CSIRO Annual Report 1992–93

CSIRO
AUSTRALIA

About CSIRO

CSIRO — the Commonwealth Scientific and Industrial Research Organisation — is one of the largest and most diverse scientific research institutions in the world. It has a staff of more than 7000, working in about 70 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 Annual Report 1992–93

CSIRO
AUSTRALIA

Photo credits: M Basaglia (p35,36), Bear Image (p70),
W Caram (p5), D Goeldner (p24), G Heath (p45), ICI Food
Specialities (p36), J Masterson (p29, 57), T Nicholls (p39, 49),
D Salt (p77), Ta-Yan Leong (p54)

Published by CSIRO Canberra
Design and artwork by Melissa Spencer,
CSIRO Information Services, Melbourne

ISSN 1030–4215

Printed in Australia by Brown Prior Anderson

Senator the Hon Chris Schacht
Minister for Science and Small Business
Parliament House
CANBERRA ACT 2600

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

Highlights for the year included the relocation of the Organisation's Head Office to Melbourne so as to promote interaction between CSIRO and the business community at the highest levels.

The increase in the number of Multi-Divisional Programs to 24 this year will enhance our ability to tackle important national issues by bringing teams rapidly together from across the traditional scientific and administrative boundaries.

We commend the Organisation's achievements to you.

Adrienne E Clarke
(Chairman of the Board)

John W Stocker
(Chief Executive)

November 1993

Contents

1992–93 AT A GLANCE

	1991–92	*1992–93*
Total revenue	$640.6m	$679.5m
Appropriation funding	$443.3m	$454.3m
External revenue	$197.3m	$225.2m
External revenue as % of total revenue	30.8%	33.1%
Total expenditure	$681.3m	$685.3m
Provisional patent applications	218	223
Staff numbers	7316	7406

- CSIRO's Head Office relocated to Melbourne to facilitate interaction with the business community at the highest levels
- A report was commissioned on how CSIRO can more effectively deliver technology to small and medium business enterprises
- A Task Force began work on finding ways of redefining CSIRO's commercial policies and practices, and finding ways of improving the transfer of CSIRO's research results
- Among commercialisation highlights, CSIRO entered two R&D Syndicated Agreements worth a total of $58.5m
- Research priorities for the 1994–97 triennium were decided. Internal funding for research in minerals, manufacturing, and information and communication industries will increase; environmental research funding will remain constant. Rural research will continue to rate highly
- Research highlights included a breakthrough in the search for a flu cure
- CSIRO is now involved in 43 of the 52 approved Cooperative Research Centres
- The number of Multi-Divisional Programs drawing on expertise from across CSIRO increased to 24 from the 17 reported last year
- $1.9 million was set aside for a five-year strategy to improve employment prospects for Aboriginal and Torres Strait Island people
- Two hundred traineeships over the next two years are being created for 18–20 year-olds, costing CSIRO $6 million from additional funds supplied by the Government
- The commercial accounting system Unibis was installed at more than 50 CSIRO sites, facilitating the move to accrual accounting
- Membership of the Double Helix Science Club increased to 20,000, up 25% from last year

Chairman's Foreword

Overriding concerns for many Australians during 1992-93 were the recession and high unemployment. One of the first major activities of the CSIRO Board in 1992 was to take two days at a Workshop to consider how CSIRO can best contribute to Australia's future in a 10–15 year perspective.

The Board examined a series of key issues in terms of their challenge to and potential impact on Australia. Board members then considered CSIRO's ability and capacity to help address emerging problems and to develop new opportunities. Topics examined included environmental resource degradation, management of waste products, communications and information technology, genetic engineering, food and nutrition, tourism, population growth, and value-adding and product branding.

The Board also discussed the Organisation's performance against expectations formally set out following the Australian Science and Technology Council Review, and offered suggestions for the future. We confirmed our view that CSIRO has indeed changed significantly over the past five or six years and is placing itself well to consolidate past changes and to move quickly when necessary in promising new directions.

One immediate issue was the tragedy of youth unemployment. Although the Organisation cannot solve the problem, we were able to help in a small way by taking 200 young school leavers into our offices, workshops and laboratories to give them some experience on which to build in seeking more permanent employment. A second key issue that emerged was the growth of small to medium-sized enterprises and their emergence as a major source of economic growth and growth of employment. Building on the Australian Manufacturing Council report, and the recognition that many of these companies are technology-dependent, we worked with McKinsey & Company to devise mechanisms for more effective delivery of technology from CSIRO to this group of companies.

Certainly science and technology emerges in all sectors as a key driver of Australia's future — it has historically underpinned our success in exporting natural resources (the minerals and energy sector) and our success in agriculture. Now we see it underpinning the emerging strength in complex manufactures. Of particular interest was the finding that, of the Chief Executive Officers leading the small to medium-sized enterprises in this sector, most were tertiary educated and most had degrees in either science or engineering. This finding has important implications for education: in a technology-dependent and technology-driven society of the future, we will need techology-literate accountants, lawyers, business people and politicians. Science and engineering as a first degree is looking an attractive option for training.

The Board also made a series of decisions relating to the goal of strengthening our links to the business community and our performance in commercialisation of technology. These included the move of the Head Office to Melbourne to be embedded in one of Australia's key financial and manufacturing centres. The office is small and focused on commercial activities. The government liaison roles remain in the Canberra office, with the Chief Executive sharing his time between these two locations

We also moved to concentrate strategic elements of the business patenting and legal work in the Melbourne Head Office and ended the arrangement by which a subsidiary of CSIRO, Sirotech Ltd, had been responsible for these activities.

Chairman's Foreword

Dr John Stocker and Professor Adrienne Clarke

There is a range of closely related questions which the Board intends to take further in the near future, including an analysis of the different ways in which Australia benefits from CSIRO's work. One focus is likely to be issues associated with work done for international companies and for Australian companies operating overseas, an increasing feature of Australia's rapidly increasing and diversifying role in the global economy.

During the year, as one consequence of the Federal Election which saw the Government returned to office, CSIRO farewelled Minister Ross Free and welcomed as the new Minister for Science, Customs and Small Business, Senator Chris Schacht. The Board thanks Minister Free for his thorough support and understanding and welcomes Senator Schacht in this important and testing time in science's efforts to serve Australia's needs.

In 1992–93 the process of change at CSIRO continued. Change is part of the everyday life of a scientist, and on the whole, scientists adapt quickly to changing circumstances. We can expect change to continue in CSIRO as the Organisation consolidates its roles of seeking out and delivering research solutions to Australia's needs and for Australia's benefit.

Adrienne E Clarke

Chief Executive's Review

CSIRO this year took some significant steps towards achieving the Board's vision for the Organisation's future and our essential role in Australia's drive for national recovery.

The result is a more outward-looking and future oriented Organisation, with a culture firmly centred on the effective delivery of technology to the people who need it.

Among measures taken to achieve this result has been the return of our Head Office to Melbourne after 20 years in the national capital. This move is an initiative to create a new kind of Head Office with a strong commercial focus.

The new Head Office is very outward looking. We are recruiting new skills to it, including the recent appointment of Peter Bradfield as Director of Corporate Business. These appointments will strengthen CSIRO's capacities in business development, contract negotiation and international marketing.

We also moved to strengthen the commercial skills in our Institutes and Divisions. Sirotech Ltd, our technology transfer company, was wound down and its commercial experts moved from the company into these operating units, under the direct supervision of line managers. This puts them at the very interface of research with business.

In addition, CSIRO this year established a special Task Force to recommend better policies and practices for commercialising our technologies.

My travels this year to Asia have convinced me that CSIRO must forge stronger international links to seize the technological opportunities that exist there in abundance. In China, for example, I found that many excellent relationships have been formed by CSIRO scientists. We are learning to take the next step in developing a more strategic approach to how Australian industry can benefit from those relationships.

The CSIRO Board's outward gaze also focused on Australia's own backyard, on the new dynamos rebuilding the economy, the so-called 'Magnificent 700' small and medium enterprises that list technology next to quality as their most important competitive advantage.

As the Chairman has noted in her Foreword, we have commissioned McKinsey and Company to investigate ways that CSIRO can perform better as a source of technology for smaller firms. We expect to increase significantly our support for this rapidly growing export sector.

These initiatives show that CSIRO understands that our obligations do not finish with excellent research; we have made great strides in equipping ourselves to go through the next crucial stage — making sure that the research finds a user to develop it for the greatest benefit.

Stronger linkages with the private sector, as well as with other research bodies, have also resulted from our continuing participation in the Cooperative Research Centre Program. We are now involved in 43 of the 52 CRCs so far approved by the Government, providing us with a very promising vehicle for creating new technological opportunities for Australia through effective co-operation with universities and with industry.

Partnership at work has also been a very strong theme within our own ranks. A cooperative spirit, harnessed to the range and depth of our scientific expertise, is perhaps CSIRO's greatest strength. It finds rich expression in our Multi-Divisional Programs (MDPs), where we bring together the best minds from across CSIRO to tackle the big issues facing Australia.

This year, the CSIRO Board defined a set of principles aimed at achieving corporate best practice for setting up MDPs. Special priority funds are being made available to encourage the establishment of larger Programs — two that have benefited already are the Coastal Zone Management Program

and the Mine Site Rehabilitation Program. In total, 24 MDPs now operate, compared to 17 last year.

CSIRO's policies, practices and partnerships are fundamentally guided by decisions we make on our research priorities — determining the match between what we do best and what Australia needs most. In June 1993, we decided on our priorities for the next triennium, beginning on 1 July 1994.

We decided to allocate additional resources to research in three areas: mineral resources, manufacturing industries, and information and communication industries. Support for environmental research will continue.

CSIRO will also continue a major research effort in support of the rural industries. To underpin that effort, the recommendations of a major Review of CSIRO's Research for the Rural Industries are now being integrated into our priorities setting process and into the Board's own planning.

The rural industries have been hard hit by the depressed prices for major commodities, particularly wool and wheat. CSIRO itself has felt the downturn through the lower funds available from rural research levies administered by the Rural Industry Research and Development Corporations. We are concerned about this situation in the long term, and in particular about its consequences for our research infrastructure in this vital sector of the Australian export economy.

The welcome allocation by the Government of an extra $12 million this year for capital infrastructure has meant that we can proceed with our capital investment program without cutting too deeply into research expenditure. Another allocation will also enable us to proceed with a major employment initiative: two hundred 18-month traineeships will be created for 18 to 20 year-olds, costing $6 million spread over this year and next.

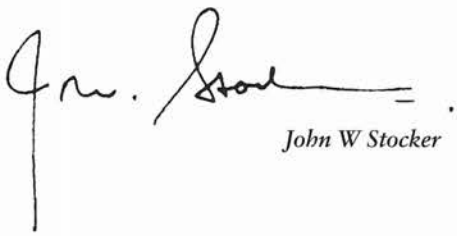
Another human resources initiative was the work by a CSIRO Consultative Council sub-group to ensure that we maximise the opportunities for redeployment and retraining of staff made potentially redundant as a result of funding and research priority shifts.

Although external funds generated through research contracts are now supporting a large part of the Organisation's work — the 33 per cent earned this year surpassing the Government's target of 30 per cent — we need to be vigilant in protecting the strategic research that underpins and drives commercialisation.

A typical example lies behind the search for a treatment for influenza, one of our major research achievements this year. The development of a successful drug through this strategic collaborative work could lead to a product with very great international market prospects and represents the culmination of 15 years' work.

CSIRO is now discussing its next triennium budget with the Government. We hope that we can arrive at a resource agreement that ensures the long-term stability so essential for planning and managing our research.

With such an outcome, CSIRO will be more strongly placed to continue to deliver what this year's record shows it can deliver — timely and relevant scientific achievement geared to serve industry, government and the Australian community.



John W Stocker

MISSION AND GOALS

CSIRO'S MISSION

CSIRO's ethos will affirm, above all, the qualities of service and excellence — service to all the Australian people through scientific excellence.

CSIRO seeks to contribute to Australia's quest for enhanced economic performance, living standards, environmental quality and community understanding of science and technology, through excellence, leadership and teamwork in research.

CORPORATE GOALS

Research

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

Research support

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

CHARTER, FUNCTIONS AND POWERS

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

From 1 July 1992 to 23 March 1993 the Minister responsible for CSIRO was Mr Ross Free (Minister for Science and Technology, Minister Assisting the Prime Minister for Science, and Minister Assisting the Treasurer).

From 23 March 1993 to 30 June 1993 the Minister responsible for CSIRO was Senator the Hon Chris Schacht (Minister for Science and Small Business, Minister Assisting the Prime Minister for Science).

FUNCTIONS

CSIRO's primary functions are:

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

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

POWERS

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

In particular it may:

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

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

STRUCTURE, MANAGEMENT AND STAFF

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

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

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

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

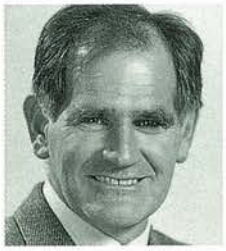
Divisions and Institutes are located all over Australia, with many Divisions having more than one site. CSIRO also maintains a small number of field stations overseas, mainly concerned with biological studies that could benefit Australia.

CSIRO staff are employed under Section 32 of the *Science and Industry Research Act* 1949. At 30 June 1993 CSIRO had a total staff of 7406, which has an equivalent full-time value of 6971 units. The numbers employed in different job categories are shown in the chart on p 75.

THE BOARD

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

Mr Laurie Carmichael
Chairman
Employment and Skills Formation Council
13 Mar 93–12 Mar 95
(reappointment)

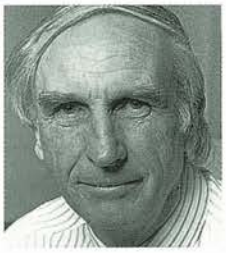


Dr Tony Gregson
PhD DSc FRACI
Primary producer, Director, Grains R&D Corporation
5 Dec 92–4 Dec 94
(reappointment)

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

Mr Nigel Stokes
BEc BA
Adviser to Bankers Trust Aust Ltd
24 Sept 91–31 Aug 94

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



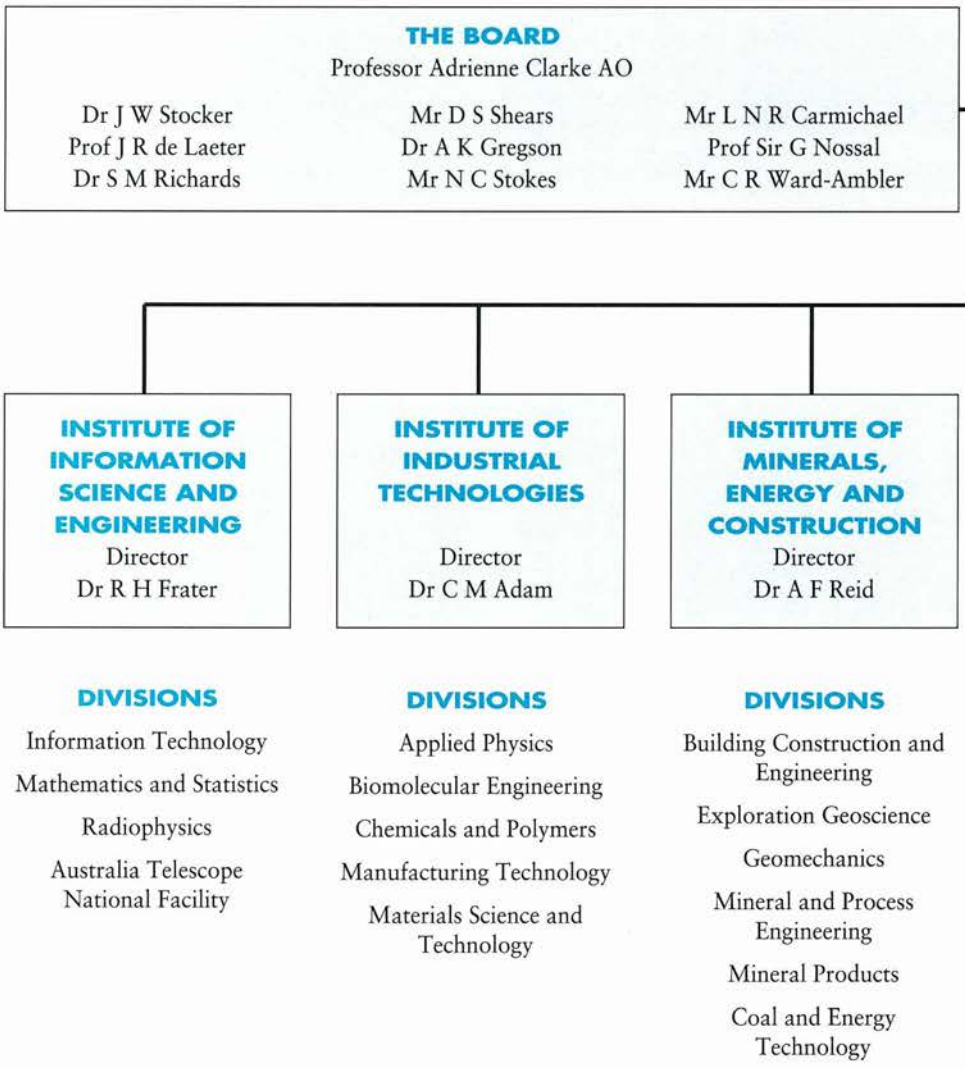
Professor John de Laeter
AO FTS FInstP FAIP
Deputy Vice-Chancellor (Research and Development)
Curtin University of Technology
5 Dec 91–4 Dec 95

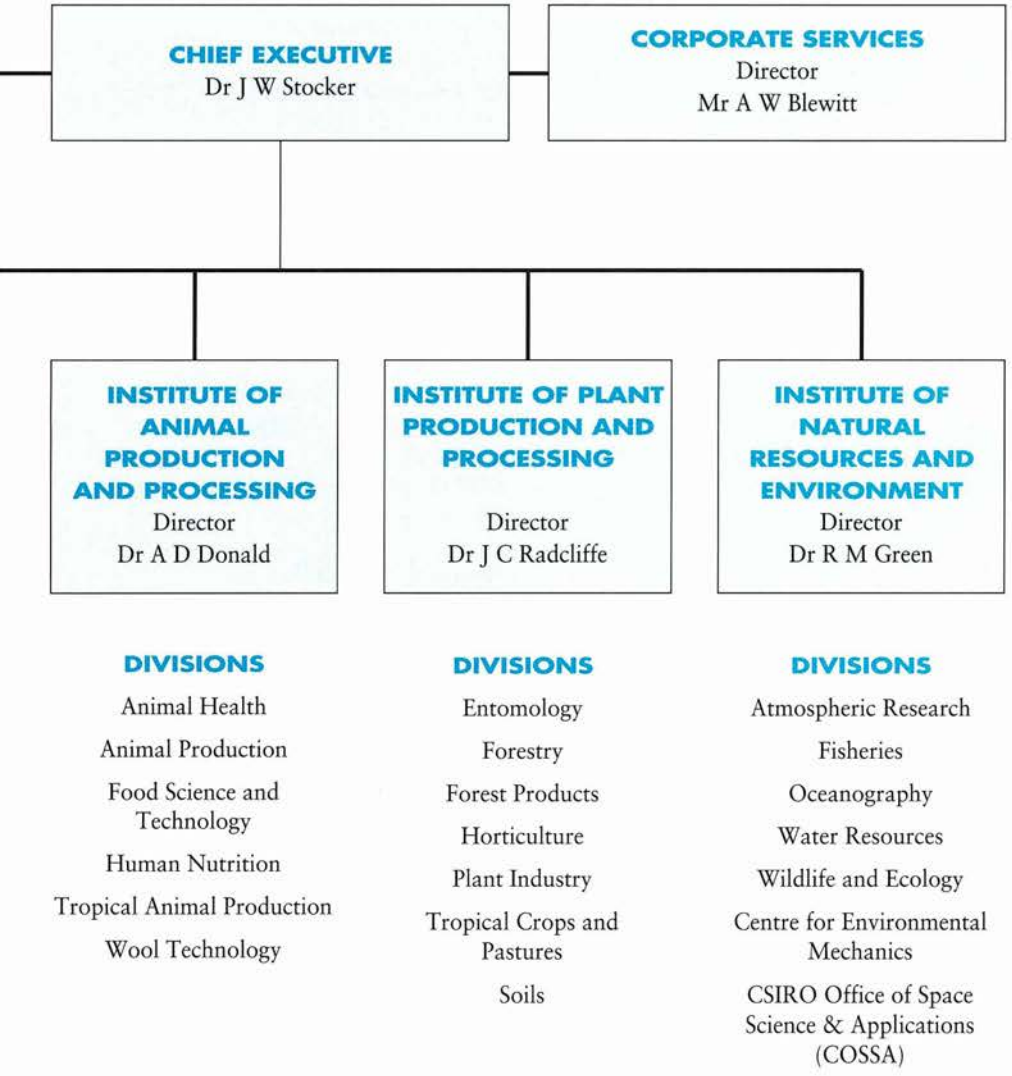
Professor Sir Gustav Nossal
AC CBE MB BS BSc PhD FTS FAA FRS
Director of the Walter and Eliza Hall Institute of Medical Research
5 Dec 91–4 Dec 93
(reappointment)

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

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

ORGANISATIONAL CHART AS AT 30 JUNE 1993




CHIEF EXECUTIVE
Dr J W Stocker
CORPORATE SERVICES
Director
Mr A W Blewitt
INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING
Director
Dr A D Donald
INSTITUTE OF PLANT PRODUCTION AND PROCESSING
Director
Dr J C Radcliffe
INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT
Director
Dr R M Green
DIVISIONS
Animal Health
Animal Production
Food Science and Technology
Human Nutrition
Tropical Animal Production
Wool Technology
DIVISIONS
Entomology
Forestry
Forest Products
Horticulture
Plant Industry
Tropical Crops and Pastures
Soils
DIVISIONS
Atmospheric Research
Fisheries
Oceanography
Water Resources
Wildlife and Ecology
Centre for Environmental Mechanics
CSIRO Office of Space Science & Applications (COSSA)

SENIOR STAFF AND ADDRESSES

(as at 30 June 1993)

HEAD OFFICE

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

Chief Executive
Dr J W Stocker

General Manager, Public Affairs
Mr L R Bevege

Corporate Lawyer
Mr T J Healy

General Manager, International Affairs
Dr B K Filshie

Corporate Planner (Canberra)
Dr D MacRae

Corporate Secretary
Dr E N Cain (Canberra)

CORPORATE SERVICES

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

Director, Corporate Services
Mr A W Blewitt

General Manager, Corporate Finance
Mr R J Garrett

General Manager, Human Resources
Ms C R Macpherson

General Manager, Corporate Property
Mr G J Harley

General Manager (Acting), Information Technology Services
Mr D B Rofe

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

Principal Secretary, Government Business & Policy
Dr T E Heyde

INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING

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

Divisions and Chiefs

Animal Health

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

Animal Production

Chief: Dr O Mayo
Clunies Ross Street
PROSPECT NSW 2149
Tel: (02) 688 0833

Food Science and Technology

Chief (acting): Dr G J Jameson
39-51 Delhi Road
NORTH RYDE NSW 2113
Tel: (02) 887 8333

Human Nutrition

Chief: Dr P J Nestel
Gate 13, Kintore Avenue
ADELAIDE SA 5000
Tel: (08) 224 1800

Tropical Animal Production

Chief: Dr P A Jennings
120 Meiers Road
INDOOROOPILLY QLD 4068
Tel: (07) 377 0711

Wool Technology

Chief: Dr K J Whiteley
Princes Highway
BELMONT VIC 3216
Tel: (052) 47 2611

INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Director: Dr C M Adam
407 Royal Parade
PARKVILLE VIC 3052
Tel: (03) 662 7135

Divisions and Chiefs

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

Biomolecular Engineering
Chief: Dr P M Colman
343 Royal Parade
PARKVILLE VIC 3052
Tel: (03) 342 4211

Chemicals and Polymers
Chief: Dr T H Spurling
Bayview Avenue
CLAYTON VIC 3168
Tel: (03) 542 2244

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

Materials Science and Technology
Chief: Dr M J Murray
Normanby Road
CLAYTON VIC 3168
Tel: (03) 542 2777

INSTITUTE OF INFORMATION SCIENCE AND ENGINEERING

Director: Dr R H Frater
105 Delhi Road
NORTH RYDE NSW 2113
Tel: (02) 887 8220

Divisions and Chiefs

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

Mathematics and Statistics
Chief: Dr R L Sandland
Building E6B
Macquarie University Campus
NORTH RYDE NSW 2113
Tel: (02) 325 3203

Radiophysics
Chief: Dr D N Cooper
Cnr Vimiera and Pembroke Roads
MARSFIELD NSW 2121
Tel: (02) 372 4200

The Australia Telescope — National Facility
Director: Dr R D Ekers
Cnr Vimiera and Pembroke Roads
MARSFIELD NSW 2121
Tel: (02) 372 4300

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

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

Divisions and Chiefs

Building, Construction and Engineering

Chief: Mr K Martin
Graham Road
HIGHETT VIC 3190
Tel: (03) 252 6114

Coal and Energy Technology

Chief: Dr P G Alfredson
51 Delhi Road
NORTH RYDE NSW 2113
Tel: (02) 887 8610

Exploration Geoscience

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

Geomechanics

Chief (acting): Dr G Price
2643 Moggill Road
PINJARRA HILLS QLD 4069
Tel: (09) 389 8421

Mineral and Process Engineering

Chief: Dr R La Nauze
Bayview Avenue
CLAYTON VIC 3168
Tel: (03) 541 1222

Mineral Products

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

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT

Director: Dr R M Green
Limestone Avenue
CAMPBELL ACT 2601
Tel: (06) 276 6614

Divisions and Chiefs

Atmospheric Research

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

Fisheries

Chief: Dr P C Young
Castray Esplanade
HOBART TAS 7000
Tel: (002) 32 5222

Oceanography

Chief: Dr A D McEwan
Castray Esplanade
HOBART TAS 7000
Tel: (002) 32 5222

Water Resources

Chief: Dr G B Allison
Waite Road
URRBRAE SA 5064
Tel: (08) 303 8700

Wildlife and Ecology

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

Centre for Environmental Mechanics

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

CSIRO Office of Space Science and Applications (COSSA)
Director: Dr G P Harris
Cnr North and Daley Roads
ANU Campus
ACTON ACT 2601
Tel: (06) 279 0811

INSTITUTE OF PLANT PRODUCTION AND PROCESSING

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

Divisions and Chiefs

Entomology
Chief: Dr M J Whitten
Clunies Ross Street
BLACK MOUNTAIN ACT 2601
Tel: (06) 246 4025

Forest Products
Chief: Dr W Hewertson
Bayview Avenue
CLAYTON VIC 3168
Tel: (03) 542 2244

Forestry
Chief: Dr G A Kile
Banks Street
YARRALUMLA ACT 2600
Tel: (06) 281 8314

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

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

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

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

RESEARCH HIGHLIGHTS

Planning and reporting of CSIRO research follows the system adopted last year for classifying the purpose of the research.

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

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

RURAL INDUSTRIES

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

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

MINERALS AND ENERGY INDUSTRIES

Minerals industry: exploration, mining and extraction, processed minerals, metal smelting and refining

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

MANUFACTURING INDUSTRIES

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

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

INFORMATION AND COMMUNICATIONS INDUSTRIES

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

ENVIRONMENT

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

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

INFRASTRUCTURE, SERVICES AND ADVANCEMENT OF KNOWLEDGE

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

The selection of achievements and developments described in this section demonstrates how CSIRO is achieving its corporate goals and research objectives.

A complete report of the year's activities in all 1000-plus projects in more than 200 Programs would quadruple the size of this Report. However, a list of Program titles is contained in Appendix 6 of this Report. The list includes the titles of the 24 Multi-Divisional Programs (MDPs) operating this year. Increasingly, CSIRO is looking to assemble multi-disciplinary teams from across the boundaries of its management structure to respond to research problems and opportunities.

A comprehensive account of the whole range of CSIRO's activities can be found in the annual *CSIRO Directory of Research Programs*, which is available electronically on the AUSTRALIS database.

CONTENTS

Research Achievements

RURAL INDUSTRIES

Improve the international competitiveness and sustainability of rural production systems

ACHIEVEMENTS

Industrial enzyme breakthrough aids paper industry

CSIRO scientists have discovered a new enzyme whose use has great potential for Australia's northern grazing industry and in the manufacture of paper pulp products.

The discovery came during an investigation into the nutrition of ruminants (cattle and sheep), carried out by the Division of Tropical Crops and Pastures and jointly funded by the Meat Research Corporation.

The bacteria in the rumen of cattle and sheep in northern Australia are poorly adapted to digest and use tough, fibrous plant fibre. The project aims to improve rumen function by endowing rumen bacteria with the more efficient fibre degrading enzymes found in the rumen fungus *Neocallimastrix patricarum*.

The scientists were able to harness these enzymes, in particular cellulases and xylanases, by cloning and expressing them into *E. coli* in a form suitable for further genetic manipulation and, incidentally, achieving a world first for this operation.

These genes can then either be inserted into rumen bacteria or used in large scale fermenter plants to produce industrial quantities of the enzyme.

The scientists discovered one clone, a highly active xylanase, has no cellulase activity and is thirty times more powerful than previously known forms. This makes it a prime candidate for the paper pulp industry. Work is now progressing on this in collaboration with the Queensland Metal Corporation and with assistance from the Stanford Research Institute, USA.

Preliminary tests at the Division of Forest Products show that this enzyme is highly efficient at attacking a component of a type of 'glue' linking lignin to cellulose. The effect of this enables a substantial saving in chlorine usage in conventional Kraft-based bleaching sequences; it also enhances paper brightness.

Pulping of acacias

The forest industry could be harvesting plantations of acacia trees next century if results of current research are borne out in commercial practice.

CSIRO is involved in an international project funded by the Australian Centre for International Agricultural Research to assess the pulping properties of various species of Acacia. The project involves scientists from the Chinese Academy of Forestry and the CSIRO Divisions of Forest Products and Forestry.

A laboratory has been set up in Nanjing, China, to assess pulping properties of locally grown acacia trees. The research program is overseen by a CSIRO scientist, and two Chinese scientists have been trained at the Division of Forest Products in this type of work. Back in Australia, CSIRO has also been assessing the pulping properties of some Australian native-grown acacias.

Results from Australia show that acacia pulp yields are within the range of current commercial pulpwoods, but bleaching can sometimes be more difficult than with eucalypts. However, the paper properties are generally good to very good. Some information on Chinese plantation-grown acacias should become available when tests are completed in Nanjing.

The research program at Nanjing has also resulted in an application for a Chinese

patent on a wattle tannin adhesive for plywood, and a rapid ultraviolet method of analysing wattle tannins has been developed.

Worm protection for livestock*

Intestinal worms are a constant problem for the livestock industry as their control is difficult and often expensive. CSIRO is trying to improve protection and reduce costs in several ways.

Currently, worms in livestock are controlled by a mix of chemical treatment and management of grazing to avoid infected pastures.

The Meat Research Corporation has been supporting a team of scientists from the Divisions of Animal Health and Animal Production to research ways of improving chemical control methods.

The aim of the project was to improve the targeting of anthelmintics (anti-worm chemicals) to sites of infection and to increase their effectiveness at killing worms.

The team designed a new drench containing an anthelmintic called albendazole (ABZ) embedded in an oil-protein matrix that had a special chemical structure. This structure helped improve delivery of the anthelmintic to key parts of the animal's digestive system where worms occur.

Drenching of sheep with 'protected ABZ' resulted in a two to three-fold increase in the amounts of ABZ reaching the fourth stomach and the small intestine when compared to conventional drenches.

The result was an increase in the removal of two types of intestinal worms that are resistant to some other drenches.

The development of protected anthelmintics provides an opportunity to target the release of the chemical at the site of infection. Further, by reducing the effective dose rate this new control method addresses the growing problem of drug resistance and community concerns about chemical residues in animal products and the environment.

An alternative, longer-term approach is to eliminate the use of chemicals altogether. So another team from the Division of Animal Health has been looking for biological methods of control. The team has been investigating fungi that kill intestinal worms and has found certain species that can survive passage though the gut of sheep and grow on fresh dung, where they prey on emerging worm larvae. Grazing sheep are therefore exposed to fewer worm larvae.

If this worm-killing fungi method can be harnessed, then biological control of worms may become a reality. Such an approach will never be a substitute for chemical treatment but would be part of an integrated management system that provides efficient and sustainable methods of worm control for the future.

Yet another way of reducing the effects of worms on sheep is to try to breed animals that resist such parasite infections. This selection for resistance may be a successful long-term control strategy.

For some years, the Division of Animal Production at Armidale has been selecting sheep with this ability and monitoring their offspring. Collaborative trials with the University of New England and the NSW Department of Agriculture have shown that young sheep, identified as resistant to one or more worm species, retain this ability in adulthood. Moreover, this characteristic is largely inherited in ensuing generations.

CSIRO is now working with commercial ram breeders to help them incorporate parasite resistance into their breeding programs.

Eradicating insects in dried fruit

Australia exports about $100 million worth of dried vine fruit every year and has a reputation as one of the world's premier producers.

In line with a national push to decrease our dependence on the use of agricultural

* *Research for Ecologically Sustainable Development*

Jan van Graver inserts test insects during an experiment on carbon dioxide treatment of sultanas

chemicals, dried vine fruit producers and packers have teamed up with CSIRO to examine alternative disinfesting agents for stored dried sultanas and currants.

Disinfestation of dried fruit is carried out regularly in the period between harvest and shipment, which can be a matter of months. Present control systems, used both before and after packing, rely heavily on chemical fumigation.

Two CSIRO Divisions, Entomology and Horticulture, have combined their expertise to investigate eradication of insects by non-chemical means throughout most stages of handling and marketing. These stages include before and after processing, long-term bulk storage and the protection of consumer packs.

After two seasons of testing, the researchers have demonstrated an effective and environmentally friendly insect eradication system. Carbon dioxide fumigation, coupled with the use of improved, sealed containers, prevents reinfestation during bulk storage. Oxygen scrubbers and low permeability plastic films have proved effective against insects in consumer packs.

Analysis of information on the fruit quality is continuing and early results look very promising. The results of the work so far have been passed on to industry in a series of workshops.

Breeding crops to handle drought

Research by the Division of Tropical Crops and Pastures into water stress in plants has broken new ground in plant genetics and is heading into an exciting phase of research with sorghum, maize and rice.

Osmotic adjustment is a natural process that minimises the effects of water shortages in organisms. It has been recognised for many years as an important survival factor in bacteria, algae and animals, and has more recently been identified in crop plants.

Increased levels of osmotic adjustment during drought help to promote greener

leaves and more root growth, which combine to give better drought resistance.

Research is now under way to allow the osmotic adjustment characteristic to be bred into crops such as maize, sorghum and rice. In doing so scientists must screen for the genes that contain the osmotic adjustment characteristic. This is difficult to screen for in the field so to overcome this problem, molecular markers, a type of biological tool, are being used to pinpoint the desired genes in the plant.

The scientists have identified three individual genes that control osmotic adjustment in sorghum and are now using molecular marker technology to screen and breed for good osmotic adjustment characteristics.

This laboratory work will soon move out to trial sites in Queensland where scientists intend to monitor osmotically adjusting lines of sorghum for their drought resistance and grain yield.

Osmotic adjustment research has now reached an advanced stage, resulting in an invitation being extended to CSIRO by the Rockefeller Foundation to conduct similar research with the International Rice Research Institute. This work aims to use osmotic adjustment to improve the drought resistance of rain-fed lowland rice in Asia.

Detecting toxins in lupins

CSIRO scientists at the Division of Animal Health have developed a simple test to monitor the level of toxins in lupin seeds.

In Australia, about one million hectares of field lupins are grown each year, producing seed worth more than $200 million. New developments are seeking to expand the use and markets for lupins for both animal and human consumption.

Lupins offer good cash returns, raise soil fertility and, when used in rotation, provide a disease break for cereal crops. The stubble and fallen seed left behind after harvest also

CSIRO post-doctoral fellow Julianne Lilley measures the water stress level in the leaf of a maize plant

provide highly nutritious feed for grazing livestock at a time when good quality fodder is scarce.

However, the benefits of grazing lupins are greatly reduced by the disease lupinosis. The toxins (phomopsins) responsible for lupinosis are produced by a fungus growing on lupin seed and stubble and can cause heavy animal losses. Because the toxins can also be harmful to humans, regulations exist to specify the maximum level allowable in seed sold for human consumption.

The lupin seed industry will therefore benefit from CSIRO's new quality control test, which has already been used for the recent harvest. Clear demonstration of quality and safety will enhance Australia's competitiveness in domestic and export markets for lupin seeds.

Deepwater fish stocks

With the urgent need to develop a management plan for the South East Fishery, the CSIRO Division of Fisheries responded to requests from the fishing industry and the Australian Fisheries Management Authority to survey the deepwater stocks — orange roughy, oreos and shark — off the southern coast of Tasmania.

In February 1992 the Division carried out a 14-day survey of some 50 coral/rock pinnacles scattered across the deep ocean south of Tasmania using a state-of-the-art towed body acoustic system designed and built at the Marine Laboratories in Hobart. The CSIRO research vessel *Southern Surveyor* was used for the survey.

The results of the survey now form the basis for the management plan for this fishery and have led to series of supplementary projects aimed at further refinement of these initial biomass estimates.

This work is now attracting considerable international interest as more countries move to expand their deepwater fishing activities and seek to acquire the expertise to estimate the size of their deepwater fish stocks.

DEVELOPMENTS

Rumentek Syndicate

In September 1992, the Division of Animal Production entered into an R&D syndicated arrangement totalling approximately $20 million with the newly formed Rumentek Syndicate. The agreement provides $5 million to enable CSIRO and the Rumentek Syndicate to construct prototype plants to manufacture patented specialised feed supplements for ruminants from oil seeds and proteins. The products will be marketed under the name 'Rumentek'. The partners will also conduct field trials, some in collaboration with commercial beef feedlots, to optimise the amount of Rumentek in the diets of cattle destined for specific markets such as Japan or Korea. Potential markets for Rumentek products in Australia are estimated at over $200 million.

In June 1993, the contract was extended and CSIRO received an additional $17.5 million. The agreement provides $5.5 million to enable CSIRO to undertake contract R&D work for the Syndicate for the next two years.

The application of the technology will enhance Australia's competitive position in beef and dairy production and provides the opportunity of adding $400 million a year of income derived from the export of these products and the Rumentek feed additives.

CSIRO stands to benefit through royalty income from the development of the technology by as much as $20 million a year.

Boran and Tuli cattle embryos on sale

The first embryos of the East African cattle, Boran and Tuli, went on sale by open auction in June 1993 and aroused great interest. This project, whose start was described in the 1989–90 Annual Report, is a joint venture

between the CSIRO Division of Tropical Animal Production and breeders in the Boran and Tuli Producer Consortium to provide new options for crossbreeding in the northern sector of the Australian beef industry. The sale of embryos followed promising results from evaluation studies conducted on the 'Belmont' National Cattle Breeding Station and on herds of members of the Consortium. It also signalled the start of the main commercial release of the breeds to the beef industry, although semen has been marketed since March 1992.

Commercial agreement for nematode technology

Ecogen Australia Ltd and CSIRO have signed an agreement for a co-exclusive licence to use nematode rearing and storage technologies developed by the Division of Entomology in its quest for species-specific biological control methods for insect pests. Ecogen purchased the nematode business from the previous licensee, Biotech Australia, in 1992.

Forestry research in Tasmania upgraded

In August 1992, the Prime Minister, Mr Keating, officially opened the new laboratories of the Division of Forestry and the CRC for Temperate Hardwood Forestry on the University of Tasmania campus. The new laboratories replace the obsolete Stowell site and, with the CRC, represent an enhancement of research capability and cooperation between the University, the forest industry in Tasmania and CSIRO.

Water hyacinth control in Papua New Guinea

The Division of Entomology has signed a contract with the Australian International Development Aid Bureau (AIDAB), for biocontrol of water hyacinth in Papua New Guinea. Water hyacinth is an increasing problem, choking up water systems that are important transport links in PNG.

MetAccess launched

MetAccess, a computer package for calculating weather conditions, was launched by Dr John Stocker, CSIRO Chief Executive, at the Outlook Conference in Canberra in February 1993. Developed by the Division of Plant Industry and marketed by Horizon Agriculture Pty Ltd, MetAccess provides access to daily weather data and enables users to estimate the likelihood of specific weather events or patterns occurring in any locality for which weather records are available.

Sugar yield decline project

Dr John Stocker, CSIRO Chief Executive, launched the Sugar Yield Decline project in Townsville in June 1993. A collaborative project between the Bureau of Sugar Experiment Stations and the Divisions of Soils and Tropical Crops and Pastures, it represents a unified and industry-led effort to maximise sugar yield in northern Queensland while optimising nutrient inputs. The project is funded by the Sugar R&D Corporation.

MINERALS AND ENERGY INDUSTRIES

ACHIEVEMENTS

Laterite geochemistry finds gold in Western Australia

The Yilgarn region of Western Australia has been the source of some of Australia's richest gold deposits. Increasingly, exploration activity has been focused on finding ore deposits concealed beneath extensive areas of laterite (deeply weathered, iron-rich materials) or areas of sedimentary cover (transported overburden).

Industry-sponsored research in the Division of Exploration Geoscience has shown that concealed gold deposits can be detected very efficiently by establishing the distribution of various trace elements in laterite. Furthermore, the surface areas over which these trace element patterns could be detected (called geochemical haloes) are up to 500 times larger than the concealed deposits themselves. This greatly enlarged target size can reduce exploration costs by over 95 per cent.

More recent studies of weathering history and landforms have revealed that extensive areas of laterite are buried beneath shallow layers of transported soils, sands and silts, and that the buried laterites also carry preserved target geochemical haloes.

Exploration trials based on these concepts showed that it is feasible to explore for gold and a range of other mineral deposits by drilling for buried laterites and recognising the preserved haloes.

Laterite geochemistry has now contributed to the discovery of a number of concealed gold deposits in Western Australia. For example the Turrett and Waroonga gold deposits were found during a collaborative study in the Lawlers district, involving Forsayth NL, Geochemex Australia and CSIRO. Others have included Bottle Creek and Bronzewing as well as the world-class Plutonic deposits.

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

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

Separating minerals in complex ores

Research by the Division of Mineral and Process Engineering is helping mining companies to extract the maximum quantities of minerals from sulphide ores.

Many of the sulphide ores now being mined present major processing challenges. The particles in the ores are often very small and the ores themselves are both mineralogically and chemically complex. It is often difficult to separate the minerals in the ores into saleable concentrates by froth flotation, the method normally used for separating non-ferrous minerals.

The research has shown that sulphide minerals in complex ores interact with each other in complicated ways, fundamentally altering flotation behaviour. For example, metal hydroxides, which are oxidation products of the minerals, can be transferred from one sulphide mineral to another and

this can suppress or promote floatability, depending on the circumstances.

Sulphur, which is another oxidation product, can also be transferred and this can promote floatability. The transfer of sulphur, in particular, is unexpected and this is the first time such behaviour has been seen.

By mapping the interactions and identifying their often competing effects, researchers at the Division have been able to account for many of the previously unexplained properties of complex ores and to explain why earlier attempts to improve the flotation of such ores had failed. The results have also pointed the way to some possible solutions, which the Division is now working on in collaboration with industry.

New magnesia products

As has been reported in earlier Annual Reports, CSIRO is a research partner in the new Kunwarara magnesite deposit in central Queensland. The companies involved and CSIRO aim to exploit the deposit to its maximum by producing a range of magnesium products that can fill market niches in Australia and overseas. Two new products have been developed this year — an environmental treatment agent and a cement.

Pollution control

One significant market demand that will be met is the need for chemicals to help reduce pollution. There is a continuing requirement to remove heavy metal and organic pollutants from natural waters, domestic and industrial effluents, and mineral processing streams.

Commercial products to assist pollutant removal are now starting to appear from the Kunwarara operation. In particular, the Division of Mineral Products has been investigating the performance of calcined magnesia (MgO) for this purpose.

Scientists have studied the relationship between the physical properties of MgO and both its reactivity and rate of consumption when used to neutralise acids or precipitate heavy metals from solution. This basic information has been used to formulate a range of products for specific environmental uses.

Large scale laboratory and field trials in several Australian States and a number of overseas sites have produced outstanding results and attention has now shifted to the marketing of commercial-scale quantities for several applications.

In parallel fundamental research on the absorption and dissolution behaviour of calcined magnesia, various physical and chemical measurements are being made on a specially modified, computer-controlled liquid chromatograph, which is capable of measuring dissolved pollutants in the parts per million range.

Water resistant cement

Magnesia-based cements are light-coloured and lightweight. They possess superior strength and resilience compared to Portland type cements, and can bind various organic and inorganic additives.

Research in the Division of Mineral Products has resulted in the production of a pre-mixed water-resistant MgO-based cement with properties that can be customised to suit diverse applications through the use of tertiary additives.

The cement can be prepared in a powdered form in an integrated operation. It can then be transported in dry form for later on-site activation by adding water.

Measuring the flow of oil from wells

New CSIRO developments will help industry to increase the efficiency of recovery of oil from oil wells and to reduce the costs of new offshore oil platforms.

A proximity detector on a coal-transporting shuttle car helps make a coal mine a safer place to work

The Division of Mineral and Process Engineering is developing a multiphase flow meter to measure flow rates of oil, water and gas in pipelines. The meter currently uses gamma-ray techniques to provide continuous flow data vital to operators.

The flow meter can be used instead of a gravity test separator, which is currently used for discontinuous flow measurements, leading to a considerable reduction in the weight and hence lower capital costs of new offshore oil platforms. In the long term, the meters are likely to be mounted about well pipelines on the sea bed, overcoming the need for most satellite platforms.

The gamma-ray techniques have been successfully tested on the flows from nine oil wells feeding to Western Mining Corporation's Vicksburg oil platform, offshore from Onslow, Western Australia.

The CSIRO project is co-ordinated by the Australian Mineral Industries Research Association. It is financially supported by the Energy Research and Development Corporation, Western Mining Corporation, West Australian Petroleum Pty Ltd (WAPET) and the Shell Company of Australia Ltd.

Safety in coal mines

The Division of Radiophysics has been using its expertise in digital signal processing techniques in an effort to improve the safety record in coal mines.

One such device, a 'proximity detector' has been operating at Myuna Colliery in New South Wales since early 1992. This device provides a warning to mine workers of the approach of a mine shuttle car when they are working near a continuous miner, a 50-tonne machine that removes the coal from the seam at the coal face.

One of the most serious hazards that miners face is being trapped between the shuttle car and the continuous miner. The proximity

detector uses radio and ultrasonic units on the vehicles to send signals to a microcomputer on the shuttle car. The computer then estimates the distance and approach velocity between the two vehicles and sends out both audible and visible alarms.

Another hazard is the collapse of the mine roof. Means of controlling and predicting roof-falls vary according to the nature of the mining conditions in a particular mine. The Division, in association with the Australian Coal Industry Research Laboratories Limited, has been commissioned by the coal industry to develop new technology to assess the integrity of conglomerate roof. This type of roof has been responsible for several unexpected falls in the Great Northern Seam in eastern New South Wales.

The collaborators are using acoustic resonance techniques to help assess the rock structure and plan to use the powerful digital signal processing microprocessors that are now available to develop suitable analysis techniques.

New coal combustion systems*

The Division of Coal and Energy Technology is investigating advanced power generation technologies that could affect the demand for Australian coals. The aim of the work is to be able to give good advice to Australian coal exporters and power utilities on the suitability of Australian coals for these advanced technologies.

Currently, all Australia's coal-fired power stations, and most of those overseas, use pulverised-fuel technology to produce steam that drives turbines to generate electricity. The energy efficiency of this process is around 35 per cent.

There is growing interest in Australia and overseas in more advanced technology that can raise the energy efficiency of electricity production from coal to 45 per cent, reduce carbon dioxide production by at least 20 per cent and almost eliminate emissions of sulphur dioxide and particulates. This new technology is called integrated gasification combined cycle, or IGCC.

The US, Germany and Japan already have demonstration scale IGCC plants, three European countries are building full-scale plants and the UK, Korea, South Africa and Canada are also working on IGCC systems. Although Australia is unlikely to need to build any new power stations until early next century, it is probable that these would use IGCC.

The Division is therefore studying which Australian coals will be most suitable for IGCC, identifying problems that arise and seeking improvements to current coal processing technology to remedy these problems. To keep up with technological developments in IGCC, CSIRO has established links with Korean researchers and is involved in technical exchanges with Japanese and German gasification experts.

Recent tests on Australian coals by the Japanese in their equipment have shown up some problems with removing the waste slag from the gasifier. This is the result of high ash-fusion temperatures, where the ash is not melting until temperatures above 1500 degrees C are reached. For best operation, gasifiers require an ash-fusion temperature of below 1400 degrees C. The CSIRO team is aiming to provide quantitative data on the temperatures at which the ash in various Australian coals will melt and produce mobile slags, and to find out the best fluxing agents to lower the temperature and increase the rate at which melting can take place.

DEVELOPMENTS

Consortium formed to develop fuel cell

The consortium Ceramic Fuel Cells Limited was formed in July 1992 to develop solid oxide fuel cell technology, based on CSIRO's

* *Research for Ecologically Sustainable Development*

solid-state zirconia expertise. The partners are CSIRO (through the Division of Materials Science and Technology), BHP, Electricity Trust of South Australia, Energy Research & Development Corporation, Pacific Power, State Electricity Commission of Victoria and Victoria's Strategic Research Foundation.

Coal quality analysis

An instrument that provides information about the quality of coal was launched onto the commercial market in July 1992; development of the prototype was reported in the 1989–90 Annual Report. The instrument , which uses proton magnetic resonance thermal analysis (PMRTA) techniques, was developed by the Division of Coal and Energy Technology in collaboration with the Joint Coal Board. Sales have been made in Australia and to the UK and there are potential sales in the US and Japan.

QCAT opens

The Queensland Centre for Advanced Technologies was opened officially on 5 February 1993 by the Premier of Queensland, Hon Wayne Goss. The Centre is a joint venture between CSIRO and the Queensland state government and its goal is to undertake research and development to assist the minerals, energy and manufacturing industries of Australia and especially Queensland. It houses staff from five CSIRO Divisions and provides the headquarters for the CRC on Mining Technology and Equipment. A substantial CSIRO activity in light metal casting, part of a new CRC for Alloy and Solidification Technology, is also be located at QCAT.

International distributorship for QEM*SEM

The Division of Mineral and Process Engineering has arranged for Wirsam Scientific Precision Instruments Pty Ltd to distribute its QEM*SEM technology. The QEM*SEM system provides an automatic, off-line, size-by-size and particle-by-particle mineralogical analysis of metallurgical flow streams and products. Wirsam, based in Johannesburg, South Africa, will have exclusive distribution rights in Africa and non-exclusive distribution rights in the rest of the world.

Visit to Chile

The Director of the Institute of Minerals, Energy and Construction, accompanied by three senior managers, visited Chile in March 1993. The aims of the visit were to strengthen the relationship between Australia and Chile in research for the minerals industry, to compare mining practices and to look for opportunities to provide R&D support to Australian mining and equipment supply companies exploring or operating in Chile. The Institute is now developing a draft strategy for involvement in overseas R&D, to be considered as part of CSIRO's overall strategy for strengthening its international involvements.

MANUFACTURING

ACHIEVEMENTS

Breakthrough in influenza treatment

In June 1993, the science journal *Nature* published news of a major Australian development in the treatment of influenza and other viral diseases. The announcement provoked immediate worldwide interest.

This development is the culmination of 15 years' research by CSIRO scientists, now in the Division of Biomolecular Engineering, and collaborators at the Australian National University and the Victorian College of Pharmacy, Monash University.

The influenza virus has long been a problem because of its rapid rate of mutation. This results in the continuous evolution of new strains of 'flu virus, against which existing vaccines are ineffective.

The CSIRO researchers determined the amino acid sequence of a functionally important protein on the virus surface and the chemical changes associated with the evolution of new strains of influenza. Then, in 1982, they succeeded in determining the three-dimensional structure of this protein and identified and characterised a part of it that remains constant for all strains of influenza. This portion of the virus became the target for a designer drug molecule, synthesised by the Victorian College of Pharmacy, which 'locks' onto this section of the virus and prevents it from spreading.

Financial backing for the project has come from Biota Holdings Ltd, which in 1989 formed a partnership with Glaxo Australia Pty Ltd to commercialise the research internationally. Support was also given to the early phase of the research by the IR&D Board.

The paper in *Nature* revealed that the trial drug had successfully protected highly susceptible ferrets against a variety of virulent influenza strains. The new drug is now being tested by Glaxo on human volunteers in the UK and is scheduled to begin full scale clinical trials in 1994.

The potential markets for such a drug are large, probably in the range of $500–1000 million a year. Both CSIRO and the Victorian College of Pharmacy will receive royalty payments from Biota when a commercial drug based on their work is successfully developed.

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

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

The BIGDIFF

A collaborative project based at the Division of Materials Science and Technology involved the design and construction of a unique high precision X-ray diffractometer ('BIGDIFF') for operation as the heart of the Australian National Beamline Facility at the Photon Factory, Tsukuba, Japan.

X-rays are used by university and industrial researchers at the Photon Factory to study the

structure and composition of materials at the atomic level in order to better understand the influence of atomic structure on their properties. Diffractometers are an essential part of this work.

BIGDIFF is a versatile multi-purpose instrument that combines functions normally carried out by three or four instruments. It has applications in fields including mineral studies, development of new pharmaceuticals, aerospace materials, natural and synthetic composites and biomedical studies.

BIGDIFF incorporates innovative design features such as the capability to operate the diffractometer entirely in a vacuum, specially designed electronic systems to standardise motor control and novel high precision backlash-free rotation stages allowing accurate adjustment of the X-ray optics. A CSIRO developed oil-free vacuum pump is an important component.

BIGDIFF is operated at the Photon Factory by an Australian consortium representing government and university research organisations.

New route to titania pigment

Scientists in the Division of Materials Science and Technology have developed a new process for making several commercially significant inorganic products, including titania.

Australia is the source of half the world's rutile and ilmenite used to produce titania pigment. However, nearly all the upgrading to pigment itself and to value-added manufactured products is carried out overseas.

Titania pigments are used in a wide range of industries, such as paper, paint, plastics, printing ink, flooring, cosmetics and tiles, to provide product opacity (hiding power). Titania pigments can also increase the resistance of some products (such as paints) to natural weathering.

The new CSIRO process is more environmentally acceptable than the two current production methods used for titania because it uses a water-based technology. One of the current methods uses large quantities of concentrated acid and the other uses chlorine gas; both processes produce environmental problems.

The new process has attracted interest and support from major pigment producers and mineral sand resource companies. It is now undergoing economic and further technical assessment. If successfully translated into industry, it could not only provide new value-added earnings for Australia but could also have an impact on other mineral resource and manufacturing sectors, the latter in areas such as ceramics and catalyst production.

Synthetic viruses

The Division of Tropical Animal Production has constructed and patented the world's first synthetic rabies virus-like particles (VLPs) for use in rabies vaccine.

Similar technology has previously been used to construct a limited range of synthetic viruses that have shown great potential as effective vaccines. The Division used CSIRO's gene shears technology to broaden the potential applications to include the rabies virus and other human and animal pathogens such as measles, mumps and canine distemper viruses.

These virus-like particles have been engineered in insect cells by using insect viruses to synthesise essential structural components of rabies virus which, in turn, produces large quantities of the required protein. This enables assembly of particles that have most of the structural characteristics of live rabies virus, but, although the VLPs contain rabies virus genes they are incapable of replicating and so are not infectious.

This discovery has exciting potential for the pharmaceutical and veterinary industries. Vaccines made from synthetic virus particles

will be safer than conventional vaccines and are likely to provide the long term effective protection that has been difficult to achieve with recombinant vaccines.

It may also be possible to apply this technology to vaccines for other human diseases such as glandular fever, cervical cancer and malaria.

Some applications of this new technology will be developed through collaboration with the Cooperative Research Centre for Vaccine Technology.

Designer antibodies

A new range of genetically engineered antibody molecules has been developed at the Division of Biomolecular Engineering.

These 'designer' antibodies form the basis for new reagents to surpass and replace the current use of monoclonal antibodies as diagnostic tools. Unlike their parent antibodies, they are single-chain derivatives in which two antibody fragments have been joined.

Added advantages for this new technology are that the production method avoids the use of live mice (used in traditional antibody production) and that it is much cheaper than current cell culture methods.

One of the first applications of the technology has been in the production of diagnostic reagents for the project's commercial partners, AGEN Biomedical Ltd, an expanding Queensland-based biotechnology company. AGEN is using these 'designer antibodies' in its SimpliRED Diagnostic Kit for AIDS diagnosis. HIV-positive patients are diagnosed by a rapid 2 minute agglutination test using just one droplet of blood. The company plans to market its reagents worldwide.

Another major achievement of this project has been more fundamental. In collaboration with scientists from the Biomolecular Research Institute in Melbourne, the CSIRO scientists have solved the three-dimensional structure of a single-chain antibody. This knowledge can now be used to determine how changes in antibody surfaces will alter the effectiveness of the antibody (its binding affinity).

CSIRO hopes this research will lead to a new generation of specially designed antibodies that will have unique properties for diagnostic or therapeutic applications.

Ultrasonic gas meter

CSIRO and AGL have joined forces to bring gas metering into the 20th century by developing a compact, ultrasonic gas meter. This new product has the potential for substantial domestic and overseas sales.

For more than a century, variants of the mechanical bellows meter have been used throughout the world to record gas usage. These meters are large, ugly and being mechanical, are subject to wear. The gas distribution industry has for some years been committed to developing a compact gas meter with an appearance and performance consistent with modern technology.

The required features of the ideal meter are compatibility with new meter reading technologies, accuracy over a wide range of flowrates, easy and unobtrusive installation, low maintenance and value for money.

Ultrasonic metering of liquid flow has been used for almost three decades and accounts for about ten per cent of the market. However, measuring gas flow ultrasonically is difficult because there is a mismatch in acoustic impedance between a gas and a conventional ultrasonic transducer.

The key to the success of the CSIRO-AGL gas meter is the invention by scientists in the Division of Applied Physics of a new transducer made by configuring a metallised piezoelectric film. This transducer has a low impedance and a relatively broad band, meaning it transmits and receives ultrasonic signals efficiently in gases.

AGL and CSIRO have been negotiating with some of the world's leading companies to licence the technology in a way that provides the best opportunity to capture world markets with participation for Australian industry. The new meter is expected to be used commercially in Australia in late 1995.

Lasers light the way for wool industry

A CSIRO invention, developed with financial assistance from Australia's woolgrowers, has received international recognition as the leader in its field.

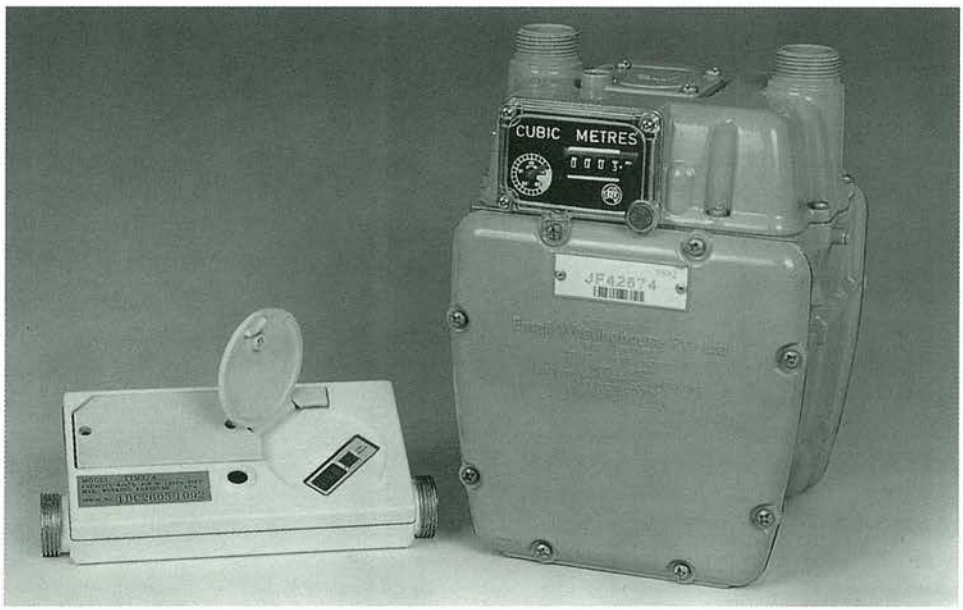
SIROLAN-LASERSCAN, which uses a laser beam to measure the thickness of wool fibres, is now set to become the world's standard method of obtaining these measurements. As well as measuring the average diameter in a sample of wool fibres, the instrument records the diameter of each individual fibre.

Average diameter largely determines the wool's processing potential and end use, while diameter distribution measurements can help control its quality throughout production, sale and processing.

The speed of the instrument is one of its most obvious advantages. The whole procedure, from collecting the sample to receiving a print-out of the results, takes less than five minutes. Current procedures take several hours to achieve a less detailed and accurate result.

The endorsement of SIROLAN-LASERSCAN by the Standardisation Committee of the International Wool Textile Organisation means that the instrument has satisfied all the technical requirements for progression to a Full IWTO Test Method.

The SIROLAN-LASERSCAN instruments are being made in Sydney and exported worldwide. More than twenty have been made so far and are being used in France, Germany, Argentina, the USA, South Africa, Italy, Australia and New Zealand.



At about the same size as a videotape, CSIRO's new ultrasonic gas meter is much smaller than the meter currently used. It has a flap which, when raised, allows a customer to read the amount of gas used

MEATSEAL

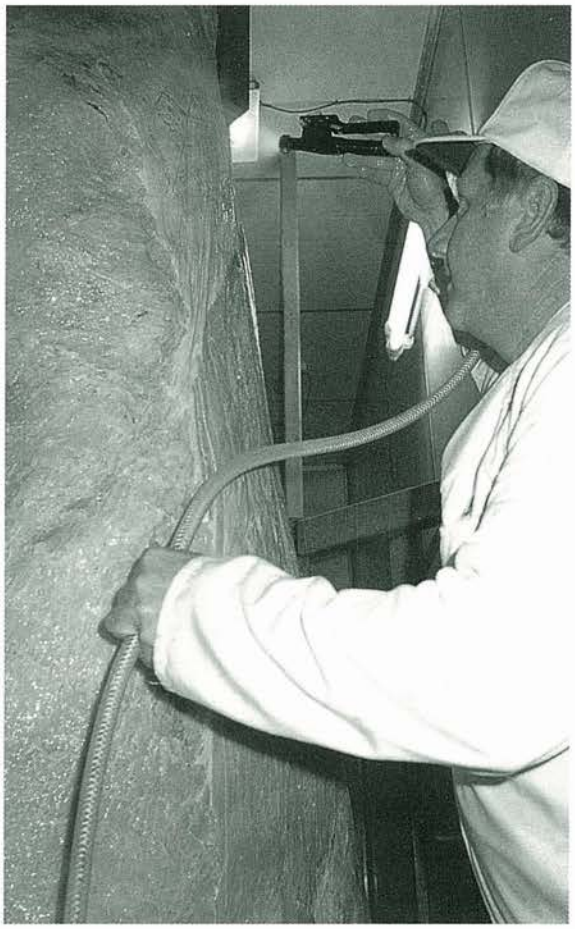
A new meat treatment developed by CSIRO has the potential to add $60 million to the value of the beef industry.

When animals are processed in abattoirs, the carcasses are stored in chillers and freezers before boning and/or despatch.

In storage, the carcasses usually lose moisture — typically about 3 per cent for pigs and 2.5 per cent for beef. For every one per cent reduction in carcass weight, there is a loss of about $30 million (based on 1990 figures of 2 million tonnes). Also, the surfaces dry out, causing darkening of the lean surface and yellowing of the fat. This has to be trimmed later at major additional cost.

MEATSEAL, developed by the Division of Food Science and Technology and commercialised by ICI Australia Pty Ltd, is an edible surface coating made from animal extracts that is sprayed on to the carcass as it enters the chiller.

Based on conservative estimates, MEATSEAL could retain saleable product to the value of $60 million every year.



MEATSEAL (ECOLAB) sprayed onto meat carcasses before chilling prevents moisture loss, discolouration and drying — factors that cost the meat industry more than $30 million a year

DEVELOPMENTS

Major pharmaceutical agreement

CSIRO has formed a $21 million agreement with Macquarie Bank and AMRAD Corporation to develop a new range of chemicals that show promise as drugs of the future. CSIRO will refine and test chemical compounds developed by the Organisation over the past six years. They include possible drugs against Alzheimer's Disease, Human Immunodeficiency Virus, Hepatitis B and Hepatitis C. The research and testing will be performed by CSIRO's Division of Chemicals and Polymers and, as sub-contractors to CSIRO, by Fairfield Hospital, the Macfarlane Burnet Centre for Medical Research, Monash University's Department of Microbiology and the University of Sydney's Department of Pharmacology.

Major agreement with car makers

In December 1992, the Australian Automotive Technology Centre announced a landmark

agreement between CSIRO and some of the major automotive manufacturing companies in Australia. Nissan, Ford, Mitsubishi, Toyota and component manufacturers Castalloy and Southern Aluminium, have joined CSIRO in a major exchange of resources, staff and facilities to improve technological development in diecasting. The AATC was set up by CSIRO in 1991.

SIROSCOUR a commercial success

CSIRO's wool washing process, SIROSCOUR, is beginning to sell well overseas. In Korea, the Hanil Company is installing SIROSCOUR to wash Australian wools in Masam. In China, the Nam Kwong International Trading Company of Macao will install computer controlled SIROSCOUR facilities to handle a wide variety of Australian wools.

New solder masks

DuPont Electronics intends to go into commercial production in 1994 of a new polymer-based solder-resistant film for printed circuits developed by the CSIRO Division of Chemical and Polymers. With a potential world market of US$150 million a year, the film will be marketed to manufacturers in the computer and telecommunications industries. This product is one outcome of work done under the strategic research alliance between CSIRO and DuPont to exploit CSIRO's expertise in molecular design and engineering.

Microbiological quality of Australian meats

Consumer concerns over food safety and Australia's image as an exporter of 'clean green' foods have led to a need for up-to-date information on the quality of Australian meat in the 1990s. The Meat Research Laboratory of the Division of Food Science and Technology has been awarded a $1.4 million industry-funded grant by the Meat Research Corporation to help provide this information. Researchers will conduct baseline surveys to determine the quality of frozen and chilled beef and sheep meats and will asses the effects of new processing procedures such as CSIRO's Fututech. Twenty five meat processors around Australia are co-operating in the study, as is the Australian Quarantine Inspection Service.

INFORMATION AND COMMUNICATIONS

ACHIEVEMENTS

Improving mobile telephones

CSIRO has completed a design study for a new radio system that will help maintain the high quality of cellular radio transmission and cope with the rapidly growing number of mobile telephone users. The Division of Radiophysics expects to produce four prototypes of the new radio link for evaluation and trials by the end of 1993, with the aim of reaching the market in 1994.

This work is part of an agreement entered into in 1992 with Exicom Australia Pty Ltd, a designer and manufacturer of telecommunications equipment based in Sydney.

The contract is using several of the Division's leading areas of technology — gallium arsenide semiconductors, electromagnetic design and microwave receiver technology. The researchers have designed new integrated circuit components based on gallium arsenide. These can provide the much higher operating frequencies needed to sustain higher volumes of telecommunications data.

The new system enables more efficient use of the available microwave spectrum and will offer companies a lower-cost, wireless means of connecting branch operations located within 5 kilometres of each other. It also has the potential to provide wide-band connections to support applications such as video conferencing and the integrated services digital network (ISDN).

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

CAD conferencing

CSIRO and Telecom Research Laboratories have jointly developed a prototype electronic conferencing system that enables participants to share Computer Aided Design text and graphics simultaneously.

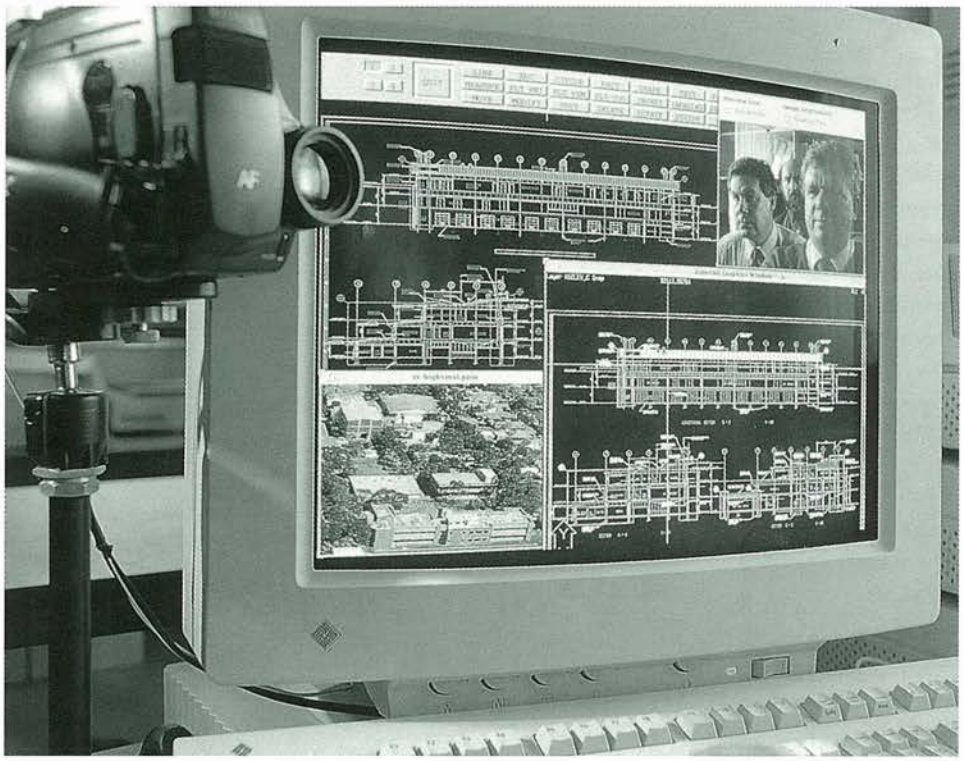
CSIRO's interest in this system, through its Division of Building, Construction and Engineering, is in assisting construction industry reform by increasing productivity through enhanced information exchange.

By building on the productivity gains that Computer Aided Design (CAD) made in the 1980s, the ability to network CAD between geographically dispersed members of a project can reduce the time for some operations by between 20 and 40 per cent, and can generate overall project savings of up to 10 per cent.

In many construction projects, over 100,000 CAD drawings will have been issued before the job is completed. These need to be viewed at several locations by different architectural, engineering and construction practitioners, some of them interstate. Currently, most interchange of documents (text and graphic) is through the postal or courier systems.

The CSIRO-Telecom conferencing system provides a wide range of network options, including file transfer, window-sharing and live video-conferencing. The system operates on high speed, wide area networks (e.g. ISDN and FASTPAC).

Window sharing provides an opportunity for the architect to highlight and enlarge elements under discussion with a project



A prototype CSIRO-Telecom electronic conferencing system allows participants to share Computer Aided Design text and graphics simultaneously

manager who is at a remote site, and both parties are able to discuss and modify the design, sharing the same visual information.

One other advantage of this system is that large projects can be serviced from anywhere in the world. This means that specialists remaining in Australia can become involved in large overseas construction projects.

New spatial information system commercialised

The Division of Information Technology has produced an improved spatial information system called SISKITS (Spatial Information System Tool-Kits). This work is a further development of the Environmental Decision Support System, reported on in the 1990–91 CSIRO Annual Report.

Release of the SISKITS package to industry partners is under way. One partner, ARC Systems, has used SISKITS concepts and software to build prototype systems to provide operators in police, ambulance and fire command centres with map displays updated in near real-time. SISKITS is also being used as the basis for decision support systems within the Urban Water Systems project that started in CSIRO during 1993.

SISKITS is aimed at an 'open applications' approach to building applications software for a particular task by bolting together standard modules for graphics, a database, modelling and modules specific to the task.

The open applications approach provides greater freedom to mix-and-match functions and to apply new techniques than is available with customary Spatial Information Systems.

Two key modules in SISKITS are the Object-User Interface (OUI) and the Data Management Module (DMM)

The OUI uses pop-up menus that appear beside a selected item in a display. This provides a solution to the problem of presenting the very extensive set of operations required in most real-life applications. It was evaluated in the GeoSIS Project, aimed at assisting mineral exploration, undertaken in collaboration with the Divisions of Exploration Geoscience and Geomechanics.

The DMM was re-designed to strengthen the capability of the original Environmental Decision Support System to draw data of many types from many databases. It has been designed as a strategic base that can be progressively extended and refined well into the future.

DEVELOPMENTS

Earth station antennas delivered

The Division of Radiophysics delivered two Ka-band earth station antennas to MITEC Ltd during the year. These antennas will be used in radio signal propagation tests at 30 gigahertz with the Optus second generation satellites.

Wire-less computers

The Division of Radiophysics has begun a $100,000 collaborative project with IBM Australia Ltd to develop a wire-less local area network that will allow computers within a building to communicate with each other without using cables.

ENVIRONMENT

ACHIEVEMENTS

Restoring endangered mammals to the mainland*

A collaborative project involving CSIRO scientists has successfully reintroduced an endangered mammal — the burrowing bettong — to a special reserve in mainland Western Australia.

The burrowing bettong is a small, rabbit-like member of the kangaroo family that once occupied the southern two-thirds of Australia. The last European record of this species on the mainland was at Pingelly in the Western Australian wheatbelt in 1942.

The bettongs were reintroduced in May 1992 from Dorre Island off Shark Bay to a secure peninsula reserve that juts into the Bay. This reserve is managed in a joint venture by the small community of Useless Loop, a mining company called Shark Bay Salt Joint Venture and the CSIRO Division of Wildlife and Ecology.

The bettong numbers on the reserve have trebled in the first fifteen months but continued incursion of feral cats remains a problem despite intensive control efforts.

This project is part of a larger program by the Division of Wildlife and Ecology to find out the size and stability of island populations of mammals in Western Australia, to identify what caused their decline and extinction on the mainland and to re-establish populations on the mainland.

Other mammals being investigated on Dorre, Bernier, Barrow and Boodie Islands include the golden and western barred bandicoots, and the rufous, banded and spectacled hare-wallabies.

The researchers aim to test theories as to why these mammals declined on the mainland. One possibility is that introduced species such as foxes and feral cats have preyed on them; another is that landscape changes caused by changes in fire and grazing regimes were primarily responsible.

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

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

Alternatives to organochlorines for termite control*

A new physical barrier to control termites has been developed by CSIRO and is now in commercial use.

There is strong pressure in Australia to ban the use of organochlorine insecticides for the control of subterranean termite attack in buildings. Some local authorities have already banned use of these chemicals. The more acceptable synthetic pyrethroids have yet to show long term good results, particularly as soil poisons, so the Division of Forest Products is investigating other methods of termite control such as physical barriers and baiting techniques.

Physical barriers based on methods pioneered overseas have been adapted to Australian conditions and termite species. In association with the Melbourne-based Mawson Group of companies, the researchers have developed a technique that uses granite as a barrier. The granite is crushed to a size range that prevents termites from being able

* *Research for Ecologically Sustainable Development*

to tunnel through it. A 100 millimetre thick layer of crushed granite is installed under the floor slab or under and around stumps where a suspended floor is used.

National accreditation has been granted for the use of "Granitgard" as an alternative to chemical termite barriers in areas south of the Tropic of Capricorn. In the northern parts of Australia, where the giant northern termite *Mastotermes darwiniensis* Froggatt is found, a different size range specification will be required and this has yet to be determined. Interest in "Granitgard" has also been expressed in Japan.

CSIRO has assessed several insecticides for use in baits. Termite baits rely on attracting or collecting the insects at a point source where a very small amount of controlling chemical can be applied to them. This chemical will be transported back to the main colony, thereby eradicating it.

CSIRO research has found the chlorocarbon Mirex to show most promise for effectiveness as a termite bait in Australia. Calculations show that one gram of Mirex can eradicate a colony of 800,000 termites in a building; three to four kilograms of organochlorines would be needed to eradicate the same colony.

Major contributions to national environment policy*

When the Commonwealth Government decided to undertake regular state of the environment reporting, it looked to CSIRO for help in preparing its major discussion paper on the subject. The result was *Development of a National State of the Environment Reporting (SER) System*, a paper prepared by CSIRO for the Commonwealth Environment Protection Authority (CEPA), and now in wide circulation for comment.

The concept of SER is well established overseas, especially in OECD countries. In Australia, the establishment of State and Federal Environment Protection Agencies and the public's desire to know what is happening to our environment heralds a new beginning for SER here.

One of the keys is to develop a set of 'environmental indicators' for environmental health and to express this health at a range of geographic scales.

In 1992–93 CSIRO prepared two further discussion papers for CEPA — *Towards Healthier Rivers* and *Urban Stormwater — a resource too valuable to waste*. Both were launched by the Minister for the Environment as major policy contributions and both received wide national coverage.

Through the urban stormwater paper, prepared by the Division of Water Resources, CEPA is inviting community feedback on all stormwater issues. In particular it is looking for ways that the public can actively facilitate the change of stormwater management of urban run-off that causes pollution of beaches, increased nutrients in rivers, lakes and streams (leading to algal blooms), sedimentation and drowning hazards during flooding.

The healthier rivers paper, also prepared by the Division of Water Resources, recommended that the Commonwealth establish a National River Health Program to run co-operatively with the States. It said the Program should have as components:

- a survey of community views of desirable river conditions, priority uses and useful health indexes;
- scientific advice about attaining these river conditions;
- an array of policy recommendations and management tools selected to meet the objectives set after community consultation;
- the framework for the implementation of the Program to be Total Catchment Management and to include land care groups, sporting and service clubs;

* *Research for Ecologically Sustainable Development*

- the inter-Governmental arrangements to parallel those proposed in the draft National Water Quality Strategy and wherever possible to embrace existing or proposed government programs relating to river health and catchment management.

Control of Mimosa pigra*

A flower-feeding weevil from Mexico was released in January 1992 in the Northern Territory to help control one of the most alarming environmental threats in northern Australia, the weed *Mimosa pigra*.

The weed, a thorny, woody legume from tropical America, is invading native Australian wetlands. It already covers over 800 square kilometres of the Northern Territory and poses a serious threat to Kakadu National Park and all coastal areas in tropical Australia. It out-competes other plants and restricts access to floodplains for native animals, stock, irrigation and recreation.

The weevil *Ceolocephalapion aculeatum* was collected by researchers from the Division of Entomology. The scientists have been working on an extensive biological control project for the weed, using insects and fungal pathogens, in a joint program with the Northern Territory Department of Primary Industry and Fisheries.

Further hopeful news is that two stem boring moths from Mexico released in 1989, *Neurostrota gunniella* and *Carmenta mimosa*, are respectively reducing seed production over a wide area and severely damaging stems

Mimosa pigra, a tropical American weed invading native Australian wetlands, is showing signs of succumbing to biological control methods.

in the Finiss River region of the Northern Territory.

The *Mimosa pigra* control project was one of several environmental projects to be promised money by the Prime Minister in his December 1992 Environmental Statement. A total of $5 million has been set aside for several *Mimosa* control projects that include mechanical, chemical and biological control. CSIRO received a share of that money for further research into biological control.

Learning more about greenhouse gases

For some years, CSIRO has mounted an interdisciplinary research effort to understand more about how the greenhouse effect occurs so that methods of reducing its occurrence and impact might be developed.

The latest research by the Division of Atmospheric Research has revealed promising signs that the rate of growth of methane and CFCs in the atmosphere is beginning to slow.

Both methane and CFCs (chlorofluorocarbons) are greenhouse gases. CFCs are also responsible for releasing chlorine in the upper atmosphere, leading to stratospheric ozone depletion.

Methane

In 1983, average global methane levels were growing at about 13.3 parts per billion a year. By 1990 this growth rate had fallen to about 9.5 parts per billion a year. If this decline in growth rate continues unchanged, the atmospheric methane concentration is likely to peak by about 2006, and then begin to drop. Analysis of methane concentrations from a global network may be able to pinpoint the cause(s) of the slowdown, which appears to be driven from the northern hemisphere.

One possible explanation for the slowdown in methane growth rate may be the efforts aimed at using energy more efficiently. It is also possible that more methane from landfills, coal mines and oil fields is being trapped and used as fuel, rather than being released into the atmosphere.

One specific source of methane gas is being studied in more intimate detail as scientists from CSIRO's Centre for Environmental Mechanics and Division of Plant Industry and the US Department of Agriculture have used a novel method to measure methane produced by cattle grazing freely in a field.

Cud-chewing animals such as cattle, sheep and goats are believed to produce about half Australia's total methane emissions, with cattle alone producing one quarter.

Most of our current knowledge of methane production by animals comes from careful measurements in respiration chambers, where the gases used and produced are measured while the animals are fed various diets. Whilst these are accurate measurements, it is important to know if they can be extrapolated safely to the field environment where there are different environmental stresses and no restraints on the animals.

To measure methane production in the field, scientists took their instruments to the animals, rather than bringing animals to their laboratory. Four Murray-Grey cattle were grazed on pasture in a small field at the CSIRO Research Station at Ginninderra, near Canberra. On each fence of the field, four sampling tubes were mounted at heights between 0.5 metres and 3.5 metres. Air was drawn into each tube through capillary tubes inserted at one metre intervals and pumped to a mobile laboratory for analysis.

The researchers also measured wind speed and direction. They calculated the rate of methane production by the cattle by subtracting the rate at which methane was carried by the wind into the field from the rate at which it was carried out of the field. Measurements were made continuously for three days.

It is believed that cattle produce about a quarter of Australia's total methane emissions. Dr Tom Denmead takes some measurements in the field

The experiment showed that the rate of methane production was nearly 500 litres per animal each day. However, this rate was more than halved when the cattle were fed a high quality diet in a three-day repeat of the outdoor experiment, confirming that improved feed quality should lead to reduced methane emissions.

This in-field method could be used to measure trace gas emission in other situations where there are scattered point sources, such as the production of nitrous oxide during grazing or production of methane from termite mounds.

CFCs

For the last ten years, the Division of Atmospheric Research has measured CFC levels in air sampled by the Cape Grim Baseline Air Pollution Station in north-western Tasmania. For most of the 1980s, CFC concentrations increased by five per cent per year. However, since 1988, the annual increase has dropped to three per cent per year.

When combined with measurements from a global network, the research provides a method of checking the compliance with Montreal Protocol commitments to cut CFC production. The conclusion so far is that atmospheric measurements confirm industry reports of drastic cutbacks in CFC production.

However, one note of caution is needed. Despite the slowdown in rates of growth of methane and CFCs, the growth rates of other greenhouse gases, such as carbon dioxide and nitrous oxide, have been steady or have increased during the past decade.

DEVELOPMENTS

SIROFLOC demonstration plant opened

The official opening of the SIROFLOC sewage demonstration plant at Malabar in Sydney was held on 18 May 1993. The plant, a joint venture by the Sydney Water Board, CSIRO and Davy John Brown Pty Ltd, took only 15 minutes to remove 85 per cent of suspended solids and 90 per cent of oils and greases. Conventional plant would take over ten hours to achieve the same results.

PLASCON developments

Nufarm, Siddons-Ramset and CSIRO have jointly won the Australian Chemical Industry Council Environment Award for the installation of the PLASCON hazardous waste destruction system at Nufarm's Melbourne plant. The 50 kW PLASCON unit installed at the Division of Applied Physics in Sydney has started to destroy Halon as part of a Siddons/Department of Arts and Administrative Services contract; an additional 50 kW PLASCON system is being commissioned to treat PCB waste.

Sydney Metropolitan Air Quality Study

Two CSIRO Divisions are partners in a consortium established by the New South Wales Environment Protection Authority to develop a system for predicting air quality in the Sydney, Wollongong and Lower Hunter regions of the State. The consortium is headed by Coffey Partners International and includes the Victorian Environment Protection Authority, Macquarie University and the CSIRO Divisions of Atmospheric Research and Coal and Energy Technology.

TREES agreement*

CSIRO's Office of Space Science and Applications has signed an agreement with the Joint Research Centre of the Commission of the European Communities for the satellite monitoring of tropical forests. The agreement has been made under the Tropical Ecosystem Environment Observations by Satellite (TREES) program of the EC in conjunction with the European Space Agency. The program aims to improve understanding of the changes occurring in tropical environments, especially tropical rainforests, due to human activity.

Resource information systems for PNG*

CSIRO, through its Division of Wildlife and Ecology, has entered a $5.5 million agreement with the Australian International Development Assistance Bureau (AIDAB) for the development of two resource information systems for Papua New Guinea. About half the work will be contracted out by CSIRO. The project represents the final phase in establishing resource information systems in PNG to help coordinate the allocation and use of land and to protect natural resources.

Centre for Plant Biodiversity Research

A joint venture between the CSIRO Division of Plant Industry and the Australian Nature Conservation Agency, particularly the Australian National Botanical Gardens, has set up the Centre for Plant Biodiversity Research. The Centre aims to expand and manage scientific collections, conduct research on Australian vegetation and co-ordinate and update botanical databases.

Australian Collaborative Land Evaluation Program*

The establishment of the Australian Collaborative Land Evaluation Program (ACLEP) in 1992 represents the beginnings of a new integrated national approach to land resource assessment in Australia. The

* *Research for Ecologically Sustainable Development*

Program is co-ordinated by the CSIRO Division of Soils and involves land management departments from all States in Australia. ACLEP will resolve issues of national standards for soil mapping and land evaluation; soil survey and land evaluation quality control; regional correlation of soil types to enhance technology transfer; and development of methods for land/soil mapping and data handling.

Minesite rehabilitation research*

The Australian Centre for Minesite Rehabilitation Research has been established as a joint venture between the mining industry (through the Australian Mineral Industries Research Association), universities (through the University of Queensland and Curtin University) and CSIRO (through its multi-Divisional minesite rehabilitation program). The Centre aims to network the best skills in rehabilitation science in Australia and focus them on problems identified by industry as the most pressing strategic research challenges. Funding for research will be primarily from the mining industry.

* *Research for Ecologically Sustainable Development*

INFRASTRUCTURE, SERVICES, ADVANCEMENT OF KNOWLEDGE

ACHIEVEMENTS

Improving image analysis

The Division of Mathematics and Statistics has been successfully working with industry to develop improved methods for routine, fast and reliable visual inspection. These methods enable companies to reduce the costs and to improve their understanding of the processes that occur during manufacture or treatment.

Many visual inspections require distinct components or segments to be identified, for example individual grains in images of metals, or the anatomical parts in images of the brain and chest. This is difficult because the edges of segments are often blurred and the brightness and colours in the images can vary.

The CSIRO scientists have developed a suite of tools that can automatically segment several types of image. Once images are segmented, it is often straightforward to extract and present quantitative information about them. They are now using these tools to help a variety of companies with their visual inspections.

For example, they have analysed the microstructure within aluminium coils at Comalco Rolled Products Division. This provided statistics on the size and shape of grains in cross sections of coils, which has led to a greater understanding of the variability of the mechanical properties of the aluminium coils.

In collaboration with the Division of Mineral Products, the Division of Mathematics and Statistics is developing an automated system for measuring the size of grains in magnesia produced by the Queensland Magnesia Project. This will enable fast and accurate grading of the magnesia to ensure the high quality standards required for refractory brick manufacture.

With the Division of Manufacturing Technology, the scientists are developing an automated weld inspection system to relieve specialists from the slow and tedious task of classifying weld microstructure manually. The system classifies regions of a weld into five categories according to international guidelines, and allows a larger area of each weld to be classified.

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

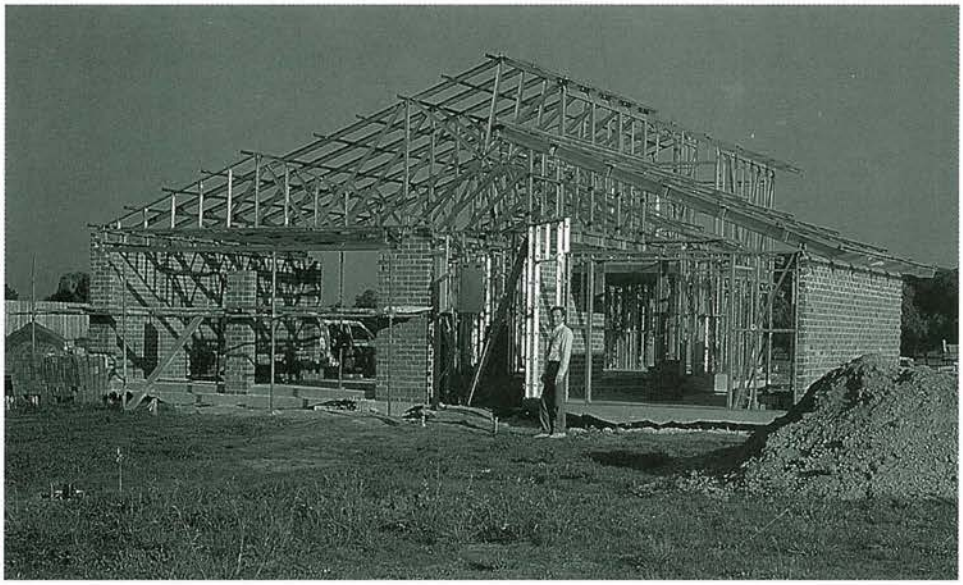
Operate and develop the Australia Telescope National Facility as a prestigious and world class radio astronomical observatory dedicated to the advancement of knowledge

Metal-framed houses

CSIRO and The BHP Company Limited have collaborated to develop a design manual and a Performance Standard for metal house frames.

Metal frames for houses have been used in Australia for thirty years but have always had strong competition from traditional timber frames. However, metal frames are now growing more popular with project builders and kit home suppliers and also have potential for export to Asia.

BHP collaborated with the Division of Building, Construction and Engineering to



CSIRO and BHP have developed a design manual and Performance Standard for metal house frames

develop the Standard to maintain the quality of metal framed houses while encouraging innovation in design. The Standard is unique in that it contains mandatory serviceability criteria, which are purely advisory in other codes.

The Division's research of the last three years forms the basis of the technical content of the Standard, which is due for publication late in 1993.

Other countries interested in this Australian Standard are the United States, New Zealand and Italy.

More signposts to forming stars

The Australia Telescope has detected a number of new radio sources of a special kind — methanol masers — which are found where stars are forming. These should help reveal more of the physical processes surrounding the birth of stars.

Stars are formed within giant clouds of gas and dust. Under certain conditions, molecules within these clouds emit intense radio signals in very narrow frequency ranges. This is 'maser' emission, which is the radio counterpart of laser light. Maser emissions seem to pinpoint the dense regions within the clouds where stars are forming, or are about to form.

Two of the molecules that can put out intense maser emission are water (H_2O) and the hydroxyl radical (OH). Water and hydroxyl masers have been hard to interpret as they have been spread around star-forming regions in a rather complex way.

Now the Australia Telescope has found that another kind of maser tends to lie in straight lines or simple arcs. These masers might be forming in material around, or flowing out from, embryonic stars.

The new masers are produced by the methanol molecule (CH_3OH). A few years ago astronomers discovered that this molecule put out maser radiation at a frequency, 12 gigahertz, that radio telescopes could handle. The Australia Telescope team worked with other teams in the southern

hemisphere to make the first finely detailed images of these 12 gigahertz masers.

In 1991 even stronger methanol masers were found, at a frequency of 6.7 gigahertz. They were then fitted into a map that located all the other masers and regions of ionised hydrogen gas that are found in star-forming regions. In one region (called Sagittarius B2), it seems that the masers and patches of ionised gas mark a line where two dense gas clouds are colliding, creating conditions just right to form stars.

DEVELOPMENTS

CSIRO-Local Government Workshop

CSIRO and Local Government representatives met in April 1993 at a Workshop organised by CSIRO to produce a working agenda for collaboration between the two. Discussions are now under way to identify areas for joint research, information transfer and consultancy.

Cholesterol-reduced foods

The SIDOAK process for extracting cholesterol from egg and dairy products has been demonstrated on a pilot plant scale with reduction of around 90 per cent in the cholesterol content. An Australian egg processing company has a licence agreement for the technology and negotiations are under way for overseas licensing agreements.

Australian Healthy Food Program

The CSIRO Division of Human Nutrition started a project in collaboration with the Commonwealth Department of Health, Housing and Community Services and Woolworths Pty Ltd in October 1992. The main aims of this two year project are to develop, implement and evaluate a variety of nutrition information materials that will help shoppers to choose healthy foods. The project, part of the Australian Food and Nutrition policy, is based on the recently revised Australian Dietary Guideline. Materials from the project will be made available to retailers when it is finished.

Awards for BCAider

BCAider, the expert software package designed to interpret the Building Code of Australia, was Software Product of the Year at the Australian Information Technology Awards in November 1992. It has also received an Australian Design Award, only the third ever for a software-based product. The package, developed by the Division of Building, Construction and Engineering, was described in the 1990–91 Annual Report.

CSIRO AND THE COOPERATIVE RESEARCH CENTRES PROGRAM

The Cooperative Research Centres (CRC) Program emphasises collaborative work and partnerships between universities, industry and other research providers such as CSIRO and State Government Instrumentalities.

CSIRO is involved in 43 CRCs and in two CRC extensions. The Organisation is investing resources valued at approximately $1.2 million per year for each CRC in which it is a participant. The listing below shows the CRCs in which CSIRO is involved through 29 of its Divisions.

Consultation over the CRC applications has been positive, reinforcing existing cooperative arrangements and forming new collaborative activities between CSIRO and other participants.

While it is early to talk about successes, the CRC Program is intended to strengthen existing links between researchers and the users of their work. It is also intended to capture the benefits of research. The Program has already reinforced the focus on the needs of research users and enables CSIRO staff to contribute to educational programs that encompass not only the important post-graduate work but also other programs for students ranging from primary age to industry executives.

The process has led CSIRO to consider key issues such as the full costing of research, alignment of joint ventures with CSIRO priorities and the most appropriate structures for joint ventures. In doing this, CSIRO worked closely with the Australian Vice Chancellors' Committee on a range of policy matters associated with the Program.

The CRCs and CSIRO's Multi-Divisional Programs together provide CSIRO staff with valuable experience in managing complex joint ventures that involve public and private sector staff and that cover a range of disciplines and needs.

COOPERATIVE RESEARCH CENTRES IN WHICH CSIRO IS A PARTICIPANT

CRC	*CSIRO Division*
Manufacturing Technology	
CRC for Materials Welding and Joining	Manufacturing Technology
CRC for Polymer Blends	Chemicals and Polymers
CRC for Molecular Engineering and Technology: Sensing and Diagnostic Technologies	Food Science and Technology Applied Physics Biomolecular Engineering
CRC for Industrial Plant Biopolymers	Food Science and Technology
CRC for Intelligent Manufacturing Systems and Technologies	Manufacturing Technology
CRC for Alloy and Solidification Technology	Manufacturing Technology
Information and Communications Technology	
CRC for Intelligent Decision Systems	Information Technology
CRC for Robust and Adaptive Systems	Radiophysics
Australian Photonics CRC	Applied Physics
CRC for Advanced Computational Systems	Information Technology
Research Data Network	Information Technology

CRC	*CSIRO Division*
Mining and Energy	
CRC for Mining Technology and Equipment	Geomechanics
	Mineral and Process Engineering
	Manufacturing Technology
	Coal and Energy Technology
GK Williams CRC for Extractive Metallurgy	Mineral and Process Engineering
AJ Parker CRC for Hydrometallurgy	Mineral Products
Australian Petroleum CRC	Geomechanics
	Exploration Geoscience
CRC for Australian Mineral Exploration Technologies	Exploration Geoscience
Australian Geodynamics CRC	Geomechanics
	Exploration Geoscience
CRC for New Technologies for Power Generation from Low Rank Coal	Mineral and Process Engineering
Agriculture and Rural Based Manufacturing	
CRC for Legumes in Mediterranean Agriculture	Laboratory for Rural Research WA
CRC for Plant Science	Plant Industry
CRC for Tropical Plant Pathology	Tropical Crops and Pastures
CRC for Tropical Pest Management	Entomology
CRC for Temperate Hardwood Forestry	Forestry
CRC for Hardwood Fibre and Paper Science	Forest Products
CRC for Viticulture	Horticulture
CRC for Premium Quality Wool	Animal Production
	Wool Technology
CRC for the Cattle and Beef Industry (Meat Quality)	Animal Production
	Animal Health
	Food Science and Technology
	Tropical Animal Production
CRC for Aquaculture	Fisheries
CRC for Sustainable Cotton Production	Plant Industry
	Entomology
CRC for Food Industry Innovation	Food Science and Technology
	Human Nutrition

CRC	*CSIRO Division*
Environment	
CRC for Waste Management and Pollution Control	Water Resources Chemicals and Polymers
CRC for Soil and Land Management	Soils
CRC for Catchment Hydrology	Water Resources
CRC for Biological Control of Vertebrate Pest Populations	Wildlife and Ecology
CRC for Antarctic and Southern Ocean Environment	Oceanography
CRC for Freshwater Ecology	Institute of Natural Resources and Environment
CRC for Southern Hemisphere Meteorology	Atmospheric Research
CRC for Tropical Rainforest Ecology and Management	Tropical Forest Research Centre
Materials Science and Technology	
CRC for Tissue Growth and Repair	Human Nutrition
CRC for Cellular Growth Factors	Biomolecular Engineering
CRC for Eye Research and Technology	Chemicals and Polymers Biomolecular Engineering
CRC for Cardiac Technology	Biomolecular Engineering Chemical and Polymers
CRC for Vaccine Technology	Animal Health Tropical Animal Production

Dr Stocker, CSIRO Chief Executive, signs an arrangement for scientific and technological cooperation with Professor Nguyen Van Hieu, President of the then National Centre for Scientific Research (now National Centre for Science and Technology) of Vietnam in Hanoi in May 1993

INTERNATIONAL ACTIVITIES

CSIRO Chief Executive Dr John Stocker travelled to Vietnam, Thailand, Malaysia, Indonesia and Singapore in May–June 1993 to visit government research organisations and to meet some key people involved in science and technology, including Professor B J Habibie, Indonesian Minister for Research and Technology; the Honourable Mr Peter Chin, Malaysian Deputy Minister for Science, Technology and the Environment; and the Honourable Dr Ahmad Mattar, Singapore Minister for the Environment.

Scientific and technological cooperation agreements were signed with the following counterpart organisations: National Centre for Scientific Research, Vietnam; Thailand Institute of Scientific and Technological Research; Standards and Industrial Research Institute of Malaysia; University of Indonesia; and the Indonesian Institute of Sciences. Some projects managed by CSIRO on behalf of the Australian Centre for International Agricultural Research (ACIAR) and AIDAB were also visited.

During the course of the various visits, areas of common interest were identified where prospects for research collaboration are good. Dr Stocker was accompanied by Dr Bob Frater, Director, CSIRO Institute of Information Science and Engineering and Dr Ta-Yan Leong, Assistant General Manager International.

During the year, CSIRO received important visitors from South East Asia including the Honourable Mr Law Hieng Ding, Malaysian Minister for Science, Technology and Environment; Mr Wardojo, the then Indonesian Minister for Agriculture and Dr Wardiman Djojonegoro, the then Deputy Chairman of the Indonesian Agency for the Assessment and Application of Technology (BPPT) and now Minister for Education.

Activities under the Arrangement between CSIRO and the National Research Council (CNR) of Italy continued with a joint New

Materials Symposium held in Victoria in April to identify mutually beneficial opportunities for pre-competitive research collaboration. This first Symposium held under the Arrangement in Australia was attended by senior scientists from a number of Australian research institutions as well as CNR and CSIRO.

Linkages made under CSIRO's Agreement with the Chinese Academy of Sciences are continuing to grow. Collaboration is now established in a number of Divisions. Arising from a visit by Dr Stocker to the General Manager of the China National Lanxing Chemical Cleaning Company in 1992, some commercial connections have now been established between the CSIRO Division of Chemicals and Polymers and an Australian company.

CSIRO welcomed His Excellency Dr Saleh Abdulrahman Al-Athel, President of the King Abdulaziz City for Science and Technology (KACST) in Saudi Arabia, who visited CSIRO in response to a long standing invitation. It is anticipated that collaborative research programs will now be established between the two organisations.

AWARDS

THE CHAIRMAN'S MEDAL

The 1992 Chairman's Medal and CSIRO Medals were presented on 25 November 1992 by Professor Adrienne Clarke AO, Chairman of the CSIRO Board.

The winner of the Chairman's Medal was Dr Ezio Rizzardo of the Division of Chemicals and Polymers for his outstanding contributions to polymer science and technology.

The winner of the Chairman's Medal, Dr Ezio Rizzardo, with CSIRO Chairman Professor Adrienne Clarke

CSIRO MEDALS

The CSIRO Medals for 1992 were awarded to:

- The SIROSCOUR Team, CSIRO Division of Wool Technology, for developing the SIROSCOUR wool scouring technology package.
  (Dr B O Bateup, Dr J R Christoe, Dr C A Anderson, Dr J Warner and Mr A Pearson)
- The Fast Fourier Transform Technology Team, CSIRO Division of Radiophysics, for the development and application of Fast Fourier Transform technology.

CSIRO medallists 1992. Standing: Dr J L McGregor, Dr J Warner, Dr C Jacka, Dr B O Bateup, Dr W L Physick, Dr J D Bunton, Dr J O'Sullivan, Dr S R Wenham, Dr P C Manins, Dr P J Hurley, Dr J R Christoe Seated: Chairman's Medallist Dr Ezio Rizzardo, Dr J A Noonan, Dr G Poulton, Professor Adrienne Clarke (Chairman, CSIRO), Dr John Stocker (Chief Executive, CSIRO), Mrs M Green, Dr C A Anderson

Sir Ian McLennan Award winners Dr Robin Hill (left) and Mr Les Edye (second from right) with CSIRO Chief Executive Dr John Stocker, CSIRO Chairman Professor Adrienne Clarke and Sir Peter Derham, Chairman of the Board of the Sir Ian McLennan Achievement for Industry Award Trust Fund

(Dr J Ables, Dr C Jacka, Dr J O'Sullivan, Dr G Poulton and Dr J D Bunton)

- The Air Pollution Meteorology Team, CSIRO Division of Atmospheric Research, for air quality research and consulting to industry and the community. (Dr P C Manins, Dr W L Physick, Dr J A Noonan, Dr P J Hurley, Dr J L McGregor and Dr D J Abbs)
- Dr S R Wenham and Professor M A Green, Centre for Photovoltaic Devices and Systems, University of New South Wales, for developing the laser grooved, buried contact solar cell.

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.

Joint winners of the Award in 1992 were Mr Les Edye of the Division of Tropical Crops and Pastures for his contributions to the tropical cattle and pasture seed industries, and Dr Robin Hill of the Division of Exploration Geoscience for his contributions to mineral exploration in Australia.

Technology Transfer

HIGHLIGHTS

- A $21 million transaction with Macquarie Bank and AMRAD Corporation to develop a new range of chemicals that show promise as drugs of the future (see p. 36).
- Transactions totalling $38 million with the Rumentek Syndicate for work on ruminant food supplements (see p. 25).
- An agreement with Ecogen Australia Ltd for a licence to use nematode technologies for biological control of insect pests (see p. 26).
- Development of a compact ultrasonic gas meter with AGL (see p. 34).
- Arrangements with Wirsam Scientific Precision Instruments Pty Ltd for worldwide distribution of QEM*SEM, which analyses metallurgical flow streams and products (see p. 31).
- An agreement with some major car manufacturers to improve technological development in diecasting (see p. 36).
- The official opening of the SIROFLOC sewage demonstration plant, a joint venture with the Sydney Water Board (see p. 46).
- Installation of a PLASCON unit to destroy halon as part of a contract with Siddons/Department of Arts and Administrative Services. (see p. 46)
- *Small and medium-sized business*
  CSIRO commissioned McKinsey and Company to survey the technology needs of small to medium enterprises (SMEs) in Australia. The final report, received in June and still being considered, assessed how effectively CSIRO had served SMEs in the past and proposed models for serving them in the future.
- *Manufacturing Month*
  In May, CSIRO ran a series of events around the country bringing together CSIRO and industry representatives to highlight the contribution that R&D can make to the productivity and world-competitiveness of Australia's manufacturing industry.
- *Local Government*
  CSIRO and Local Government representatives met in April at a two-day workshop organised by CSIRO to produce a working agenda for collaboration between the two. Discussions are now under way to identify areas for joint research, information transfer and consultancy.

SIROTECH

CSIRO's technology transfer company, Sirotech Limited, ceased trading by the end of the 1992–93 financial year and its activities devolved to CSIRO and external contractors. This decision by the Board of CSIRO was aimed at strengthening the responsibility of line managers for the commercial operations of the Organisation. The commercial capacity of CSIRO Institutes was increased by the addition of expert staff, some deployed from Sirotech, to improve commercial practice in CSIRO at the interface between research and business.

The management of the Organisation's intellectual property portfolio, a key corporate resource which must be owned, controlled and managed by CSIRO, was transferred from Sirotech to Head Office together with responsibility for the provision of commercial legal advice. Flexible arrangements have been made for expert advice in these two areas to be outsourced through fixed term contracts with professional patent attorneys and legal firms.

ESTABLISHMENT OF HEAD OFFICE IN MELBOURNE

The CSIRO Board's decision to locate the Organisation's Head Office in Melbourne was aimed at promoting interaction between CSIRO and the business community at the highest levels and, through this interaction, to:

- align the long-term plans of CSIRO with those of the business community in Australia;
- increase the investment in research and innovation in Australia by local and overseas companies;
- further increase the level of CSIRO's budget derived directly from industry.

The structure for the Organisation's new Head Office was designed to meet these aims and, with the wind down of Sirotech, to integrate commercialisation activity fully into the fabric of CSIRO. The diagram below indicates the main functional features of the Office.

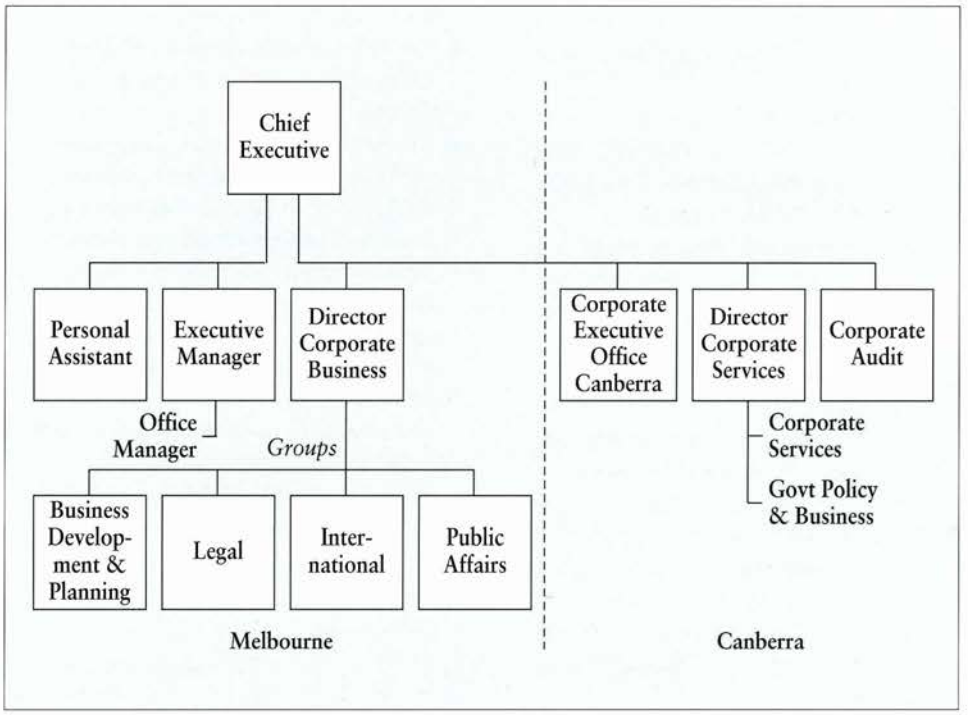
CSIRO has maintained a strong corporate presence in Canberra. The Director, Corporate Services and one Institute Director continue to work from Canberra to maintain the important relationship between CSIRO and the Australian Government and its Departments and national institutions based in the ACT.

Director Corporate Business

A key position in the new Head Office is that of the Director Corporate Business. This position will support the Chief Executive in his overview of and, where necessary, involvement in, commercialisation procedures.

An appointment had not been made to the position by the end of the reporting year. It is intended that the Director Corporate Business be commercially oriented and sufficiently aware of the major flow of commercialisation contracts that she or he can keep the Chief Executive informed and assured as to their integrity, value to the Organisation, and potential liability or otherwise for creating negative outcomes for the Organisation.

The role of the Director Corporate Business will be central in determining that common legal practices and procedures are applied throughout the Organisation, that intellectual property and patents are properly protected,



and that the possibility of downstream disputes with third parties are minimised. The position will have a strategic role in formulating commercialisation policy in conjunction with the Chief Executive and the Institute Directors, and will support the Directors in their handling of the larger commercialisation issues and activities.

COMMERCIALISATION TASK FORCE

In May this year CSIRO established a Task Force to examine and report on CSIRO's policies, procedures and practices relating to the commercialisation of technology.

The Task Force will make recommendations for improvements in these areas with particular reference to compliance with all relevant legal requirements, accepted standards of business ethics and public sector accountability.

The CSIRO Board and the Minister for Science and Small Business have shown considerable interest in how CSIRO responds to the issues leading to the establishment of the Task Force.

These issues include:

- The level of interaction between CSIRO and customers in industry and the public sector. External research funds as a proportion of total CSIRO expenditure on a cash basis have risen dramatically over the past six years, from about 15 per cent in 1986–87 to more than 30 per cent in 1992–93, now amounting to well over $200 million.
- The number of contracts being negotiated and concluded to achieve this level of sponsorship is significant, approaching 500 a year. Clear delegations, responsibilities and accountabilities are required to ensure that CSIRO achieves positive relationships with customers and that we have shared expectations of the outcomes of these relationships.
- The need for a contemporary statement of the Organisation's purpose for entering sponsored research arrangements, particularly where the commercialisation of technology is a planned outcome. This context is essential to ensure that the contracts CSIRO enters provide the best return to Australia.
- When CSIRO becomes involved in commercialisation it becomes subject to the same laws that govern business. In recent years these laws have become much more strict, and the risk of infringing is correspondingly higher.
- CSIRO now has many staff involved in the commercialisation process. Commercial managers have been appointed to some Divisions and a commercial or business oriented role has been added to the responsibilities of most program managers and many Divisional Secretaries. The training and development of these staff in areas specific to commercialisation to ensure appropriate standards of knowledge and understanding across the Organisation has emerged recently as a critical issue for CSIRO.
- Institutes have also appointed specialist staff in the commercial area. Since the disbandment of Sirotech they have adopted additional responsibilities in commercial legal and intellectual property matters. CSIRO needs to develop a common approach across the Organisation to establishing procedures and practices relevant to each Institute's specific customer needs in relation to technology transfer and commercialisation.

A revised statement of CSIRO policy, delegations and controls is before the CSIRO Board for approval and work is advanced on the preparation of a commercial practice manual.

QUALITY MANAGEMENT SYSTEMS APPROACH TO COMMERCIALISATION

The Commercialisation Task Force has recommended that CSIRO adopt a 'quality management' approach to handling all of its activities, including commercialisation, based on the international quality management systems standard ISO9001 and its Australian equivalent AS3901. The Standard emphasises an approach involving a combination of committed top management policy and direction setting together with practices and procedures developed at the working level to meet the needs of individual Institutes and Divisions.

CSIRO is increasingly being called upon to align itself with industry best practice; in many cases this will include adoption of quality management systems and compliance with the Standard.

INTERESTS IN COMPANIES

The companies in which CSIRO had a commercial interest as at 30 June 1993 are as follows:

Name of Company	CSIRO's interest (%)	Principal activity
Sirotech Ltd (ceased operations)	Limited by Guarantee and controlled by CSIRO	Technology transfer
Bio-Coal Briquette Company Ltd	17.2%	Smokeless briquettes
Cassiro Pty Ltd	50.0%	Improved soil productivity
Dunlena Pty Ltd	47.0%	From discovery to commercialisation of agricultural chemicals
Gene Shears Pty Ltd	34.7%	Modifying the effects of unwanted genes
Gropep Pty Ltd	35.1%	R&D of growth factors and related peptides
Dynamic Transport Management Pty Ltd	10.0%	Real time transport management system
Preston Group Ltd	16.1%	Simulation and scheduling systems for aviation and ground transportation

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

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

Funding

1992–93 year was the second year of the Organisation's second triennium appropriation budget. The additional capital infrastructure funding announced by the Government in 1991–92 ($20.72m, of which $6m was for 1992–93) was followed up by the 1992–93 Budget announcement of a further $12m in each of the second and third years of the triennium (1992–93 and 1993–94).

33.1% of CSIRO's revenue came from external sources

This support has enabled CSIRO to continue to carry out its capital investment program without the reductions to the overall levels of research activity which would otherwise have been necessary.

The employment of 200 youth trainees throughout CSIRO in 1992–93 and 1993–94 has also been made possible through the additional funding.

The Organisation's external revenue was $225.2m, which represented 33.1 per cent of its total revenue. Expenditure of these external earnings by source of funds is shown in the following table.

During the year the Organisation entered into two R&D Syndicated transactions totalling approximately $58.5m. Generally, $17.1m will be available to the Divisions for research over a three-year period with the balance being invested to meet future obligations associated with ownership of the intellectual property.

The triennium funding arrangements for CSIRO (and for the other two science agencies within the portfolio, ANSTO and AIMS) were reviewed with the Department of Finance and the Department of Industry, Technology and Regional Development.

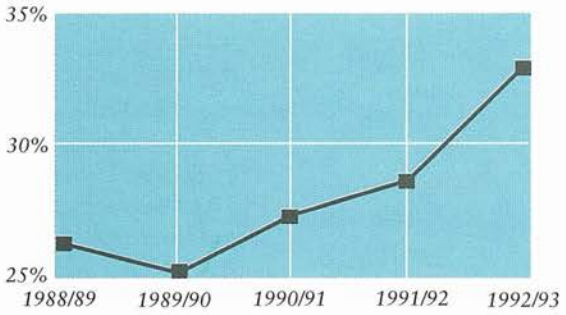
The review recommended that the main elements of the current arrangements (maintenance of appropriation funding in real terms for a three-year period; continuation of the 30 per cent external earnings targets; retention by the agencies of all external revenue) continue, with the efficiency dividend to be applied to non-research costs only. The review also recommended that the three-year funding level be determined one year in advance of the triennium.

EXPENDITURE OF EXTERNAL EARNINGS BY SOURCE 1992–93

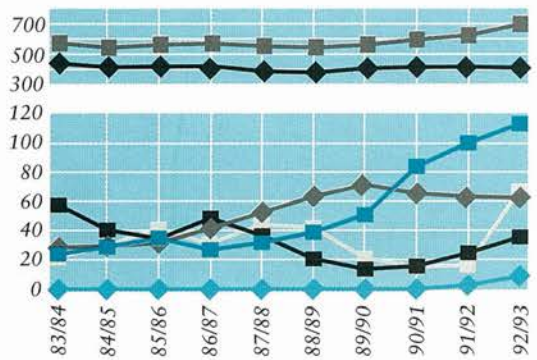
	$m	
Rural Industry R&D Corporations/Councils	49.993	22.4%
NERDDC/ERDC	2.235	1.0%
Other Competitive Funding Schemes	8.543	3.8%
Commonwealth and State Governments	34.097	15.3%
Co-operative Research Centres	8.498	3.8%
Australian Industry	62.352	27.9%
Overseas Bodies	8.578	3.8%
Miscellaneous Bodies	4.514	2.0%
Earned Revenue	44.682	20.0%
Total expenditure of external earnings	**223.490**	**100%**

These are 'cash' expenditure figures used for Budget Papers and Parliamentary reporting

CSIRO EXTERNALLY-FUNDED CASH EXPENDITURE AS A PROPORTION OF TOTAL

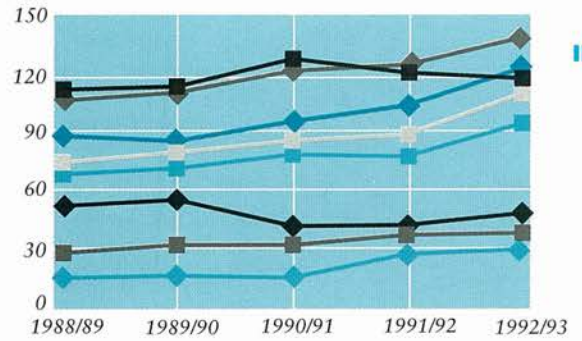


CSIRO EXPENDITURE BY SOURCE OF FUNDS IN 1993 DOLLARS*



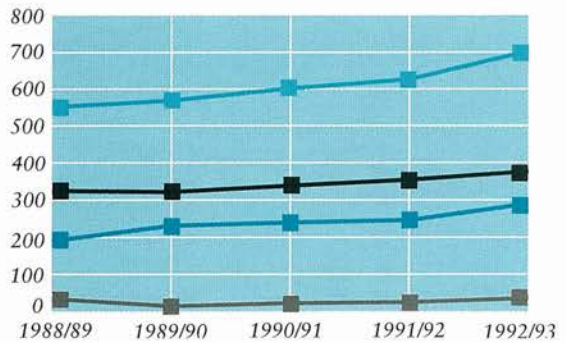
Total
Appropriation Annual (Bills 1&3)
Appropriation Capital (Bills 2&4)
Earned Revenue
Competitive Govt & Industry Funds
Research Funded Directly by Industry & Other Users
Cooperative Research Centres

CSIRO EXPENDITURE BY INSTITUTE IN 1993 DOLLARS*



Animal Production & Processing
Industrial Technologies
Information Science & Engineering
Minerals Energy & Construction
Natural Resources & Environment
Plant Production & Processing
National Facilities
Corporate Research Support

CSIRO EXPENDITURE BY CATEGORY IN 1993 DOLLARS*



Total
Salaries
Operating
Capital, Land & Buildings

* *In 1992-93 CSIRO adopted accrual accounting, which affects comparability between years. In addition, 27 pay periods were counted during the year. 1992–93 figures exclude provision for employee entitlements and depreciation of buildings; equipment depreciation is included in place of asset purchases. Previous years' figures are calcualted on a cash basis*

PLANNING

PRIORITIES FOR THE 1994–97 TRIENNIUM

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

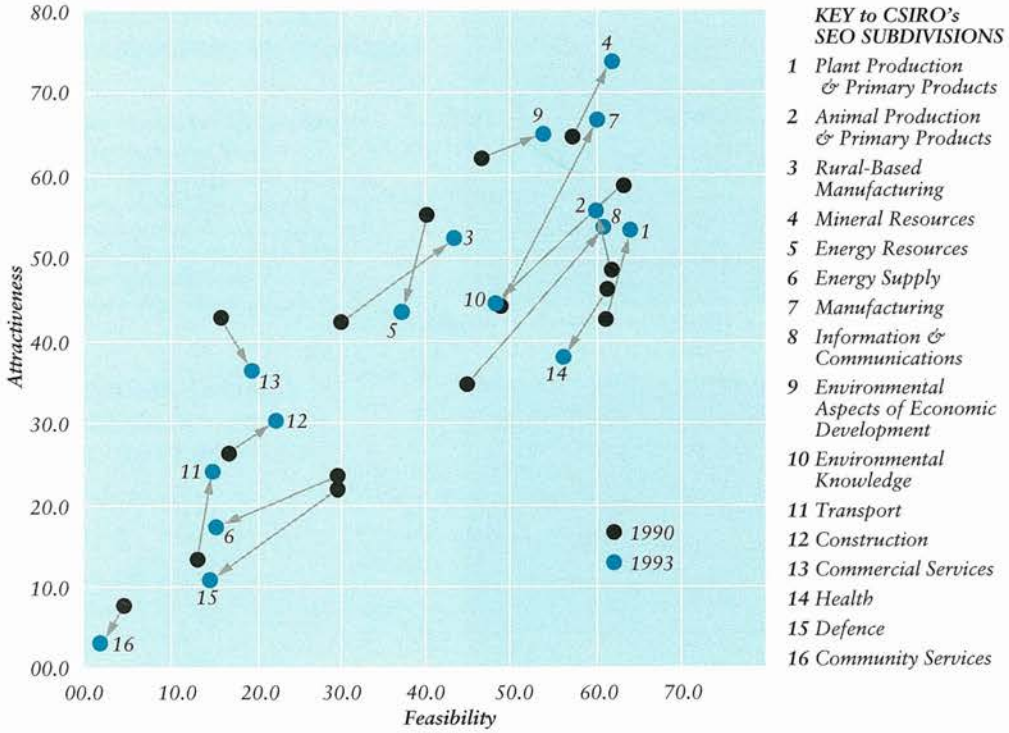
In June 1993, the CSIRO Board decided on research priorities for the next triennium, which begins on 1 July 1994.

CSIRO continues to rate minerals, environmental and rural research highly, but the Board decided that manufacturing and information and communications industries have had inadequate resources in relation to their importance to Australia.

The Board decided that priority funds (financed by an annual allocation from the CSIRO budget and amounting to $33 million over the next triennium when the funds allocated have been matched by the Organisation's Institutes and Divisions) are to be directed as increased funding to research in three Socio-Economic Objective (SEO) sub-divisions: Mineral Resources, Manufacturing, and Information and Communications Industries. In addition, the share of appropriation funding will be maintained at the 1992–93 level in the SEO sub-divisions Environmental Knowledge and Environmental Aspects of Economic Development (EDEA).

The key outcome of CSIRO's deliberations

BOX 1: RETURN TO AUSTRALIA FROM R & D, 1990 AND 1993



is summarised in Box 1. This shows the return to Australia from R&D for 1990 and 1993 for each SEO sub-division according to two components:

1. Attractiveness, defined by the product of scores for two priorities criteria: potential benefits and Australia's ability to capture the benefits;
2. Feasibility, given by the product of scores for two priorities criteria: R&D potential and R&D capacity.

To arrive at these priorities decisions, CSIRO has made many improvements to the initial 1990 triennial review process. Major features of these improvements included:

- greater external stakeholder participation in the priorities process at sectoral levels, with the aim of building greater commitment to the process at these levels, and improving the quality of input to corporate priority setting;
- the CSIRO Socio-Economic Objective (SEO) research classification structure was upgraded. A SEO module of the Executive Information System was successfully trialled, and a CSIRO Research Priorities Data Compendium developed. This included vastly improved data on CSIRO's external environment, particularly in relation to the provision of time series data and trend analysis, medium to long term sectoral/industry projections and the coverage of key global, national, sectoral and industry/enterprise issues.

RESEARCH PRIORITIES 1993–94

In accordance with the original priority decisions reported in last year's annual report, special research priority funds (raised by an annual 1.5 per cent levy applied to CSIRO's recurrent appropriation budget and totalling $4.7 million) have been allocated for 1993–94 as follows:

- 26.3 per cent to strategic research for Mineral Resources;
- 26.7 per cent to Environmental Aspects of Economic Development (EAED);
- 47.0 per cent to priority areas among other research purposes. (see Box 2)

BOX 2: DISTRIBUTION OF PRIORITY RESEARCH FUNDS AND BOARD INITIATIVE FUNDS 1993-94

Research Purpose	Priority funds *($million)*	Board Initiative Funds *($million)*
Mineral Resources	1.235	1.305
Environmental Aspects of Economic Development	1.255	1.107
Rural Based Manufacturing	0.200	0.344
Environmental Knowledge	0.390	0.153
Manufacturing	0.600	0.860
Information and Communications	0.125	0.062
Plant Production and Primary Products	0.350	0.112
Animal Production and Primary Products	0.170	0.225
Commercial Services	0.250	0.190
Construction	0.125	0.050
Health		0.002
Energy Resources and Supply		0.090
Total:	**4.700**	**4.500**

With matching funds from Institutes, a total of $9.4 million will be redirected to these high priority areas in 1993–94 as a direct result of the priorities process. Institutes and Divisions will also independently move resources into priority research areas.

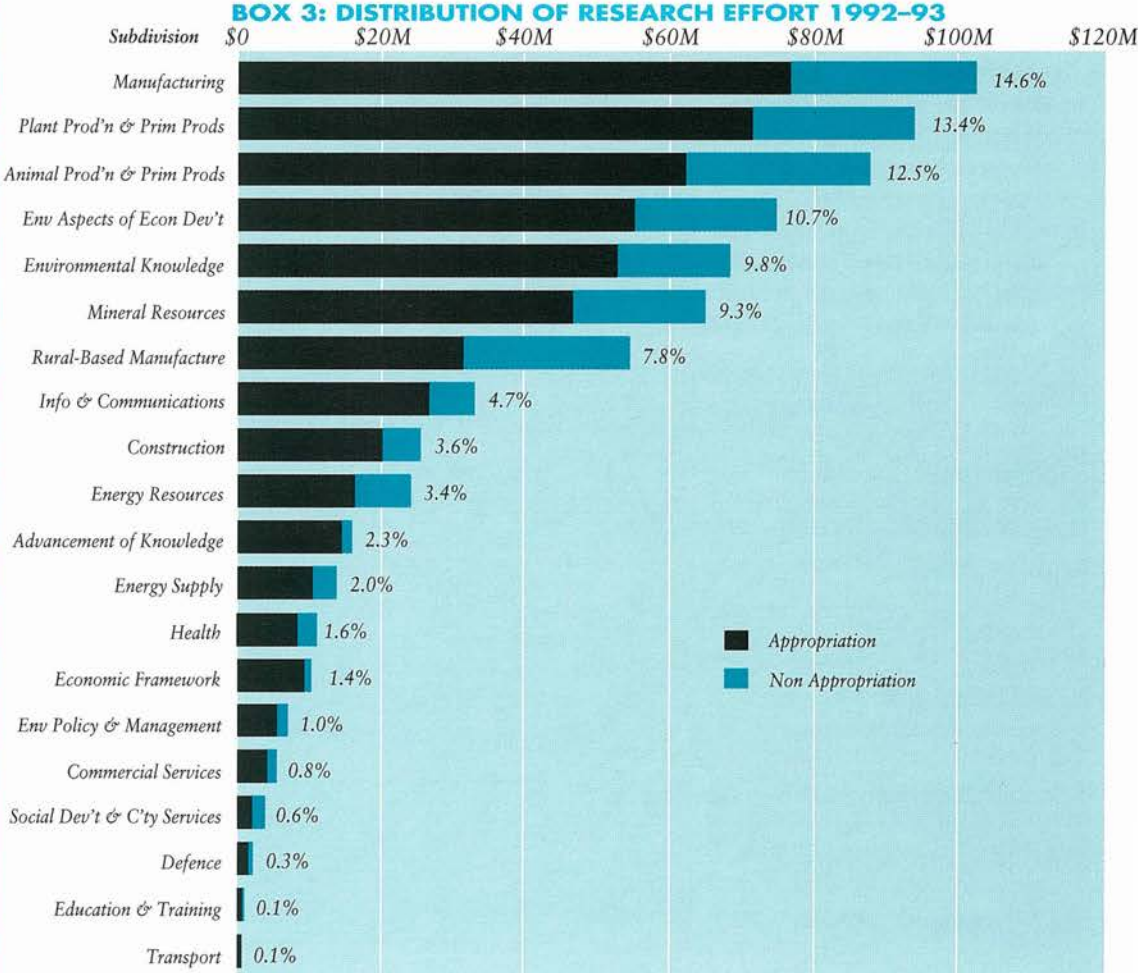
The priorities framework was also used to allocate non-recurrent Board Initiative May Statement funds. For 1993–94, $4.5 million was allocated as follows: 29.0 per cent to strategic research for Mineral Resources, 24.6 per cent to EAED, and 46.4 per cent among other research purposes. (see Box 2)

DISTRIBUTION OF RESEARCH EFFORT

CSIRO's distribution of research effort for 1992–93 is shown in the following chart. The basis of this chart is a slightly modified version of the classification system of socio-economic activities defined by the Australian Bureau of Statistics.

CSIRO has used this system to focus its priority deliberations on how research can benefit the nation — that is, on the outcomes of research.

BOX 3: DISTRIBUTION OF RESEARCH EFFORT 1992–93



CSIRO EVALUATION STRATEGY

CSIRO's research priorities are established on the basis of anticipated returns to Australia, derived from comprehensive assessments of the attractiveness and feasibility of conducting research directed to identified socio-economic objectives. These assessments form the basis for CSIRO's strategic and operational planning.

Evaluation activity is consequently focused on CSIRO's performance in achieving planned outcomes in relation to these socio-economic objectives. A complementary perspective is provided by additional assessments of performance conducted and reported by management unit.

Evaluation activity spans each of the six key areas in which CSIRO gauges its performance — research, commercialisation and transfer, funding, human resource management, communication and corporate development.

The key elements of CSIRO's current evaluation strategy are described below. Following observations on CSIRO's program evaluation activity by the Australian National Audit Office in Audit Report No 35, 1992–93 *Program evaluation: strategies, practices and impacts*, CSIRO is endeavoring to establish a more coherent evaluation strategy and more consistent reporting of evaluation activities in key planning documents.

Evaluation Plans

The most comprehensive record of CSIRO's program evaluation activity is found in the CSIRO Evaluation Plan. It describes evaluations completed by each Institute in the current year and those planned for the next two to three years. Major evaluations — those of portfolio significance or potential interest to the Minister — are also reported in the annual Portfolio Evaluation Plan compiled by the Department of Industry, Technology and Regional Development.

Program Performance Statement

An overview of the performance of CSIRO's research effort is provided in the contribution CSIRO makes to the annual Portfolio Program Performance Statement (PPS) tabled in Parliament as a budget related paper. The PPS focuses on the outcomes (and planned outcomes) of research targeted to particular socio-economic objectives.

Operational Plans and Performance Reports

The annual CSIRO Operational Plan, and Institute and Divisional Operational Plans, are not strictly evaluation documents. Nevertheless, planned outcomes which are focused on program evaluation are included and identified as such in the CSIRO Operational Plan. In many cases performance reports are prepared using operational plans as the documentary basis for evaluation of progress toward planned outcomes. Practice varies between Institute and Division but all are subject to some form of regular performance evaluation encompassing at least the six key performance areas noted above.

Corporate Audit

The Corporate Audit Group conducts a program of management reviews in CSIRO's administrative units and risk-based reviews of administrative funitions. Details of the review cycle are set out in a three-yearly Strategic Audit Plan and updated annually to reflect current concerns in the Tactical Audit Plan.

Individual Performance

CSIRO's Performance, Planning and Evaluation (PPE) Scheme involves all staff in evaluating their work performance against agreed objectives and milestones.

CORPORATE FINANCE

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

This year saw the implementation of the commercial accounting package, UNIBIS, at more than 50 sites throughout Australia. This provides the Organisation with the opportunity to move closer to managing and reporting on an accrual accounting basis.

A major training program associated with the introduction of accrual accounting and the implementation of the Unibis system was provided for over 500 members of staff.

REVALUATION OF LAND AND BUILDINGS

As required by the new Department of Finance Guidelines for Financial Statements of Public Authorities and Commercial Activities, the Organisation revalued its land and buildings in June 1993. The basis and methodology adopted in the valuation was approved by the Board.

INVESTMENT OF MONIES

During the year our fund managers continued to invest the Organisation's temporary surplus funds in approved securities so as to maximise the rate of return on funds invested. To date they have consistently returned between one per cent to two per cent above cash management rates. In addition the CSIRO Board has endorsed an investment strategy and targeted returns for our fund managers.

FINANCE

During the year the Organisation took further steps to affirm the responsibility of its Institutes to manage within their existing budgets. Central contingency funding was eliminated. Arrangements were agreed with Institutes about corporate support for meeting any large unforeseeable costs.

INTERNAL AUDIT

The internal audit program is supervised by an Audit Sub-committee of the CSIRO Board. This committee consists of two non-executive Board members supplemented by an audit partner of a major accounting firm.

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

During 1992–93 six Divisions were reviewed and reviews of a number of corporate systems or functions were completed. These include:

- funds Management;
- records Management;
- Divisional Management Accountability Checklists;
- purchasing

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

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

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

LEGAL SERVICES

SCIENCE AND INDUSTRY RESEARCH ACT 1949

Section 10B(4) was amended to transfer from the Governor-General to the Minister the role of determining certain of the Chief Executive's terms of office (*Industry, Technology and Commerce Legislation Amendment Act 1992).*

SYNDICATED R&D

CSIRO entered into agreements relating to:

- potential anti-viral pharmaceutical compounds;
- technology for producing modified animal feeds.

JOINT VENTURE

The Dunlena joint venture with DuPont (Australia) Ltd and AIDC Limited was restructured into an unincorporated structure. The venture is continuing research to develop a range of crop protection chemicals which are environmentally friendly.

CO-OPERATIVE RESEARCH CENTRES

At the conclusion of the third round of grants made by the Commonwealth under the Co-operative Research Centre (CRC) program CSIRO is involved in 43 of the 52 CRCs and has received additional funds to extend two first round CRCs. The question of incorporation remained an issue during negotiation and development of CRC agreements for the third round. Ultimately, only three of the 15 third round CRCs in which CSIRO is a participant involved incorporation in any form. CSIRO is not an equity holder in any of the CRC-related companies.

TECHNOLOGY LITIGATION

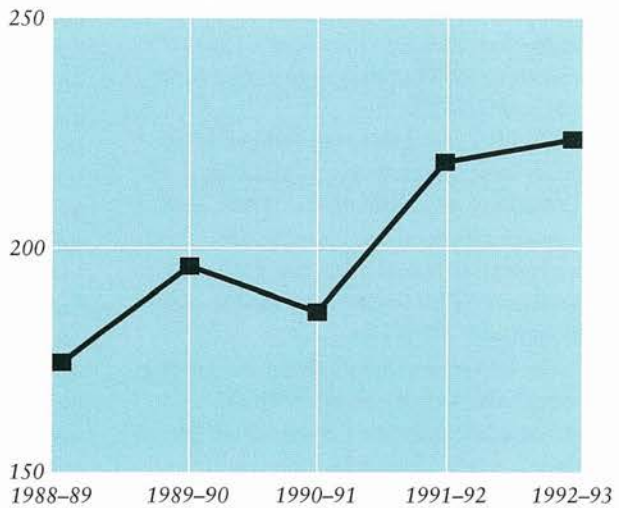
Two of CSIRO's technologies remained the subject of litigation. Neither of these matters is resolved as at 30 June 1993.

SIROTECH

A comprehensive diligence was conducted to transfer assets and liabilities from Sirotech Limited to CSIRO following the decision to devolve its activities to CSIRO and external contractors by 30 June 1993.

To maintain continuity of service in the transition period following the closure of Sirotech, contracts have been entered into to supply certain legal and patent management services. The contracts are with firms formed by ex-Sirotech employees. The legal services contract is for 12 months and the patent management contract for nine months.

NUMBERS OF PROVISIONAL PATENT APPLICATIONS



CSIRO's information technology services manager David Rofe (right) with Jim Anderson of Windhover Data Systems after the signing of an agreement for the implementation of Unibis, CSIRO's new financial system

INFORMATION TECHNOLOGY SERVICES

Following the internal review of the corporate management information systems function reported last year, an Information Technology Steering Committee (ITSC) chaired by the Director Corporate Services was established.

The ITSC met four times, addressing key policy issues in relation to Information Technology (IT) planning for CSIRO, such as resource allocation and management arrangements including the distribution of responsibility between central and local site IT staff.

The ITSC ensured the implementation of a formal structure of systems ownership and the introduction of the user-pays principle for the voice network and discretionary IT services have improved the level of accountability and acceptance of systems by the user community.

The largest and most important project completed during the year, the installation of the Australian accounting software Unibis, was completed on time and within budget to facilitate the move to accrual accounting. This will enable Divisions to better understand the true costs of research. With this move came the implementation of a long-term strategy to move to UNIX, a lower cost, more open computing environment that links closely with Divisional scientific systems.

As a national organisation CSIRO relies heavily on its internal telecommunications networks to deliver voice and data information. The first stage of the project Universal Access, which provides connections for all to E-mail and the wide area network, has been completed. The move to a UNIX architecture provided the opportunity to

further integrate these networks with the use of the Australian Academic Research Network (AARNet) for some administrative data traffic.

Under the PABX replacement program, ten fourth generation PABXs were installed for the integration of voice and data and access to high quality digital services (ISDN). The telephone management system TIMS was also installed, providing call accounting under the user-pays system. The voice network continues to generate savings by the introduction of least cost call routing that reduces STD costs by more than $600,000 a year.

Expenditure on systems development has led to savings and efficiencies in many parts of the organisation This year the executive information system was used for the first time at the CSIRO Executive Committee's triennial priorities review workshop. This system provided senior management with graphical tools showing the shifts required in resources to align CSIRO's research better with the nation's needs.

When fully developed this system will provide the integration of many sources of external data with CSIRO's internal data to assist management in formulating research trend analysis for the continuing assessment of priorities.

PROPERTY

Project design and development of facilities continued in Stage 1 of the redevelopment of CSIRO's major Sydney site at North Ryde. So too did infrastructure works, including extensive road works inside and outside the site.

CSIRO's $105 million current Capital Investment Plan proceeded within budget.

Major works in progress include those at:

- the Division of Biomolecular Engineering at Parkville, Victoria;
- The Division of Mineral and Process Engineering at Clayton, Victoria;
- the Division of Atmospheric Research at Aspendale, Victoria;
- the Division of Building, Construction and Engineering at Highett, Victoria;
- the Division of Tropical Crops and Pastures at St Lucia, Queensland;
- tripartite facilities (CSIRO, the South Australian Research and Development Institute and the University of Adelaide) at the Division of Soils, Adelaide, South Australia.

Major capital projects completed or partially handed over were those at:

- the Division ofMathematics and Statistics at the Macquarie Information Centre in New South Wales;
- the Division of Coal and Energy Technology at Lucas Heights, New South Wales.

Human Resources Development

STRATEGIC DEVELOPMENT

CSIRO's human resources (HR) policy development and program management are now being steered by an Advisory Committee of internal clients and stakeholders. The objective is to deliver HR policies and services to help CSIRO achieve its research objectives and to deliver policies and programs that can be adapted to meet local management needs.

All new corporate HR policy proposals are now put through a rigorous priority assessment process based on the Organisation's research feasibility - attractiveness model.

Protocols for more effective workforce planning have been developed following completion of pilot studies at three CSIRO Divisions. Enhancements to information systems and other workforce planning tools are now on trial.

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

The final bedding down of major Award restructuring changes introduced in 1990–91 is now almost complete. In completing Award variations the Industrial Relations Commission, in a major decision, determined common conditions for all staff who perform duty at sea and abolished penalty overtime payments applying to them.

CSIRO is looking to enterprise bargaining to achieve further changes in human resource strategies to achieve best practice in a more commercially orientated environment.

With this in mind, CSIRO hosted an international conference on *Human Resource Management in R&D and Knowledge -based Organisations* held in Canberra in March 1993. CSIRO Chief Executive Dr John Stocker delivered the opening address to an audience of 250 human resource specialists including participants from the U.K., Ireland, Sweden, New Zealand, South Africa, Malaysia and Indonesia. Sessions included identification of best practice in aligning HR strategy with organisational goals, managing growth and decline, performance management and rewards.

WORKING WITH STAFF AND UNIONS

The CSIRO Consultative Council, made up of an equal number of representatives from management and staff associations, continued to operate as the central forum for consultation on a range of staffing and general issues.

The Council worked closely with the CSIRO Board in reviewing current redeployment and redundancy processes to ensure minimum impact on staff who lose their jobs either through a refocusing of research directions or as a result of funding cuts in specific research sectors. Council has also been involved in development of a CSIRO Code of Conduct and an Aboriginal and Torres Strait Islander Employment Strategy, as well as reviewing and progressing other employment issues encompassed by the CSIRO Human Resources Plan.

A review of current Industrial Participation policy and committee arrangements suggested a refocus towards more participative work arrangements at the research project level.

Enterprise bargaining discussions with unions began. A number of issues for inclusion in a CSIRO Agreement were identified. However, uncertainties about productivity measurement and CSIRO's future budgetary and salary supplementation situation have hampered progress. It is expected that a joint management/union committee will be established to take the matter further.

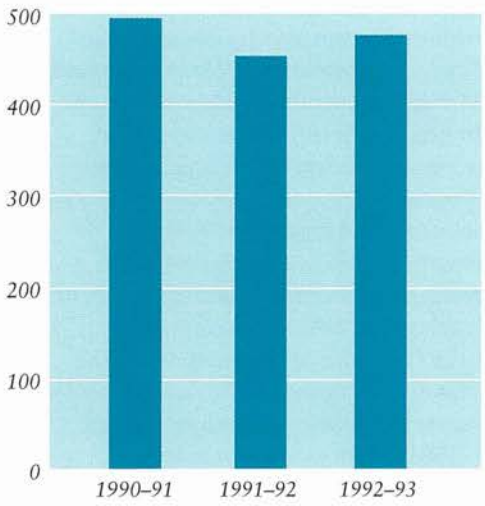
OCCUPATIONAL HEALTH AND SAFETY

A revised CSIRO Occupational Health and Safety Policy and Agreement were published in booklet format and distributed to staff. All existing health and safety policies are progressively being revised to ensure alignment with the *Occupational Health and Safety (Commonwealth Employees) Act* 1991.

A system of auditing health and safety management in all areas of CSIRO was developed and implemented. It is designed to systematically examine the level of compliance with the OHS *Act*, Regulations, Codes of Practice and CSIRO policies. The individual reports will provide information that will either justify continuation of the same strategies or identify the need to develop new strategies.

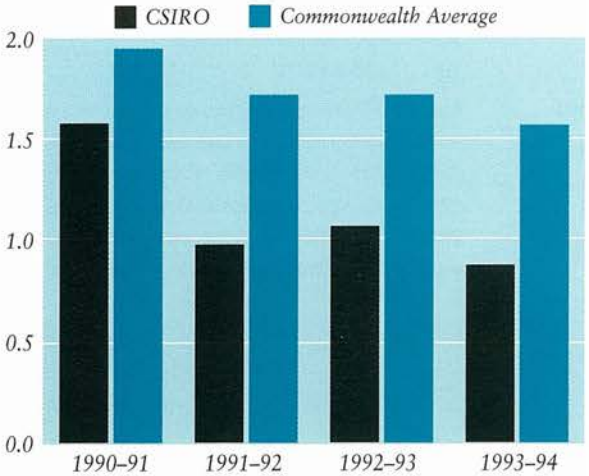
A recent survey has shown that safety committees have been established on all CSIRO sites throughout Australia. Two hundred and seventy-three Designated Work Groups have been established and health and safety representatives have been selected and trained to represent these groups.

NUMBER OF COMPENSABLE INCIDENTS



Continued emphasis on accident prevention strategies and the management of rehabilitation of injured staff during the year has resulted in a reduction of twenty per cent in CSIRO's workers' compensation premium rate. Our rate of 0.87 per cent of CSIRO's salaries and wages bill is almost half that of the average for Commonwealth Government employers.

CSIRO OCCUPATIONAL HEALTH & SAFETY PERFORMANCE PREMIUM AS A PERCENTAGE TO THE COMMONWEALTH AVERAGE 1990–1994 (EST)



Footnote: Compensation premium for each financial year is calculated on performance in the previous financial year

COUNSELLING SERVICES

A review of counselling arrangements was conducted this year in response to perceived concerns about conflicting demands and limited access to the services at many sites. New arrangements for 1993–94 will place greater emphasis on locally based personal counselling.

Human Resources Development

EQUAL EMPLOYMENT OPPORTUNITY (EEO)

CSIRO now has a five-year recruitment and career development strategy to improve employment prospects for Aboriginal and Torres Strait Islanders. CSIRO has allocated $1.9 million over the next five years to the Strategy which will establish a range of recruitment, induction, training and career development programs and support measures across a broad range of occupational functions, levels and where possible, geographical locations. The Department of Employment, Education and Training (DEET) has also committed funds to help CSIRO to implement the Strategy. A support unit to the Strategy has been established.

The EEO Unit has had continued responsibility for oversight of the three established child care centres at Black Mountain (ACT), North Ryde (NSW) and Clayton (Vic.). All sites are running well. A new child care initiative for the year has involved a three way joint venture in Adelaide between CSIRO, University of Adelaide and South Australian Department of Agriculture for a purpose-built full day-care centre.

For child care services for staff at less populated sites, CSIRO has investigated such options as securing purchased places and family day care initiatives.

STAFF APPRAISAL AND PERFORMANCE MANAGEMENT

A major review of CSIRO's Performance Planning and Evaluation (PPE) process was conducted by unions and management. As a result, changes to the ranking scale and appraisal form have been introduced. A survey and discussion sessions conducted during the review showed overwhelming support for the general approach to objective setting and performance appraisal.

An interim review of CSIRO's competency-based classification system was also completed. Enhancements to the current system, plus possible alterations to the model, are being further developed.

RECRUITMENT

Following a major review of how vacancies are filled, changes have been made to advertising processes.

As part of developing improved selection tools to help managers in the recruitment process, a validation exercise was undertaken to test the matching accuracy of occupational personality questionnaires for research staff. A recruitment module in the CSIRO Human Resource Information System is now available to streamline the selection administrative process.

Greater use is being made of salary market survey data for classification, recruitment and wages strategy development.

TRAINEESHIP SCHEME

From additional funds provided by the Government to CSIRO for the 1992–93 and 1993–94 years, the Organisation will spend $6 million on a youth employment program to provide up to 18 months' employment for 18–20 year-olds. In late 1992, CSIRO offered traineeships to 203 people under 21.

REDEPLOYMENT AND REDUNDANCY

Continued pressure on resources and changing research priorities have caused an increase in the number of staff declared surplus. While many such staff are internally redeployed within their operating unit, an increasing number have been formally made redundant.

	90/91	91/92	92/93
Retrenchments	83	103	115
–lump sum	80	98	111
–retention	3	5	4

DEVELOPMENT AND LEADERSHIP PROGRAMS

The Performance Planning and Evaluation process continues to provide the main mechanism for individual training and development needs analysis in CSIRO. Divisions and Units are generally responsible for co-ordinating delivery of, or group access to, training and development programs. Two Institute Training and Development co-ordinators have been appointed to assist this process.

Corporately, CSIRO continued to run its two-week residential program for senior research managers and the individually tailored two-year training program for potential future leaders. These programs have been operating since 1988 and 1990 respectively. During the year a total of 70 staff participated in them.

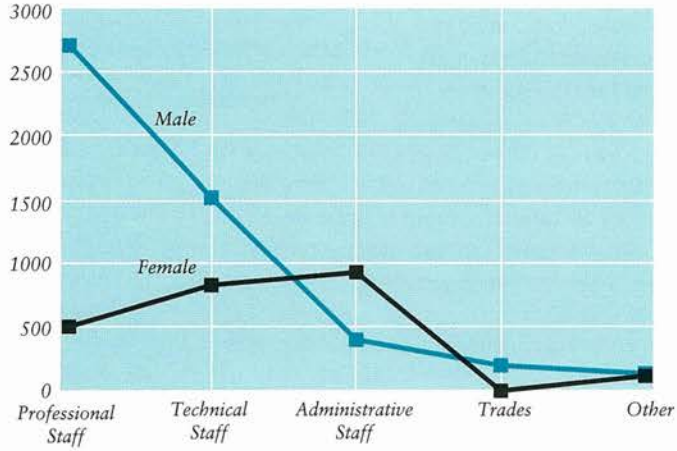
Special induction and development programs and seminars for Division Chiefs have been introduced.

A specific allocation of resources in the 1992–3 Budget enabled CSIRO to launch its own nationwide traineeship scheme for young people. Two hundred and three post-secondary students have been recruited under the scheme and are undertaking 18-month work experience programs in CSIRO laboratory and support service areas to complement their part-time academic studies.

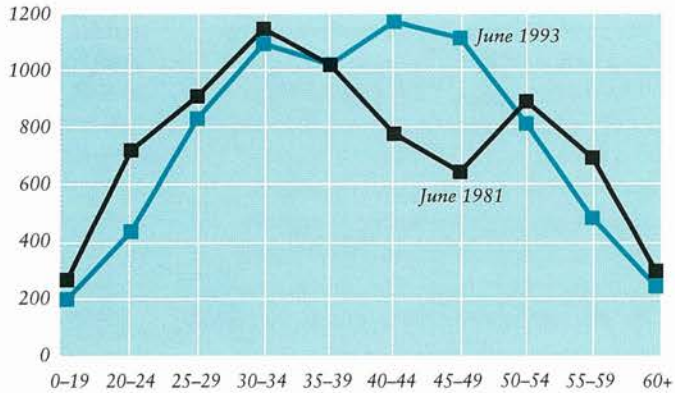
HUMAN RESOURCES INFORMATION SYSTEMS

Several new modules of the CSIRO Human Resource Information System (CHRIS) were released including enhancements for pay processing, OHS/Comcare, workforce planning and general personnel statistics. An extensive user training program was launched to help line managers make use of these systems in planning for and managing their research.

CSIRO STAFF BY STAFF GROUP BY GENDER AS AT JUNE 1993



CSIRO AGE STRUCTURE OF STAFF AT JUNE 1981 AND JUNE 1993



PUBLIC RELATIONS

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

The Organisation used a variety of means to convey to stakeholders and the community its key messages — that it gives value for money, that it is helping in the drive to sustainable development, and that its science is accessible to all, especially the young.

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

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

To raise the profile of CSIRO research for manufacturing industry, May 1993 was declared 'Manufacturing Month'. Highlights of a series of events included a number of business breakfasts, seminars and open days at CSIRO sites.

A brochure titled *Australia Taking on the World* presented CSIRO research achievements and capabilities to the business and science communities through insertion into the *Financial Review* and *New Scientist* magazine in December. In May, the latter also carried a supplement called 'Australian science in Asia' featuring CSIRO research that can help Australian businesses make the most of opportunities in Asia.

Media coverage of CSIRO research continued to increase. A survey has shown that positive print and electronic coverage grew by more than 20 per cent during the year, a growth created in part by improvements in computerised information delivery methods. About 70 scientists benefited during the year from a media skills training program, and a presentation skills program is being established to complement it.

CSIRO brought issues and developments in science and technology before the general community through a variety of public events. 'Will Pigs Fly?', an interactive exhibition about genetic engineering, continued its progress around Australia's science centres and museums. The education kit specially designed for the exhibition continued to sell well.

A new travelling interactive exhibition on minerals exploration and processing began its tour of duty around the country in May. In the planning stage is another travelling display about the nutrition and safety aspects of food.

The Organisation maintained its presence at agricultural shows in Perth, Adelaide and Darwin, at Farmfest in Queensland/northern New South Wales and at the Outlook Conference in Canberra.

As part of the first Australian Science Festival held in Canberra in April, CSIRO mounted 'Biota', a three-day festival of natural science and the environment. The event attracted more than 30,000 people and extensive media coverage.

In May, the Minister for Science and Small Business Senator Chris Schacht launched the 'Talk to a Scientist' program. When nearly 100 scientists from CSIRO joined forces with the NSW Department of School Education, students from around Australia were able to use computers to ask the scientists questions by electronic mail.

CSIRO's National Information Network answered 34,000 enquiries on science and technology topics during the year. The recent

installation of a 0055 number to handle common queries about topics like insulation and white ant control has freed up staff to concentrate on servicing more complex enquiries.

A survey of public attitudes was undertaken in June 1992 to provide a baseline for future evaluations of CSIRO. It showed a high public recognition of CSIRO (89 per cent), with 65 per cent believing CSIRO gives value for money — a significant improvement on the last such survey in 1984, although the two were not directly comparable.

Another survey by the Secretariat of the Government's working groups on Ecologically Sustainable Development confirmed the high level of public trust in CSIRO on environmental matters. Earlier research had shown that 50 per cent of people identified CSIRO as the most trustworthy organisation in the area, with environmental groups next on 26 per cent.

Linda Meisel, co-ordinator of the national 'Earthworms Downunder' experiment, at the media launch announcing the results of the project

CSIRO EDUCATION PROGRAMS

Membership of CSIRO's Double Helix Science Club grew from 16,000 to over 20,000 members during the year, an increase due in part to an additional 3,000 sales of *The Helix* magazine through newsagents and the Troll school book club.

The Club successfully completed the national experiment, 'Earthworms Downunder'. Members investigated and sent sample earthworms to the CSIRO Divisions of Entomology and Soils for analysis. The results gave new information about earthworm distribution in Australia. Farmers, acting on the advice of the researchers, should ultimately be able to increase productivity and reduce fertiliser use.

BHP sponsored Double Helix for an additional year.

The seven existing CSIRO Science Education Centres for school students have continued to develop new experiments showing the value of scientific research. A new CSIROSEC in Canberra, *The Green Machine*, is being developed in conjunction with the Plant Science Centre and the ACT Department of Education and Training. It will open in late 1993. Agreement was

reached with the Queensland Department of Education and James Cook University to establish an additional CSIROSEC in Townsville. An official opening is planned for early 1994.

The Science and Technology Awareness program of the Department of Industry, Technology and Regional Development agreed to provide over $100,000 a year for two years to support the travelling component of the CSIROSECs nationally.

The NSW Education and Training Foundation provided funding to establish a teacher professional development centre in Sydney over two years. Three staff have been appointed and programs both developed and presented to teachers. Feedback from those attending and the NSW Department of School Education has been extremely positive. The Centre will be self-funding after the two year period.

The CSIRO Student Research Scheme was introduced into South Australia, the Northern Territory and a number of regional centres, completing the national spread of the project. Over 430 senior secondary students took part in the research experience offered by the Scheme. The Institution of Engineers, Australia and the Science and Technology Awareness program of the Department of Industry, Technology and Regional Development continued to support the Scheme financially.

The BHP Science Awards, jointly organised by CSIRO and BHP, attracted more than 1,000 student entries. The teacher section of the Awards recognises the pursuit of excellence and was also well patronised. In 1993, financial rewards will not only be offered to the four winning teachers but also to the ten highly commended teachers.

The CSIRO Women In Science Project linked with Lateral Learning, a group providing speakers to schools, and this association has proved to be effective in three states.

INFORMATION SERVICES

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

Information services underwent a major reorganisation this year. Senior staff were recruited to head the finance, human resources and customer support services groups, and a sales and marketing group was established. Enquiry services for the general public were transferred to the public affairs section, and production of CSIRO magazines was relocated from Canberra to Melbourne to achieve economies of scale and to improve the integration of sales.

These changes and activities represent a significant change of direction for CSIRO information services, towards a much stronger focus on the needs of customers and users, both external and within CSIRO.

For 1992–93, more than 40 per cent of the budget for information services came from sources other than direct Appropriation funding, including export earnings of more than $2 million. Sales of the Australian Journals of Scientific Research generated most of the export earnings, and sales from the book publishing program increased by about 25 per cent to $0.75 million.

CSIRO clients

The CSIRO library network coordinated the purchase of 12,000 journal subscriptions, maintained quality control for the shared online catalogue, and bought the ADONIS Document Delivery System which uses CD-ROM technology to provide page images of 500 biomedical journals.

To meet the increasing need within CSIRO for business information, access was provided to the Australian Securities Commission database and subscription made to the Nikkei service which offers detailed coverage of companies in Japan and Asia. A CSIRO-wide

subscription to the Australian business databases on Ausinet was also managed.

Other achievements included:

- publication of more than 30 books, including several major reference works and 3 CD-ROMs. CSIRO Divisions received more than $100,000 in royalties from the book publishing project;
- production of four episodes of the internal video magazine CSIRO Video News;
- improved comprehensiveness of the CSIRO Index of Publications;
- a strategy to transfer records to the Australian Archives for storage.

External clients

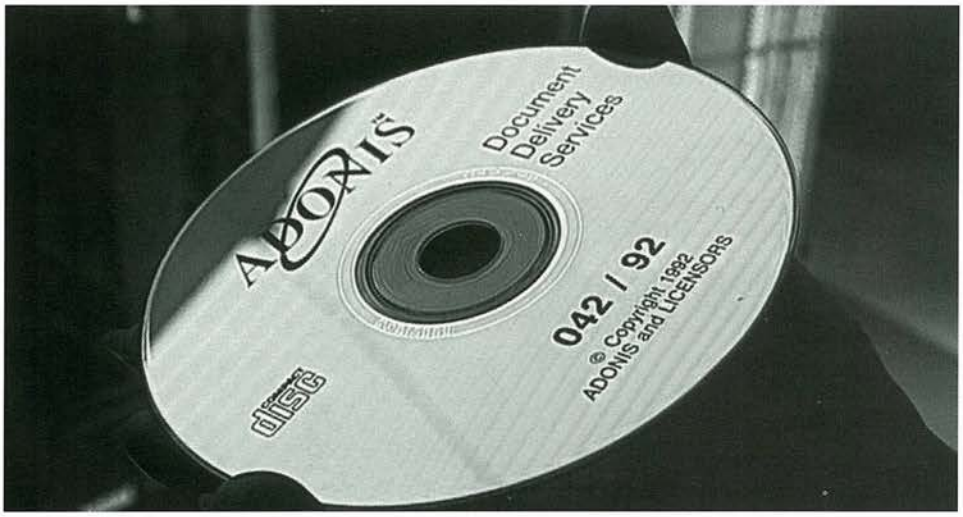
CSIRO kept pace with worldwide trends in the information services and publishing industries towards electronic publishing by:

- developing new CD-ROM products;
- increasing the use of full-text databases and other forms of electronic document delivery;
- preparing for electronic publishing of Australian scientific journals;
- increasing the use of electronic mail and in-house desktop publishing.

For the agricultural sector, CSIRO developed a new CD-ROM product called Ag.Round containing the two major Australian agricultural databases and page images from the Australian Journal of Experimental Agriculture.

For business and industry, database search services increased by about 50 per cent as a result of a marketing campaign funded by a DITAC grant. A major achievement was the acquisition of the US Department of Energy Research-in-Progress database in exchange for the Australian counterpart which CSIRO produced on behalf of DPIE. Both databases are available on the Australis service.

In the education sector, demand for information products is beginning to grow rapidly, especially for CD-ROM technology. Sales of the SAGE database increased five-fold to more than 400 subscriptions. CSIRO collaborated with the Apple Corporation to develop an interactive multimedia CD-ROM entitled *Insects – A World of Diversity*. The first in a new series of schools video programs called *Science for the Future* was released. These programs show the role of CSIRO research in management of environmental problems and sustainable agriculture.



ADONIS — biomedical information at the spin of a disk

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 pages 4–7, 8, 58–79);
- any determinations made by the Minister under sub-paragraph 9(1)(a)(iv) of the *Act* during the year;
- any directions or guidelines given by the Minister under section 13 on the *Act* during the year;
- any policies notified by the Minister under section 14 of the *Act* during the year;
- financial statements for the reporting year in a form approved by the Minister for Finance (see pages 92–114);
- the Auditor-General's report on these statements (see page 91).

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

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 co-operate with tertiary-education institutions in relation to education in that field;

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

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

(g) to establish, develop and maintain standards of measurement of physical quantities, and in relation to those standards
  (i) to promote their use;
  (ii) to promote, and participate in, the development of calibration with respect to them; and
  (iii) to take any other action with respect to them that the Chief Executive determines;

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

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

2. The Organisation shall

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

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

POWERS OF THE ORGANISATION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

APPENDIX 4: FREEDOM OF INFORMATION

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

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

In the year to 30 June 1993, CSIRO received 12 requests under the *Act.*

At the end of October 1991 changes were made by the Freedom of Information Act Amendment Bill to the *Freedom of Information Act.* The Bill inserts a new section 15A to provide that an employee may not request access to his or her personnel records under the FOI *Act* unless the employee has first sought access to the records under the agency's internal procedures for staff access to records.

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

CATEGORIES OF DOCUMENTS

CSIRO holds documents under the following headings:

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

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

ARCHIVES AND DISPOSAL ARRANGEMENTS FOR DOCUMENTS

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

FACILITIES FOR ACCESS

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

FOI PROCEDURES AND INITIAL CONTACT POINTS

A central Freedom of Information co-ordinator is responsible for the receipt of requests, referring these to senior officers for decision and granting access to the documents. Initial enquiries should be made to:
FOI Co-ordinator
CSIRO
Limestone Avenue,
CAMPBELL ACT 2601 *or*
PO Box 225
DICKSON ACT 2602
Tel: (06) 276 6123
In accordance with the *Freedom of Information Act*, formal requests to CSIRO should be addressed to:
The Chief Executive
CSIRO
PO Box 53
PARKVILLE VIC 3052

PRIVACY

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

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

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

During 1992–93 the Privacy Commissioner undertook one investigation under s.36 of the *Privacy Act 1988* in relation to a CSIRO staff member. The complaint was resolved through conciliation.

PRIVACY PROCEDURES AND INITIAL CONTACT POINTS

A central Privacy co-ordinator manages CSIRO's privacy responsibilities. Initial enquiries should be made to:
Privacy Co-ordinator
CSIRO
Limestone Avenue
CAMPBELL ACT 2601 *or*
PO Box 225
DICKSON ACT 2602

APPENDIX 5: TRUST FUNDS

SCIENCE AND INDUSTRY ENDOWMENT FUND

In 1992–93, eight grants totalling $8,250 were provided from this Fund, which was established under the *Science and Industry Endowment Act* of 1926. Recipients of the grants ranged from retired professional scientists to science teachers' associations. This was in keeping with the intention of the *Act* to promote interest in scientific and industrial research and to provide support to worthy individuals who have no institutional support.

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

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

F. D. MCMASTER BEQUEST TRUST FUND

From this fund, eight Fellowships were awarded in 1992–93, totalling $189,998. They were given to support eminent overseas scientists selected to work for a period in CSIRO Divisions.

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

SIR IAN MCLENNAN ACHIEVEMENT FOR INDUSTRY AWARD

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

The winning scientist receives a medal and a grant of up to $10,000 to undertake an overseas study visit appropriate to the achievement. The company or organisation involved in the development and/or marketing of the innovation is presented with a plaque.

The award recognises the contributions of Sir Ian McLennan to the application of science and technology to Australia's industrial development.

Details of this year's winners can be found on p 57.

APPENDIX 6: CSIRO RESEARCH PROGRAMS 1992–93

MULTI-DIVISIONAL PROGRAMS

Multi-Divisional Programs (MDPs) assemble multi-disciplinary teams from across the boundaries of CSIRO's management structure to respond to research problems and opportunities. They involve more than one Division and have their own formal management structures or steering committees.

1. Lessening Dependence on Chemical Pesticides
2. Algal Research
3. Coastal Zone
4. Management of Marine Living Resources
5. Energy Storage
6. Alumina Production
7. Aluminium Production
8. Heavy Mineral Processing
9. Integrated Geological, Geophysical, Mine Design Visualisation
10. Magnesium Alloys
11. Magnesium Production
12. Iron Ore Processing
13. Fibre Utilisation
14. Biomaterials and Medical Devices
15. Process and Maintenance Optimisation in Manufacturing
16. Urban Water Systems
17. Conserving Biodiversity for Australia's Future
18. Climate Change
19. Gene Shears
20. Land and Water Care
21. Active Packaging
22. Boeing-CSIRO Joint Research Effort
23. Minesite Rehabilitation
24. Data Acquisition and Utilisation

INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING

Animal Health

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

Animal Production

Efficiency of the Rumen Ecosystem
Sustainable Grazing Systems and Livestock Production
Reproductive Technology
Sheep Breeding
Wool Biology
Livestock Growth and Meat Quality

Australian Animal Health Laboratory

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

Biometrics Unit

Statistics for Animal Science
Statistics for Food Science

Food Processing

Process Technology
Processing and Optimisation of Efficiency of Meat Industry Operations
Meat Quality
Value-Added Processing
Energy Management
Microbial Technology
Protein Products
New Dairy Products
Microbiology and Food Components
Food Processing and Preservation
Sensory Studies

Human Nutrition

Diet, Heredity and High Blood Pressure
Tissue Growth and Repair
Dietary Fats and Heart Attacks
Social Nutrition, Epidemiology and Food Policy
Nutrition Control of Cardiovascular Disease
Nutrition and Cancer
Nutritional Pharmacology

Tropical Animal Production

Vector-borne Diseases
Ectoparasite Vaccines
Quantitative Genetics
Molecular Genetics
Reproduction
Growth and Receptors
Animal Nutrition

Wool Technology

Wool Product Technology
Wool Processing Technology
Raw Wool Marketing
Sheepskin Processing
Systems Development

INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Applied Physics

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

Biomolecular Engineering

Protein Structure
Protein Engineering
Gene Therapeutics
Virus Replication and Assembly
Receptors and Cytokines
Cell Surface Receptors and Cytokines
Biomaterials
Recombinant Vaccines and Diseases Control
Vascular Cell Technology

Chemicals and Polymers

Fine Chemicals
Industrial Chemicals
Polymers
Water and Wastewater Treatment
Pharmaceutical Chemicals

Manufacturing Technology

Process Technology
Integrated Manufacture

Materials Science and Technology

Alloys Research
Ceramics
Solid State Science
Advanced Materials Synthesis

INSTITUTE OF INFORMATION SCIENCE AND ENGINEERING

Australia Telescope National Facility

National Facility Support
Astrophysics
Parkes Operation
Parkes Visitors Centre
Narrabri Operation
Computing Support

Information Technology

High Performance Computing
Knowledge-Based Systems
Open Systems
Spatial Decision Support Systems
Visualisation Systems

Mathematics and Statistics

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

Radiophysics

Real Time and Video Processing
Array and Adaptive Beamforming
Signal Processing General
Image Processing
Ultrasonics
Solid-State Devices
Electromagnetics and Optics
Antenna Contract Support

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

Building Construction and Engineering

Construction Materials
Engineered Products and Services
Structural Engineering
Planning and Management Systems
Fire Technology

Coal and Energy Technology

Coal Preparation
Coal Quality
Coal Combustion and Gasification
Liquid Fuels
Coal-derived Products
Environment — Air
Environment — Water

Exploration Geoscience

Petroleum Exploration
Exploration for Ore Deposits in Regolith Dominated Terrains
Integrated Geological and Geophysical Mapping Techniques
Exploration for World-Class Hydrothermal Ore Deposits
Exploration for Ore Deposits associated with Magmatic Processes

Geomechanics

Metalliferous Mining
Oil and Gas Engineering
Coal Mining
Minesite Rehabilition (Inter-Institute Program)

Mineral and Process Engineering

Non-ferrous Beneficiation
Ferrous Metal Production
Non-ferrous Metal Production
Iron Ore Processing
Aluminium Production

Mineral Products

Energy Storage Production
Alumina Production
Heavy Mineral Processing
Magnesite Processing Production
Precious Metals Production
Magnesium Production

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT

Atmospheric Research

Atmospheric Pollution
Atmospheric Processes
Global Atmospheric change
Climate Modelling

Centre for Environmental Mechanics

Physical Ecology
Micrometeorology
Soil Physics
Physical Limnology

Fisheries

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

Oceanography

Climate
Marine Environment
Environmental Prediction
Marine Resources and Pollution

Wildlife and Ecology

National Rangelands
Ecology and Conservation Management of Tropical Forests and Savannas
Conservation Biology and Ecology
Physiological Adaptation of Australia's Vertebrate Fauna and Biological Control of Vertebrate Populations
Assessment and Management of Natural Resource Systems

Water Resources

Land and Water Care
Catchment Management
Sustainable Irrigated Agriculture
Management of Rivers and Wetlands
Public Policy Issues
Contamination and Salinity

CSIRO Office of Space Science and Applications (COSSA)

Access to Aircraft Facilities
Environmental Multispectral Imaging
Data Acquisition and Utilisation

INSTITUTE OF PLANT PRODUCTION AND PROCESSING

Entomology

Molecular Biology and Physiology
Pests of Humans, Livestock and Pasture
Pests of Field Crops, Horticulture and Timber
Biological Control of Weeds
Decision Support Systems for IPM
Taxonomy and General Biology
Microbial Insects and Electron Microscopy
Stored Grain

Forestry

Softwood Plantations
Australian Tree Resources
Regrowth Forest Management
Hardwood Plantations

Forest Products

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

Horticulture

Breeding and Management
Crop Environment Interaction
Postharvest Horticulture
Molecular Crop Improvement

Plant Industry

Sustainable Pasture Systems
Photosynthesis and Plant Performance
Plant Hormones, Growth and Development
Plant Disease Control
Crop Adaptation
Dryland Crops and Soils
Cotton Management and Production
Australian Flora Resources and Management
Processing Quality of Cereal Grains
Gene Isolation, Regulation and Transfer
Gene Manipulation for Plant Improvement
Crop and Soil Management

Soils

Environmental Protection and Land Rehabilitation
Soil Fertility and Toxicity
Soil Management and Erosion Control
Soil Organisms and Plant Growth
Soil Resource Assessment and Land Evaluation

Tropical Crops and Pasture

Crop Improvement and Management
Pasture Management and Livestock Production
Pasture Plant Improvement
Agricultural Systems and Land Resource Management
Applications of Biotechnology

APPENDIX 7: INSTITUTE/SECTOR ADVISORY COMMITTEES

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

CSIRO AGRICULTURAL SECTOR ADVISORY COMMITTEE

Covers the Institutes of Animal Production & Processing, Plant Production & Processing and parts of Natural Resources & Environment

Chair

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

Members

Mrs Marion Becker
Grazier, Central Queensland
Mr Keith Campbell
Grazier, southern NSW; commercial grazing consultant; Committee member, Wool Council of Australia and General Council & Wool Committee of NSW Farmers' Federation
Mr Julian Cribb
Agricultural journalist
Dr Brian Fisher
Director, Australian Bureau of Agricultural and Resource Economics
Dr John Keniry
Managing Director, Goodman Fielder Ingredients Ltd
Mr John Mackenzie
Treasurer, National Farmers Federation, several NFF committees; Chairman of Directors, Farmwide
Mr Ian Macrow
Grain and cattle producer, central Queensland; Chairman, Grains Research Foundation; Northern Regional Panel, Grain Research and Development Corporation
Mr Doug McGuffog
Managing Director, McGuffog & Co Pty Ltd; Agricultural chemicals consultant

Dr Kevin Sheridan
Director-General, NSW Agriculture
Dr Ross Squire
Managing Director, 'Sylvaterre'; silviculture and forestry consultant
Professor Harold Woolhouse
Director, Waite Agricultural Research Institute

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT ADVISORY COMMITTEE

Chair

Mr Neil Inall
Cox, Inall and Associates

Members

Mr Alex Campbell
Senior Vice President, The Western Australian Farmers' Federation
Professor David Green
Chief Science Advisor, Department of the Environment, Sport and Territories
Mr Bob Wilson
Formerly Managing Director, Water Board
Mr Brian Hill
Executive Director, Agriculture and Forestry Group, Department of Primary Industries and Energy
Mr Michael Rae
World Wide Fund for Nature
Professor Ann Henderson-Sellers, Director, Climatic Impacts, Professor of Physical Geography, School of Earth Sciences, Macquarie University

INSTITUTE OF INFORMATION SCIENCE AND ENGINEERING ADVISORY COMMITTEE

Chair

Mr E T Robinson
Special Adviser for Information Industries, Office of the Minister for Industry, Technology and Commerce

Members

Dr W J Caelli
Director, Eracom Pty Ltd
Mr P F Rehn
General Manager, Computer Sciences Australia Pty Ltd
Dr R K Steedman
Executive Director, Steedman Science and Engineering
Dr Peter Robinson
Chief, CSIRO Division of Manufacturing Technology
Mr M K Ward
120 Collins St Melbourne
Mrs Lyndsey Cattermole
Managing Director, Aspect Computing Pty Ltd
Mr Chris Howells
Managing Director, NetComm (Australia) Pty Ltd
Mr Ian J Kowalick

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION ADVISORY COMMITTEE

Chair

Dr I Gould
Group Executive, CRA Ltd

Members

Mr D Chandler
Fletcher Construction Group
Mr P Favretto
Director, Projects Finance Group
Dr T Haraldson
Chief Executive, Coal & Allied Industries
Mr J J Linden
General Manager (Marketing), Gwalia Consolidated Ltd
Dr P E Power
Managing Director, Ampolex Ltd
Dr S M Richards
Managing Director, Aberfoyle Ltd

THE INSTITUTE OF INDUSTRIAL TECHNOLOGIES MANUFACTURING SECTOR ADVISORY COMMITTEE

Chair

Sir Brian Inglis
ASTA/Optus/AMCOR

Members

Mr Keith Daniel
Telectronics
Mr Noel Godfrey
BHP
Mr Malcolm Richmond
CRA
Mr Rob Trenberth
DIT&RD
Dr Don Williams
Australian Submarine Corporation
Mr Ian Vaughan
Ford Australia
Mr Ken Windle
Glaxo Australia

APPENDIX 8: PUBLICATIONS

CSIRO publishes every year about 4,000 scientific papers, monographs and reports, annual or biennial reports from its Institutes and Divisions, brochures, information leaflets and books. It is not practicable to list all these in CSIRO's Annual Report, but full details can be found in the reports of each of CSIRO's Divisions, from the Information Services Branch (314 Albert Street, East Melbourne, Vic. 3002) or by consulting the CSIRO Index on the AUSTRALIS database.

Corporate publications during the year have included:

- *CSIRO Annual Report 1991–92*
- *CSIRO data book 1993*
- *Australian Science, Australia's Future* (a guide to CSIRO)
- *Ecos* environmental magazine (quarterly);
- *Rural Research* magazine (quarterly insert to *Australian Farm Journal*);
- *CSIRO Business* (monthly insert to *Business Review Weekly*);
- *The Helix* (quarterly magazine for Double Helix Club members);
- Occasional Paper No. 8: *Environmental Research — the pay-off*

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

INDEPENDENT AUDIT REPORT

To the Minister for Science and Small Business

Scope

I have audited the financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1993. The statements comprise:

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

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

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

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

Audit Opinion

In accordance with sub-section 63M(2) of the *Audit Act 1901*, I now report that the statements are in agreement with the accounts and records of the Organisation, and in my opinion:

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

(ii) the statements show fairly in accordance with Statements of Accounting Concepts and applicable Accounting Standards the financial transactions and cash flows for the year ended 30 June 1993 and the state of affairs of the Organisation as at that date

(iii) the receipt, expenditure and investment of moneys, and the acquisition and disposal of assets, by the Organisation during the year have been in accordance with the *Science and Industry Research Act 1949*, and

(iv) the statements are in accordance with the Guidelines for Financial Statements of Public Authorities and Commercial Activities.

D. S. Lennie
Executive Director
Australian National Audit Office
Canberra
25 October 1993

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

OPERATING STATEMENT
FOR THE YEAR ENDED 30 JUNE 1993

	Notes	1993 $'000	1992 $'000
COST OF SERVICES			
Operating expenses	2		
Research Programs			
Animal Production and Processing		134 118	134 834
Industrial Technologies		103 847	90 675
Information Science and Engineering		35 356	34 294
Minerals, Energy and Construction		114 068	102 919
Natural Resources and Environment		103 110	88 093
Plant Production and Processing		128 047	126 050
National Facilities		18 550	16 098
Research Support		47 993	44 965
Total operating expenses		685 089	637 928
Operating revenues from independent sources			
Revenue from research activities and user charges		192 203	173 375
Other revenue	3	32 983	23 964
Total operating revenues from independent sources		225 186	197 339
Net cost of services		(459 903)	(440 589)
REVENUE FROM GOVERNMENT			
Parliamentary appropriations received	2	454 251	443 264
Operating results (deficits) before abnormal items		(5 652)	2 675
Abnormal items	4	(176)	(43 334)
Operating results (deficits)		(5 828)	(40 659)
Accumulated results of operations at beginning of financial year		653 412	694 071
Accumulated results of operations at end of financial year		647 584	653 412

The accompanying notes form part of these statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

STATEMENT OF FINANCIAL POSITION AS AT 30 JUNE 1993

	Notes	1993 $'000	1992 $'000
Current assets			
Cash	5	22 571	37 398
Receivables	6	14 800	2 805
Investments	7	78 597	87 047
Other	8	32 767	32 924
		148 735	160 174
Non-current assets			
Investments	7	65 748	3 729
Property, plant and equipment	9	953 789	708 352
		1 019 537	712 081
Total assets		**1 168 272**	**872 255**
Current liabilities			
Creditors and borrowings	10	9 910	9 788
Leases	13	2 658	–
Provisions	11	61 304	49 757
Other	12	85 940	88 715
		159 812	148 260
Non-current liabilities			
Creditors and borrowings	10	5 064	3 000
Leases	13	22 346	–
Provisions	11	70 263	67 583
Other	12	63 472	–
		161 145	70 583
Total liabilities		**320 957**	**218 843**
Net assets		**847 315**	**653 412**
Equity			
Accumulated results of operations		647 584	653 412
Asset revaluation reserve	1.16	199 731	–
Total equity		**847 315**	**653 412**

The accompanying notes form part of these statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

STATEMENT OF CASH FLOWS
FOR THE YEAR ENDED 30 JUNE 1993

	Notes	1993 $'000	1992 $'000
Cash flows from operating activities			
Receipts from research activities and user charges		252 215	179 440
Interest received	2	11 052	12 115
Dividends received		7 655	–
Payments to suppliers and employees		(614 611)	(547 020)
Finance charges on finance lease paid		(682)	–
Net cash flows used by operating activities	14(b)	**(344 371)**	**(355 465)**
Cash flows from investing activities			
Payments for property, plant and equipment		(76 802)	(59 491)
Payments for investments		(324)	(620)
Proceeds from sale of property, plant and equipment		5 974	4 664
Proceeds from sale of investment		1 549	–
Net cash flows used by investing activities		**(69 603)**	**(55 447)**
Cash flows from financing activities			
Principal repayment under finance lease		(2 146)	–
Net cash flows used by financing activities		**(2 146)**	**–**
Cash flows from government activities			
Parliamentary appropriations	2	454 251	443 264
Loan from the Commonwealth	10	2 064	3 000
Net cash flows provided by government activities		**456 315**	**446 264**
Net increase in cash held		**40 195**	**35 352**
Cash at beginning of financial year		124 445	89 093
Cash at end of financial year	14(a)	**164 640**	**124 445**

The accompanying notes form part of these statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

NOTE 1 SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

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

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

1.3 **Principles of Consolidation**
CSIRO has only one fully owned entity, Sirotech Limited. Having considered Sirotech's commercial activities and its immaterial effect on CSIRO's financial statements, CSIRO has, in accordance with Australian Accounting Standard AAS 24 (paragraph 16), elected not to consolidate its accounts (Note 15).

1.4 **Economic Dependency**
CSIRO receives approximately two thirds of its funding from the appropriation of moneys by Parliament.

1.5 **Foreign Currency**
Foreign currency transactions are translated to Australian currency at the rates of exchange ruling at the dates of the transactions. Amounts receivable and payable in foreign currencies at balance date are translated at the rates of exchange ruling at that date.
Exchange differences relating to amounts payable and receivable in foreign currencies are brought to account as exchange gains or losses in the Operating Statement.

Hedges
All non-specific hedge transactions are recorded at the spot rate at the date of the transaction. Hedges outstanding at balance date are translated at the rates of exchange ruling on that date and any exchange gains or losses are brought to account in the Operating Statement.
Where hedge transactions are designed to hedge the purchase or sale of goods or services, exchange differences arising up to the date of purchase or sale, together with any costs or gains arising at the time of entering into the hedge, are included in the measurement of the purchase or sale.

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

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

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

1.9 **Revenue Recognition**
Parliamentary appropriations are recognised as revenue in the year of receipt in accordance with the Minister for Finance's Guidelines for Public Authorities and Commercial Activities.
Revenue from contract research activities is recognised in the Operating Statement when work is performed; the balances of research activities in progress are accounted as either research work in progress or contract research moneys received in advance in the Statement of Financial Position.
A surplus/deficit is recognised on completion of each research activity. However, where a deficit is anticipated over the life of the research activity then it is brought to account when first recognised.
Other revenue including licensing fees and royalties from the sale of products or technologies developed under agreements are brought to account when received. While this basis of accounting constitutes a departure from an accrual basis the effect is not material to the financial statements.

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

1.11 **Finance and Operating Leases**
In prior years CSIRO has elected not to account and disclose finance and operating leases because the amount involved was not material. This policy was in accordance with the Australian Accounting Standard AAS17 (paragraph 23). However, it is now appropriate to account for and disclose finance and operating leases in accordance with AAS17 as CSIRO has entered into three major finance leases with respect to property, plant and equipment during the year (Note 13). Assets acquired under finance leases are included in property, plant and equipment (Note 9).
Finance leases effectively transfer from the lessor to the lessee substantially all the risks and benefits incidental to the ownership of the leased assets. Where assets are acquired by means of finance leases, the present value of the minimum lease payments is recognised as an asset at the beginning of the lease term and amortised on a straight line basis over the expected useful life of the leased asset. A corresponding lease liability is also established and each lease payment is allocated between the liability and finance charge. Other leases under which all the risks and benefits of ownership are effectively retained by the lessor are classified as operating leases. Operating lease payments are expensed over the period of expected benefit.

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

1.13 **Investments**
Controlled Entities
Investment in a controlled entity, Sirotech Ltd is disclosed in Note 15. Dividends and distributions are brought to account in the Operating Statement when they are received. There is no other controlled entity.

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

Other Companies
Investments in other companies are carried at cost or Board Members' valuation. Dividends are brought to account as they are received.
Where, in the opinion of the Board, there has been a permanent diminution in the value of an investment, the carrying amount of the investment is written down to its recoverable amount. In doing so, the Board considers the nature of the underlying net assets with particular regard to any deferred expenditure on research, development and intellectual property (Note 1.14).

Managed Funds
Managed funds comprise government, semi-government and bank endorsed securities which are valued at market values on 30 June 1993. In prior years managed funds were brought to account at their book values being the cost of the securities plus accrued interest.
This change in the method of valuation is considered appropriate due to the significant increase in funds held and traded in long term securities compared to last financial year. Had last year's managed funds been valued at market values, their value would have increased by $1 026 353.

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

1.15 Co-operative Research Centres
The activities attributable to the interests of CSIRO in Co-operative Research Centres have been expensed consistent with Note 1.14. CSIRO's interests in Co-operative Research Centres are disclosed in Note 22.

1.16 Property
All land, buildings and leasehold improvements were revalued in June 1993 and the revaluation increments credited directly to the asset revaluation reserve.
Land which will continue to be used for research activity has been valued by CSIRO's registered valuer G.J.Harley, AAVLE at "in use value" and the valuation has been adopted as a Board members' valuation.
Land and buildings designated for sale have been valued by registered external valuers D Schuter, FVLE(Val) and J.Curley, FVLE(Val) AREI and the valuation has been adopted as a Board Members' valuation.
Buildings and leasehold improvements which will continue to be used for research activity have been valued based upon the written down replacement costs using external building price indices to arrive at current replacement costs less accumulated depreciation having regard to the age and condition of the buildings.

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

1.17 Plant and Equipment

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

Property, plant and equipment which are purchased from contract research funds and where their sale proceeds are refunded to the contributors under the terms of the agreements, are expensed during the year of purchase. Separate records for these assets are maintained (Note 18).

1.18 Depreciation and Amortisation

Depreciation is calculated on a straight line basis so as to write off the net cost or revalued amount of each item of building, plant and equipment over its expected useful life. The cost of improvements to or on leasehold properties is amortised over the unexpired period of the lease or the estimated useful life of the improvement, whichever is the shorter.

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

1.19 Employee Entitlements

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

1.20 Superannuation

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

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

1.21 Workers' Compensation

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

1.22 Cash Flows

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

1.23 Comparative Figures

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

NOTE 2 OPERATING RESULTS

	1993 $'000	1992 $'000
Operating results have been determined:		
After crediting as revenues:		
Interest received or due and receivable	11 052	12 115
Parliamentary appropriations		
– annual (Bills 1&2)	414 993	417 669
– capital (Bills 3&4)	39 258	25 595
After charging as expenses:		
Foreign exchange losses	544	–
Interest on finance leases	682	–
Loss on sale of property, plant and equipment	1 706	2 359
Wages and salaries related payments	287 859	270 705
Superannuation (including productivity benefits)	50 112	46 093
Provision for legal settlements	9 500	–
Provision for long service leave	9 987	10 490
Provision for recreation leave	26 299	30 205
Provision for doubtful debts	524	–
Provision for diminution in value of shares	979	–
Provision for refit of research vessels	200	–
Intellectual property written-off	8 201	–
Depreciation and amortisation	49 540	51 644

NOTE 3 OTHER REVENUE

	1993 $'000	1992 $'000
Department of Primary Industries and Energy's contribution to the cost of the Australian Animal Health Laboratory	6 055	5 536
Dividends	7 655	–
Interest on appropriation funds	7 259	7 197
Royalties	2 314	2 774
Sale of publications	2 487	2 484
Sale of produce and livestock	1 008	930
Profit on sale of investments	751	–
Miscellaneous (testing fees, rental income, etc)	5 454	5 043
Total other revenue	32 983	23 964

NOTE 4 ABNORMAL ITEMS

	1993 $'000	1992 $'000
Prior period net gains/(losses) relating to non-current assets	(176)	3 001
Prior period depreciation charge as a result of changes in the depreciation rates	–	(46 335)
Total abnormal items	(176)	(43 334)

NOTE 5 CASH

	1993 $'000	1992 $'000
Cash at bank and on hand	14 437	33 984
Deposits - at call	481	1 242
Managed funds - at call	7 653	2 172
Total cash	22 571	37 398

NOTE 6 RECEIVABLES

	1993 $'000	1992 $'000
Trade debtors	15 376	1 555
Advances – Sirotech Ltd	–	1 252
– Other	298	348
	15 674	3 155
Provision for doubtful debts	(874)	(350)
Total receivables	14 800	2 805

NOTE 7 INVESTMENTS (NOTE 1.13)

	Notes	1993 $'000	1992 $'000
Current			
Managed funds			
Government and semi-government stocks and bonds		60 401	29 296
Bank endorsed bills and government guaranteed promissory notes		6 468	22 676
Negotiable certificate of deposits		5 315	14 588
		72 184	66 560
R&D syndicate deposits			
Term deposits - under contract	17	6 413	20 487
		78 597	87 047

NOTE 7 INVESTMENTS (NOTE 1.13) (CONT.)

	Notes	1993 $'000	1992 $'000
Non-current			
R&D syndicate deposits			
Term deposits - under contract	17	63 472	–

Shares - at valuation	%CSIRO interest	1993 $'000	1992 $'000
Associated companies			
Bio-Coal Briquette Pty Ltd	17.2	88	88
Dunlena Pty Ltd	47.0	5	419
Gene Shears Pty Ltd	34.7	501	501
Gropep Pty Ltd	35.1	101	101
Preston Group Ltd	16.1	784	495
		1 479	1 604
Provision for diminution in value		(1 479)	(500)
		–	1 104
Shares - at cost			
Listed companies			
Mineral Control Instrumentation Ltd		260	260
Queensland Metals Corporation NL		2 005	2 354
Unlisted companies			
Other corporations		8	8
Debentures and unsecured notes - at cost		3	3
		2 276	2 625
		65 748	**3 729**
Total investments		**144 345**	**90 776**

Mineral Control Instrumentation Ltd and Queensland Metals Corporation N.L. are public listed companies. As at 30 June 1993 the total market values of these quoted shares were $300 000 and $7 241 164 respectively. These exceeded the total book values of CSIRO's non-current investments. CSIRO is a minority shareholder (less than 5%) in these listed companies.

In addition to the abovenamed associated companies, CSIRO holds a 50% interest in Cassiro Pty Ltd (50 shares @ $1) and a 10% interest in Dynamic Transport Management Pty Ltd (20 shares @ $1).

NOTE 8 OTHER ASSETS

	Notes	1993 $'000	1992 $'000
Current			
Prepayments		14 510	8 523
Property held for resale - at acquisition cost		479	450
Research work in progress - at cost	1.9	17 778	23 951
Total other assets		32 767	32 924

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

	1993 $'000	1992 $'000
Land (a)		
At cost	–	11 752
At valuation	180 001	94 560
	180 001	106 312
Buildings		
At cost	–	55 450
At valuation	525 918	462 412
	525 918	517 862
Accumulated depreciation	–	(97 551)
	525 918	420 311
Capital works in progress - at cost	25 831	14 482
	551 749	434 793
Leasehold improvements		
At cost	–	910
At valuation	31 757	16 943
	31 757	17 853
Accumulated amortisation	–	(8 175)
	31 757	9 678
Plant and equipment		
Equipment - at cost	277 653	250 657
Research vessel 'Southern Surveyor' - at cost	16 776	16 753
	294 429	267 410
Accumulated depreciation	(179 037)	(162 600)
Provision for refit of research vessel	(100)	–
	115 292	104 810

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

	1993 $'000	1992 $'000
National facilities		
Oceanographic research vessel 'Franklin' - at cost	15 132	14 963
Australia Telescope - at cost	48 856	49 945
	63 988	64 908
Accumulated depreciation	(14 242)	(12 149)
Provision for refit of research vessel	(100)	–
	49 646	52 759
Buildings and equipment under finance lease		
Buildings	20 150	–
Equipment	6 456	–
	26 606	–
Accumulated amortisation	(1 262)	–
	25 344	–
Total property, plant and equipment	953 789	708 352

(a) Includes Crown land and land held in Commonwealth title totalling $1 155 000 (1992 $12 075 000). Negotiations are continuing between CSIRO, the Commonwealth Government and ACT Government to have leases issued in CSIRO's name.

Total property, plant and equipment (Summary)		
At cost	410 854	414 912
At valuation	737 676	573 915
	1 148 530	988 827
Accumulated depreciation and amortisation	(194 541)	(280 475)
Provision for refit of research vessels	(200)	–
Total property, plant and equipment	953 789	708 352

NOTE 10 CREDITORS AND BORROWINGS

	1993 $'000	1992 $'000
Current		
Trade creditors	9 069	9 788
Sundry creditors	415	–
Amounts payable to Sirotech Ltd	426	–
	9 910	9 788
Non-current		
Loan from the Commonwealth (a)	5 064	3 000
Total creditors and borrowings	14 974	12 788

(a) The loan of $5 064 000 (1992 $3 000 000) from the Commonwealth is the drawdown of an approved loan of $10 million for the North Ryde Redevelopment Project. The balance of the loan will be made in 1993/94 . Interest is paid annually and the principal will be repaid in full on 1 October 1997. Interest totalling $321 089 (1992 $72 352) has been capitalised on the North Ryde Redevelopment Project.

NOTE 11 PROVISIONS

	Notes	1993 $'000	1992 $'000
Current			
Provision for recreation leave	1.19	42 223	40 541
Provision for long service leave	1.19	9 581	9 216
Provision for legal settlements		9 500	–
		61 304	**49 757**
Non-current			
Provision for long service leave	1.19	**70 263**	**67 583**
Total provisions		131 567	117 340

NOTE 12 OTHER LIABILITIES

	Notes	1993 $'000	1992 $'000
Current			
Accrued expenses		13 866	12 175
Research revenue received in advance	1.9	65 511	56 053
Unearned revenue - R&D syndicate	17	6 563	20 487
		85 940	**88 715**
Non current			
Unearned revenue - R&D syndicate	17	**63 472**	–
Total other liabilities		149 412	88 715

NOTE 13 LEASE COMMITMENTS (NOTE 1.11)

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

	1993 $'000	1992 $'000
Payable no later than one year	5 706	1 763
Payable later than one year, but no later than two years	5 628	1 597
Payable later than two years, but no later than five years	6 942	3 203
Payable later than five years	29 374	5 399
Total lease commitments	47 650	11 962
Representing:		
Non-cancellable operating leases	14 126	11 962
Finance leases	33 524	–
Total lease commitments	47 650	11 962

NOTE 13 LEASE COMMITMENTS (NOTE 1.11) (CONT.)

	1993 $'000	1992 $'000
Non-cancellable operating lease commitments contracted for at balance date and not provided for in the accounts:		
Payable no later than one year	1 829	1 763
Payable later than one year, but no later than two years	1 744	1 597
Payable later than two years, but no later than five years	3 980	3 203
Payable later than five years	6 573	5 399
	14 126	**11 962**
Finance lease commitments:		
Payable no later than one year	3 877	–
Payable later than one year, but no later than two years	3 884	–
Payable later than two years, but no later than five years	2 962	–
Payable later than five years	22 801	–
	33 524	–
Deduct, Future lease expenditure not provided for in the accounts:		
Maintenance charges	(878)	–
Future finance charges	(7 642)	–
Total lease liabilities provided for in the accounts	**25 004**	**–**
(a) Representing lease liabilities		
Current	2 658	–
Non-current	22 346	–
	25 004	**–**

(b) The lease liabilities are allocated between current and non-current elements. The principal component of the lease payment due for the year ending 30 June 1994 is shown as current and the remainder of the liability as non-current.

NOTE 14 STATEMENT OF CASH FLOWS (NOTE 1.22)

(a) Reconciliation of cash

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

	Notes	1993 $'000	1992 $'000
Cash at bank and on hand	5	14 437	33 984
Deposits - at call	5	481	1 242
Managed funds	5 & 7	79 837	68 732
Term deposits - under contract	7	69 885	20 487
		164 640	**124 445**

NOTE 14 STATEMENT OF CASH FLOWS (NOTE 1.22) (CONT.)

(b) Reconciliation of operating results with net cash flows from operations		1993 $'000	1992 $'000
Operating results (deficits)		(5 828)	(40 659)
Non cash flows in operating results			
Depreciation and amortisation		49 540	51 644
Loss on disposal of property, plant and equipment		1 706	2 359
Profit on disposal of investment		(751)	–
Increase in provision for doubtful debts	6	524	–
Increase in provision for diminution in value	7	979	–
Increase in provision for employee entitlements	11	4 727	9 356
Increase in provision for refit of research vessel		200	–
Increase in provision for legal settlements		9 500	–
Abnormal items		(374)	43 334
Changes in assets and liabilities			
(Increase)/decrease in receivables	6	(12 519)	(5 784)
(Increase)/decrease in prepayments	8	1 357	(2 500)
Increase/(decrease) in creditors	10	122	24 082
Increase/(decrease) in other current and non-current liabilities	12	60 697	5 967
		109 880	87 799
Parliamentary appropriations		(454 251)	(443 264)
Net cash outflows from operating activities		(344 371)	(355 465)

Non-cash financing activities

During the financial year CSIRO acquired property, plant and equipment with an aggregate fair value of $26 605 603 (1992 $nil) by means of finance leases. These acquisitions are not reflected in the Statements of Cash Flows.

NOTE 15 SIROTECH LTD

Sirotech Ltd has been established by CSIRO, limited by guarantee and governed by a Board of Directors who are also Board members of CSIRO. It was incorporated on 15 November 1984. The company's main source of revenue is from service fees paid by CSIRO to cover day to day commercial and intellectual property advice. During the year fees received from CSIRO totalled $3 979 147 (1992 $4 068 527). Its net assets as at 30 June 1993 amounted to $1 033 126 (1992 $754 686).

From 1 July 1993, Sirotech Limited ceased trading and its activities devolved to CSIRO and external contractors.

NOTE 16 CAPITAL EXPENDITURE COMMITMENTS

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

	1993 $'000	*1992 $'000*
Payable no later than one year	17 528	31 429
Payable later than one year, but not later than two years	203	10 080
Payable later than two years, but not later than five years	-	6 000
Total capital expenditure commitments	**17 731**	**47 509**

NOTE 17 RESEARCH AND DEVELOPMENT (R & D) SYNDICATE (NOTES 7 AND 12)

CSIRO has entered into several agreements whereby R&D syndicates have provided funds in respect of R&D projects.

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

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

NOTE 18 RESOURCES PROVIDED FREE OF CHARGE AND NOT INCLUDED IN THE STATEMENT OF FINANCIAL POSITION

	Land(a) $'000	*Buildings $'000*	*Plant and equipment $'000*	*Total 1993 $'000*	*Total 1992 $'000*
At valuation or cost	18 500	31 627	37 932	88 059	81 424
Accumulated depreciation	–	(4 340)	(26 721)	(31 061)	(30 067)
	18 500	**27 287**	**11 211**	**56 998**	**51 357**

(a) Includes land $10 890 000 (1992 $8 866 293) which was previously purchased out of contract research monies and are in CSIRO titles. In accordance with the contract research agreements, any sales proceeds from disposal of these assets shall be refunded to the contributors.

NOTE 19 MONIES HELD IN TRUST

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

Investments	*1993 $'000*	*1992 $'000*
Advance Bank	89	203
Commonwealth Bank of Australia	2 659	2 567
State Electricity Commission of Victoria	12	12
St George Bank	122	114
	2 882	2 896
Cash at bank	78	83
Total monies held in trust	**2 960**	**2 979**
The components of trust funds are as follows:		
William McIlrath Trust Fund	221	209
David Rivett Memorial Lecture Fund	82	86
FD McMaster Bequest	2 514	2 542
Sir Ian McLennan Achievement for Industry Award	143	142
Total monies held in trust	**2 960**	**2 979**

NOTE 20 CONTINGENT LIABILITIES

Contingent liabilities for which no provision has been made in the accounts as at 30 June 1993 were:

	1993 $'000	*1992 $'000*
Performance guarantee	184	193
Estimated personal injury and workers compensation claims pre 1988 which are being defended.	1 500	2 000
Total contingent liabilities	**1 684**	**2 193**

In addition, CSIRO is a respondent to legal proceedings in the Federal Court of Australia. These proceedings are brought by Charter Pacific Corporation Ltd and an associated entity for damages and other relief in connection with arrangements for the commercialisation of optically variable device technology known as Pixelgram. CSIRO is vigorously defending the proceedings. Legal advice indicates that the total future legal fees and disbursements to be incurred by CSIRO in respect of the proceedings, including a trial, will be in the order of $1.3M to $1.6M. No reasonable estimate of any liability that may arise in the proceedings can be made at this stage.

NOTE 21 AUDITOR'S REMUNERATION

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

	1993 *$'000*	*1992* *$'000*
Auditing the accounts	290	236

(No other services were received by the auditors)

NOTE 22 CO-OPERATIVE RESEARCH CENTRES (CRC)

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

At 30 June 1993, CSIRO's commitment to CRCs is approximately $271 million over a 5-7 year period.

Of the 52 CRCs, CSIRO is a partner in 43, 4 of which had not been formalised by the end of the financial year. CSIRO's interest in each of the remaining 39 CRCs is listed as follows:

Names of Co-operative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
Legumes in Mediterranean Agriculture	18
Plant Science	49
Tropical Plant Pathology	25
Temperate Hardwood Forestry	46
Hardwood Fibre and Paper Science	54
Viticulture	11
Waste Management and Pollution Control	6
Vaccine Technology	26
Tissue Growth and Repair	35
Cellular Growth Factors	19
Cardiac Technology	17
Intelligent Manufacturing Systems and Technology	15
Alloy and Solidification Technology	47
Materials Welding & Joining	31
Polymer Blends	31
Molecular Engineering & Technology	40
Industrial Plant Biopolymers	27
Intelligent Decision Systems	5
Robust & Adaptive Systems	22
Australian Photonics	4
G K Williams CRC for Extractive Metallurgy	39
Australian Petroleum	61

NOTE 22 CO-OPERATIVE RESEARCH CENTRES (CRC) (CONT.)

Names of Co-operative Research Centres	CSIRO's Equity Interest (%) (excluding Commonwealth contributions)
Sustainable Cotton Production	28
Southern Hemisphere Meteorology	19
Freshwater Ecology	14
The Cattle & Beef Industry (meat quality)	30
Biological Control of Vertebrate Pest Population	67
Tropical Rainforest Ecology & Management	37
Eye Research and Technology	11
Food Industry Innovation	15
Premium Quality Wool	46
Soil and Land Management	54
New Technologies for Power Generation from Low Rank Coal	10
Catchment Hydrology	26
A J Parker CRC for Hydrometallurgy	49
Tropical Pest Management	34
The Antarctic and Southern Ocean Environment	16
Australian Mineral Exploration Technologies	31
Mining Technology and Equipment	36

NOTE 23 BOARD MEMBERS' REMUNERATION

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

	1993 *$'000*	*1992* *$'000*
Full-time member	219	215
Part-time members	166	134
Total Board members' remuneration	**385**	**349**

In addition, a Board member of CSIRO who is also a Director of the controlled entity Sirotech Ltd, has received Directors fees totalling $21 875 (1992 $25 000) from that entity.

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

$	*1993* *Number*	*1992* *Number*
1-10 000	–	3
10 001-20 000	8	5
20 001-30 000	–	1
30 001-40 000	1	–
210 001-220 000	1	1

NOTE 24 EXECUTIVES' REMUNERATION

Total remuneration received, or due and receivable, by the Executives whose remuneration exceeds $100 000 was as follows:

	1993 *$'000*	*1992* *$'000*
	1 268	**1 196**

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

$	*1993* *Number*	*1992* *Number*
120 001-130 000	1	1
130 001-140 000	1	–
140 001-150 000	–	6
150 001-160 000	4	–
170 001-180 000	1	–
210 001-220 000	1	1

NOTE 25 RELATED PARTY INFORMATION

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

A E Clarke
L N R Carmichael
A K Gregson
S M Richards
N C Stokes
J W Stocker
J R de Laeter
Sir Gustav Nossal
D S Shears
C R Ward-Ambler

Remuneration
Information on remuneration of Board Members is disclosed in Note 23

Board Members' interests in contracts
Since 1 July 1992 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 23 by reason of a contract made by CSIRO with the Board Member or with a firm of which the Board Member is a member or with a company in which the Board Member has a substantial financial interest.

Other transactions of Board Member-related entities
The Chairman of the Board , Professor AE Clarke, is a director of Alcoa of Australia Limited. CSIRO has received monies from Alcoa of Australia Limited for contract research and development work during the year. The contracts are based on normal commercial terms and conditions.

NOTE 25 RELATED PARTY INFORMATION (CONT.)

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

A Board Member, Mr CR Ward-Ambler, is a director of AMRAD Corporation Ltd and a member of Pratt Group Advisory Committee. These companies have a number of contractual relationships in the field of research and development. The contracts are based on normal commercial terms and conditions.

A Board Member, Professor Sir Gustav Nossal is a non-executive director of CRA Limited. CSIRO has received funding and/or fees for services provided in the field of research and development and they are based on normal commercial terms and conditions.

A Board Member, Dr SM Richards is a managing director of Aberfoyle Limited. CSIRO is involved in a number of research and development contracts with Aberfoyle Limited or one of its subsidiaries through the agency of the Australian Mineral Industries Research Association (AMIRA). As of September 1993, he is no longer a member of the AMIRA Council and has no influence on its management. The contracts are based on normal commercial terms and conditions.

A Board Member, Dr AK Gregson is a director of the Grains Research and Development Corporation. CSIRO receives research and development grants from the Corporation. These grants are based on normal commercial terms and conditions of the Corporation.

Controlled entity

Information relating to transactions with the fully controlled entity, Sirotech Ltd is disclosed in Note 15.

NOTE 26 SUBSEQUENT EVENTS

In July 1993 the Minister for Science and Small Business announced a proposal to incorporate Australian Nuclear Science and Technology Organisation (ANSTO) into CSIRO and to review existing institutional arrangements including the CSIRO Divisions of Fisheries and Oceanography to provide a strong focus for marine research in Australia. These proposals are currently under review and are to be considered by the Government by the end of 1993 calendar year.

BOARD MEMBERS' STATEMENT

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

- the state of affairs as at 30 June 1993;
- the operating result for the year ended 30 June 1993; and
- the cash flows for the year ended 30 June 1993.

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

Signed at Melbourne this 19th day of October 1993 in accordance with a resolution of the Board Members.

Adrienne E Clarke
Chairman

John W Stocker
Chief Executive and Board Member

Index

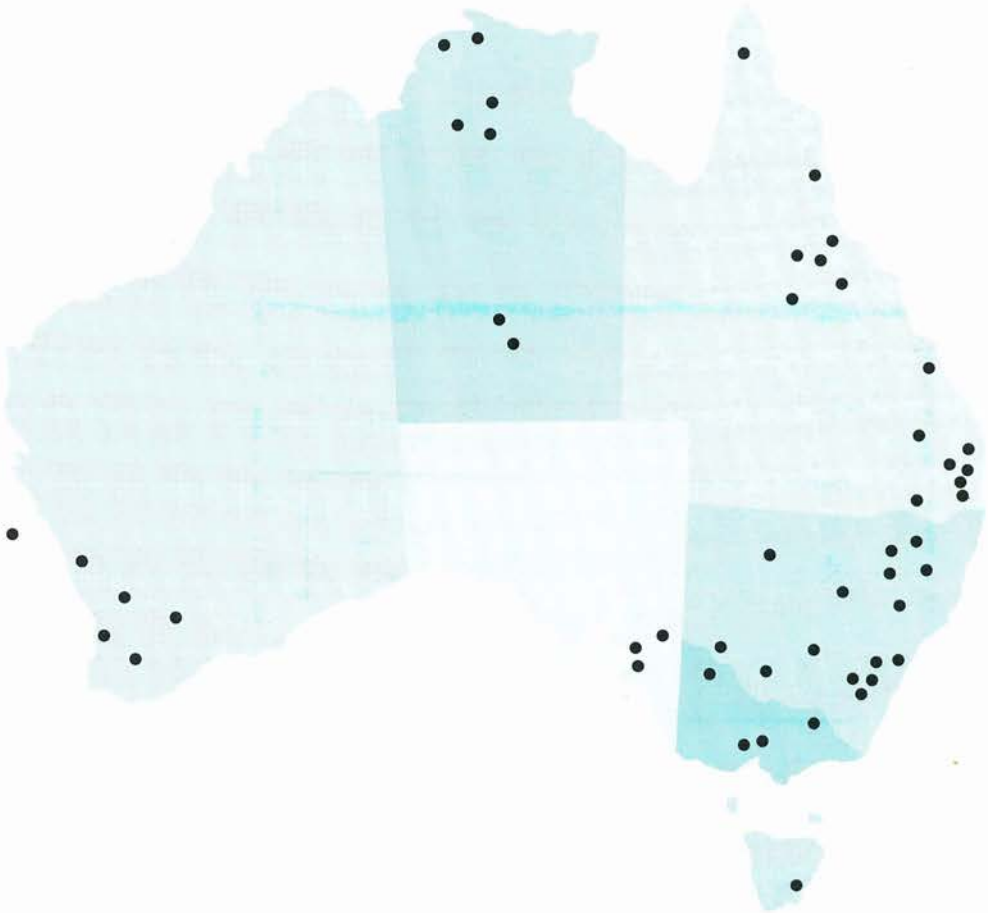
Index

Index

Index

Index

CSIRO Sites



GENERAL CONTACTS

CSIRO Head Office
PO Box 53
Parkville VIC 3052
Tel: (03) 662 7166

Corporate Services
PO Box 225
Dickson ACT 2602
Tel: (06) 276 6766

General:
South Australia
PO Box 4
Woodville SA 5011
Tel: (08) 268 0116

New South Wales
PO Box 218
Lindfield NSW 2070
Tel: (02) 413 7528

Northern Territory
Private Mail Bag No 44
Winnellie NT 0821
Tel: (089) 22 1711

Queensland
206 Carmody Road
St Lucia QLD 4067
Tel: (07) 377 0387

Victoria
PO Box 89
East Melbourne
VIC 3002
Tel: (03) 662 7111

Western Australia
Private Bag, PO
Wembley WA 6014
Tel: (09) 387 0710

ACT
PO Box 225
DICKSON ACT 2602
Tel: (06) 276 6266

Media
CSIRO Public Affairs
Tel: (06) 276 6479

International
CSIRO International
Affairs Group
Tel: (03) 662 7111

For enquiries on particular research, see contact numbers under Institutes and Divisions on pages 14–17.


CSIRO
AUSTRALIA