being.

The latest changes in our restructuring took place during the year with the creation of Food Science Australia.

Food Science Australia is one of several new relationships and structures CSIRO developed in order to adapt to the changing environment in which we operate and to respond to the needs of our customers and stakeholders. CSIRO's Division of Food Science and Technology and the Victorian Government's Australian Food Industry Science Centre (AFISC) at Werribee formed an unincorporated joint venture on 1 December 1997.

The joint venture brings together a range of complementary skills and assets, and has created an outstanding national network of laboratories and facilities to provide support to Australia's food industry and enhance its international competitiveness.

Raising awareness of CSIRO

Last year we mentioned a renewed focus on raising public awareness of what CSIRO does. Two major events during 1997-98 illustrate the emphasis we are placing on communication of our research, especially to industry.

In April 1998 CSIRO took part in the influential industry trade fair in Hannover, Germany. This was our first involvement in Hannover Messe, where over 7000 companies from all over the world exhibited, making it one of the premier international industry shows.

The CSIRO display brought together a number of Australian high technology companies and leading-edge CSIRO technologies. The exhibit received great attention and praise from key industry and government attendees, and a significant number of contracts have resulted for our industry partners.

We also took part in the inaugural National Science Week in May, when science organisations and media outlets around the country wrote and talked about and displayed scientific activities to the public. CSIRO activities included exhibitions, laboratory open days, an astronomy tour, and many radio interviews.

To help us plan our communication activities better, we conducted our first qualitative survey of public opinion and understanding of CSIRO and its activities, fleshing out earlier quantitative surveys. Interviews with members of the public and with key community and industry stakeholders revealed that they hold a generally high opinion of CSIRO, but that very few are aware of the range of our activities and they are keen to know more. We hope that activities such as Hannover and National Science Week, and other communication initiatives, will help fulfil this need.

Our staff

Clearly the success of CSIRO in all our activities depends on the quality and morale of our staff. Negotiations between staff and management to develop a new Enterprise Bargaining Agreement continued for most of the year. The final proposals were agreed to by a majority of staff in a ballot in June 1998 and will deliver a 10 per cent pay rise over the next three years, more flexible redundancy and disciplinary arrangements and a review of the current staff performance evaluation process.

We are pleased with the agreement that has been reached after protracted negotiations and believe it will enable us to attract and retain the best possible staff in all areas of our work.

The past few years have, in many different ways, been a time of change and uncertainty for many of our staff. We decided therefore to conduct a poll of staff opinions in early 1998 to measure any significant change since the last audit in 1987. The key findings of this new poll are that:

- When CSIRO is benchmarked against many other organisations we rank as a high performing organisation.
- Staff have very high levels of pride in their jobs and cohesiveness within immediate work teams.
- However, many staff are very strongly inwardly focused on their work and are unaware of the needs and opinions of our customers and stakeholders.
- Staff also showed significant but variable concerns about trust between project level and senior management.

CSIRO management is considering how best to deal with concerns raised by staff in the poll and, in particular, how to improve the two-way flow of communication within the Organisation.

Corporate governance

Phase One of our Project Support System was introduced in April 1998. This new system, a modification of our general ledger system, allows detailed cost attribution to projects to parallel our current allocations to Divisions. It will increase the effectiveness of our management and financial accounting by supporting better costing and pricing of all external contracts and internal resource allocation and help us comply with new government guidelines on competitive neutrality.

We are also well advanced with our preparations for dealing with the Year 2000 computer problem. Coordination of activities is being conducted at the Organisational level; each Division is undertaking appropriate detailed remedial action; and consultants from several external organisations have been engaged to assist us in both general and specialist technical areas.

On 1 January 1998 the new CAC (Commonwealth Authorities and Companies) legislation came into effect, with the objective of bringing the corporate governance practices of Government agencies such as CSIRO into line with developments in recent years in the private sector (particularly through the Corporations Law). This new legislation has required CSIRO, including the CSIRO Board, to develop and introduce a range of new arrangements to address the changed responsibilities and accountabilities of the new law.

During the year Mr Kevin Davern, Dr Max Richards and Professor Beth Woods completed their terms on the CSIRO Board and we thank them for their very valuable contributions to the Board's activities. We welcomed Mr Don Mercer to the Board in March 1998.



D Charles K Allen, AO
Chairman of the Board



Malcolm K McIntosh
Chief Executive

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 that 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.

CHARTER, FUNCTIONS AND POWERS

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

Functions

CSIRO's primary functions are:

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

Secondary functions include international scientific liaison, training of research workers, publication of research results, and

dissemination of information about science and technology.

Powers

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

In particular it may:

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

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

RESPONSIBLE MINISTER

From 1 July 1997 to 26 September 1997, the Minister responsible for CSIRO was the Honourable Peter McGauran, Minister for Science and Technology. The Honourable John Moore, Minister for Industry, Science and Tourism was responsible for CSIRO from 27 September 1997 to 30 June 1998.

Under the Act, the Minister has the power to:

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

The Ministers did not exercise any of these powers during 1997-98.

CORPORATE GOVERNANCE

Role of the CSIRO Board

The CSIRO Board was established under the *Science and Industry Research Legislation Amendment Act 1986 (the Act)*, which came into operation on 5 December 1986.

The functions of the Board are to:

- 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 new Commonwealth Authorities and Companies Act 1997 (the *CAC Act*), which was introduced on 1 January 1998, now requires the Board to comply with certain accountability and corporate governance principles including:

- the maintenance of an Audit Committee;
- specific financial and reporting provisions;
- disclosure of Directors' 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 *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. All matters considered and determined by the Audit

Committee are submitted to the Board for information and, where appropriate, ratification.

Board membership

Under the *Act*, the CSIRO Board comprises a part-time Chairman and up to eight other part-time members plus the full-time Chief Executive. Details of 1997-98 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.

Board Committee members' remuneration

Part-time members' remuneration and allowances are determined by the Remuneration Tribunal.

Board Committees

Audit Committee

The Audit Committee, a formal sub-committee of the Board, meets at least four times a year. As at 30 June 1998, the Audit Committee comprises 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 Risk Assessment and Audit, 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

Other sub-committees of the Board are established from time to time to address specific issues, such as the identification of a potential new Chief Executive; they are not permanent entities.

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.

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 1998. 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 and 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.

THE CSIRO BOARD (1997-98)



Chairman

Mr Charles Allen

AO MA MSc FTSE

Company Director

5 December 1996 –

14 December 2001



Mr Norbury Rogers

BCom FCA

Senior Consultant,

Ernst & Young

28 May 1997 –

31 December 2000

Members Current at 30 June 1998:



Dr Malcolm McIntosh

Kt, BSc PhD FTSE FRAeS

FIEAust CPEng

Chief Executive of CSIRO

3 January 1996 –

2 January 2001



Dr Eric Tan

AM MBBS FRACS FACS

Company Director

12 December 1995 –

11 December 1998

Terms completed during year:



Mr Russell Higgins

BEC(Hons)

Secretary, Department of
Industry, Science and Tourism

7 April 1997 – 30 June 2000



Mr Kevin Davern

Joint National Secretary
Finance Sector Union of
Australia

1 September 1994 – 31

August 1997



Mr Don Mercer

BSc(Hons) MA(Econ)

Company Director

4 March 1998 – 3 March 2003



Dr Max Richards

BSc PhD FAIMM

Chairman

Aberfoyle Limited

12 December 1995 –

11 December 1997



Professor Mary O'Kane

BSc PhD

Vice-Chancellor, University
of Adelaide

28 May 1997 –

31 December 2000



Professor Beth Woods

OAM BAgSc PhD

Professor of Agribusiness
University of Queensland,
Gatton

9 June 1995 – 8 June 1998

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).

CSIRO staff are employed under Section 32 of the *Science and Industry Research Act 1949*. At 30 June 1998 CSIRO had a total staff of 6600, which has an equivalent full-time value of 6287 units. The numbers employed in different job categories are shown below.

Staff by gender and principal functional area

	FEMALE	MALE	TOTAL
Administrative Support	653	243	896
Communication & Information	220	122	342
Corporate Management	6	49	55
General Services	86	80	166
Research Management	12	209	221
Research Projects	942	1675	2617
Research Scientist	161	1281	1442
Senior Specialist	1	25	26
Technical Services	138	697	835
TOTAL	2219	4381	6600

**CHART 1:
CORPORATE RESPONSIBILITIES AS AT 30 JUNE 1998**

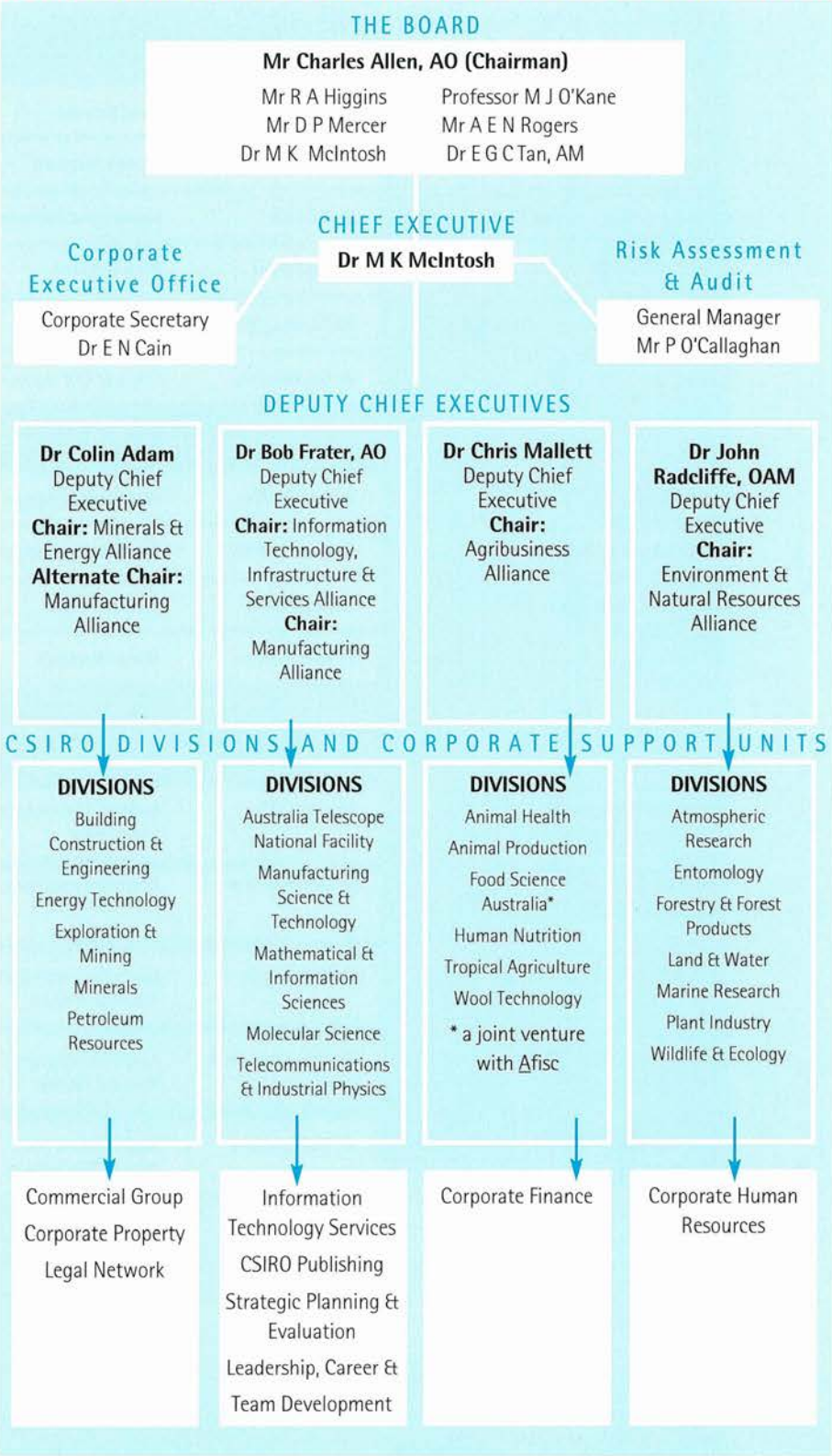


CHART 2: SECTOR RESPONSIBILITIES AS AT 30 JUNE 1998

	COORDINATOR	LOCATION
AGRIBUSINESS (DCE: Dr Chris Mallett)		
Field Crops	Dr Jim Peacock	Plant Industry
Food Processing	Professor Richard Head	Human Nutrition
Forestry, Wood and Paper Industries	Dr Glen Kile	Forestry and Forest Products
Horticulture	Dr Nigel Scott	Plant Industry
Meat, Dairy and Aquaculture	Mr Shaun Coffey	Tropical Agriculture
Wool and Textiles	Dr Ken Whiteley	Office of DCE Agribusiness
ENVIRONMENT AND NATURAL RESOURCES (DCE: Dr John Radcliffe)		
Biodiversity	Dr Brian Walker	Wildlife and Ecology
Climate and Atmosphere	Dr Brian Sawford	Atmospheric Research
Land and Water	Dr Roger Swift	Land and Water
Marine	Dr Nancy Bray	Marine Research
INFORMATION TECHNOLOGY, INFRASTRUCTURE AND SERVICES (DCE: Dr Bob Frater)		
Built Environment	Mr Larry Little	Building, Construction and Engineering
Information Technology and Telecommunications	Dr Dennis Cooper	Telecommunications and Industrial Physics
Measurement Standards	Dr Barry Inglis	Telecommunications and Industrial Physics
Radio Astronomy	Professor Ron Ekers	Australia Telescope National Facility
Services	Dr Ron Sandland	Mathematical and Information Sciences

SECTOR RESPONSIBILITIES AS AT 30 JUNE 1998

COORDINATOR LOCATION

MANUFACTURING (DCE: Dr Bob Frater)

Chemicals and Plastics

Dr Albert Mau

Molecular Science

Integrated Manufactured Products

Dr Ian Sare

Manufacturing Science
and Technology

Pharmaceuticals and Human Health

Dr Tom Spurling

Molecular Science

MINERALS AND ENERGY (DCE: Dr Colin Adam)

Energy

Dr John Wright

Energy Technology

Mineral Exploration and Mining

Dr John Read

Exploration and Mining

Mineral Processing and Metal Production

Dr Rod Hill

Minerals

Petroleum

Dr Adrian Williams

Petroleum Resources

CHART 3: OPERATIONAL ARRANGEMENTS

CSIRO OPERATIONS AND REPORTING Chief Executive - Dr Malcolm McIntosh												
ALLIANCES AND SECTORS												
	Agribusiness					Environment & Natural Resources			Information Technology Infrastructure & Services			
	Field Crops	Food Processing	Forestry, Wood & Paper Industries	Horticulture	Meat, Dairy & Aquaculture	Wool & Textiles	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	■				■	■	■	■	■			
Wool Technology						■						
Dr John Radeliffe												
Atmospheric Research								■				
Entomology	■		■	■	■		■	■	■		■	■
Forestry & Forest Products			■				■	■	■		■	
Land & Water	■		■	■	■	■	■	■	■	■		■
Marine Research					■		■	■	■			
Plant Industry	■	■	■	■	■	■	■	■			■	■
Wildlife & Ecology	■		■		■	■	■	■	■		■	■
Dr Bob Frater												
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												■

SENIOR STAFF AND ADDRESSES (AS AT 30 JUNE 1998)

CSIRO Corporate Centre—Canberra

PO Box 225, DICKSON, ACT 2602

Tel: (02) 6276 6766

Chief Executive

Dr Malcolm McIntosh

Deputy Chief Executives

Dr Colin Adam

Dr Bob Frater, AO

Dr Chris Mallett

Dr John Radcliffe, OAM

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

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Mr George Harley

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C O R P O R A T E D E V E L O P M E N T

EDUCATION PROGRAMS

During the year a new web page for CSIRO's Double Helix Science Club for schoolchildren was launched (www.csiro.au/helix). Funding was obtained from the Science and Technology Awareness program of the Department of Industry, Science and Tourism to establish Double Helix Science Drama groups around Australia, working through the original group in Tasmania. The Club merchandise program developed further with new activity kits, and with sales totalling \$150 000.

The Creativity in Science and Technology (CREST) project involving school students undertaking their own scientific research projects continued to develop. Over 3000 students achieved Awards in 1997. More than 100 schools were trained for the Global Learning and Observation to Benefit the Environment (GLOBE) international environmental monitoring program, bringing the total of participating schools to 176.

ENERGY SERVICES

The Energy Services Unit (previously the Energy Management Unit) was transferred from a Division to Corporate Property in April 1998. The objectives of the Unit were redefined in keeping with the Organisational and Government philosophy of energy usage and cost minimisation.

FINANCE

A financial strategy for the triennium was approved by the Executive and Board, and budgets were set at cost centre level for the three Key Performance Indicators of cash, operating result and capital expenditure.

In April 1998 CSIRO implemented Phase 1 of a Project Support System (PSS). Phase 1 delivers descriptive and financial reporting at the

project level, including direct costs, attribution of overheads and effort logging. The system will support better costing and pricing of external contracts, internal resource allocation and reporting.

HUMAN RESOURCES

The delivery of Human Resource Services to support CSIRO research was reviewed in 1997. As a result a range of strategies to develop a higher level of integration among Human Resource professionals in CSIRO is being pursued. These strategies are designed to provide overall unity of purpose and corporate compliance, while supporting the differing needs of operating Divisions. Another outcome of the review is that work has commenced on developing a process that will allow greater coherence between Scientific Planning and Human Resource Practices and Policy in CSIRO.

A new Enterprise Agreement was negotiated to address a number of long standing issues in CSIRO. This took advantage of the provisions of the *Work Place Relations Act* and saw extensive staff input to assist in resolving these issues. The new Agreement was certified on 17 June 1998 and will operate until 31 August 2000.

An Organisation-wide staff survey was conducted to identify areas of organisation improvement that employees thought needed to be addressed. While some areas have been identified for attention the overall result shows that CSIRO performs very highly when compared with other organisations that have used the same survey.

Equal Employment Opportunity (EEO)

1997-98 was the final year of CSIRO's three year Equal Employment Opportunity Program. The Program included a number of strategies aimed at increasing awareness and commitment to EEO issues as well as employment targets for the EEO target groups.

CSIRO's restructuring and the devolution of many corporate tasks to Divisions has slowed down the Program, but it is likely that CSIRO will go very close to achieving its target (12 per cent) for women research scientists and for the level of staff awareness of CSIRO's flexible work policies.

The 1998 Organisation-wide staff survey showed that in the last ten years there has been a reduction in the incidence of perceived race and gender discrimination and in various forms of harassment. In the same period there has been an increase in staff awareness of and access to flexible working arrangements.

INFORMATION TECHNOLOGY SERVICES

During the year, the Information Management function has introduced additional electronic information products and services to support CSIRO's work. The Records Management Unit has merged with Information Technology Services, resulting in the introduction of electronic document management procedures and increased advice to Divisions on electronic and scientific records as major priorities.

All CSIRO Divisions and units continue to be assisted with Year 2000 planning and monitoring activities. An intranet site, e-mail forum and network of Divisional coordinators have been set up to facilitate the efficient sharing of technical, legal and compliance information. CSIRO also communicates regularly with other Government agencies through the Office of Government Information Technology forums.

1998 has seen the release of the Project Support System (PSS), which provides a repository of information on projects across CSIRO available for project managers, Divisional management, corporate planning and decision making. The software was developed using Java on a client/server environment.

Upgrades to servers, voice and data networks remain a priority to meet the demands of both research and corporate systems. CSIRO site

networks will be further enhanced by a CSIRO-wide wiring upgrade project.

NATIONAL AWARENESS AND COMMUNICATION

Nine National Science Briefings were held in Parliament House in Canberra during the year on a variety of topics and arrangements have been made to extend the Briefings to some State Parliaments in the latter half of 1998.

Evaluations were made of print media coverage in 1997 and of public opinions about CSIRO; both studies showed CSIRO is held in high regard by the public.

In December 1997 the first edition of *Australia Advances*, CSIRO's new TV science series, was circulated to metropolitan and regional television networks. This consisted of eight segments covering a wide range of CSIRO research. A second series was produced in June 1998. The first edition of a national radio science show *The Sci Files* was produced and circulated to radio stations nation-wide in February 1998; monthly editions issued since then have proved extremely popular.

Corporate staff and CSIRO Divisions organised another successful showcase of manufacturing research, *Manufesto '97*, in September and took part in many events held in National Science Week in May 1998. CSIRO was guest exhibitor at the Australian National Field days in Orange, New South Wales. Participation by several Divisions and industry partners in the Hannover Fair, Germany, in April 1998 was such a success that plans are underway to repeat the exercise in 1999.

PROPERTY

The CSIRO Property Management Plan 2000 was developed and promulgated in 1997-98. The Plan outlines the general principles and strategies for the future management of CSIRO's property portfolio and accords with Organisational priorities.

Capital works worth \$30.5 million were completed at Black Mountain and Gungahlin

(Australian Capital Territory), North Ryde (New South Wales), Hobart (Tasmania), Clayton (two projects) (Victoria) and Floreat Park (Western Australia). Major projects are underway at Black Mountain and Gungahlin (Australian Capital Territory), Lindfield and North Ryde (New South Wales), Adelaide (South Australia), Hobart (Tasmania) and Werribee (Victoria).

The rationalisation of sites continued with the disposal of a number of properties worth a total of \$19.6 million. The long-term plan to develop Riverside Corporate Park at North Ryde (New South Wales) is proving successful with sales of \$39 million completed by June 1998 and further sales of \$12 million expected by December 1998. This underpins a projected redevelopment program of \$100 million, \$40 million of which will be completed by December 1998.

Joint CSIRO/State initiatives at the Queensland Centre for Advanced Technology in Brisbane and at Bentley, Western Australia are progressing.

RISK ASSESSMENT AND AUDIT

During 1997-98, eight Divisional risk assessments were updated and three information technology risk assessments were facilitated. In addition risk assessments completed at an Organisational level included occupational health and safety and environment, information technology security and asset management. Nine Divisional and three Organisation-wide audits were completed; the latter included redundancy processing, procurement practices and management of software licences.

SECURITY

During 1997-98 the Security Policy Implementation Program continued with the conduct of Security Reviews of Divisions covering protective, physical, personnel and administrative security practices. Strategies were developed to guide Divisions in meeting their security responsibilities.

SERVICE CHARTER

Work has begun on developing a Service Charter for the Organisation. This is due for completion by June 1999.

LATE NOTICE-FOOD SCIENCE AUSTRALIA

CSIRO has consolidated into its financial statements an unaudited financial statement of the joint venture, Food Science Australia (FSA). At the time of this Annual Report and subsequent to the finalisation of CSIRO's accounts, the FSA Board in consultation with the joint venture participants, is still considering options for reflecting in its accounts contributions made by participants. Depending on the treatment adopted by FSA, CSIRO might need to adjust its accounts in 1998-99. However, any adjustments will not have a material effect on CSIRO's accounts.

November 10 1998

INTRODUCTION

CSIRO completed its three-year trial of six performance indicators in 1996-97. Following an internal assessment and discussions with the Department of Industry, Science and Tourism, the six key indicators have been retained for the current funding triennium with minor modifications to some.

They are:

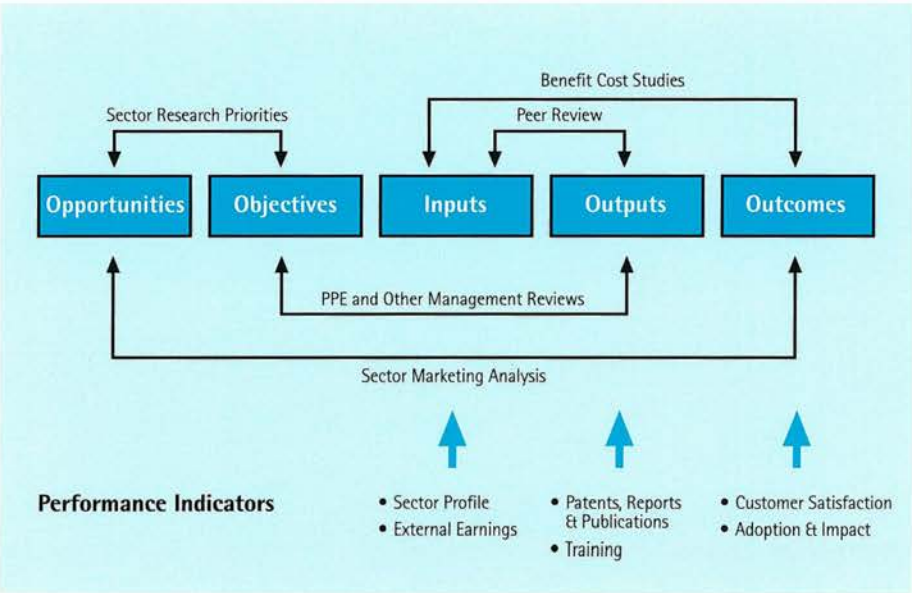
- Input Indicators – Sector Profile; External Earnings
- Output Indicators – Publications, Reports and Patents; Training
- Outcome Indicators – Customer Satisfaction; Adoption and Impact of Research and Advice.

The overall framework for their consideration has also been modified in line with the Government's move to an accrual-based output and outcome budget approach. See Figure 1.

The framework shows the relationship between the overall planning and evaluation processes in CSIRO and how the six key performance indicators are but part of a much richer evaluation culture in the Organisation—both in evaluating which opportunities CSIRO should pursue and the efficiency and effectiveness of what CSIRO does.

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, 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 for CSIRO's role in the national innovation system).

FIGURE 1 : CSIRO PLANNING AND EVALUATION FRAMEWORK



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 to access Australian and overseas technology, and fostering local and international scientific cooperation; and 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 shows CSIRO's shift of resources in line with changing priorities as determined in consultation with Government and CSIRO's customers in the public and private sectors.

CSIRO's investment decisions for 1997-98 were framed for the first time against a set of 22 customer-focused Sectors—rather than against the classification of socio-economic objectives (SEOs) in the Australian Standard Research Classification. Figure 2 compares CSIRO's actual expenditure on research for each Sector with the planned investment decisions published in the *CSIRO Strategic Research Plan 1997-98 to 1999-2000*.

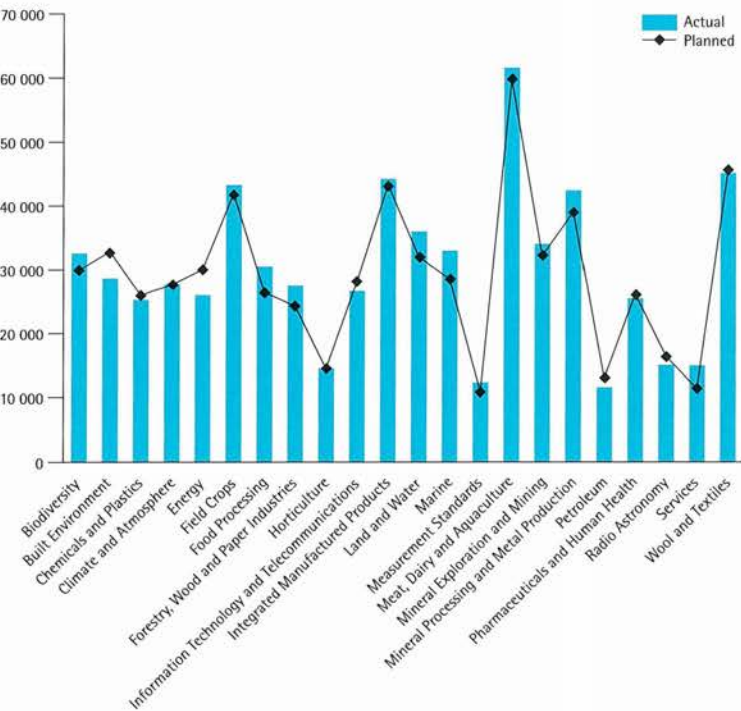
Figure 2 shows that the broad pattern of total expenditure for 22 Sectors in 1997-98 (sourced from Government appropriation and

external income) was in line with CSIRO's strategic investment decisions. Variances can be attributed to a number of factors:

- Economic and other circumstances, which affect the capacity of firms and agencies to undertake and/or commission research, and which affect CSIRO's external earnings in some sectors.
- Cash management decisions taken throughout the year. (Decisions on the use of cash reserves by Divisions were not explicitly factored into planned expenditure).
- The establishment of the Food Science Australia joint venture and the associated treatment of financial data.

The reasons for, and future implications of, the major variances will be analysed and considered as part of the lead up to the investment decisions for the next funding triennium.

FIGURE 2 : CSIRO EXPENDITURE BY SECTOR, 1997-98: ACTUAL VS PLANNED, \$'000



External Earnings

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

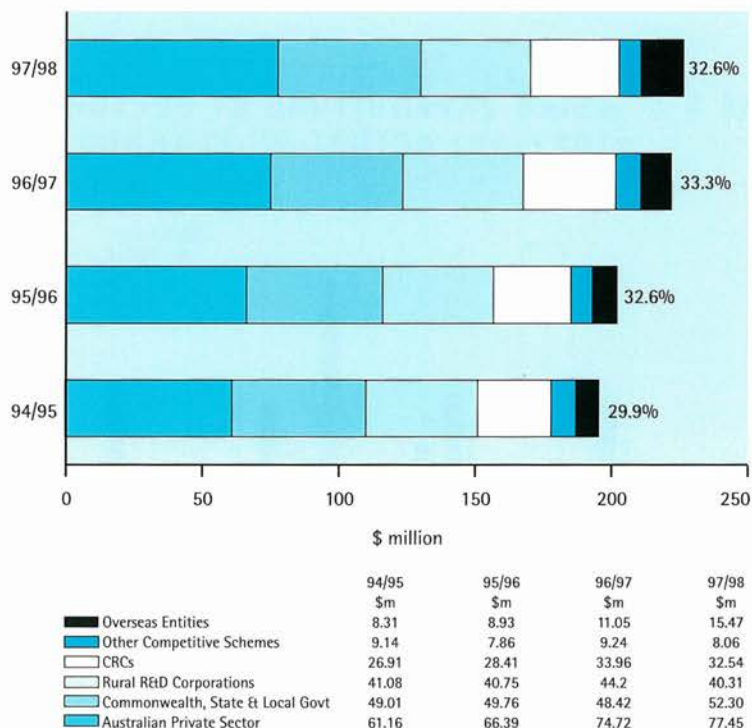
CSIRO's external earnings in 1997-98 are slightly above the Government mandated target of 30 per cent of total income, amounting to \$226 million or 32.6 per cent of total income. Although there has been some variability in the sources of external earnings, the figures for the past four years indicate an on-target performance in this area.

The sources and trends for the external income are shown in Figure 3. (Note data from earlier years has been revised since the figures published last year).

The data show that external earnings by CSIRO from the private sector have continued to increase (a 4 per cent increase on the previous year) despite the reported reduction in overall expenditure by business on R&D in 1996-97.

Contract research income from industry now represents 11 per cent of CSIRO's turnover. When the industry levy component of the Rural Industry R&D Corporation funds are included (estimated at \$20 million, or 50 per cent of their funds), total income from industry rises to 14 per cent of CSIRO's turnover.

FIGURE 3: AMOUNTS AND SOURCES OF EXTERNAL EARNINGS



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.

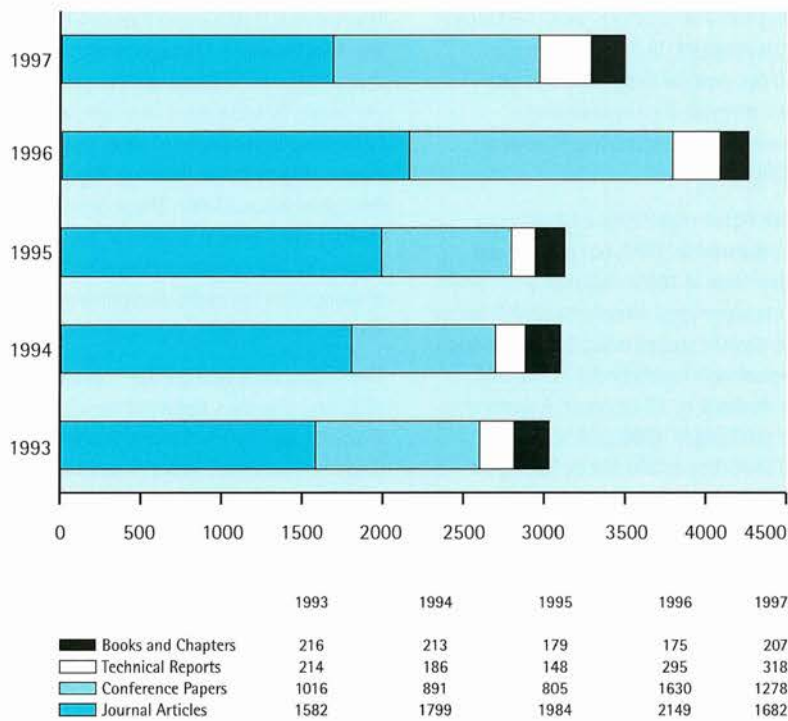
Publications

The publications data, reported by calendar year, are shown in Figure 4. As noted in last year's report, the method of collecting the data was changed in 1996. That change is thought to have accounted for a large part of the reported increase in the number of conference papers in that year.

Citation analysis of publications in refereed journals was undertaken in 1996 and reported last year in the Annual Report and in the publication *CSIRO: Profile of Basic Research*, by the Australian National University. The analysis will be repeated in 2001.

The number of client reports recorded rose to 7095 in 1997, up from 5076 in the previous year. The collection of this data is not yet as streamlined as that for publications and hence the actual increase may not be as large as these numbers indicate. Further work on standardising the reporting procedures for these reports will be undertaken this year. Around half of the reports are from two Divisions and are reports resulting from providing testing and calibration services.

FIGURE 4: PUBLICATIONS AND REPORTS



Patents

In 1997-98 CSIRO filed 51 Patent Cooperation Treaty applications, up from 46 in 1996-97, but on par with the average over the last five years. The total number of Australian and foreign patents and applications held at 30 June 1998 is 3182. The decision to file and/or maintain a patent takes into account legal advice, market conditions, and the wishes of commercial partners. Income from the patent holding in 1997-98 amounted to \$5.26 million against an expenditure of \$4.7 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.

Training by CSIRO staff

In collaboration with universities throughout Australia, CSIRO in 1998 is jointly supervising a total of 743 postgraduate students, comprising 585 PhD students and 158 Masters or Honours students. In 1998, 26 per cent (1997, 30 per cent) of these students are supervised through the Organisation's involvement in the Cooperative Research Centre (CRC) program.

The overall figure represents a 19 per cent decline compared to 1997, but is still 7 per cent higher than in 1994. This year the number of students supervised directly by CSIRO fell by 12 per cent while students supervised through the Organisation's involvement in the CRC program declined by 33 per cent. A number of CRCs are finishing in 1998 so it was to be expected that they would not be taking on more students.

In 1998 CSIRO is sponsoring 132 postgraduate students. This includes full scholarships for 26 PhD and eight Masters or Honours students, and partial scholarships to a further 88 PhD and ten Masters or Honours students. This is 25 more students than in 1997 and is consistent with the average number sponsored over the past four years.

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

Training of CSIRO staff

The role of the corporate leadership, career and team development program is to identify areas where staff training can have the maximum leverage on achieving CSIRO's goals.

A video induction program was prepared and distributed to Divisions to help new staff to understand the purpose, values and achievements of CSIRO. A methodology for assessing members' perceptions of research team effectiveness has been developed and will be made available through Human Resource Managers later this year.

Three project leadership programs were conducted for corporate groups and an additional three programs were conducted for staff in the Divisions of Minerals and Telecommunications and Industrial Physics. The 17th Research Management Program was completed. The fourth and fifth programs in the series "Achievement Through Teams: Leadership in Innovation" were conducted in partnership with the Business Higher Education Round Table. These experiential courses are aimed at leaders in the public, university and private sectors who have responsibility for multi-disciplinary, multi-functional and multi-organisational activities.

This corporate training effort equates to over 4732 training days delivered during 1997-98. Divisions also conduct many training courses themselves with the assistance of outside agencies.

In addition, CSIRO's Commercial Committee has overseen a number of specific training programs related to the Organisation's commercial practice. These have included training in negotiation (about 60 staff) and to meet requirements for delegated authority to sign contracts on behalf of CSIRO (about 12 staff).

OUTCOME INDICATORS

Customer Satisfaction

This indicator relates to CSIRO's responsiveness to the needs of customers with whom the Organisation has a contractual arrangement. It will therefore tend to exclude satisfaction with, for example, the provision of scientific advice to aid Government policy making.

The indicator is assessed through a range of measures including formal surveys, repeat business, and joint project management. The response rate to formal surveys is variable. Consideration is being given by some Divisions to introducing statistically based sampling and phone, rather than written, surveys.

The level of repeat business is high at around 70 per cent on average across all Divisions. The range of scores on this aspect (38–98 per cent) reflects a range of factors such as the number and size of contracts and the maturity of the market.

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

"CSIRO has professional skills in legal and contractual areas and is ahead of other researchers in terms of commercialisation."

"Good working relationships with research staff; dealings get better and better over time; successful and fruitful relationship."

"CSIRO provides good value for money."

"CSIRO recruits and retains staff of recognised high calibre; forged strong links for future work."

"Client's expectations met or exceeded."

"Final report is an excellent reflection of a well conducted project."

The two areas that still most often attract

adverse comment are delays in delivery of reports against agreed milestones, and lack of flexibility in contract negotiations.

CSIRO's Commercial Committee and Divisional management will address these and other issues raised by customers in the ongoing effort to improve CSIRO's interaction with customers.

Adoption and Impact of Research and Advice

The Adoption and Impact of CSIRO Research and Advice 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.

However for this Annual Report we have also included information on some of the major milestones or significant events in our research activities, to provide a fuller picture of our operations. Some stories appear in more than one Sector because they are equally relevant to each area.

The research is reported by Sectors, grouped into Alliances. Only a selection of outcomes is presented in this Report. A fuller list of Sector outcomes can be found on CSIRO's WWW site at <http://www.csiro.au/news/ach9798/contents.htm>

This section concludes with a brief description of the CSIRO research awards for research achievement.

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AGRIBUSINESS

Field Crops Sector

Biofumigation—breaking the disease cycle in cereal crops

CSIRO Plant Industry scientists, in collaboration with CSIRO Entomology, have shown that brassicas such as canola and mustard are valuable break crops that reduce pests and diseases in other agricultural crops. Brassicas release highly toxic 'biofumigants' from their roots that control root fungal diseases like Take-All. The researchers have now shown that the levels of these toxic biofumigants vary significantly among different canola varieties. This opens the door to a breeding program that could produce canola varieties with high concentrations of biofumigants in their roots.

Managing mouse plagues

Researchers from CSIRO Wildlife and Ecology have developed practical recommendations for possible farm management actions for early tactical management of mouse plagues in grain-growing regions in southeastern Australia. These recommendations were developed during a three-year collaborative study involving Agriculture Victoria, farmers and industry representatives from four states. The research is supported by the CSIRO, the Grains Research and Development Corporation, and the Bureau of Resource Sciences.

Boosting lucerne seed production

Scientists at CSIRO Entomology have been working with the Australian Quarantine Inspection Service (AQIS) and Pioneer Hybrids to solve the problem of low seed production in lucerne. Lucerne grown in Australia produces only one third the seed of lucerne grown in Canada and the United States due to low pollination rates. In Canada and the USA, the main pollinator of lucerne is the European leafcutter bee, *Megachile rotundata*. CSIRO scientists

studied the bee and verified that the risk of it introducing parasites and diseases was very low, and its potential impact on Australian native bees would be minimal. In collaboration with AQIS, CSIRO then developed an importation protocol for adult bees to be introduced through quarantine and then into the field within a single generation. The first field releases of 200 000 bees were made in 1998 in southern New South Wales.

Seeds without sex

CSIRO Plant Industry researchers have found genes that could make male plant parts in crops redundant, and dramatically lift grain production around the world. These genes allow *Arabidopsis* (a test plant used because of its rapid life cycle) to bypass the normal pollination process and begin seed formation. This is the crucial first step in developing plants that can produce seed without pollination. This research is the result of an ongoing 15-year collaboration between CSIRO, the Australian Centre for International Agricultural Research and the International Rice Research Institute.

Antioxidant potential of soy

Scientists at CSIRO Human Nutrition have demonstrated that a compound called genistein, present in relatively high concentrations in soybeans, has potent antioxidant properties. These properties are believed to help protect against cancer, cardiovascular disease and the ageing process.

Disease control agents

A research team from the Cooperative Research Centre for Tropical Plant Pathology, which includes scientists from CSIRO Tropical Agriculture, has successfully determined the 3-D structure of the anti-microbial peptide MiAMP. Working in collaboration with the Drug Design and Development Centre at the University of Queensland, the scientists have generated up to 20 variants, five of which have anti-

microbial activity greater than the wild-type protein. One variant exhibits activity ten times greater against *Sclerotinia*, a disease that affects sunflowers, canola, peanuts, soybeans and navy beans. The team has therefore successfully demonstrated that re-engineered anti-microbial plant peptides show greater biological activity than the original molecules.

Food Processing Sector

Why Japan loves

Australia's noodle wheats

Australia can tailor future wheat varieties to meet the demands of the Japanese market following the discovery of why the Japanese select some cultivars of wheat in preference to others. Scientists at CSIRO Plant Industry and the University of Western Australia identified genes in wheat that contribute to starch viscosity and quality characteristics of products such as noodles. Research has shown that it is the noodles' texture—the feeling in the mouth that triggers the taste, and so is responsible for the preference the Japanese have for noodles made from certain wheat cultivars. The 'mouth feel' is effected by granules of starch. These granules are the keys to the noodles' texture, and the absence of one of the starch granule proteins leads to increased swelling in the noodle.

Time to revise recommended dietary intakes

A research project undertaken by CSIRO Human Nutrition has confirmed that an update is needed to Australia's Recommended Dietary Intakes (RDIs). Background research was carried out into the purposes and uses of RDIs, current overseas approaches, possible directions for changes to RDIs in Australia and the ramifications of those changes. A national workshop considered key issues and recommended the direction and parameters for the revision of RDIs. This project, which was funded by the

Commonwealth Department of Health and Family Services, will form the basis of the updating of the Australian Dietary Guidelines that affect both the health and food industries.

Detecting *Escherichia coli* (*E.coli*) in foods

Food Science Australia developed methods for detecting Enterohaemorrhagic *E. coli* (EHEC) in animal faeces, carcasses, retail meat and raw milk to determine its prevalence and spread in Australian meat, animals and raw milk. The study, which was funded by the Meat Research Corporation and the Dairy Research and Development Corporation, has provided the meat and dairy industries with data for assessing potential public health risks.

Improved safety for the lupin crop

Technology to measure the toxin phomopsin in lupins and lupin-derived products has been transferred to the grain industry via the Academy of Grain Technology at Werribee, Victoria. Developed by the CSIRO Australian Animal Health Laboratory, the enzyme-linked immuno-sorbent assay (ELISA) can detect phomopsins below the level specified by the food standards code. This technology lets lupin producers and processors ensure the safety of their product.

Hot side rib deboning

A process that mechanically removes the muscle and associated tissue from a 10- or 12-rib chilled forequarter has been adapted for deboning hot beef sides at the end of a cattle slaughterline. Food Science Australia designed and built a prototype hot rib boning machine that has undergone extensive testing in a large export abattoir. The automated process is quicker than manual deboning, produces a higher yield of meat and requires less labour.

Fat helps weight loss in obese diabetics and non-diabetics

Scientists at CSIRO Human Nutrition have shown that weight loss diets can be high in fat and still be effective. Compared with a low fat weight loss diet, a weight loss diet rich in mono-unsaturated fat (from canola) can lower the harmful low density lipoprotein cholesterol and elevate the beneficial high density lipoprotein cholesterol, reducing the risk of heart disease. Research showed that even small amounts of weight loss dramatically reduced blood pressure and blood glucose response to a glucose drink, and should be encouraged in all overweight people at risk of heart disease.

Forestry, Wood and Paper Industries Sector

Improved wood quality analysis

SilviScan-2 is an enhanced version of SilviScan-1, reported on last year, and has been developed by the Cooperative Research Centre for Hardwood Fibre and Paper Science to measure key hardwood fibre characteristics related to pulp and paper quality. This product is now being improved to be able to determine rapidly and accurately the wood density distribution in eucalypt samples. These data will be important as a basis for assessing other wood properties such as fibre coarseness. Previously, assessment of these properties required thousands of x-ray beam scans and many days to complete the process.

Using Australian hardwoods for furniture

A CSIRO study has enabled furniture manufacturers to use both artistic design and engineering principles to produce aesthetically pleasing structures with adequate strength from Australian hardwoods. A large proportion of furniture manufactured in Australia is made from imported timber, but decreasing availability

of tropical rainforest timber species has stimulated a search for an alternative supply. The high structural strength and stiffness of many Australian hardwoods allow the use of smaller cross section furniture components, developing a new 'fine, delicate design'. Research by CSIRO Forestry and Forest Products has resulted in recommendations to reduce sizes of furniture components to take advantage of this.

Greenhouse impact on Australian forests

A major collaborative study by CSIRO Forestry and Forest Products and the University of New South Wales has provided a more reliable means of predicting the impacts of the build-up of greenhouse gases on Australian forests. Impacts on forests will result from the direct 'fertilising' effect of higher carbon dioxide levels and indirectly from increases in temperatures and changes in rainfall patterns. The outcome has been three linked models covering the responses of forests on time-scales ranging from days to successive rotations, and long-term soil responses.

Timber substitutes from waste

Industrial-scale trials of a structural timber substitute made from waste paper and plastic have begun. The product shows promise of being suitable for many applications that currently use timber. The wood-fibre reinforced plastic was developed by researchers at CSIRO Forestry and Forest Products in collaboration with Equinox Research and Development Pty Ltd.

Managing forests sustainably

Researchers at CSIRO Forestry and Forest Products are helping governments implement an agreed national goal of sustainable forest management. A review of codes of practice covering plantation management in each State is completed and further work is leading to the

development of Regional Forest Agreements for the management of native forests. Much of CSIRO's input focuses on provision of the scientific underpinning for environmentally sound management practices.

Design and management of effluent-irrigated forest plantations

CSIRO Forestry and Forest Products has completed draft guidelines for the design and management of effluent-irrigated forest plantations. These plantations are a preferred option for land disposal of nutrient-rich municipal effluent, since they use water at a higher rate and require less intensive management than agricultural crops. Until recently, there has been little information on the best management practices to be applied to these plantations. The scientists used a holistic and multi-disciplinary approach to study the ecosystem processes and develop a detailed computer model, which formed the basis for the new guidelines.

Horticulture Sector

More mangoes

CSIRO Plant Industry scientists have identified a mango flowering treatment with the potential to increase yield in the principal variety, Kensington Pride, by up to 80 per cent. Early mangoes from the Northern Territory and the Kimberley region of north west Australia command a premium price in the market, but flowering in Kensington Pride can be unreliable, causing financial uncertainty for growers. CSIRO has developed a new treatment for mango that results in reliable, heavy flowering and increased yields. Seven thousand trees have been successfully treated in recent field trials, resulting in a bumper harvest. The treatment is now undergoing commercial trials.

Rind pitting of citrus fruit

In a collaborative project with the South Australian Research and Development Institute and NSW Agriculture, CSIRO Plant Industry is studying the factors that make citrus fruit susceptible to oleocellosis, a disfiguring rind disorder that affects fruit appearance and reduces its local and export market value. The project has resulted in a two-pronged approach to reduce the incidence of the disorder. Spraying with Gibberellic Acid while fruit is on the tree is the first action; the second involves a set of recommendations for harvest, handling, and storage of citrus to reduce risk of oleocellosis development.

Sunmuscat – a new drying grape

Collaborating researchers from CSIRO Plant Industry and the United States Department of Agriculture have developed, and released to industry, a new variety of drying grape with a distinct muscat flavour. The new variety, called *Sunmuscat*, will provide a major boost to Australia's dried grape market, currently worth \$70 million annually. *Sunmuscat* is seedless, succulent, sweet, and has an appealing spicy aftertaste. The fruit processes well due to its durable skin and also retains its rich light amber colour. The Australian Food Industry Science Centre's consumer evaluation trial indicated a strong preference for *Sunmuscat* compared with traditional raisin varieties and jumbo sultanas. First commercial production of this new variety will occur this year.

Molecular system for identifying fruit fly

CSIRO Entomology scientists have developed a rapid and simple molecular diagnostic system for identifying larval and adult fruit flies captured as quarantine interceptions or from surveys in Northern Australia. The goal is to establish for the Australian Quarantine Inspection Service

simple DNA markers for a target list of 82 fruit fly species. The technique has been successfully used to distinguish 40 of the 52 species so far received.

Australian limes for the food industry

Using indigenous citrus germplasm resources, CSIRO scientists bred and selected novel citrus varieties that have potential for the expanding native foods industry. CSIRO and Australian Native Produce Industries Pty Ltd (ANPI) have now joined forces to develop further and commercialise three new varieties of lime. Applications for Plant Breeders Rights have been made for the descriptively named 'Blood' and 'Sunrise' limes (both *Citrus x Microcitrus* hybrids) and the 'Outback' lime (a selection of *Eremocitrus glauca*). The varieties are being distributed by ANPI to commercial growers for large scale trials. The potential uses of these fruits include bottled relishes and other preserves, essential oils and possibly a niche fresh market.

Meat, Dairy and Aquaculture Sector

Vaccine for feedlot cattle

A new vaccine is expected to boost cattle health and welfare, promoting a more sustainable and profitable feedlot cattle industry in Australia. CSIRO Animal Health, with support from the Cattle and Beef Industry Cooperative Research Centre, and collaboration through an options agreement with Australian pharmaceutical company, Ausvac, has developed a vaccine that can be used to protect cattle from bovine respiratory disease (shipping fever), which can cost \$50 million a year in production losses. The vaccine has performed very well under field trials and it is expected to complete the registration in 1999.

Biological control of worm parasites

Proof of concept has been achieved by CSIRO Animal Production that fungi can be used to control the free-living stages of worm parasites of sheep under grazing conditions. Trials using the spores of a particular fungus fed in a grain supplement showed that pasture levels of the parasites could be maintained at a sufficiently low level for an extended period to improve the performance of weaners and remove the necessity for treatment with chemical drenches. In collaboration with an Australian and a British company, work has commenced on the development and registration of products to deliver this system of parasite control to grazing livestock. Biological control of parasites will help farmers keep animals healthy with fewer chemicals.

Control of nodding thistle

All three biological agents released by CSIRO Entomology to control nodding thistle have established in the field. Up to 98 per cent attack by a seed fly released in 1991 has been recorded on some sites, with seed reduction ranging from 50-70 per cent. A rosette weevil released in 1993 is established at several sites, causing death of some plants and indirectly reducing seeding by 70 per cent. A receptacle weevil was released in 1988. Theoretical models indicate that weed populations should decline if seeding is reduced by 65 per cent. Nodding thistle is a weed currently limited to the northern and southern tablelands of New South Wales with localised infestations in southeast Queensland, Victoria and Tasmania.

Replacing fishmeal in aquaculture diets

Scientists in CSIRO Marine Research and colleagues in the Aquaculture Diet

Development Project funded by the Fisheries Research and Development Corporation have formulated aquaculture diets that reduce dependence on expensive fishmeal. Up to two-thirds of fishmeal protein in prawn diets and virtually all the fishmeal in barramundi diets can be replaced with high quality meat meals. In addition, new micro-algal strains have been introduced as live feeds in the aquaculture industry and have demonstrated enhanced growth in Pacific oysters when used as a supplement to the traditional micro-algal feeds.

Mapping genetic traits in cattle and prawns

CSIRO Tropical Agriculture scientists have made impressive progress in their efforts to identify, characterise and utilise genes associated with economically important attributes in livestock. Markers associated with tenderness, yield, and marbling in ten chromosomal regions have been evaluated in Angus, Brahman, Belmont Red, Hereford, Murray Grey, Santa Gertrudis and Shorthorn breeds. A first prawn genetic map has also been produced, and this is improving our understanding of the underlying genetic basis for improving the breeding and management of farmed aquaculture species.

Wool and Textiles Sector

OPTIM™ transforming wool

Optim™ is the commercial realisation of a project developed by CSIRO Wool Technology and The Woolmark Company (formerly the International Wool Secretariat) for transforming wool fibre. Optim™ fibres are thinner, longer and stronger. Optim™ technology has been licensed to Port Phillip Wool Processing and a prototype commercial plant with 200 tonnes a year capacity has been relocated from CSIRO Wool Technology to the commercial mill in Williamstown, Victoria. Optim™ fibre will be marketed by Itochu

and The Woolmark Company. Products from Optim™ technology have been test marketed successfully in Japan for two years by two Japanese companies who have used 40 tonnes of fibre supplied by CSIRO.

Weavable singles technology enters commercial phase

Technology to produce yarns that can be woven without twofolding, or doubling, has completed commercial trials. A commercialisation consortium has been established and negotiations with two distributors are at an advanced stage. Requests for the technology are being received from industry. The technology was developed earlier by CSIRO Wool Technology in collaboration with The International Wool Secretariat and the Wool Research Organisation of New Zealand.

Biological wool harvesting

Wool harvested without the use of a mechanical hand piece became available in 1998 using technology available from CSIRO licensees, Biological Wool Harvesting Company Pty Limited. Wool harvested using Bioclip will be free of second cuts and skin pieces contaminating the fleece. Developed by CSIRO Animal Production with support from The Woolmark Company, Bioclip is offering natural wool harvesting to woolgrowers meeting stringent farm accreditation pre-requisites.

Recapturing phosphorus

Scientists at CSIRO Plant Industry have identified ways of freeing up phosphorus that was previously applied as fertiliser, but has become tightly held in soil. With support from The Woolmark Company, scientists found that phosphorus bound in soil can be released by organic acids secreted from special roots of some plants like white lupin. Australian agricultural soils may hold up to \$10 billion worth of phosphorus as a result of fertiliser applications. Of the \$600 million spent

each year on phosphate-based fertiliser, only about 10 to 20 per cent of the phosphorus is used by plants in the year it is applied—the rest becomes locked in soil.

The spread of RCD

Epidemiological studies of rabbit calicivirus disease (RCD) in a semi-arid area in the Flinders Ranges, South Australia, indicate that RCD is persisting in the wild with recurrent outbreaks in Spring or Autumn. In this region rabbit populations are at 10–15 per cent of their former numbers. Most young rabbits carry maternal antibodies that are lost by about eight to 11 weeks of age; they are then susceptible to RCD. At least 11 species of insects—flies, mosquitoes and fleas—become contaminated with RCD during outbreaks. Flyspots—faeces and regurgita—contain enough viable virus for a single fresh spot to infect a rabbit. Research is funded by the Meat Research Corporation, The Woolmark Company and a consortium of State and Federal governments, and coordinated by the RCD Management Group.

Sensor for a good yarn

A sensor that detects contaminants, and thick and thin spots in running yarn will be manufactured and sold to the global textile industry by CSIRO licensee Premier Polytronics of India. Developed by CSIRO Wool Technology with funding from The Woolmark Company and Premier Polytronics, the sensor operates at yarn speeds of up to 3000 metres per minute and detects faults as short as 0.1 millimetres. It also detects faults in coloured and undyed yarn.

ENVIRONMENT AND NATURAL RESOURCES

Biodiversity Sector

Computer guide to identifying eucalypts

CSIRO Plant Industry has launched EUCLID (EUcalyptus IDentification)—the world's first comprehensive computer guide for identifying eucalypts. The interactive CD-ROM, which includes extensive colour images, allows the user to identify over 300 eucalypt species, quickly and simply, from almost any plant sample that has some leaves, flowers or gum nuts.

OzEcco: an energy model of Australia

CSIRO Wildlife and Ecology completed development of the embodied energy model *OzEcco* and used it to test some alternative scenarios of Australia's future. *OzEcco* represents the first substantial attempt to produce an integrated representation of the physical and economic systems of Australia. Bringing these two systems together is necessary for exploring how sustainability (physical) goals might be achieved through planning and policy (economic) tools, and conversely, how economic decisions impact on sustainability.

Plant taxonomy

CSIRO Plant Industry scientists have completed major taxonomic works on *Grevillea*, *Melaleuca* and *Grastidium*. These works all provide a vital taxonomic base for ecological and conservation studies of these groups.

Indicators of mine rehabilitation success

A set of indicators of ecosystem rehabilitation success has been developed for a consortium of mining companies. Field studies by CSIRO Wildlife and Ecology

at 13 mine sites around Australia covered bauxite, iron ore, hard rock, coal and mineral sand mine sites. CSIRO developed an explicit and consistent landscape ecology framework using a package of field procedures called Ecosystem Function Analysis (EFA).

Strategies and indicators for environmental monitoring

CSIRO Marine Research and CSIRO Wildlife and Ecology led the development of reports on strategies and indicators for monitoring the state of Australia's marine environment and biological diversity. The former dealt with all major elements of Australia's marine environment, with particular emphasis on the coastal zone where human usage is most extensive, and reviewed the comparable strategy and indicators developed by the New Zealand Government. The latter presented indicators for monitoring the state of biological diversity, particularly with reference to achieving the objectives of the National Strategy for the Conservation of Australia's Biological Diversity.

Catalogues of Australian mites

Two major inventories of Australian mites have been completed by CSIRO Entomology. The *Checklist and Bibliography of the Mites of Australia* brings together for the first time information about the 2500 named species of Australian mites in a form that is accessible to the specialist and non-specialist alike. It will be an indispensable source of information for quarantine officers, ecologists, and researchers in pest control, agriculture, human and animal health, parasitology, and soil biology. The second publication catalogues Australian Oribatid mites, which are ancient, minute mites that live in soil, where they contribute to plant litter decomposition, soil formation and nutrient cycling. They have considerable capacity as indicators of soil health and environmental quality. A CD-ROM on these mites has also been produced.

Using management agreements to conserve native vegetation

A report by CSIRO Wildlife and Ecology has had a significant impact on proposals to use management agreements to conserve formally native vegetation outside reserves. Prepared for Bushcare and the Land and Water Resources Research and Development Corporation, the report has also had a direct role in developing the range of incentives that are being supported by the Bushcare program of the \$1 billion Natural Heritage Trust.

Climate and Atmosphere Sector

Atmospheric chemistry experiment

Results from a major atmospheric chemistry experiment are contributing to our understanding of the sources and impacts of atmospheric haze over Australia and Asia. The experiment was part of a long-running scientific collaboration between CSIRO Atmospheric Research and CSIRO Office of Space Science and Applications with Japan's Meteorological Research Institute and the Indonesian Bureau of Meteorology and Geophysics. Scientists examined the atmosphere over northern Australia during the annual biomass burning-off period, determining the composition and likely origin of particles responsible for haze. In response to the severe air quality problems in South-East Asia due to large-scale forest fires, the measurement campaign expanded to study chemistry and dispersion of smoke in Indonesia. The atmospheric particles over Indonesia differed considerably in elemental composition from those collected over Australia. They were also far more hygroscopic, contributing to visibility reduction problems in the region.

Plants grow better with more carbon dioxide

CSIRO Plant Industry scientists have shown that increased carbon dioxide in the air,

primarily responsible for greenhouse warming, makes plants grow faster and improves their ability to cope with drought and salinity. Studies revealed that a doubling in carbon dioxide can increase the growth rate of plants by 30 to 40 per cent under well watered conditions.

Probing El Niño

CSIRO Atmospheric Research is contributing to understanding and modelling El Niño. As well as the two to seven year cycle of El Niño, scientists identified two additional longer climatic fluctuations: one every 11 to 13 years; the other, every 15 to 20 years. This suggests that it is unlikely that global warming this century influenced El Niño. In a project for Environment Australia, scientists modelled the impact on El Niño during the next 150 years of increasing atmospheric concentrations of carbon dioxide. Results suggest that El Niño, and its opposite, La Niña, are likely to continue to occur, and possibly more frequently.

Greenhouse impact on Australian forests

A study by CSIRO Forestry and Forest Products and the University of NSW has provided a way to predict the impact of greenhouse gases on Australian forests. Outcomes are three models covering the responses of forests on time-scales from days to successive rotations, and long-term soil responses. The models will assist forest planning and management and provide information on the potential of forests and the soil to reduce carbon dioxide build-up by storing carbon.

Insects and climate change

CSIRO Entomology has produced integrated impact assessments for Queensland fruit fly, light brown apple moth and insect-related dieback of rural woodlands. Information on climate variability was used to provide an ENSO (El Niño Southern Oscillation)-based warning of the need to vaccinate cattle in southern Queensland against tick fevers. CSIRO

Entomology is also leading international collaborative research on global change and pests, diseases and weeds through the International Geosphere-Biosphere Program-Global Change and Terrestrial Ecosystems (IGBP-GCTE).

Ocean circulation and climate change

CSIRO Marine Research has discovered a number of large-scale currents circulating deep in the North Pacific, which was previously thought to be an almost motionless basin. The discovery of the currents has implications for understanding the circulation of the deep ocean, which is a critical element in simulations of climate change.

Land and Water Sector

Storing salt out of harm's way

A \$2.5 million project to find a sustainable way to deal with unwanted saline water in the Murray-Darling Basin shows that millions of tonnes of salt could be stored in special ponds in irrigation areas. Under the proposal, irrigators will provide medium-term storage for saline drainage water in carefully managed ponds near their farms, helping preserve rivers and freshwater lakes from salinity. Project collaborators include the Murray-Darling Basin Commission, CSIRO Land and Water, the Cooperative Research Centre for Catchment Hydrology, Goulburn-Murray Water, Flinders University, Murrumbidgee Irrigation, Murrumbidgee Irrigation Area Sustainable Development Committee, New South Wales Department of Land and Water Conservation, and Department of Natural Resources and Environment, Victoria.

Land monitor project

CSIRO Mathematical and Information Sciences has developed techniques for calibrating and processing multi-temporal sequences of Landsat Thematic Mapper satellite images. These sequences will be used as the basis for the Land Monitor

project, which aims to produce information for improving land management in south-west Western Australia. Land Monitor products will be available at paddock, farm and catchment scales. Supported by the Natural Heritage Trust, the project involves Agriculture Western Australia, the Western Australia Department of Land Administration, Water and Rivers, the Environmental Protection Authority, Main Roads Western Australia, Department of Conservation and Land Management and CSIRO.

Advantages of 'precision farming'

'Precision agriculture' is a technique using navigation satellites and special yield-monitoring devices to look at how Australian farmers can employ these tools to improve management and increase profits. Funded by the Grains Research and Development Corporation, the project by CSIRO Land and Water found that efficiencies in fertiliser application is one of the keys to better farming margins. Farmers now need apply only as much herbicide or insecticide as necessary, keeping environmental impacts to a minimum.

Management of effluent- irrigated plantations

A multi-disciplinary approach to study interactions between climate, plant, soil, water and nutrients in eucalypt and pine plantations irrigated with effluent or fresh water, has produced a model and draft guidelines for the design and management of effluent-irrigated plantations. Irrigation of forest plantations is a preferred option for land disposal of nutrient-rich municipal effluent, since they use water at a higher rate and require less intensive management than agricultural crops.

Aluminium intake from food and water

A new study into aluminium intake from alum-treated drinking water shows there is little risk to human health. Research by the

CSIRO Centre for Advanced Analytical Chemistry showed that the bioavailability—the amount of aluminium that can be absorbed by the body—of aluminium from food and water were similar. This suggests that the aluminium from alum-treated drinking water does not have unusually high bioavailability and is unlikely to contribute disproportionately to the incidence of Alzheimer's disease.

Tools evaluate sugarcane practices

A decision-support system (DSS) that assists users to evaluate the implications of changes in natural resource use in the Herbert River catchment is now operational and available on a website for testing and use by a range of stakeholders. A prototype version of an economic-environmental model of the regional sugar industry to analyse land use change scenarios will be incorporated into the DSS. Involved in the project are the sugar industry, CSIRO Tropical Agriculture and the Cooperative Research Centre for Sustainable Sugar Production.

Marine Sector

Strategies and indicators for marine monitoring

CSIRO Marine Research staff led development of a multi-agency report on strategies and indicators for monitoring the state of the marine environment. The report looked at all major elements of Australia's marine environment, with emphasis on the coastal zone where human usage is extensive. It also reviewed the comparable strategy and indicators developed by the New Zealand Government.

Commonwealth fisheries sustainability improved

CSIRO Marine Research provided stock assessments and management strategy advice as the scientific base for the ecologically sustainable management of

several of Australia's major fisheries including the Northern Prawn, East Coast Tuna and Billfish, and Torres Strait traditional, artisanal and commercial fisheries.

In collaboration with the fishing industry, Queensland Department of Primary Industry, and the Australian Maritime College, CSIRO Marine Research completed a project developing and testing bycatch reduction devices. The results contributed to the agreement by industry and management for the compulsory adoption of Bycatch Reduction Devices in the Northern Prawn Fishery by 2000.

Ocean forecasting by satellite

Techniques for the real-time mapping of three-dimensional ocean structure and currents from satellite imagery and historical sub-surface data are under trial by CSIRO Marine Research and the Fisheries Department of Western Australia. The trials aim to predict breeding success in a rock lobster fishery, the movement of objects in the sea for search and rescue, and to identify events giving natural nutrient enrichment near a sewage ocean outfall. Techniques have been developed in collaboration with the University of Colorado to determine ocean currents by using data from concurrent satellite passes occurring within 6 to 24 hours. Part of this work has been supported by the Earth Observation Centre.

Better aquaculture production and coastal management

CSIRO Marine Research through cooperative projects with several state departments developed a Geographic Information System (GIS) to help industry investors and environmental managers reach optimal aquaculture production and coastal zone management by appropriate site selection. Software developed by CSIRO Marine Research with the Cooperative Research Centre for Aquaculture is helping aquaculture farmers improve production by monitoring environmental conditions in

their ponds. Models from the data allow accurate forecasts of production cycles to meet specific market demands.

Controlling marine pest invasions

The Centre for Research on Introduced Marine Pests (CRIMP) within CSIRO Marine Research completed the field component of an Australia wide survey of ports for exotic marine pests. The study, jointly funded by port authorities, CSIRO and the Australian Ballast Water Management Advisory Council, details infestation patterns, and will lead to recommendations for management options to minimise rates of invasion. CRIMP also completed the first stage of a comprehensive risk-analysis system for ship-based sources of infection and undertook the first laboratory trials exposing Australian native species to Japanese and European parasites that may be potential biological control agents.

INFORMATION TECHNOLOGY, INFRASTRUCTURE AND SERVICES

Built Environment Sector

Improved adhesion to polymers

The bonding of adhesives and paints to polymers such as polypropylene and polyethylene has previously only been possible through the use of costly and environment-damaging solvent-based materials or expensive batch processing techniques. CSIRO Building, Construction and Engineering has developed a technology that matches the best of these techniques using an environmentally friendly process, SICOR, that can be integrated into manufacturing processes at up to 300 metres per minute. The Division has already signed a ten-year \$16 million licence agreement with a US building products company that will use the

technology for the treatment of recycled polyethylene-based products.

Clean air for Sydney 2000

CSIRO Building, Construction and Engineering has produced a set of Indoor Air Quality Guidelines for the Sydney Olympics. The document has been developed in collaboration with Green Games Watch and the Olympic Coordination Authority to ensure a human-friendly environment for spectators and participants. It will support national guidelines that will put Australia at the forefront of clean air construction and significantly reduce the nation's health bill. Many modern buildings are causing increased ill-health because of the volatile organic compounds and other pollutants that are emitted by building materials, paint, carpets, furniture and office equipment. The national cost of poor internal air quality in Australia has been estimated at \$12 billion per year.

RACOD meter

The Rapidly Assimilable Chemical Oxygen Demand (RACOD) Meter is a patented technology, developed by CSIRO Molecular Science, to provide on-line measurement of Biochemical Oxygen Demand (BOD) for sewage and industrial effluents. Valued at approximately \$1 million, the technology has been licensed to US FILTER Wallace and Tiernan Pacific, who have already sold ten units to Scottish Water and are due to launch the meters worldwide later this year.

Gold Coast transport study

Improved public transport is one of the most pressing issues facing Australia's fastest growing city. With traffic levels forecast to double in less than 20 years, a desire to minimise the environmental impact of transport and a rapidly growing population of elderly people, the Gold Coast City Council has joined forces with CSIRO Mathematical and Information Sciences to develop a more effective public transport system. CSIRO research on

'intelligent transport systems' has led to the creation of software that can simulate existing bus, rail and taxi services combined with new 'demand-responsive' services that could be booked by phone, Internet or via roadside kiosks.

Natural air conditioning

CSIRO Building, Construction and Engineering has developed software to simulate airflows and temperature changes and demonstrate that natural ventilation can be the most cost-effective solution to an airconditioning problem. Application of this information in buildings such as the Sydney Fruit Market, Manly Hydraulics Laboratory and a copper smelter at Olympic Dam has successfully demonstrated that natural ventilation can achieve acceptable levels of comfort without detrimental effect on the environment.

Information Technology and Telecommunications Sector

Electronic commerce report for tax office

CSIRO Mathematical and Information Sciences was enlisted by the Australian Taxation Office (ATO) to participate in its Electronic Commerce project. This project developed a blueprint for the ATO's approach to taxation of goods and services traded over the Internet. Researchers provided key advice on technical aspects of the Internet and assisted the ATO in the development of compliance strategies, taking into account the widespread use of developing technologies such as encryption, anonymous messages and globally mobile network connections.

GrapeVINE software

Sydney-based IT company, grapeVINE Technologies, has developed with CSIRO Mathematical and Information Sciences, an Internet version of their software product—

Internet grapeVINE. The software combats the information overload often experienced on the Internet by delivering only the most relevant and valuable resources to the user by referring to the user's interest profile. This development has enabled grapeVINE Technologies to sign a deal with US Internet-software giant Netscape Communications that will see its software bundled with Netscape's Compass Server, an intranet platform aimed at tracking corporate information as well as information on the Internet.

SPOT-LITE

CSIRO Mathematical and Information Sciences delivered a prototype on-line image distribution archiving system to the Australian Centre for Remote Sensing (ACRES) in March 1998. The system, which manages a new ACRES product called 'SPOT-LITE', will be implemented by ACRES from late 1998. The images are obtained from the French SPOT satellite and provide Earth observation data to resource managers. SPOT-LITE will increase efficiency and productivity in sectors relying on access to Earth observation information services and provide greater opportunity for growth in small to medium sized enterprises offering value-added services in their respective marketplaces. The market size for Earth observation data is valued at around \$2 billion worldwide and is growing at an estimated 30 per cent per year.

Nancay Telescope

CSIRO Telecommunications and Industrial Physics and the Paris Observatory have almost completed the upgrade of one of the world's largest radio telescopes. Based in the Loire Valley in France, the radio telescope observes the skies of the Northern hemisphere and a considerable slice of the Southern hemisphere. The equipment designed and built by CSIRO will make the Nancay telescope more than twice as sensitive, increase the range of frequencies at which it can operate, and boost its speed of operation by a factor of

five. The advanced reflectors, corrugated feedhorns and transducers were designed by CSIRO. Sydney-based fabrication company Sydney Engineering Sales manufactured the complex and very accurate reflectors and feedhorns.

Measurement Standards Sector

Agreement for changes in international standards infrastructure

CSIRO's National Measurement Laboratory (NML) has played a major role in the development of a global Mutual Recognition Agreement to assist international trade. The Agreement generates a very significant work program for conducting international comparisons of national standards of measurement and specifies the criteria that national metrology institutes must satisfy in order for their capabilities and measurement reports to be recognised internationally. The Agreement is expected to be ratified in October 1999.

Improvements in regional metrology capability

The National Measurement Laboratory (NML) has continued its 1994-98 role of providing the Secretariat for the Asia Pacific Metrology Programme (APMP). In December 1997 it hosted the 14th APMP Meeting and International Symposium on Traceability. Given that the proposed global Mutual Recognition Agreement requires objective evidence of measurement competence, there is an imperative for the APMP Chairman and Secretariat to define and supervise regional comparisons of national measurement standards, and 22 such comparisons are underway in 1997-98. The APMP has also established two Specialist Regional Groups, one in Length Metrology (chaired by Australia through NML) and one in Metrology in Chemistry (chaired by Japan).

Through contracts sponsored by Australia's Department of Industry, Science and Tourism, AusAID and the World Bank, NML staff have provided training in 1997-98 for over 40 scientists from national metrology institutes in Asia-Pacific, with particular emphasis on Indonesia, Malaysia, the Philippines, Thailand, and Vietnam. In addition, training courses have been provided in Hong Kong, Malaysia, Thailand and Singapore.

Trapped ion frequency standard

The National Measurement Laboratory's Trapped Ion clock project has in the past demonstrated world-leading stability performance using a cloud of electromagnetically trapped ytterbium ions as a frequency reference. During the year the absolute accuracy of the system was improved by optically cooling the ions to very low temperatures in order to remove instabilities and frequency shifts caused by relativistic effects. Some major technical and scientific impediments to using a cold crystal of ions as a frequency reference have recently been overcome.

Time transfer

Amendments to the National Measurement Act 1960, enacted in 1997-98, have given responsibility to CSIRO for maintaining Universal Coordinated Time (UTC) in Australia. Transfer of some technical facilities for dissemination of UTC from the Australian Surveying and Land Information Group to the National Measurement Laboratory commenced in April 1998, and transfer of the legislative responsibility will occur from 1 July 1998.

Electromagnetic compatibility

In order for Australian manufacturers to export, and to protect Australian markets from sub-standard imports, it is necessary for many classes of electrical and electronic equipment to be tested for electromagnetic compatibility. For test certificates to be recognised overseas, the laboratories that

provide these testing services need to demonstrate that their measurements are soundly based and this is done by tracing the measurements to physical standards developed at the National Measurement Laboratory (NML). During the year, in a project funded by the Department of Industry, Science and Tourism, NML has implemented a method to improve the accuracy of an electromagnetic cell that is used to calibrate field probes used for testing electrical equipment.

Radio Astronomy Sector

Extragalactic surveys

Two long-term surveys by the Parkes telescope for faint and obscured galaxies have already turned up exciting results. One survey has found more than 100 new galaxies hidden behind the Milky Way. The second survey has made a unique picture, covering 2400 square degrees of sky, which shows for the first time our Galaxy interacting with its two nearest neighbouring galaxies, the Large and Small Magellanic Clouds. The image reveals an 'arm' of hydrogen gas torn from the Clouds by a tidal interaction between the Galaxy and the Clouds. The presence of the arm settles a long-standing controversy about the dynamics of the system.

Parkes multibeam pulsar survey

The Parkes telescope is finding pulsars more than ten times faster than in any previous pulsar search anywhere, thanks to the power of the telescope's new multibeam receiving system, which drastically cuts the time needed to scan the sky. The search has found 140 new pulsars, one orbiting another neutron star.

Brown dwarf spotted

Data from Australian radio telescopes and a European satellite have been combined in a new technique that holds promise for finding planets around other stars. The gravitational pull of an orbiting planet makes its parent star 'wobble' around in a

small ellipse. Australian radio telescopes, including the Parkes telescope, have for the first time directly measured the wobble of a nearby star, AB Doradus. The radio data, supplemented with extra measurements from the Hipparcos satellite, strongly suggest that the star is orbited by a companion about a tenth the mass of the Sun—not a planet, but a type of small 'failed' star called a 'brown dwarf'.

Fractals in space

After putting together data from the Parkes telescope and the Australia Telescope Compact Array, astronomers suggest that the hydrogen gas in a nearby galaxy (the Small Magellanic Cloud) may have a fractal structure, that is, it may exist in clouds in a hierarchy of sizes. This is a departure from the accepted model of the gas existing in regular-sized clouds.

Telescopes follow enigmatic explosion

In May and June 1998 Australian astronomers watched a giant explosion in a nearby galaxy that may help to solve the puzzle of the mysterious 'gamma-ray bursters'. In late April an astronomy satellite, BeppoSAX, picked up a flash of gamma rays from a particular region of the sky. CSIRO's Australia Telescope Compact Array and major Australian optical telescopes looked to the region of the flash and found a spectacular fireball, in the nearby galaxy ESO 184-82. The fireball looks like a supernova, but gamma-ray bursts have not been seen before from supernovae. And this object is fairly near, while most gamma-ray bursts of the kind BeppoSAX detects seem to originate far across the Universe. Most astronomers believe that gamma-ray bursters are caused by hugely energetic events such as two neutron stars colliding or some kind of accident involving a black hole. If this burst of gamma-rays is linked to the supernova, this event re-opens the question of what gamma-ray bursters are.

Service Sector

Road cracks detected

Field trials of an automated pavement crack detection system that operates on a vehicle travelling up to 105 kilometres per hour show that it accurately detects and classifies road cracks on chip seal, asphalt and concrete surfaces down to 1 millimetre width in all surfaces. Developed by CSIRO Manufacturing Science and Technology, CSIRO Mathematical and Information Sciences, and CSIRO Telecommunications and Industrial Physics with the NSW Roads and Traffic Authority (RTA) the system provides an objective, cost effective assessment of road condition and has the potential to save considerable resources annually in rehabilitation costs.

Australian Tourist Commission on schedule

A scheduler that gives the Australian Tourist Commission (ATC) a reliable meeting schedule in less than an hour instead of days has streamlined ATC international trade events held each year to promote travel to Australia. Developed by CSIRO Mathematical and Information Sciences, the scheduler gives the ATC complete control of appointment scheduling and adds value to its existing data base of buyers and sellers. Each trade event costs over a million dollars to stage, so meetings must be carefully scheduled to make the event cost effective.

Measuring an ambulance service

CSIRO Mathematical and Information Sciences worked with the South Australian Ambulance Service (SAAS) to measure the Service's performance and develop a plan defining its direction into the next century. A key to the plan is a measurement system that defines the performance of the Service and integrates measurement at the organisational level with day-to-day decisions of managers and staff. The

integrated system of measurements ensures the efforts of each part of the organisation are being measured in the same way, and gives SAAS management a clear picture of its long and short-term performance.

Study uncovers public fraud

A study exploring the use of high performance Data Mining tools and techniques to uncover public fraud in Medicare identified patterns and trends that will enable the Medicare system to monitor payments as they are made, stopping fraud as it happens. Patterns of public fraud were searched for, and cases with fraud convictions recorded against them have been identified. The study was conducted by the Professional Review Division of the Health Insurance Commission in collaboration with CSIRO Mathematical and Information Sciences within the Advanced Computational Systems Cooperative Research Centre (ACSys). The work showed that the effort required to deploy this technology is offset by the high returns it can generate.

Melanoma detection system on trial

Six Skin Polarprobe® prototypes have been built and introduced into clinics for data collection and market feedback. The Skin Polarprobe® is an automated melanoma detection system developed by CSIRO Mathematical and Information Sciences, Polartechnics Ltd and the Sydney Melanoma Unit. A diagnostic aid for general practitioners, the Skin Polarprobe® assesses suspect skin lesions using expert knowledge about melanoma characteristics. Practitioners will be able to assess and identify suspect lesions as melanomas more easily, saving time if treatment is necessary. With BodyMap software, images of moles can be stored and linked to a pictorial body map showing their location and allowing their appearance and condition to be monitored.

MANUFACTURING

Chemicals and Plastics Sector

New biological pesticides

CSIRO Entomology is collaborating with the Bureau of Sugar Experiment Stations and two commercial companies to develop insecticides from the fungus *Metarhizium*. This fungus can be grown on simple media such as rice to produce a stable green spore that can be made into a biopesticide. A strain of the fungus is being tested on a large scale in sugarcane for control of greyback canegrub. A commercial product to control cockchafer is registered in Tasmania and Victoria, and other products are planned to give a much needed biological alternative for control of pests such as locusts, canegrubs, termites, crickets, and even nuisance flies.

Crops as industrial feedstocks

CSIRO Plant Industry scientists, working as part of an international team, have developed a technology that could enable crop plants to produce raw materials needed to make industrial chemicals and polymers. The team has identified genes which, when introduced into plants, could see the plants operating as mini factories, offering an alternative to petrochemical oils. As the genes identified come from wild plants not suitable for farming, the scientists are now working to introduce the genes into oilseed plants.

Improved protection against UV

CSIRO Manufacturing Science and Technology and a consortium of companies have developed a range of transparent ultraviolet stabilisers for various commercial applications. New timber varnishes and sunscreens, incorporating nanometre-sized particles of metal oxides, are now being marketed in Australia and overseas.

Wheat flour properties

CSIRO Plant Industry scientists have completed a detailed analysis of seed storage proteins, enzymes, and their respective genes, that control carbohydrate synthesis in developing grain. The outcomes of this research include the large-scale production of specific wheat proteins in bacterial fermentors (in collaboration with CSIRO Molecular Science) and demonstrating the alteration of the polymer properties of wheat flour following the incorporation of these proteins. The cataloguing of all the genes involved in starch biosynthesis in wheat has provided the basis for analytical procedures that, in turn, allow the selection of wheat lines with particular alterations in starch properties.

Lepton™ test kits in USA

A new version of the CSIRO-developed Lepton™ diagnostic kit for heliothine moths (pests of broad-acre agriculture) is on sale in the USA following successful field trials during 1997. CSIRO Entomology and Abbott Laboratories worked jointly to develop a test for use in North America, which has different species of moths than those found in Australia. The Australian kit has been available since 1993.

Slow release polymer systems

CSIRO Manufacturing Science and Technology has developed multi-phase polymer systems, including one that slowly releases sulphur dioxide into packaging at a constant low and sustained rate. This experimental polymer has been successfully tested with export grapes (in conjunction with the Cooperative Research Centre for International Food Manufacture and Packaging Science).

Integrated Manufactured Products Sector

Magnesium seat frame—light and strong

A magnesium seat frame that is one of the lightest in the world is the result of a joint project between CSIRO Manufacturing Science and Technology and Henderson's Automotive Group. The one-piece seat back replaces a steel fabrication of over 13 steel parts, is less than half the weight, has twice the load bearing capacity and yet is an equivalent price to the current design. Local and international automotive manufacturers are reviewing the seat and the Department of Industry, Science and Tourism, which partly funded the project, has requested it be cited as an example of a successful CSIRO/industry collaboration.

Exelgram wins anti-counterfeiting contracts

American Express adopted CSIRO Manufacturing Science and Technology's Exelgram optically variable device technology for use on a new series of travellers' cheques. US\$50, \$100, \$500 and \$1000 travellers' cheques now incorporate Exelgram foils to protect against counterfeiting. The first two denominations of a new series of Hungarian banknotes also use CSIRO Exelgram technology to protect against counterfeiting.

X-ray start-up

A technique for hard X-ray phase contrast imaging developed by the X-Ray Science and Instrumentation Group in CSIRO Manufacturing Science and Technology has led to the formation of X-Ray Technologies Pty Ltd. A joint venture between CSIRO, the Strategic Industry Research Foundation and private investors, the company aims to fund on-going CSIRO research and to bring the X-ray technology to market. Applications now targeted by the company include soft-tissue imaging, aerospace,

microelectronics inspection and food inspection.

Fastflo goes global

UK firm Numerical Algorithms Group Ltd launched CSIRO Mathematical and Information Sciences' *Fastflo* on the international market in July 1997. *Fastflo* is one of only a handful of mathematical software packages developed in Australia to be sold overseas. *Fastflo* offers faster, more flexible techniques to solve a wide class of engineering problems.

Key-hole gas tungsten arc welding

A variant of gas-tungsten arc welding is set to bring industry significant savings while improving productivity. Key-hole welding of thicker materials, previously only thought possible with high capital cost and technically complex welding processes is now a low cost option that is gaining acceptance in Australia and internationally. CSIRO Manufacturing Science and Technology, with the Cooperative Research Centre for Materials Welding and Joining and a number of Australian companies, developed the process, which is capable of joining up to 12 millimetre thick structural steels, stainless steels, aluminium alloys and titanium alloys in a single pass from one side with square-butt edge preparation.

Fresh look at high-pressure die casting

Measurements of the high-pressure die casting process at the Nissan Casting Australia Plant have transformed understanding of the process. The new knowledge has led to process adjustments that have significantly improved quality, and led CSIRO Manufacturing Science and Technology to start research with Nissan into technology that could further improve casting quality.

Pharmaceuticals and Human Health Sector

Flu drug at last hurdle

The influenza drug, GG167(now called Relenza™) developed jointly by CSIRO, Biota and partners, has entered the regulatory and commercial phase of its development. Glaxo Wellcome Australia has applied for regulatory approval in Australia following successful Phase 3 clinical trials last winter. This means that the drug could be available to the Australian public by mid 1999. Regulatory approval in the USA and UK will probably be sought following clinical trials during the Northern hemisphere winter.

Growth factor structure determined

Scientists at CSIRO Molecular Science and the Biomolecular Research Institute have succeeded in determining the 3D structure of the first three domains of the Insulin-like growth factor (IGF-1) receptor protein. Many other research groups world-wide have tried to achieve this milestone. The research has important implications for understanding the actions of IGF and insulin. The research is to be published in *Nature* in July 1998.

Extended wear contact lens

A contact lens that can be worn continuously day and night without irritating the eye has been developed by the Cooperative Research Centre for Eye Research and Technology (in which CSIRO is a major participant) and the international eyecare company CIBA Vision. CSIRO and CIBA Vision scientists developed polymers and surfaces that allow the eye to 'breathe' oxygen through the lens from the eyelid during sleep. The new lens has successfully completed a six-month pilot study and is scheduled for trials with the Food and Drug Administration in the United States. The lens is expected to earn Australia a multi-million dollar income when studies are complete. The world market for contact lenses and solutions is

currently around US\$4 billion, with over 70 million wearers globally.

Medical device spin-off company formed

Elastomedic Pty Ltd was formed in early 1998 to commercialise biostable polyurethane technology developed by CSIRO and Unisearch Pty Ltd and more lately by the Cooperative Research Centre for Cardiac Technology. Elastomedic intend to use this technology for making components for medical devices. The technology has subsequently been licensed to a UK firm for the development of artificial heart valves.

Novel bowel health product

Collaborative studies between CSIRO Human Nutrition and Sigma Pharmaceuticals have led to the development by Sigma Pharmaceuticals of a novel bowel health product (Nucolox™) which incorporates psyllium and resistant starch. The product improves faecal bulk and enhances the release of beneficial short-chain fatty acids by microflora in the large bowel. The product also contributes meaningfully to reduced plasma cholesterol levels. It will be available shortly in Australia and will then be marketed overseas.

Drug delivery technology

A contract with FH Faulding & Co Ltd for the development of CSIRO's fatty acid-based drug delivery technology has been extended following the satisfactory conclusion of the initial stages of the collaboration. A new compound for the treatment of psoriasis is in human trials and negotiations with potential international partners are proceeding. A range of alternative applications for the technology is being investigated. An additional agreement with Faulding covering gene therapy technology for the treatment of prostate cancer is being finalised and will include CSIRO's research collaborator in this area, the Prince of Wales Hospital.

MINERALS AND ENERGY

Energy Sector

Sustainable energy concept

CSIRO Energy Technology has completed an initial six-month feasibility study for a hybrid solar/fossil fuel system. The study has proved the engineering design of the project and sourced major components, including a solar dish, microturbines and fuel cells. The project, which received a major funding boost of \$4.8 million from the Chief Executive's Special Project program, offers efficiencies double that of today's coal-fired electricity generators and is capable of significantly reducing greenhouse emissions.

Dragline automation

The technical feasibility of automatically controlling the swing of draglines has been demonstrated in the first phase of a project designed to increase the efficiency of dragline operations, particularly in Australia's large open cut coal mining operations. The technology being developed in this project is expected to increase dragline productivity by at least 4 per cent. This translates to an average saving of \$3 million a year per dragline for a typical Australian coalmine. The project was carried out by CSIRO Manufacturing Science and Technology in conjunction with the Cooperative Research Centre for Mining Technology and Equipment, and was funded under the Australian Coal Association Research Program.

Streamlining coal port operations

CSIRO Mathematical and Information Sciences has developed planning software that helps managers at Dalrymple Bay Coal Terminal in Queensland to operate the facility more efficiently and in a way that is fair and cost effective for each of the terminal's users. The software incorporates

various levels of detail of the terminal's operation and can be used for planning a three-month or daily schedule.

Reclaiming fine coal

The feasibility of using a selective oil agglomeration process for the recovery of fine coal from washery tailings streams has been proven in pilot plants at two collieries in the Hunter Valley, New South Wales. The agglomeration process attaches the light fine coal to oil droplets, leaving the heavier unwanted mineral particles in free suspension. This makes the recovery of the fine coal more efficient and reduces the amount of fines that are currently wasted and left in unsightly tailings ponds. The process is well known, but economics is the key: advances have been made by CSIRO Energy Technology and Australian Mining Investments who are now seeking to commercialise the process.

Battery for Brisbane hybrid-electric bus

CSIRO Minerals has purpose-designed a gel battery for the revolutionary hybrid electric bus under development in Brisbane. This novel bus is expected to have performance and lifetime costs similar to those of diesel-powered vehicles, but will emit considerably less atmospheric pollution. The maintenance-free CSIRO battery is the first in the world to incorporate both gelled-electrolyte and high compression—a combination that offers significant life improvement over commercial products.

Scientists prepare to reap the wind

CSIRO scientists working in one of the most promising among the renewable energy sources—wind harvesting, have developed a modelling technique that pinpoints the areas of richest energy potential in terms of landscape and prevailing winds. Working with New South Wales energy supplier Pacific Power, a team from CSIRO Land and Water has identified a major wind 'hot spot' near Crookwell, New South Wales,

soon to be the home of Australia's largest and first grid-connected wind farm. With a good wind, the Crookwell farm will pump out a steady 5 megawatts from eight propeller-driven turbines.

Mineral Exploration and Mining Sector

Finding bigger orebodies by better methods

Exploration for diamonds, base metals and precious metals is being improved through the use of new equipment developed by CSIRO Exploration and Mining. Scientists in the Heavy Ion Analytical Facility (HIAF) laboratory have developed the AUSTRALIS (accelerator mass spectrometry for ultra sensitive trace element and isotopic studies) system and a proton microprobe to study new, highly sensitive, exploration methods designed to reduce discovery and evaluation time.

Volcano research helps find more nickel

A sustained research effort in Western Australia and overseas over the last decade has identified close links between nickel deposits and the emplacement mechanisms for ancient ultramafic lavas called komatiites with which the ore bodies are associated. Research in Hawaii has confirmed Australian findings by CSIRO Exploration and Mining that ancient ore deposits formed during the prolonged flow of lava in tubes that fed the extensive komatiite flow fields. This knowledge has been used successfully in the search for rich economic nickel orebodies of this type in Western Australia.

Airborne radar

Work currently underway through the Cooperative Research Centre for Landscape Evolution and Mineral Exploration has successfully demonstrated the use of airborne radar techniques for mineral exploration. The AIRSAR (AIRborne Synthetic Aperture Radar) system works

particularly well in arid or sand-covered regions where the more common remote sensing systems are less successful. For example, when used near the Telfer gold mine in Western Australia, the AIRSAR system gave significant new insights into the geological structure of the region.

Visual integration of mine planning

CSIRO Exploration and Mining scientists have developed a visual mine concept that will provide mine staff with a better understanding and interpretation of their data and improve the evaluation of risk for various mining scenarios. The 3D virtual mine concept links virtual reality computer modelling language, JAVA and the Internet to create a powerful tool for viewing and interacting with different types of information. It integrates mine planning, operational, geological and geophysical data. The opportunities to create virtual open cut and underground mines were demonstrated recently to 15 international organisations in a prototype system.

Design guidelines for highwall coal mining

Highwall mining has the potential to extend the life of some of Australia's current open cut coal operations by as much as 20 years, yielding many billions of dollars of coal far more economically than recovery by underground mining. This technique involves driving a series of parallel unsupported entries from the highwall of an open pit mine for a distance of up to 400 metres by remotely controlled continuous miners. A collaborative research project between CSIRO Exploration and Mining and BHP Coal Pty Ltd has assessed the stability of highwalls, unsupported spans and pillars, and mapped hazards, basing the investigation on a geological model for the site and the region. Guidelines resulting from this research are being successfully implemented and further refined for introduction at other mines.

Mineral Processing and Metal Production Sector

The first magnesium smelter in Australia

Commissioning of a large demonstration plant for the first magnesium smelter in Australia is well advanced. Work on the process commenced more than a decade ago at CSIRO Minerals and was subsequently developed by CSIRO and Queensland Metals through the Australian Magnesium Research and Development Project. CSIRO is conducting supporting research and transferring technology to the Australian Magnesium Corporation through secondment of key staff, who are contributing their expertise in the feasibility evaluation team for the demonstration plant.

New dry separation technology for mineral processing

CSIRO Minerals is patenting new particle separation devices that represent a technology breakthrough with the potential to change current industry thinking on dry particle separation in mineral processing. Results to date from the new generation prototypes show that remarkably high productivity and separation efficiencies can be obtained under a wide range of operating conditions and materials.

Fine nickel flotation

CSIRO Minerals has developed and patented a process for improving the flotability of fine nickel particles. The poor recovery of fine particles during the flotation process to produce a concentrate is the single largest technical problem in the recovery of nickel sulphides from nickel ores. It represents a loss of millions of dollars annually for the Australian industry. The researchers found that the major reason for the poor flotability is the

presence of coatings on the mineral surfaces.

Uranium and thorium analyser for ilmenite sand

CSIRO Minerals' new on-line analyser will assist Australia's mineral sands industry to respond to increasing market pressure from customers for premium products with low radioactivity. Designed and built by CSIRO with the support of Westralian Sands Ltd, the analyser measures the amount of uranium and thorium in ilmenite and plant products from the mineral sands industry. The analyser will assist with sorting and blending feedstocks, as well as monitoring plant products to ensure their radioactivity levels meet customer specifications.

Single stage continuous copper making process

Fundamental research at the GK Williams Cooperative Research Centre, in which CSIRO is a partner, has led to the development of a continuous process for copper making that can offer considerable economic and environmental benefits over conventional processes. The new process is currently being tested at pilot plant scale.

More QEM*SEM sales

CSIRO Minerals' new generation QEM*SEM automated mineral analysis software, released last year, continues to sell around the world. An agreement has been made with Leo Electron Microscopy Ltd to market the technology worldwide. Rio Tinto in Australia, Falconbridge in Canada and MINTEK in South Africa have purchased machines to add to previous sales in Australia and South Africa. In Australia, QEM*SEM analysis of native gold and gold in pyrite and tellurides was the key component of test work in a recent Kalgoorlie Consolidated Gold Mines project.

Fast-tracking calciner design

CSIRO Minerals has designed and optimised air and fuel-gas tuyeres that are central to

the operation of the fluidised bed section of Westralian Sands' calcination plant. By assembling a project team with both computational fluid dynamics and physical modelling skills, CSIRO was able to deliver an optimal solution on time, enabling the customer to meet a rigid commissioning schedule.

Petroleum Sector

Reservoir characterisation

Fractal mathematics have been used by CSIRO Petroleum Resources to create new and better algorithms and computer software for forecasting the properties of petroleum reservoirs. The software is now available to industry. The scientists have also succeeded in improving the integration of low resolution data with high resolution fractal geostatistics. This process makes a more effective use of surface and down-hole geophysical data for planning reservoir development.

Total drilling fluids management

CSIRO Petroleum Resources has developed state-of-the-art methodology for designing and optimising drilling fluids for the efficient management of shale instability. The outcomes of this research, funded by the Energy Research and Development Corporation, have encouraged two further major collaborative projects with American and Malaysian companies.

Geochemistry of reservoirs

A suite of innovative techniques has been developed by CSIRO Petroleum Resources for analysing oil trapped in fluid inclusions in reservoir sandstones. Collectively called MCI (molecular composition of inclusions), the techniques allow very high quality geochemical data to be obtained about oil reservoirs. Uptake of MCI by petroleum companies in 1997-1998 has been strong, with several large projects carried out on wells in the North-West Shelf and Timor Sea areas.

Thermal maturity

Following the development of laser fluorescence microscopy within CSIRO Petroleum Resources, a second generation optic-fibre fluorescence microprobe has been produced. The technology is used to make improved assessments of thermal maturity, a measure of the quality of the hydrocarbons in a reservoir. Maturity assessments have been made for a variety of sequences in the Northwest Shelf, the Timor Sea and from various basins worldwide. Thermal maturity and hydrocarbon generation modelling for sequences of the Dampier Sub-basin indicate that petroleum generation appears to play an important role in overpressuring, which may help choose exploration targets.

Helping in the hunt for oil and gas

Using science developed to study the movement of deep underground water, CSIRO scientists have devised a method for assessing whether petroleum reservoirs are likely to have retained or lost their oil and gas with time. The research is backed by 12 of the nation's major petroleum resources companies, the Australian Geological Survey Organisation (AGSO) and the Western Australian Government. This advance should lower the costs and risks of exploration and production and allow oil companies to estimate with much greater accuracy the size and characteristics of the fields they are exploiting.

Tracing pollution

Scientists from CSIRO Marine Research have traced hydrocarbon and faecal pollution in coastal ecosystems using advanced biomarker techniques. Major studies have monitored the fate of oil following the *Iron Baron* oil spill in Tasmania, and inputs of hydrocarbons and faecal matter from urban stormwater in Hobart.

Design criteria for the offshore petroleum industry

CSIRO Marine Research has been working with the industry consultant, WNI Science and Engineering, to provide estimates of water currents under tropical cyclones for the design of offshore platforms and seabed pipelines. The team has provided estimates to Wapet for its Gorgon development, and Woodside for the new Rankin trunkline. In both cases, ocean modelling software has been developed and validated against data by CSIRO, then transferred to WNI for compilation of a statistical design database by simulation of historical tropical cyclones.

RESEARCH AWARDS

The Chairman's Medal

The 1997 Chairman's Medal and CSIRO Medals were presented on 9 December 1997 by Mr Charles Allen, AO, Chairman of the Board.

The winners of the Chairman's Medal were Dr Ahmed Azad and the IBVD Vaccine Research Team—Dr Kevin Fahey, Dr Ian Macreadie, Dr Mittur Jagadish, Dr Peter Hudson, Dr Neil McKern, Dr Paul Vaughan, Dr Tony Chapman, Dr Hans-Georg Heine, Dr John Skicko, Mr Andrew Wolfe, Dr Dean Hewish, Dr Ian O'Donnell and Dr Colin Ward for their outstanding contributions to our knowledge of the structure and biology of the

Birnaviridae family of double-stranded RNA viruses leading to the development of a prototype recombinant vaccine against infectious bursal disease virus.

CSIRO Medals

The CSIRO Medals for 1997 for CSIRO staff were awarded to:

- Dr Jim Davidson, for contributions to wheat breeding and agronomy.
- Mr Paul Gottlieb, for his development of the QEM*SEM system for mineral analysis.
- Dr Raymond Smith, for contributions to mineral exploration.

No CSIRO External Medal was awarded.

Chairman's Medal

From left to right are Dr Hans-Georg Heine, Dr John Skicko, Dr Colin Ward, Dr Dean Hewish, Dr Paul Vaughan, Mr Andrew Wolfe, Dr Neil McKern, Dr Ahmed Azad, Mr Charles Allen, (Chairman) Dr Peter Hudson, Dr Ian O'Donnell and Dr Ian Macreadie. (Absent from photo are Dr Kevin Fahey, Dr Mittur Jagadish and Dr Tony Chapman.) Photo: Stewart Duff



CSIRO Medallists

From left to right are Mr Paul Gottlieb, Mr Charles Allen (Chairman), Dr Ahmed Azad, Dr Malcolm McIntosh (Chief Executive), Dr Jim Davidson and Dr Raymond Smith. Photo: Stewart Duff



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 1997 Award was presented on 11 November 1997 by the Honourable Mark Birrell, Minister for Industry, Science and Technology (Victoria). The winner was Dr Robin Bedding of the Division of Entomology for his work in the use of nematodes (unsegmented worms) for the traditional and novel biological control of a range of insect pests.



Sir Ian McLennan Award

From left to right are the Honourable Mark Birrell, MP, Sir Ian McLennan, winner of the 1997 Sir Ian McLennan Award, Dr Robin Bedding, and Sir Peter Derham.

Photo: Mark Fergus

APPENDIX 1.

Statutory reporting requirements

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

- a statement of the policies of the Organisation in relation to the carrying out of the scientific research of the Organisation that were current at the beginning of the year, together with a description of any developments in those policies that occurred during the year (see Corporate Overview and Corporate Development);
- any determinations made by the Minister under sub-paragraph 9(1)(a)(iv) of the Act during the year (see below);
- any directions or guidelines given by the Minister under section 13 of the Act during the year (see below);
- any policies notified by the Minister under section 14 of the Act during the year (see below);
- financial statements for the reporting year in a form in accordance with the Minister for Finance's Guidelines for Financial Statements of Commonwealth Authorities (see Financial Statements); and
- the Auditor-General's report on these statements (see Financial Statements).

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

APPENDIX 2.

Index of compliance with reporting guidelines

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APPENDIX 3.

Functions and powers of CSIRO

Functions of the Organisation

- (1) The functions of the Organisation are:
- (a) to carry out scientific research for any of the following purposes:
 - (i) assisting Australian industry;
 - (ii) furthering the interests of the Australian community;
 - (iii) contributing to the achievement of Australian national objectives or the performance of the national and international responsibilities of the Commonwealth;
 - (iv) any other purpose determined by the Minister;
 - (b) to encourage or facilitate the application or utilisation of the results of such research;
 - (ba) to encourage or facilitate the application or utilisation of the results of any other scientific research;
 - (bb) to carry out services, and make available facilities, in relation to science;
 - (c) to act as a means of liaison between Australia and other countries in matters connected with scientific research;
 - (d) to train, and to assist in the training of, research workers in the field of science and to cooperate with tertiary education institutions in relation to education in that field;
 - (e) to establish and award fellowships and studentships for research, and to make grants in aid of research, for a purpose referred to in paragraph (a);
 - (f) to recognise associations of persons engaged in industry for the purpose of carrying out industrial scientific research and to cooperate with, and make grants to, such associations;

- (g) to establish, develop and maintain standards of measurement of physical quantities, and in relation to those standards:
 - (i) to promote their use;
 - (ii) to promote, and participate in, the development of calibration with respect to them; and
 - (iii) to take any other action with respect to them that the Chief Executive determines;
 - (h) to collect, interpret and disseminate information relating to scientific and technical matters; and
 - (i) to publish scientific and technical reports, periodicals and papers.
- (2) The Organisation shall:
- (a) treat the functions referred to in paragraphs (1) (a) and (b) as its primary functions; and
 - (b) treat the other functions referred to in sub-section (1) as its secondary functions.

Powers of the Organisation

- (1) The Organisation has power to do all things necessary or convenient to be done for or in connection with the performance of its functions and, in particular, may:
- (a) arrange for scientific research or other work to be undertaken, on behalf of the Organisation, by any person or body;
 - (b) join in the formation of a partnership or company;
 - (c) make available to a person, on such conditions and on payment of such fees or royalties, or otherwise, as the Chief Executive determines, a discovery, invention or improvement to the property of the Organisation;
 - (d) pay to officers, or to persons undertaking work on behalf of the Organisation, such bonuses as the Chief Executive, with the approval of the Minister, determines in respect of discoveries or inventions made by them; and
 - (e) charge such fees, and agree to such conditions, as the Chief Executive

determines for research and other services carried out or facilities made available by the Organisation at the request of any person.

- (2) The Organisation shall not, without the written approval of the Minister, hold a controlling interest in a company.
- (3) An approval under sub-section (2):
 - (a) may be of general application or may relate to a particular company or proposed company; and
 - (b) may be given subject to conditions or restrictions set out in the instrument of approval;
- (4) Where the Organisation commences to hold a controlling interest in a company, the Minister shall:
 - (a) cause to be prepared a statement setting out particulars of, and the reasons for, the holding of that controlling interest; and
 - (b) cause a copy of the statement to be laid before each House of the Parliament within 15 sitting days of that House after:
 - (i) the Organisation commenced to hold that controlling interest; or
 - (ii) if the Minister is of the opinion that the disclosure of the holding of the controlling interest would affect adversely the commercial interests of the Organisation, the Minister ceases to be of that opinion.
- (5) Nothing is invalid on the ground that the Organisation has failed to comply with sub-section (2).
- (6) Where the Organisation holds a controlling interest in a company, the Organisation shall ensure that the company does not do any act or thing that, if done by the Organisation, would not be within the functions of the Organisation.

APPENDIX 4.

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 1998, CSIRO received 18 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 3 of this Annual Report.

Consultative procedures

Valuable input from industry and other users and stakeholders into the identification of strategic research needs and the formulation of policy and administration is obtained through formal advisory and consultative committees as well through receipt of representations from industry, scientific and employee groups. Membership of Sector Advisory Committees is listed in Appendix 7.

Categories of documents

CSIRO holds the following categories of documents:

- (1) Corporate records: containing information of corporate and residual value such as financial management and administration, buildings and property, personnel and industrial relations and scientific and industrial research.
- (2) Work group records: these are records generated within a work group such as research records and materials created in

the course of scientific and technical investigations including:

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

(3) Personal records.

The following CSIRO documents are customarily made available to the public free of charge: policy circulars; information circulars; staff circulars; *CoResearch* (staff newspaper); film catalogues; list of saleable publications; information service leaflets issued by Divisions on a wide range of technical subjects attracting frequent enquiries 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 2612—Scientific and technical publications including magazines, journals and books as well as CSIRO administrative manuals. A list of these manuals is available from the Freedom of Information (FOI) Coordinator.

Archives and disposal arrangements for documents

CSIRO maintains an archives collection in Canberra that has records dating from the establishment in 1916 of the Advisory Council for Science and Industry, the original predecessor of CSIRO. Certain Australian Archives Regional 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. Help will be given to people with disabilities in entering and leaving CSIRO premises.

FOI procedures and initial contact points

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

FOI Coordinator
CSIRO
Limestone Avenue
CAMPBELL ACT 2612

or

PO Box 225
DICKSON ACT 2602
Tel: (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 Australian Capital Territory 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 1997-98 the Privacy Commissioner did not undertake any investigations under s.36 of the *Privacy Act* 1988 in relation to CSIRO.

Privacy procedures and initial contact points

A central Privacy Coordinator manages CSIRO's privacy responsibilities.

Initial enquiries should be made to:

Privacy Coordinator
CSIRO
Limestone Avenue
CAMPBELL ACT 2612

or

PO Box 225
DICKSON ACT 2602
Tel: (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 1998, CSIRO received one request for statements of reason under the AD(JR) Act.

APPENDIX 5.

Trust Funds

William Mellrath

Fellowship Trust Fund

This trust was created in 1953 when Mr William Mellrath donated a cheque for £50 000 to CSIRO, to be held in trust and the income used for the appointment of a Senior Research Fellow in Animal Husbandry. In 1995 approval was gained to vary the trust to appoint a postgraduate student in the field of Animal Husbandry at the McMaster Laboratory in Prospect. 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.

A number of new excretory/secretory antigens from the larval stage of an important nematode parasite of sheep have been isolated. These antigens have been cloned using a novel, rapid cloning system developed by Ms MacDiarmid in order to overcome the tedious and expensive business of screening a cDNA library. Antigens that have potential as vaccine candidates will be cloned into different vaccine delivery vectors so that sheep immune responses can be analysed.

Sir Ian McLennan Achievement for Industry Award Fund

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 Robin Bedding, of CSIRO Entomology (see p53).

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 1997-98, totalling \$129 700. They were given to support eminent overseas scientists selected to work for a period in CSIRO Divisions.

Six Research Fellowships and one Visiting Fellowship were awarded. For the former, the Fellow is actively involved in a CSIRO research project for three to 12 months. For the latter, the Fellow undertakes to review and make

recommendations on a specific area of research, or a program of public lectures and high level discussions on research policy and management, or other activities approved by the selection committee.

The Ken and Yasuko Myer Plant Science Research Fund

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

One Myer Fellow, Dr Candice Sheldon, has identified a gene that controls flowering time in a model plant and is now attempting to isolate this gene in other species. She has also identified a gene that mediates the interaction between the hormone gibberellin and plant growth and development, which includes the ability to initiate flowering.

The second Myer Fellow, Dr Frank van der Loo, has identified genes in bacteria that produce indigoidine, a chemical very similar to indigo in colour. He is attempting to transfer these genes into plants; one result could be the production of naturally blue cotton.

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 1997-98.

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.

Grants from the fund were advertised, eliciting a strong response. Seven grants were approved for a total of \$13 112.

APPENDIX 6.

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.

More information about Sectors is on CSIRO's WWW site at <http://www.csiro.au/csiro/structure/index.html>

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

Wool and Textiles

- 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 7.

Sector Advisory Committees, as at 30 June 1998

(Updated information is on WWW at <http://www.csiro.au/csiro/structure/sac.htm>)

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
Consultant

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
Department of Crop Science
University of Sydney

Mr Brendan Stewart
President
Grains Council of Australia

Food Processing Sector

Chairman

Mr Steve Marshall
Group Director Corporate Technology
Goodman Fielder Ltd

Members

Mr Simon Brooke-Taylor
Australian & New Zealand Food Authority

Professor Ken Buckle
Department Food Science & Technology
University of New South Wales

Dr Bryan Cox
Director
Clever Country Research Pty Ltd

Dr Paul Donnelly
Managing Director
Dairy R&D Corporation

Dr Roger MacBean
R&D Technical Manager
QUF Industries Ltd

Mr Hans Sidler
General Manager, National Food Buying
Woolworths Supermarkets

Mr Peter Wallace
Chief Executive Officer
National Heart Foundation

Dr Peter White
Executive Director, Rural Industries Export
Development Unit
Queensland Department of Primary Industries

Dr Robert Young
General Development Manager
Unifoods

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 Gary Bacon
Director
Queensland Department of Primary Industries,
Fisheries and Forestry

Dr Ian Bevege
Principal Adviser
Australian Centre for International
Agricultural Research

Mr Ian Dench
General Manager
AMCOR Research & Technology Centre

Mr Peter Law
General Manager, Engineering
Boral Timber Industries Ltd

Mr Richard Rawson
Executive Director, Forests Service
Department of Natural Resources and
Environment, Victoria

Mr Mark Thomas
Chief Executive
Greening Australia

Mr Peter Yuile
First Assistant Secretary
Forests Division
Department of Primary Industries and Energy

Horticulture Sector

Chairman

Mr David Pullar
David Pullar & Associates

Members

Mr Tony Biggs
Editor, *Good Fruit & Vegetables*
Rural Publishers Ltd

Mr Bob Calder
Assistant Secretary, Agribusiness Branch
Department of Primary Industries & Energy

Mr Brian Carroll
Chairman
Ausveg Board

Mr Phillip Laffer
Director of Viticulture & Winemaking
Orlando-Wyndham Pty Ltd

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 Robin Hart
Chairman
Kerwee Pastoral Company

Mr John Landy
Chairman
Meat Research Corporation

Ms Wendy Lapointe
Veterinarian & beef producer

Dr Gardner Murray
Consultant

Mr Wayne Sanderson
Executive Director, R&D Technical Services
Murray/Goulburn Co-op Co Ltd

Mr Ervin Vidor
Director & Chairman
Sea Farms Ltd

Mr Shane Walsh
Beef producer

Mr Tony Wharton
Chief Executive Officer
Q-Meat

Wool and Textiles Sector

Chairman

Ms Margaret Moroney
Margaret Moroney Pty Ltd

Members

Mr John Blood
Textile & garment consultant

Mr Ray Chapman
Managing Director
COOGI Australia Pty Ltd

Mr Bill Cook
Manager, Financial Analysis
Wooltech

Mr Trevor Dawson
Managing Director
Rocklea Spinning Mills Pty Ltd

Dr Brian Fisher
Executive Director
Australian Bureau of Agricultural & Resource
Economics

Mr Guy Fitzhardinge
Livestock Producer

Mr John Menzies
Managing Director
Austanners

Mr Andrew Vizard
Veterinary Clinical Centre
University of Melbourne

Mr David Ward
Managing Director
Australian Wool Testing Authority Ltd

Mr Brian van Rooyen
Managing Director
Australian Country Spinners

Environment and Natural Resources

Biodiversity Sector

Chairman

Ms Robyn Kruk
Director General's Unit
NSW Premiers Department

Members

Mr Malcolm Forbes
Executive Director, Biodiversity Conservation
Environment Australia

Dr Des Griffin
Executive Director
Australian Museum

Mr Colin Griffiths
Director, Biodiversity Conservation
Environment Australia

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

Mr Oleg Morozow
Manager Environmental Affairs
Santos Ltd

Members

Mr Ian Carruthers
Executive Manager Greenhouse Policy Group
Australian Greenhouse Office
Environment Australia

Dr Stephen Corbett
Acting Director R&D
NSW Health

Dr Doug Gauntlett
Deputy Director (Research & Systems)
Bureau of Meteorology

Mr Mark McKenzie
Engineering & Environment
National Roads & Motorists Association

Mr Michael Rae
Manager Sustainable Development
World Wide Fund for Nature

Dr Peter Scaife
Director, Centre for Sustainable Technology
University of Newcastle

Dr Ros Taplin
Taplin Ecoconsulting

Mr Frank van Schagen
Executive Director
Department of Natural Resources, Queensland

Land and Water Sector

Chairman

Dr Wendy Craik
Executive Director
National Farmers Federation

Members

Dr Joe Baker
Chairman
National Landcare Advisory Committee

Mr Don Blackmore
Chief Executive
Murray Darling Basin Commission

Mr Andrew Campbell
Assistant Secretary, Sustainable
Landscapes Branch
Environment Australia

Dr John Langford
Executive Director
Water Services Association

Dr Phil Price
Executive Director
Land & Water Resources R&D Corp

Dr Graeme Robertson
Chief Executive Officer
Agriculture WA

Ms Kathryn Tayles
General Manager Environmental Policy
Rio Tinto Ltd

Marine Sector

Chairman

Professor Graeme Kelleher
Vice Chair, IUCN Commission on
National Parks & Protected Areas

Members

Dr Peter Bridgewater
Chief Science Advisor
Environment Australia

Mr Ron Eagle
Consultant

Ms Mary Harwood
Assistant Secretary, Fisheries Branch
Department of Primary Industries & Energy

Mr Ted Loveday
President
Queensland Commercial Fishermens
Organisation

Professor Helene Marsh
Tropical Environment Studies & Geography
James Cook University

Dr Peter O'Clery
Director
O'Clery & Associates

Dr Russell Reichelt
Director
Australian Institute of Marine Studies

Mr Richard Stevens
Managing Director
Australian Fisheries Management Authority

Information Technology,
Infrastructure and
Services

Built Environment Sector

Chairman

Dr Jack Wynhoven
Chief Executive
Connell Wagner

Members

Mr Richard Dinham
Managing Director
SJPH Design Partnership

Mr Alan Evans
First Assistant Secretary, Industry Division A
Department of Industry, Science & Tourism

Mr Ian Johnston
Chief Executive Officer
Government Property Office (WA)

Mr Vincent O'Rourke
Chief Executive
Queensland Rail

Dr Michael Sargent
Chief Executive Officer
Transfield Power Systems

Mr Bill Service
Director
Saltcoats Consulting Pty Limited

Mr David Thomson
Director Technology
Roads & Traffic Authority (NSW)

Ms Yvonne von Hartel
Senior Partner
Robert Peck von Hartel Trethowan

Mr Lionel Wonneberger
Managing Director
Thomson Radar Australia Corporation

Information Technology and
Telecommunications Sector

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Ernst & Young

Members

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Consultant

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Managing Director
Aspect Computing Pty Ltd

Mr Rob Cook
Chief Executive
CITR Pty Ltd

Mr David Laidlaw
General Manager Solutions Development
ISSC Australia

Mr Andy Macdonald
Secretary/Chief Government
Information Officer
Office of Government Information Technology

Mr Peter Rule
Director Strategic Development
Ericsson Australia Pty Ltd

Dr Ockert van Zyl
Executive Director Telecommunications-
Manufacturing
Siemens Ltd

Measurement Standards Sector

Chairman

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Members

Mr John Birch, AM
Executive Director
National Standards Commission

Professor Lawrence Cram
School of Physics
University of Sydney

Ms Margaret Fanning
Assistant Secretary, Business Environment
Branch
Department of Industry, Science & Tourism

Mr John Gilmour
Chief Executive
National Association of Testing Authorities
Australia

Mr John Hulbert
Executive Director
Joint Accreditation System of Australia and
New Zealand

Mr Ian Monro
Principal Consultant Testing & Measurement
Testing & Certification Australia

Mr Chris Nesbitt-Hawes
Consultant

Mr Ross Wraight
Chief Executive
Standards Australia

Radio Astronomy Sector

Chairman

Dr Rachel Webster
School of Physics
University of Melbourne

Members

Dr Jacqueline Bergeron
European Southern Observatory, Germany

Professor Paul Goldsmith
National Astronomy & Ionosphere Centre
Cornell University, USA

Professor Hirashi Hirabayashi
Deep Space Communication & Research
Institute of Space & Astronautical Science,
Japan

Professor Peter McCulloch
Physics Department
University of Tasmania

Professor Jeremy Mould
Director
Mount Stromlo & Siding Springs Observatories

Dr John O'Sullivan
Director of Technology
News Ltd

Dr Marcus Price
Officer in Charge
Australia Telescope National Facility

Dr Peter Scaife
Director, Centre for Sustainable Technology
University of Newcastle

Professor John Storey
School of Physics
University of New South Wales

Service Sector

Chairman

Mr Peter O'Grady
Quality consultant

Members

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Director Information Services
Coles Myer Ltd

Ms Carmel Cray
Managing Director
Logica

Ms Judith King
Executive Director
Australian Coalition of Service Industries

Mr Michael Mannington
Director
ID Tours

Mr Roger Nairn
National Australia Bank

Dr John Primrose
Senior Medical Advisor,
Pharmaceutical Benefits
Department of Health & Family Services

Mr Seong Who Choo
Senior Manager R&D
National Roads & Motorists Association

Mr Victor Skladnev
Managing Director
Polartechnics

Manufacturing

Chemicals & Plastics Sector

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General Manager Technology
Orica Ltd

Members

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Analchem Bioassay
- Mr Claude Gauchat
Executive Director
Avcare
- Mr Leo Hyde
R&D Manager
Du Pont Australia Ltd
- Mr Roger Karge
Managing Director
Innovative Technology & Licensing Australia
(Chemicals)
- Mr Michael MacKellar
Chief Executive Officer
Plastics & Chemicals Industries Association
- Professor Ian Rae
History & Philosophy of Science
University of Melbourne
- Mr Greg Rappo
General Manager
Chemicals & Agricultural Products Division
Abbott Laboratories
- Mr Doug Rathbone
Chief Executive Officer
Nufarm Pty Ltd

**Integrated Manufactured
Products Sector**

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Company Director

Members

- Mr Peter Coates, CBE
Chairman
Ceramic Fuel Cells Ltd
- Mr Keith Croker
Acting Head Industry Division B
Department of Industry, Science and Tourism
- Mrs Patricia Crook
Managing Director
Dyneck Pty Ltd
- Mr Frank Cunningham
Manager Business Development
BHP Research Laboratories
- Mr Keith Daniel
Chief Executive Officer
AMBRI Pty Ltd

- Mr Vince Evans
Technical Service Manager
Federation of Automotive Products
Manufacturers
- Mr Roger James
Industry Specialist - Aviation & Aerospace
Manufacturing Technology Unit
Business Victoria
- Mr Ross McNeil
General Manager
ANI Engineering Technology Group
- Mr Stuart Romm
Chief Executive
H.P.M. Industries Pty Ltd
- Mr Antony Simpson
Company Director
- Mr Robert Trenberth
Consultant
Ernst & Young
- Dr Katherine Woodthorpe
Associate
IT Services

**Pharmaceuticals & Human
Health Sector**

Chairman

- Professor John Funder
Director
Baker Medical Research Institute

Members

- Ms Dallas Ariotti
Health economist
- Mr Pat Clear
Chief Executive Officer
Australian Pharmaceutical Manufacturers
Association Inc
- Dr Bill Coote
Secretary General
Australian Medical Association Ltd
- Mr Malcolm Eppingstall
Archer Consulting Group
- Ms Patricia Kelly
Assistant Secretary, Purchasing,
Pharmaceutical and Environmental
Industries Branch
Department of Industry, Science & Tourism

Dr Graham Mitchell
Foursight Associates Pty Limited

Mr Graham Thurston
Secretary
Australian Diagnostic
Manufacturers Association

Minerals and Energy

Energy Sector

Chairman

Mr Keith Orchison
Executive Director
Electricity Supply Association of Australia

Members

Ms Margaret Beardow
Benchmark Economics

Mr Noshir Bharucha
Director Energy Innovation Section
Department of Primary Industries & Energy

Mr Robyn Bryant
Assistant Secretary, Coal Development Branch
Department of Primary Industries & Energy

Mr David Cain
General Manager
Energy Technology Technical Group
Rio Tinto

Mr George Edwards
George Edwards Consulting Services Pty Ltd

Mr Ross Graham
Director
Australian Coal Research Ltd

Professor Don Nicklin
Consultant

Mr Bruce Robertson
Consulting Mining Engineer
Shell Coal Australia Ltd

Dr John Sligar
Director
Sligar & Associates Pty Ltd

Dr Jim Smitham
Manager Research - Mineral & Petroleum
Programs
BHP Research

Mr George Webb
Research Manager
Australian Gas Association

Dr John Zillman
Director
Bureau of Meteorology

Mineral Exploration & Mining Sector

Chairman

Mr Dick Carter
Consultant

Members

Mr Alan Broome
Chairman
AUSTMINE-ACIRL

Mr Alan Castleman
Chairman
Australian Unity

Mr Keith Croker
Acting Head Industry Division B
Department of Industry, Science and Tourism

Mr Mark Cutifani
Group Executive Mining
Normandy Ltd

Mr Dick Davies
Chief Executive Officer
Australian Mineral Industries
Research Association

Dr Geoff Dickie
Director, Resource Development Division
Department of Mines and Energy, Queensland

Dr Ross Farden
Consultant

Mr Jeff Harris
Assistant Secretary
Coal and Minerals Industry Division
Department of Primary Industries and Energy

Dr Neil Phillips
General Manager Geology
Great Central Mines

Mr Lee Ranford
Director General
Department of Mines and Energy WA

Dr Vivienne Snowden
Joint Managing Director
Snowden Associates

Dr Tom Whiting
Manager Exploration - Australia & SW Pacific
BHP Minerals

Mr Mark Woffenden
General Manager Mine Planning & Technology
Hamersley Iron Pty Ltd

Mineral Processing & Metal
Production Sector

Chairman

Mr Ian Lawrence
Lawrence Consultants Pty Ltd

Members

Dr Robin Batterham
Vice President Research & Technology
Rio Tinto Ltd

Mr Dick Davies
Chief Executive Officer
Australian Mineral Industries
Research Association

Mr John den Dryver
Executive General Manager
Normandy Mining Limited

Mr Mike Eager
Managing Director
Aberfoyle Limited

Dr Robert Hobbs
General Manager Corporate Research
BHP Co Ltd

Dr Bruce Kelley
General Manager
Rio Tinto Technology Development

Mr Phil Lansdown
Manager Chemicals, Plastics, Metals &
Mineral Processing
Department of Industry, Science & Tourism

Mr Jim Mitchell
General Manager Technical Services
North Limited

Dr John Tilley
Assistant Secretary Minerals Branch
Department of Primary Industries & Energy

Mr John Winckel
Executive General Manager Metals
Pasminco Limited

Petroleum Sector

Chairman

Dr Agu Kantsler
General Manager New Ventures
Woodside Offshore Petroleum Pty Ltd

Members

Mr Frank Aquino
Well Construction Manager
Woodside Offshore Petroleum Pty Ltd

Mr Charles Balnaves
Group Manager Petroleum Engineering
BHP Petroleum Pty Ltd

Dr Peter Goode
General Manager Petroleum Department
Santos Ltd

Dr Rodney Halyburton
Manager Petroleum Technology, PNG
BHP Petroleum Pty Ltd

Mrs Eve Howell
Deputy Managing Director
Apache Energy Ltd

Dr John McPherson
Senior Geological Adviser
Mobil Exploration & Producing
Australia Pty Ltd

Mr Rob Male
Alliance Contract Manager
Woodside Offshore Petroleum Pty Ltd

Mr Michael Sayers
Geophysicist
West Australian Petroleum Pty Ltd

Dr Robert Willink
General Manager - Oil & Gas Exploration
Boral Energy Resources Ltd

APPENDIX 8.

Cooperative Research Centres Program

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

CSIRO is involved in 53 of the 67 CRCs established under the CRC Program to 30 June 1998 and will take part in a number of the 1998 Cooperative Research Centre applications, which close in September.

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

Communications 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

FINANCIAL STATEMENTS



INDEPENDENT AUDIT REPORT

To the Minister for Industry, Science and Tourism

Scope

I have audited the financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1998. The financial statements comprise:

- Statement by the 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 for Industry, Science and Tourism.

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 (Urgent Issues Group Consensus Views) 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 operations 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 the Guidelines for Financial Statements of Commonwealth Authorities
- (ii) the financial statements give a true and fair view, in accordance with applicable Accounting Standards, other mandatory professional reporting requirements and the Guidelines for Financial Statements of Commonwealth Authorities, of the financial position of the Commonwealth Scientific and Industrial Research Organisation as at 30 June 1998 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
7 September 1998

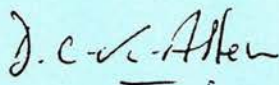
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BARTON ACT
Phone (02) 6203 7300 Fax (02) 6203 7777

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

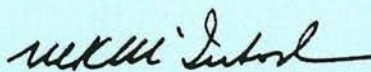
BOARD MEMBERS' STATEMENT

In our opinion, the attached financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1998 present fairly the information required by the Minister for Finance and Administration's *Guidelines for Financial Statements of Commonwealth Authorities*.

Signed at Canberra this 31 day of August 1998 in accordance with a resolution of the Board Members.



D C K Allen
Chairman



M K McIntosh
Chief Executive
and Board Member

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

OPERATING STATEMENT

For the year ended 30 June 1998

	Notes	1998 \$'000	1997 \$'000
NET COST OF SERVICES			
Operating expenses			
Business Units			
Animal Health (incl. Australian Animal Health Laboratory)		21 416	22 434
Animal Production		19 666	21 661
Atmospheric Research		14 885	13 446
Australia Telescope National Facility		14 963	11 129
Building, Construction & Engineering		26 739	26 938
Energy Technology		19 764	20 105
CSIRO Discovery Centre		98	-
CSIRO Publishing		5 180	5 858
Entomology		29 679	28 552
Exploration & Mining		32 348	29 658
Food Science & Technology		10 053	22 139
Food Science Australia Joint Venture	21	9 684	-
Forestry & Forest Products		30 767	30 100
Human Nutrition		8 395	9 433
Land & Water		46 030	46 188
Magnesium Project		3 733	2 266
Marine Research		35 486	34 143
Manufacturing Science & Technology		40 894	39 698
Mathematical & Information Sciences		28 812	29 612
Mediterranean Agricultural Research		66	229
Minerals		34 479	33 381
Molecular Science		35 701	33 702
ORV <i>Franklin</i> National Facility		4 964	5 163
Petroleum Resources		9 856	9 264
Plant Industry		46 226	46 077
Telecommunications & Industrial Physics (incl. National Measurement Laboratory)		51 554	45 782
Tropical Agriculture		33 811	32 100
Wildlife & Ecology		22 358	22 619
Wool Technology		25 264	26 514
Corporate Activities	4 (b)	39 681	45 611
Total operating expenses	4 (a)	702 552	693 802
Operating revenues from independent sources			
Revenue from research activities and user charges		219 048	209 232
Other revenue	5	30 574	35 436
Total operating revenues from independent sources		249 622	244 668
Net cost of services		452 930	449 134
REVENUES FROM GOVERNMENT			
Parliamentary appropriations received	6	466 837	444 502
Surplus/(deficit) of revenues from Government over net cost of services		13 907	(4 632)
Accumulated surpluses at beginning of reporting period		613 433	618 065
		627 340	613 433
Revenue measure – payment to Government	7	(30 000)	-
Accumulated surpluses at end of reporting period		597 340	613 433

The accompanying notes form part of these financial statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

STATEMENT OF ASSETS AND LIABILITIES

As at 30 June 1998

	Notes	1998 \$'000	1997 \$'000
DEBT			
Leases	8	19 534	18 998
Total debt		19 534	18 998
PROVISIONS AND PAYABLES			
Employees	9	139 027	135 639
Suppliers	10	18 112	22 033
Other	11	142 154	142 422
Total provisions and payables		299 293	300 094
Total liabilities		318 827	319 092
EQUITY			
Reserves		252 407	252 407
Accumulated surpluses		597 340	613 433
Total equity	12	849 747	865 840
Total liabilities and equity		1 168 574	1 184 932
FINANCIAL ASSETS			
Cash	13	28 042	44 341
Receivables	14	44 580	38 438
Investments	15	94 245	84 975
Total financial assets		166 867	167 754
NON-FINANCIAL ASSETS			
Land and buildings	16	817 522	844 736
Plant and equipment	17	165 597	158 242
Inventories	18	876	1 011
Other	19	17 712	13 189
Total non-financial assets		1 001 707	1 017 178
Total assets		1 168 574	1 184 932
Current liabilities		127 961	140 294
Non-current liabilities		190 866	178 798
Current assets		93 641	86 550
Non-current assets		1 074 933	1 098 382

The accompanying notes form part of these financial statements

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

STATEMENT OF CASH FLOWS For the year ended 30 June 1998

	Notes	1998 \$'000	1997 \$'000
OPERATING ACTIVITIES			
Cash received			
Appropriations		466 837	444 502
Sales of goods and services		239 879	240 989
Interest		2 153	2 110
Other		497	5 162
		709 366	692 763
Cash used			
Employees		408 304	406 186
Suppliers		230 122	214 705
Interest and other financing costs		1 276	511
		639 702	621 402
Net cash provided by operating activities	20	69 664	71 361
INVESTING ACTIVITIES			
Cash received			
Proceeds from sale of property, plant and equipment		22 737	22 325
Proceeds from sale of equity instruments		156	1 309
		22 893	23 634
Cash used			
Purchase of property, plant and equipment		68 672	76 360
Purchase of equity investment		829	-
		69 501	76 360
Net cash used by investing activities		(46 608)	(52 726)
FINANCING ACTIVITIES			
Cash received			
Proceeds from debt		5	-
Cash used			
Revenue measure - payment to Government		30 000	-
Repayment of debt		-	10 514
Net cash used by financing activities		(29 995)	(10 514)
Net increase/(decrease) in cash held		(6 939)	8 121
Cash at 1 July		128 287	120 166
Cash at 30 June		121 348	128 287
For the purpose of the Statement of Cash Flows, cash is represented by:			
Cash at bank and on hand	13	14 770	30 114
Cash at bank - trust monies	11 & 13	13 096	12 836
Deposits - at call	13	176	1 391
Short term bank bills	15	2 539	-
R&D Syndicate deposits - under contract	15	90 767	83 946
		121 348	128 287

The accompanying notes form part of these financial statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

SCHEDULE OF COMMITMENTS As at 30 June 1998

	1998 \$'000	1997 \$'000
By Type		
Commitments payable		
Capital commitments		
Land and buildings	16 630	5 666
Plant and equipment	11 468	10 097
Total capital commitments	28 098	15 763
Other commitments		
Operating leases	12 277	10 822
Research and development commitments	252 454	271 268
Other commitments	2 249	595
Total other commitments	266 980	282 685
Total commitments payable	295 078	298 448
Commitments receivable		
Research and development commitments	233 193	251 915
Other receivables	11 978	9 622
Total commitments receivable	245 171	261 537
Net commitments	49 907	36 911

By Maturity

All net commitments		
One year or less	37 573	25 729
From one to two years	4 334	4 271
From two to five years	4 909	4 613
Over five years	3 091	2 298
Net commitments	49 907	36 911
Operating lease commitments		
One year or less	3 866	2 384
From one to two years	4 202	2 344
From two to five years	2 535	4 279
Over five years	1 674	1 815
Total operating lease commitments	12 277	10 822

The accompanying notes form part of these financial statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

SCHEDULE OF CONTINGENCIES As at 30 June 1998

	1998 \$'000	1997 \$'000
Contingent losses		
Performance guarantees	–	1 427
Estimated legal claims arising from employment, motor vehicle accidents and contractual disputes. These matters are being fully defended.	700	383
	<hr/> 700	<hr/> 1 810
Contingent gains		
Legal claims	(259)	–
	<hr/> 441	<hr/> 1 810

SCHEDULE OF UNQUANTIFIABLE CONTINGENCIES As at 30 June 1998

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 identifies a range of potential environmental risks associated with storage of low level radioactive waste at Woomera, South Australia, 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 has 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

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Equity	12	88
Cash	13	88
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COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

Note 1 Summary of significant accounting policies

1.1 Basis of Accounting

The financial statements are a general purpose financial report.

As required by sub-section 51(2) of the *Science and Industry Research Act 1949*, the financial statements are prepared in accordance with the *Guidelines for Financial Statements of Commonwealth Authorities* issued by the Minister for Finance in July 1997 (the 'Guidelines') which require that the financial statements:

- comply with the Australian Accounting Standards and the Accounting Guidance Releases issued by the Australian Accounting Research Foundation 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 Principles of Consolidation

As at 30 June 1998, CSIRO has provided in-kind contributions totalling 34 per cent and 38.6 per cent of the total resources of Biomolecular Research Institute Limited and Ceramic Fuel Cells Limited respectively. These contributions have been accounted for in CSIRO's Operating Statement (Note 22). CSIRO does not have the capacity to control the Boards or financial and operating policies of the companies. Having considered this matter and their immaterial effect on CSIRO's financial statements, CSIRO has, in accordance with Australian Accounting Standard AAS24, elected not to consolidate these accounts.

1.4 Taxation

In accordance with section 53 of the *Science and Industry Research Act 1949*, CSIRO is exempt from all forms of Australian taxation except fringe benefits tax.

1.5 Foreign Currency Transactions

Foreign currency transactions are initially translated into Australian currency at the rate of exchange at the date of the transaction. At balance date, amounts receivable and payable in foreign currencies are translated to Australian currency at rates of exchange current 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 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 losses in excess of normal self insurance.

1.7 Revenue Recognition

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

Revenue from contract research activities is recognised in the Operating Statement when work is performed. The balances of 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.

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

1.8 Inventories Held for Resale

Inventories disclosed in Note 18 include books, CD-ROMs and videos which, for the first time, have been brought to account as an asset in the Statement of Assets and Liabilities this financial year. They are held for resale and valued at the lower of cost and net realisable value. This change in accounting policy has increased the operating surplus by \$695 309. In addition, residential property held for resale at cost is included in 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 associated companies that 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.

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

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 1998 no research and development costs nor 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 Guidelines require that property be revalued in accordance with the "deprival" method of valuation (as set out in the *Guidelines on Accounting Policy for Valuation of Assets of Government Trading Enterprises*) and thereafter every three years.

All land, buildings and leasehold improvements were revalued in June 1996 using methods that comply with the Guidelines.

Land that will continue to be used for research activity was valued by CSIRO's registered valuer, George Harley AAVLE at "existing use value" and the valuation adopted as Board Members' valuation. 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 by registered external valuers, Paul McBurnie FVLE(Vall), AVLE(Econ), and Ross Stevens AVLE(Vall), at market value and the valuation adopted as Board Members' valuation.

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

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

1.16 Plant and Equipment

All plant and equipment is valued at historical cost. The capitalisation threshold limit is \$3 000. The \$3 000 threshold was selected because it facilitated 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 that is purchased from contract research funds and where the sale proceeds are refunded to the contributors under the terms of the agreements, is 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.

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	2 years (with 80 per cent residual value)
• Agricultural and transport equipment	5 years (with 10 per cent residual value)
• Computing, scientific, workshop, furniture and office equipment	5 to 7 years
• Research Vessels	20 years
• Australia Telescope	30 years

The aggregate amount of depreciation and amortisation for the year is disclosed in Note 4(a).

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

The provision for annual leave reflects the value of total annual leave entitlements of all employees at 30 June 1998 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 1998. In determining the present value of the liability, attrition rates and pay increases through promotion and inflation have been taken into account.

1.19 Superannuation

CSIRO discharges its liability for 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 per cent of salary (CSS) and 10.2 per cent of salary (PSS). These contribution rates are determined by regular actuarial review. In addition a 3 per cent employer productivity benefit is contributed for CSS and PSS members. For term employees who have chosen not to join CSS or PSS, a 6 per cent 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 proportionate interests in the assets, liabilities, revenue and expenses of a joint venture, Food Science Australia (FSA), have been incorporated in the financial statements. Details of the joint venture are disclosed in Note 21.

1.24 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.

	1998 \$'000	1997 \$'000
Note 4 (a) Operating expenses		
Goods and services expenses:		
Employee expenses		
Remuneration for services provided	405 431	401 759
Separation and redundancy	6 438	11 002
	411 869	412 761
Suppliers expenses		
Supply of goods and services	221 969	214 413
Operating lease rental	2 938	2 682
	224 907	217 095
Depreciation and amortisation		
Depreciation and amortisation of property, plant and equipment	61 257	62 591
Amortisation of finance leased assets	532	553
	61 789	63 144
Net foreign exchange losses		
Non-speculative	202	-
Net losses from sale of assets		
Property, plant and equipment	751	-
	953	-
Write-down of financial assets		
Receivable for goods and services	239	41
Investment – associate companies	829	-
	1 068	41
Interest and other expenses:		
Finance lease charges – current year	601	511
Finance lease charges – prior years' adjustment	1 207	-
Refit expense for research vessels	158	250
	1 966	761
Total operating expenses	702 552	693 802
(b) Corporate activities – operating expenses		
Corporate Business	2 040	2 285
Corporate Executive Office	6 443	5 952
Corporate Finance	2 156	2 226
Corporate Human Resources	4 212	3 655
Corporate Property	1 705	1 813
Corporate Training	1 164	1 298
Executive	6 771	7 195
Information Technology Services	7 687	13 427
Risk Assessment & Audit	1 251	1 360
Strategic Planning	430	556
Other	5 822	5 844
	39 681	45 611

1998
\$'000

1997
\$'000

Note 5 Other revenue from independent sources

Department of Primary Industries and Energy's contribution to the operation of the Australian Animal Health Laboratory National Facility

6 090 6 047

Interest

2 154 2 110

Royalties and license fees

5 262 5 141

Sale of produce and livestock

4 735 7 116

Fees for provision of services

9 547 10 588

Rental proceeds

2 292 1 737

Net foreign exchange gains

- 47

Net gains from disposal of property, plant and equipment

- 1 772

Net gains from sale of shares

66 673

Miscellaneous

428 205

Total other revenue from independent sources

30 574 35 436

Note 6 Revenue from Government

Parliamentary appropriations received:

Appropriation Acts Nos. 1 and 3, 1997/98

439 433 417 102

Appropriation Acts Nos. 2 and 4, 1997/98

27 404 27 400

Total revenue from Government

466 837 444 502

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 \$60 million to be paid periodically to the Government over three years. During the year CSIRO paid \$30 million (1996/97 \$nil) to the Government.

Note 8 Finance lease liabilities

Lease liabilities recognised in the Statement of Assets and Liabilities:

Current

296 377

Non-Current

19 238 18 621

Total finance lease liabilities

19 534 18 998

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

Within one year

971 888

Within one to two years

992 930

Within two to five years

3 054 2 838

More than five years

22 725 20 291

27 742 24 947

Service and maintenance charges

(1) -

Minimum lease charges

27 741 24 947

Future finance charges

(8 207) (5 949)

Total finance lease liabilities

19 534 18 998

Note 9 Liabilities to employees

Accrued wages and salaries

6 651 4 408

Provision for recreation leave

42 696 46 707

Provision for long service leave

89 680 84 524

Total liabilities to employees

139 027 135 639

		Notes	1998 \$'000	1997 \$'000		
Note 10	Liabilities to suppliers					
	Trade creditors		18 112	19 387		
	Operating lease rentals		-	2 646		
	Total liabilities to suppliers		18 112	22 033		
Note 11	Other liabilities					
	Contract research revenue received in advance	1.7	37 624	44 278		
	R&D Syndicates – under contract	23	90 917	84 096		
	Trust monies	13	13 096	12 836		
	Other creditors		517	1 212		
	Total other liabilities		142 154	142 422		
Note 12	Equity – movement summary 1997/98					
		Asset	Asset			
	Description	Accumulated Surpluses \$'000	Revaluation Reserve \$'000	Realisation Reserve \$'000	Total Reserves \$'000	Total Equity \$'000
	Balance at 1.7.97	613 433	236 654	15 753	252 407	865 840
	Surplus	13 907	-	-	-	13 907
	Revenue measure – payment to Government	(30 000)	-	-	-	(30 000)
	Transfers to/(from) reserves	-	(9 213)	9 213	-	-
	Balance at 30.6.98	597 340	227 441	24 966	252 407	849 747
				Notes	1998 \$'000	1997 \$'000
Note 13	Cash					
	Cash at bank and on hand				14 770	30 114
	Cash at bank – trust monies			11	13 096	12 836
	Deposits – at call				176	1 391
	Total cash				28 042	44 341
Note 14	Receivables					
	Goods and services				23 461	21 858
	Provision for doubtful debts				(473)	(327)
					22 988	21 531
	Property sales				15 722	11 447
	Other				5 870	5 460
	Total receivables				44 580	38 438
	Receivables overdue by:					
	Less than 30 days				4 247	2 778
	Between 30 and 60 days				1 229	1 451
	Between 60 and 90 days				677	533
	Greater than 90 days				1 066	634
	Total receivables overdue				7 219	5 396

		1998	1997
		\$'000	\$'000
Note 15	Investments		
	R&D Syndicate deposits - under contract	23 90 767	83 946
	Short term bank bills	2 539	-
		93 306	83 946
	Shares - at valuation		
	Associate companies		
	Dunlena Pty Ltd	47.0 5	5
	Gene Shears Pty Ltd	50.0 580	501
	Gropep Pty Ltd	35.1 101	101
	Preston Group Ltd	7.5 784	784
	X-Ray Technologies Pty Ltd	46.9 750	-
		2 220	1 391
	Provision for diminution in value	(2 220)	(1 391)
		-	-
	Shares - at cost		
	Other companies		
	Listed companies	928	1 018
	Unlisted companies	8	8
	Debentures and unsecured notes	3	3
		939	1 029
	Total investments	94 245	84 975

CSIRO has shares in a listed company, Queensland Metals Corporation NL.
As at 30 June 1998 the market value was \$1 352 239 (1997 \$1 986 747).

Note 16 Land and buildings

Land		
At cost	978	978
At June 1996 valuation	170 914	182 804
	171 892	183 782
Buildings		
At cost	55 058	32 854
At June 1996 valuation	564 239	565 119
	619 297	597 973
Accumulated depreciation	(46 113)	(23 095)
	573 184	574 878
Capital works in progress - at cost	10 488	16 595
	583 672	591 473
Leasehold improvements		
At cost	4 263	3 294
At June 1996 valuation	42 217	48 751
	46 480	52 045
Accumulated amortisation	(3 511)	(2 085)
	42 969	49 960

		1998 \$'000	1997 \$'000
Note 16	Land and buildings (cont'd)		
	Buildings under finance lease		
	Buildings - at valuation	20 052	20 052
	Accumulated amortisation	(1 063)	(531)
		18 989	19 521
	Total land and buildings	817 522	844 736
Note 17	Plant and equipment		
	Plant and equipment - at cost	409 188	396 016
	Accumulated depreciation	(259 271)	(254 751)
		149 917	141 265
	Research vessels - at cost	32 361	32 205
	Accumulated depreciation	(16 210)	(14 652)
	Provision for refit	(560)	(750)
		15 591	16 803
	Plant and equipment under finance lease - at cost	108	233
	Accumulated amortisation	(19)	(59)
		89	174
	Total plant and equipment	165 597	158 242

(a) Analysis of property, plant and equipment

Movement summary 1997/98 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 1.7.97	183 782	686 665	870 447	428 454	1 298 901
Additions	971	16 967	17 938	50 528	68 466
Disposals	(12 861)	(7 316)	(20 177)	(37 325)	(57 502)
Gross value at 30.6.98	171 892	696 316	868 208	441 657	1 309 865
Accumulated depreciation/ amortisation as at 1.7.97	-	25 711	25 711	270 212	295 923
Depreciation/amortisation	-	25 783	25 783	35 816	61 599
Adjustment for disposals	-	(808)	(808)	(29 968)	(30 776)
Accumulated depreciation/ amortisation as at 30.6.98	-	50 686	50 686	276 060	326 746
Net book value as at 30.6.98	171 892	645 630	817 522	165 597	983 119
Net book value as at 1.7.97	183 782	660 954	844 736	158 242	1 002 978

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 1998 \$'000	Total 1997 \$'000
Freehold	150 039	335 694	-	485 733	508 344
Commonwealth Crown Leases	18 620	103 887	-	122 507	116 567
Leasehold	-	46 480	-	46 480	52 046
National Facilities	1 450	179 093	82 908	263 451	229 510
Deed of Grant	-	623	-	623	623
Finance Lease	1 783	20 051	118	21 952	22 068
Capital Work in Progress	-	10 488	-	10 488	16 595
	171 892	696 316	83 026	951 234	945 753
Plant and Equipment	-	-	358 631	358 631	353 148
	171 892	696 316	441 657	1 309 865	1 298 901
Accumulated depreciation/ amortisation (including refit provision)	-	(50 686)	(276 060)	(326 746)	(295 923)

**Total property,
plant and
equipment**

171 892	645 630	165 597	983 119	1 002 978
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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 AAHL, AT, NML 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.

The NML was identified as a National Facility in December 1996 and disclosed above as a National Facility this financial year.

(c) National Facilities (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 1998 \$'000	Total 1997 \$'000
Land	1 450	-	-	-	1 450	1 450
Buildings	153 091	-	-	26 001	179 092	152 987
Accumulated depreciation	(8 690)	-	-	(1 471)	(10 161)	(4 330)
	144 401	-	-	24 530	168 931	148 657
Plant and equipment	8 701	53 577	15 488	5 142	82 908	75 073
Accumulated depreciation	(6 300)	(12 509)	(9 646)	(3 919)	(32 374)	(25 860)
Provision for refit	-	-	(420)	-	(420)	(500)
	2 401	41 068	5 422	1 223	50 114	48 713
Net book value as at 30.6.98	148 252	41 068	5 422	25 753	220 495	198 820

The operating expenses for the above named National Facilities for the financial year amounted to \$44 407 478 (1997 \$29 401 661) and they have been included in CSIRO's Operating Statement.

Note 18 Inventories held for resale

	Notes	1998 \$'000	1997 \$'000
Books and media products - at lower of cost and net realisable value	1.8	695	-
Properties held for resale - at cost		181	1 011
Total inventories held for resale		876	1 011

Note 19 Other non-financial assets

Prepaid property rentals		1 284	1 262
Other prepayments		1 265	809
Contract research work in progress - at cost	1.7	15 163	11 118
Total other non-financial assets		17 712	13 189

Note 20 Statement of cash flows - cash flow reconciliation

Net cost of services		(452 930)	(449 134)
Revenue from Government	6	466 837	444 502
Operating surplus/(deficit)		13 907	(4 632)
Depreciation and amortisation of property, plant and equipment	4	61 789	63 144
Increase/(decrease) in provision for refit	17	(190)	250
Increase/(decrease) in provision for diminution in value	15	829	-
(Profit)/loss on disposal of property, plant and equipment	4	751	(1 772)
(Profit)/loss on disposal of shares	5	(66)	(673)
(Increase)/decrease in receivables	14	(1 867)	(3 506)
(Increase)/decrease in inventories	18	(695)	-
(Increase)/decrease in other non-financial assets	19	(4 523)	1 538
Increase/(decrease) in employee liabilities	9	3 388	5 493
Increase/(decrease) in liability to suppliers	10	(3 921)	3 864
Increase/(decrease) in other liabilities	8 & 11	262	7 655
Net cash provided by operating activities		69 664	71 361

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.

CSIRO's 50 per cent interest in the assets, liabilities and outputs of the joint venture was based on FSA's unaudited financial statements for the period 1 December 1997 to 30 June 1998 and they are included in CSIRO's accounts as follows:

	1998 \$'000
Financial assets	
Cash	2 123
Investment	2 539
Receivables	723
Other	186
	5 571
Non-financial assets	
Plant and equipment – at written down value	251
Total assets	5 822
Debt	
Leases	5
Provisions and payables	
Employees	132
Suppliers	459
Other	1 557
Total liabilities	2 153
Equity	
Accumulated surpluses	3 669
Total liabilities and equity	5 822

Note 22 Related entities (Note 1.3)

During the financial year CSIRO has provided actual in-kind contributions in the form of scientific staff and accommodation totalling \$3 136 159 (1997 \$3 238 409) to Biomolecular Research Institute Limited (BRI) and \$1 866 737 (1997 \$2 158 426) to Ceramic Fuel Cells Limited (CFC). The contributions have been in accordance with formal agreements between CSIRO and the related entities and have been accounted for in CSIRO's Operating Statement.

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

Note 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

Description	Land \$'000	Buildings \$'000	Plant and Equipment \$'000	Total 1998 \$'000	Total 1997 \$'000
At valuation or cost	17 630	27 290	41 162	86 082	50 885
Accumulated depreciation	-	(2 211)	(35 353)	(37 564)	(34 467)
	17 630	25 079	5 809	48 518	16 418

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 could not be 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

1998
\$'000

1997
\$'000

Monies held in trust that 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 :

Investments

Commonwealth Bank of Australia	2 599	2 590
St George Bank	216	220
M F Cash Management Fund	875	943
	3 690	3 753
Cash at bank	132	23
	3 822	3 776

(a) The components of trust funds are as follows:

William McIlrath Trust Fund	235	254
David Rivett Memorial Lecture Fund	100	95
FD McMaster Bequest	2 389	2 377
Sir Ian McLennan Achievement for Industry Award	100	107
The Ken and Yasuko Myer Plant Science Research Fund	998	943
	3 822	3 776

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.

Note 25 Monies held in trust (cont'd)

(b) Movements of trust funds summary

	Myer	McLennan	McMaster	McIlrath	Rivett	Total 1998	Total 1997
	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000	\$'000
Balance at 1 July	943	107	2 377	254	95	3 776	3 868
Receipts during year	-	-	-	-	-	-	2
Interest and dividends	209	8	117	12	5	351	245
Expenditure	(154)	(15)	(105)	(31)	-	(305)	(339)
Balance at 30 June	998	100	2 389	235	100	3 822	3 776
						1998	1997
						\$	\$

Note 26 Remuneration of auditors

Remuneration to the Auditor-General for:

Auditing the financial statements for the reporting period	225 000	260 000
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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 \$108 million. As the CRC agreements include a 12 month termination clause, this amount approximates CSIRO's forward commitment for 1998/99.

At 30 June 1998, 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 (previously Temperate Hardwood Forestry)	32
Sustainable Rice Production	15
Sustainable Sugar Production	19
Tropical Pest Management	33
Tropical Plant Pathology	27
Viticulture	21

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

Note 27 Cooperative Research Centres (CRCs) (cont'd)**Names of Cooperative Research Centres****CSIRO's Equity Interest (%)**
(excluding Commonwealth contributions)**ENVIRONMENT cont'd**

Southern Hemisphere Meteorology	27
Sustainable Development of Tropical Savannas	11
Tropical Rainforest Ecology and Management	40
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	14
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	26
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	53
Black Coal Utilisation	9
G K Williams CRC for Extractive Metallurgy	56
Landscape Evolution and Mineral Exploration	44
Mining Technology and Equipment	35
New Technologies for Power Generation from Low Rank Coal	10

Note 28 Remuneration of Board Members

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

	1998 \$	1997 \$
Board Members' remuneration	451 784	440 588
Payments to superannuation funds for Board Members	59 629	49 131
	511 413	489 719

Note 28 Remuneration of Board Members (cont'd)

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

			1998 number	1997 number
	\$			
Nil	-	10 000	3	5
10 001	-	20 000	1	1
20 001	-	30 000	4	6
50 001	-	60 000	1	-
330 001	-	340 000	-	1
350 001	-	360 000	1	-

Note 29 Meetings of Board Members and Audit Committee

During the financial year, six Board Meetings and four 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	4	4
K W Davern (completed term 3.8.97)	1	1	-	-
R Higgins	6	4	-	-
D P Mercer (appointed 4.3.98)	2	2	-	-
M K McIntosh	6	5	4	1
M J O'Kane	6	6	-	-
S M Richards (completed term 11.12.97)	3	3	3	3
A E de N Rogers	6	6	2	2
E G C Tan	6	5	-	-
E J Woods (completed term 8.6.98)	5	5	4	4

The members of the Audit Committee are Mr D P Mercer (Chairman from 26.5.98), Dr S M Richards (Chairman until term completed 11.12.97), Prof E J Woods (until term completed 8.6.98), Mr A E de N Rogers (appointed 20.8.97) 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. The Chairman, Mr D C K Allen, served as Acting Chairman of the Audit Committee for the period 12.12.97 to 26.5.98.

Note 30 Remuneration of Officers

	1998 \$	1997 \$
Remuneration received or due and receivable by Officers	1 210 601	1 207 338

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

	\$			
180 001	-	190 000	1	1
200 001	-	210 000	2	1
230 001	-	240 000	-	2
260 001	-	270 000	1	-
330 001	-	340 000	-	1
350 001	-	360 000	1	-

The Officers' remuneration includes the Chief Executive and the Deputy Chief Executives concerned with, or taking part in, the management of CSIRO during 1997/98.

Note 31 Related party disclosures

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

D C K Allen (Chairman)	M J O'Kane
K W Davern	S M Richards
R Higgins	A E de N Rogers
M K McIntosh	E G C Tan
D P Mercer	E J Woods

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

Board Members' interests in contracts

Since 1 July 1997 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 Tourism (DIST). During the financial year a number of grants and consultancy contracts were entered into between DIST, 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 commercial terms and conditions.

Dr M K McIntosh is also a Director of an associated company of CSIRO, Gene Shears Pty Ltd. It has a number of contractual relationships with CSIRO in the field of research and development. The contracts are based on normal commercial terms and conditions. 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 and Australian Prudential Regulation Authority, Chairman of Australia Pacific Airports Ltd and National Office for the Information Economy and a Member of the Advisory Board of Fujitsu Australia. Transactions with these entities, if any, 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.

Dr S M Richards is the Chairman of Aberfoyle Limited and the Chairman of the Australian Nuclear Science and Technology Organisation (ANSTO). Aberfoyle Limited through its subsidiary, Aberfoyle Resources Limited, contributes to several research projects for which CSIRO is the sole or joint contractor. ANSTO has a number of contractual relationships with CSIRO in the field of research and development. All contracts are based on normal commercial terms and conditions.

Mr A E de N Rogers is Chairman of Uniquest Limited, 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.

Prof E J Woods is Chairman of the Rural Industries Research and Development Corporation which has a number of contractual relationships with CSIRO in the field of research and development. All contracts are based on normal commercial terms and conditions.

Note 32 Financial instruments

(a) Terms, conditions and accounting policies

Financial instrument	Notes	Accounting policies and methods	Nature of underlying instrument
Financial assets		Financial assets are recognised when control over future economic benefits is established and the amount of the benefit can be reliably measured.	
Cash at bank and deposit 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 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 30 November 1998.
Short term bank bills	15	These bank bills are recognised at cost. Interest is accrued as it is earned.	These bank bills mature between 30 to 90 days and earn 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.	-

Note 32 Financial instruments (cont'd)

(a) Terms, conditions and accounting policies

Financial instrument	Notes	Accounting policies and methods	Nature of underlying instrument
Financial liabilities		Financial liabilities are recognised when a present obligation to another party is entered into and the amount of the liability can be reliably measured.	
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 8.62% (1996/97: 8.61%). 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 (and 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 1998.	Research revenue received in advance is not recognised as revenue until work is performed by CSIRO.
Trust monies	11	As above in cash at bank – trust monies.	Being monies held in trust for third parties. They are payable on demand.

(b) Interest rate risk

(b) Interest Rate Risk																Weighted Average Effective Interest Rate	
Financial Instrument	Notes	Floating Interest Rate		Fixed Interest Rate								Non Interest Bearing		Total			
				1 year or less		1 to 2 years		2 to 5 years		> 5 years							
		1998 \$'000	1997 \$'000	1998 \$'000	1997 \$'000	1998 \$'000	1997 \$'000	1998 \$'000	1997 \$'000	1998 \$'000	1997 \$'000	1998 \$'000	1997 \$'000	1998 \$'000	1997 \$'000	1998 %	1997 %
FINANCIAL ASSETS (RECOGNISED)																	
Cash at bank and cash on hand	13	14 770	30 114											14 770	30 114	4.8	6.1
Cash at bank - trust monies	13	13 096	12 836											13 096	12 836	4.8	6.1
Deposits - at call	13	176	1 391											176	1 391	4.9	5.2
Short term bank bills	15	2 539	-											2 539	-	5.0	-
Receivables for goods and services	14											22 988	21 531	22 988	21 531	n/a	n/a
Receivables for property sales	14											15 722	11 447	15 722	11 447	n/a	n/a
Other receivables	14											5 870	5 460	5 870	5 460	n/a	n/a
R&D Syndicate deposits	15									73 767	66 946	17 000	17 000	90 767	83 946	9.8	9.8
Shares	15											939	1 029	939	1 029	n/a	n/a
Total financial assets (recognised)		30 581	44 341							73 767	66 946	62 519	56 467	166 867	167 754		
Total Assets														1 168 574	1 184 932		
FINANCIAL LIABILITIES (RECOGNISED)																	
Finance lease liabilities	8			14 264	14 235			5 270	4 763					19 534	18 998	8.62	8.61
Trade creditors	10											18 112	22 033	18 112	22 033	n/a	n/a
Research revenue received in advance	11											37 624	44 278	37 624	44 278	n/a	n/a
R&D Syndicates - under contract	11									73 767	66 946	17 150	17 150	90 917	84 096	9.84	9.84
Trust monies	11	13 096	12 836											13 096	12 836	4.8	6.1
Other creditors	11											517	1 212	517	1 212	n/a	n/a
Total financial liabilities (recognised)		13 096	12 836	14 264	14 235			5 270	4 763	73 767	66 946	73 403	84 673	179 800	183 453	n/a	n/a
Total liabilities														318 827	319 092		
Performance guarantees												-	1 427	-	1 427	n/a	n/a
Legal claims												700	383	700	383	n/a	n/a
Total financial liabilities (unrecognised)												700	1 810	700	1 810		

Note 32 Financial instruments (cont'd)**(c) Net fair values of financial assets and liabilities**

		1998		1997	
	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	14 770	14 770	30 114	30 114
Cash at bank – trust monies	13	13 096	13 096	12 836	12 836
Deposits at call	13	176	176	1 391	1 391
Short term bank bills	15	2 539	2 539	–	–
Receivables for goods and services	14	22 988	22 988	21 531	21 531
Receivables for property sales	14	15 722	15 722	11 447	11 447
Other receivables	14	5 870	5 870	5 460	5 460
R&D Syndicate deposits - under contract	15	90 767	90 767	83 946	83 946
Shares	15	939	1 360	1 029	1 993
		166 867	167 288	167 754	168 718
Financial liabilities (recognised)					
Finance lease liabilities	8	19 534	19 534	18 998	18 998
Trade creditors	10	18 112	18 112	22 033	22 033
Research revenue received in advance	11	37 624	37 624	44 278	44 278
R&D Syndicate - under contract	11	90 917	90 917	84 096	84 096
Trust monies	11	13 096	13 096	12 836	12 836
Other creditors	11	517	517	1 212	1 212
		179 800	179 800	183 453	183 453
Financial liabilities (unrecognised)					
Performance guarantees	Schedule of	–	–	1 427	1 427
Legal claims	Contingencies	700	700	383	383
		700	700	1 810	1 810

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.

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