CSIRO Annual Report



CSIRO Annual Report

1990-1991



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The Honourable Ross Free, MP Minister for Science and Technology Minister Assisting the Prime Minister for Science Minister Assisting the Treasurer Parliament House CANBERRA ACT 2600

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

One of the year's main achievements has been the identification of priority areas of our research according to the contribution they make to the economic, environmental and social well-being of the nation. Research into the minerals industry and environmental aspects of economic development was selected for increased support in the first application of a more rigorous and systematic methodology to our resource allocation. The process, which has attracted considerable interest nationally, will be repeated regularly at all levels within the Organisation to keep it responsive to Australia's needs.

'Sustainable development' has become a watchword of the age. CSIRO has lent its voice by providing independent, scientific and useable advice on matters such as forestry, land degradation and water resources. Our participation in the working parties set up by the Federal Government to investigate ecologically sustainable development also shows our commitment to our new socially active role. We will continue to promote vigorously the view that science and technology are pervasive issues in all decisions about Australia's future.

Availle to an.

Neville Wran (Chairman of the Board)

John Stocker (Chief Executive)

November 1991

Chairman's foreword	3
Chief Executive's review	6
About CSIRO	
Charter, functions and powers	9
Statistics at a glance	10
Structure, management and staff	12
The Board Organisation short	13
Senior staff and addresses	16
Interests in companies	19
Mission, goals and objectives	20
Research	
Research highlights	22
Co-operative Research Centres	47
International relations	48
Awards	49
Technology transfer	51
Funding	54
Corporate development	
Planning	55
Distribution of research effort	58
Finance Internal audit	60
Legal services	60
Management information systems	61
Property	61
Human resources development	63
Communication	66
Statutory reporting requirements	70
Trust funds	71
Freedom of Information	72
Appendixes	73
Finance	77
Index	97

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The first year of the last decade of the century has been one of the most significant years in the history of CSIRO. We have achieved more secure funding, strengthened our relationship with industry, introduced procedures for allocating funds in accordance with agreed priorities and improved the remuneration of and career prospects for our staff.

1990–91 has seen CSIRO once again firmly established as a world-class research organisation, visibly responsive to the needs and expectations of government, industry and the community. It is acknowledged that CSIRO has an increasingly important role to play in addressing the challenges of Australia's future and that it is now better positioned than ever to identify and develop new export opportunities and increase productivity.

On behalf of the Board I would like to acknowledge the important role played by the former Minister for Science and Technology, the Hon. Simon Crean MP, in promoting the cause of science and CSIRO during the 15 months he was our Minister. The Board is pleased to welcome the new Minister for Science and Technology, Mr Ross Free MP. Mr Free's own background in science and his commitment to putting science more in touch with industry and the community should ensure a very productive partnership between the Minister, the Board and our Chief Executive, John Stocker.

I also wish to take this opportunity to acknowledge the valuable contribution to the Board's activities by Mr David Hoare, who



The Hon Neville Wran AC QC

completed his term as a Board Member during the year.

In the year 1990–91 one achievement stands out above all others — the identification of research priorities and the redirection of resources to support these priorities.

In 1987 the Board had set in motion a process to determine national research priorities. The process, then developed by the Chief Executive and Directors, took into account the potential return to the nation from different areas of research, and the likelihood of CSIRO achieving success in those areas. The first round of that process is now complete and significant levels of funds have been allocated to the priority areas. The next CSIRO Strategic Plan, soon to be released, will reflect these continuing reallocations.

Throughout 1990–91, CSIRO continued to increase its involvement in the development of government policy. In particular, the Organisation's contributions to the work of parliamentary committees and its interaction with government departments increased markedly. For example, CSIRO has taken a strong role in the Ecologically Sustainable Development Working Groups that are soon to recommend ways whereby Australians can care for the environment while promoting the economic growth essential for the future.

This year was the final year of the first period of triennium funding. The stable environment created by these new arrangements has enabled CSIRO to plan ahead with far greater certainty and to enter into major co-operative research programs with industry partners (such as BHP). We will be arguing strongly for a continuation of triennium funding beginning in 1991–92.

During 1990–91 CSIRO worked more profitably with industry. Cash expenditure on research from fund sources other than annual appropriation increased substantially from \$132 million in 1989–90 to \$156.8 million. This expenditure represents 27.4 per cent of our total outlays.

Sirotech Ltd, CSIRO's technology transfer company, underwent considerable changes. Members of the CSIRO Board now constitute the Sirotech Board and a new Chief Executive has been appointed who is, for the first time, a member of the CSIRO Executive Committee. As a result of these changes, interaction between Sirotech and CSIRO has improved considerably and the company is now better equipped to fulfil its mission to assist in the commercial development of CSIRO research results.

A significant milestone for Australian science was reached with the announcement in March of funding for the successful first-round Co-operative Research Centres (CRCs). CSIRO is a partner in all 15 proposals accepted for funding and it is now actively involved in around 50 second round proposals. The CRC Program has already done much to facilitate interaction between CSIRO, universities and the private sector and CSIRO looks forward to making a strong contribution through this new program to Australian industry and to scientific education and training.

1990–91 saw CSIRO playing a strong part in revitalising the image of science as a career and in fostering a more scientific culture in Australia.

A major award restructuring, determined by the Industrial Relations Commission, provided better rewards and career opportunities for all CSIRO staff, and it has set the benchmark for the scientific cause nationwide. The Board introduced an incentive for exceptional research achievement with a new annual Chairman's Medal with a monetary award of \$25,000.

CSIRO's Double Helix Club membership peaked at 17,000, up 40 per cent on the previous year. The Club has a high community profile and attracts support from State and Federal Governments and the private sector. As well, CSIRO's Science Education Centres are operating in every capital city except Canberra.

I am especially pleased to report the construction of child care centres on CSIRO's major sites in Melbourne, Sydney and Canberra. The capital costs of approximately \$1.5 million were provided by CSIRO; running costs are on a cost-recovery basis. No other government agency in Australia has provided so many work-based centres from its own resources.

This Report cites many achievements and developments during 1990–91. From new food packaging wraps to maintain freshness to new telecommunication systems; from new insights into global climate change to ways of keeping livestock healthy; from accurately measuring our coins to making air travel safer. These achievements and developments emphasise that it is the return on investment and the improvement to the lifestyle of Australians which really count when assessing the impact of CSIRO research.

The year ended with science higher on the national agenda than ever before; recognition that Australia needs science to survive and prosper; a CSIRO more responsive to the needs of industry and the community; and a general acknowledgement of CSIRO's important place in the structuring of the national economy.

Juille to

N.K. Wran AC QC



Mr Wran and Dr Ramakrishnan at the Division of Manufacturing Technology inspecting a prototype of an electronic plasma torch, an exciting prospect for destroying hazardous industrial waste.

CSIRO has had an active and productive year. We have also deliberately set out to ensure that people *hear* about these activities.

Last year I asked all CSIRO staff to represent and promote CSIRO and science in the public arena as part of what I called Project Ambassador. They have done this capably, proudly and successfully. Project Ambassador is not finished, it will never be finished, but it has proven its worth and I thank all the staff who have participated.

A major comparative advantage of our Organisation lies in our ability to assemble teams of experts from diverse disciplines to tackle a common problem. The success of major programs like the Land and Water Care Program has helped establish our reputation as a worthy partner in working with numerous industry groups. This in turn has helped us in the past year to forge a number of new alliances with a variety of business collaborators.

We have also contributed our expertise and experience to many issues on the national policy agenda. More and more the Australian science community must take charge of its own destiny instead of passively being buffeted by the politics of the day. We have made our presence felt through channels such as the Prime Minister's Science Council, the Co-ordination Committee on Science and Technology, the Public Accounts Committee, the Ecologically Sustainable Development Working Groups and the Parliamentary inquiry into Genetically Modified Organisms.

There are many reasons for our successes in research and its



Dr John Stocker

impacts. Within CSIRO it is individual scientists, individual CSIRO staff members who have had the most important influence.

CSIRO will remember 1990–91 as being the year we tackled the task of assessing Australia's national research priorities. Within this framework we then set research priorities for CSIRO to respond to the national priorities, and to form the basis for our Strategic Plan.

Three areas emerged as high national priorities in terms of attractiveness to Australia and the feasibility of conducting the research in a timely way minerals research, environmental research and research into the environmental aspects of development. All areas of CSIRO research were assessed according to their potential benefits, Australia's ability to capture these benefits, and the feasibility of the research. The first stage of the Research Priorities exercise is now complete, with nearly \$5 million to be redirected next financial year to high priority research within CSIRO. The money will be raised by a 1.5 per cent levy across the Organisation.

The money from the 1.5 per cent levy will go to high priority projects which I selected from nominations put forward by the Institute Directors. These projects are then presented to the CSIRO Board for approval.

However, this central redirection of funds is only part of the process. Institute and Divisional managers will now apply the priorities exercise to their own budgets, ensuring we are targeting our research toward areas which have the greatest potential returns for Australia.

The Research Priorities exercise has been a satisfying process. For the first time it allows us to plan in detail for Australia's scientific future. I hope other research institutions, and the Federal and State Governments, will find our methodology applicable to their own planning processes and will use a similar research classification system so that we can compare outcomes.

Performance Planning and Evaluation (PPE) is another new feature on the landscape for CSIRO staff. It is an outcome of the successful wage case CSIRO took to the Industrial Relations Commission last October and encourages career planning for all staff.

CSIRO management and unions made a united approach to the Industrial Relations Commission.



Dr Stocker demonstrated CSIRO's new biological defleecing technology at the Royal Easter Show, Sydney

We told the Commission we were worth more than we were getting, and the Commission agreed. Later, in an equally important decision, the Federal Government agreed the raises would not have to be met from CSIRO's existing funds but would be supplemented by an increase in our annual budget.

Healthy scientific salary increases — up to 19 per cent — sprang from the IRC decision, and the wage case was an important watershed in the recognition of research in Australia.

As part of PPE, all staff will now negotiate with their supervisors about what they should be doing and how their work should be judged. Across the organisation this will bring a 'reward for merit' philosophy, and it will help loosen the strictures of scientific career paths. During the 1990–91 financial year we recognised that it was essential to allocate substantial funds to maintain, refurbish and rebuild our crumbling infrastructure. A comprehensive plan was developed and we have been seeking support from the Government to implement it as rapidly as possible.

Work is urgently needed on projects such as redeveloping the 53-year-old Division of Biomolecular Engineering site at Parkville, replacing temporary buildings at the Division of Mineral and Process Engineering in Clayton and the Division of Atmospheric Research in Aspendale, and replacing obsolete facilities at the Division of Tropical Crops and Pastures site in St Lucia, Brisbane. We also need to accelerate the development of the North Ryde site in Sydney.

In its industry statement in March the Government extended the tax deductibility of research and development. This decision aids research planning and investment by the private sector and is a welcome move for CSIRO and the science community. Extension of the system of triennium funding for CSIRO and other research agencies similarly would provide much-needed stability for our own research planning.

Unfortunately CSIRO continues to face the demand to shave 1.25 per cent off our budget across the board under the pretence it will improve our efficiency. We have still not managed to convince the Government that for CSIRO's research work the so-called 'efficiency dividend' is a contradiction in terms. Most importantly the past financial year has again seen CSIRO list important achievements in many areas. In laboratories from Perth to Darwin our scientists have applied themselves with ingenuity and common sense to the great problems which confront our country.

In my first full year as Chief Executive I have now visited nearly all CSIRO sites — quite a task given the size, spread and diversity of the Organisation. I have seen how our scientists work in widely differing fields across Australia.

As well as performing excellent science, CSIRO's people are explaining why our great Organisation is a truly 'sustainable development' which must continue to achieve to ensure Australia's competitiveness. We must continue to promote our important message — that Australian science is Australia's future.

qm.

J.W. Stocker

Charter, functions and powers

CSIRO is an independent statutory authority operating under the provisions of the Science and Industry Research Act 1949. From 1 July 1990 to 4 June 1991 the Minister responsible for CSIRO was Mr Simon Crean (Minister for Science and Technology, and Minister Assisting the Prime Minister for Science, and Minister Assisting the Treasurer). From 4 June 1991 to 30 June 1991 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).

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.

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.





Structure, management and staff

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

The Chief Executive, the six Institute Directors, the Chief Executive of SIROTECH Ltd 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.

A Corporate Centre provides central services 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 1991 CSIRO had a total staff of 7,278. The numbers employed in different job categories are shown in the chart on p.11.

The Board



Formerly Premier of New South Wales (1976-1986) 5 Dec 86—4 Dec 91

Chairman

AC QC

Chairman

The Hon.Neville Wran

Turnbull & Partners

Mr Laurie Carmichael Assistant Secretary of the Australian Council of Trade Unions 13 Mar 89—12 Mar 93



Sir Roderick Carnegie BSc MA(Oxon) MBA

FTS Company Director 5 Dec 86—4 Dec 91



Dr John Stocker

PhD FRACP FTS

Chief Executive of

5 Mar 90-4 Mar 95

MB BS

CSIBO



Professor Adrienne Clarke AO BSc PhD FAA FTS Director, Plant Cell Biology Research Centre, University of Melbourne 5 Dec 89—4 Dec 91 (reappointment)



Dr Kevin Foley MCom PhD Managing Director, Kevin Foley and Associates Pty Ltd and founding member, Commission for the Future 5 Dec 89—4 Dec 91 (reappointment)

Dr Tony Gregson PhD DSc FRACI Primary producer, formerly Associate Professor of Chemistry at the University of New England 5 Dec 90-4 Dec 92 (reappointment)



BEC AASA ASIA Chairman, Bankers Trust Australia Ltd and AUSSAT Pty Ltd 5 Dec 86 —4 Dec 90

Mr David Hoare



Mr Ralph Ward-Ambler BMechE Company Director 8 Feb 89—7 Feb 93



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 86—4 Dec 91





Organisation Chart As at 30 June 1991





Senior staff and addresses (as at 30 June 1991)

Corporate Centre

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

Chief Executive Dr J.W. Stocker

Director, Corporate Services Mr P.H. Langhorne

Board and Executive Committee Secretary Dr E.N. Cain

Principal Secretary Dr T.E. Heyde

Corporate Planner Dr D. MacRae

Manager, Public Affairs Mr L.R. Bevege

SIROTECH Ltd

Chief Executive: Dr D.C. Gibson 580 Church St RICHMOND, VIC 3121 Tel: (03) 428 0466

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 Cnr North and Daley Roads ANU Campus Acton ACT 2601 Tel: (06) 275 0901

Mathematics and Statistics

Chief: Dr R. L. Sandland 105 Delhi Road NORTH RYDE NSW 2113 Tel: (02) 887 8103

Radiophysics

Chief: Dr D.N. Cooper Cnr Vimiera and Pembroke Roads MARSFIELD NSW 2121 Tel: (02) 868 0210

The Australia Telescope — National Facility

Director: Dr R.D. Ekers Cnr Vimiera and Pembroke Roads MARSFIELD NSW 2121 Tel: (02) 868 0222

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 0800

Institute of Industrial Technologies

Director: Dr C.M. Adam Normanby Road CLAYTON VIC 3168 Tel: (03) 542 2898

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) 487 9211

Materials Science and Technology

Chief: Dr M.J. Murray Normanby Road, CLAYTON VIC 3168 Tel: (03) 542 2777

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 (acting) Graham Road HIGHETT VIC 3190 Tel: (03) 556 2211

Exploration Geoscience

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

Coal and Energy Technology

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

Geomechanics

Chief: Dr B.E. Hobbs Kinnoull Grove, SYNDAL VIC 3149 Tel: (03) 881 1285

Mineral and Process Engineering

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

Mineral Products

Chief: Dr T. Biegler Floreat Park Laboratories Underwood Avenue FLOREAT PARK WA 6014 Tel: (09) 387 0711

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. Rickard Cnr Flemington Road and Park Drive PARKVILLE VIC 3052 Tel: (03) 342 9700

Animal Production

Chief: Dr O. Mayo Quarry Road PROSPECT NSW 2149 Tel: (02) 688 0833

Food Processing

Chief: Dr D.J. Walker 39-51 Delhi Road NORTH RYDE NSW 2113 Tel: (02) 887 8333

Human Nutrition

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

Tropical Animal Production

Chief: Dr D.F. Mahoney 120 Meiers Road INDOOROOPILLY QLD 4068 Tel: (07) 377 0711

Around CSIRO

Wool Technology

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

Institute of Plant Production and Processing

Director: Dr E.F. Henzell Limestone Avenue CAMPBELL ACT 2601 Tel: (06) 276 6613

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: Mr A.G. Brown Banks Street YARRALUMLA ACT 2600 Tel: (06) 281 8314

Horticulture

Chief: Dr J.V. Possingham Hartley Grove URRBRAE SA 5001 Tel: (08) 274 9244

Plant Industry

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

Soils

Chief: Dr D.E. Smiles Clunies Ross Street BLACK MOUNTAIN ACT 2601 Tel: (06) 246 5937

Tropical Crops and Pastures

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

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.B. Tucker Station Street ASPENDALE VIC 3195 Tel: (03) 586 7666

Fisheries

Chief: Dr P. Young Castray Esplanade HOBART TAS 7000 Tel: (002) 20 6222

Oceanography

Chief: Dr A.D. McEwan Castray Esplanade HOBART TAS 7000 Tel: (002) 20 6222

Water Resources

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

Wildlife and Ecology

Chief: Dr B.H. Walker Barton Highway GUNGAHLIN NSW 2912 Tel: (06) 242 1742

Centre for Environmental Mechanics

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

Interests in companies

The companies in which CSIRO had an interest as at 30 June 1991 are as follows:

Name of Company	CSIRO's interest	Principal activity
SIROTECH Ltd	Limited by guarantee and controlled by CSIRO	Technology transfer
Bio-Coal Briquette Company Ltd	17.2%	Smokeless briquettes
Dunlena Pty Ltd	45·2%	From discovery to commercialisation of agricultural chemicals
Gene Shears Pty Ltd	34.7%	Modifying the effects of unwanted genes
Gropep Pty Ltd	50%	R&D of growth factors and related peptides
Preston Group Ltd	20.7%	Simulation and scheduling systems for aviation and ground transportation

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

- Queensland Metals Corp. N.L.: magnesite processing
- Mineral Control Instrumentation Ltd: the Universal Smog Monitor
- Austek Microsystems Pty Ltd and Incor Ltd: shares in these companies have been written down during the year to \$10 each

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. Our goal is to give Australians a better future.

Corporate goals

- 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.
- To enhance the efficiency, international competitiveness and growth of Australia's
 - information and communications industries
 - manufacturing industries
 - minerals and energy industries
 - rural production and processing industries
 construction industries
- To provide the scientific
- knowledge required for the effective management and conservation of Australia's natural resources and environment.
- To improve human well-being and community health in Australia.
- To provide support to facilitate the conduct of efficient and effective research by the Organisation.

Research objectives

Plant production and primary products (field crops, horticultural crops, forestry, primary products from plants) Improve the international competitiveness and sustainability of rural production systems.

Animal production and primary products (livestock, fishing, primary products from animals) Improve the international competitiveness and sustainability of rural production systems.

Rural-based manufacturing (processed food products and beverages, fibre processing and textiles, wood products and furniture, other (processed skins, leather and leather products)) Improve the competitive position of Australian rural-based manufacturing industries, and add value to plant and animal primary products used as inputs.

Minerals industry

(exploration, mining and extraction, processed minerals, basic metal products)

Enhance the international competitiveness of Australia's minerals industry through the improvement of existing key technologies and the development of new, value-adding industries based on innovative technologies that will underpin industry competitiveness, productivity and safety over the next decade. Develop technologies which are environmentally acceptable and sustainable. *Energy resources and supply* (exploration, mining and extraction, preparation and supply, energy transformation, energy distribution, conservation and efficiency) Increase the efficiency, production and safety of Australia's coal, oil and gas exploration and extraction industries to improve international competitiveness through the identification and development of key technologies and practices in both the production and transformation sectors.

Manufacturing industries

(ceramics, glass and other industrial mineral products, fabricated metal products, transport equipment, chemical petroleum and coal products, machinery and equipment, instrumentation, measurement standards and calibration services, other industrial production) Provide leading edge strategic support to Australian industry, notably those companies able to exploit technological opportunities and to access international markets.

Information and communications industries

(computer hardware and electronic equipment, communications equipment, computer software and services, communication services, and other information services) Add value to Australia's production of goods and services and increase the international competitiveness of Australian industry through innovative use of information technology and telecommunications; contribute to reducing the trade deficit of the information and communications industries. *Economic development environmental aspects* (rural production, minerals, energy resources and supply, manufacturing, construction, transport, commercial services, economy) Achieve sustainable development in production systems and develop technologies to minimise environmental damage from economic development.

Environment

(climate, natural ecosystems, oceans, land use, atmosphere, water resources, environmental impact and protection, other environment) Develop ecologically sound management principles and practices for the use and conservation of Australia's natural resources.

Infrastructure and services (transport industry, construction industry, commercial services, health, defence, and social development and community services) Enhance productivity and effectiveness in provision of infrastructure and services with particular emphasis on public health and construction.

Advancement of knowledge In undertaking research to advance knowledge, CSIRO will provide a standard for research and teaching, and seek to maintain the currency of the Organisation's intellectual capital base.

Research Highlights

As part of this year's exercise for assessing CSIRO's research priorities (described on pages 55-57), a new system to classify the purpose of the research was adopted. Planning and reporting of CSIRO research now follow this system.

The new system is a modified version of the 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 itself. The result is a set of 16 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; Animal production and primary products.

Minerals and energy

Minerals industry; Energy resource industry; Energy supply industry.

Manufacturing

Rural-based manufacturing; Manufacturing industries.

Information and communications

Information and communications.

Environment

Environment; Economic development — environmental aspects.

Infrastructure, services and advancement of knowledge

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

The selection of achievements and activities described in this section demonstrates how CSIRO is achieving its corporate goals and research objectives. A complete report of the year's activities in all 1,000–plus projects would quadruple the size of this Report. However, a list of the 190 Program titles is contained in Appendix 1 of this Report.

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 both electronically (on the AUSTRALIS database) and as a book (obtainable from the CSIRO Bookshop, 314 Albert Street, East Melbourne, Vic. 3002).

Contents

Rural industries	
Achievements	
New edible oil	25
Biocontrol agents	25
Disease-free grapevines	25
Control of root diseases	26
Detecting bluetongue virus in sheep	26
Improving reproductive performance	
in Northern cattle	27
Developments	
Commercialisation of AUSPIG	28
New laboratory for fly vaccine	
research	28
Software for assessing worm	
resistance	28
Trees for Rural Australia	28
Environmental Prize	28
Minerals and energy industries	
Achievements	
Major savings for North West	
Shelf project	29
Diamond exploration	29
Mine safety with NUMBAT	30
Modelling of underground coal seams	31
Natural gas conversion	31
Developments	
WA Remote Sensing Centre	32
WA Rock Mechanics Research	
Centre	32
Centre for Advanced Technologies,	
Brisbane	32
Isasmelt/Sirosmelt technology	32
Manufacturing industries	
Achievements	
Measuring money	33
New vision processor	33
Narrow gap welding	34
Gear geometry	34
Low temperature dyeing of wool	35
Packaging for export	35
Commercial fats that lower cholesterol	36

Developments Real-time colour imaging 37 commercialised New method for making rayon 37 37 Casting technology Kodak fine chemicals 37 International markets for UMIS 37 Bovine tuberculosis test 37 Commercialisation of IBDV vaccine 38 Low cholesterol eggs 38 Information and communications industries Achievements 39 Mobile telecommunications systems **Developments** Centre for Spatial Information Systems 39 GIRD grant for parallel image 39 processing and display Environment Achievements The impact of climate change 40 Sydney air quality study 40 Mediation in forest disputes 41 Environmental decision support system 41 Use of germs to clean water 42 Disposing of saline groundwaters 42 **Developments** GASLAB 43 Rangelands laboratory opened 43 Tropical Remote Sensing Unit 43 Imaging spectrometer project 44 Pulp mill research contracts 44 New satellite station for Hobart 44 Infrastructure, services and advancement of knowledge **Achievements** BCAider 45 Demonstration of volcanic ash detector 45 The Australia Telescope National Facility 46

Rural industries

Achievements New edible oil

Researchers at the Division of Plant Industry have produced a new type of linseed plant called Linola. The improved variety transforms linseed oil from an unglamorous industrial product with limited prospects to a top grade poly-unsaturated edible oil with worldwide market potential.

Linola will also provide a new crop for farmers as an alternative to wheat and other cereals.

After extensive testing in collaboration with all State Departments of Agriculture, CSIRO has selected two varieties of Linola for release in Australia in 1992 under the Plant Variety Rights Scheme. Negotiations on marketing are under way with Australian seed companies.

Recent tests by margarine manufacturers indicate that Linola equals sunflower oil in quality. CSIRO is collaborating with Australian vegetable oil processors to enable the rapid introduction of Linola oil into a range of products that should start appearing on supermarket shelves early in 1993.

Biocontrol agents

The Division of Entomology is using a fungus and a beetle in two projects to help rid Australia of pests by biological control. Biological methods of weed and pest control are fast becoming preferred to chemical or other methods because they are more environmentally friendly and economical. In January 1991, the Division launched a major assault on the noxious weed, common heliotrope. This weed grows in all States except Tasmania and costs Australia over \$46 million a year by reducing crop yields and causing severe liver damage to sheep and cattle grazing on it.

Researchers released a rust fungus near Jugiong, New South Wales, and near Albany, Western Australia. The fungus spores attack the heliotrope in spring, killing many seedlings, and infest leaves and stems of larger plants later in the season, causing dieback, reduced seed production and death of plants. At present the germination and spread of the fungus looks promising.

In a joint project with the Northern Territory Department of Primary Industry and Fisheries, the Division is using biological control to tackle the weed Sida acuta, which has infested large areas of pasture in the Territory.

The Mexican beetle, *Caligrapha pantherina*, has been imported and released in stands of the weed. It eats the leaves of the shrub, which then withers and dies. Tests have confirmed that the beetle is reducing seed production in Sida stands by as much as 94 per cent.

In all CSIRO biocontrol projects, no imported plant, fungus or insect is released in Australia until a long series of tests has been completed to confirm that they will not get out of control and will only attack the desired target.

Disease-free grapevines

The Division of Horticulture has developed highly sensitive molecular biology techniques to detect viral disease agents in grapevines. These techniques, combined with tissue culture procedures, are being used to eliminate diseases from nursery stock.

Grapevine diseases cost the Australian and world viticulture industries millions of dollars a year by lowering yield and fruit quality. Conventional methods of disease testing and elimination are time consuming and expensive, whereas the new CSIRO techniques are fast, cheap and accurate. They also identify some of the agents causing diseases, something not possible before.

Disease-free grapevines arising from the CSIRO research are now being marketed under the trademark VITECH by the licensed agent Phytotech Australia Pty Ltd, a South Australian company.

Control of root diseases

The Division of Soils is developing biological and chemical control methods for root diseases in crops and nursery seedlings. The diseases cost Australia many millions of dollars in lost production.

The Take-all fungus can reduce cereal yields by over 50 per cent by growing on roots, blocking them and making them less effective. During 1990, CSIRO started testing a genetically engineered biocontrol bacterium that prevents infection of the roots, possibly by producing antibiotics that stop fungal growth.

Tests are taking place in a small enclosed area at Roseworthy Agricultural College in South Australia and will last until mid 1992. The scientists are using a new 'tracking' technique, developed in the USA by Monsanto Company, to monitor the biocontrol agent for its distribution and survival on the roots of field-grown wheat.

In work supported by Incitec Ltd Australia, scientists in the Division have isolated soil bacteria and fungi that are potential control agents for 'damping off infections of nursery bedding plants. Damping off is caused by one of four microscopic fungi and results in seedlings either failing to emerge or collapsing at soil level. Biological control of damping-off is expected to provide significant cost, labour and environmental advantages over current chemical control methods.

The third achievement this year has been the demonstration that phosphorous acid may have potential in controlling root disease in regenerating medic pastures in South Australia. This finding is now being followed up by various laboratory and field tests.

Detecting bluetongue virus in sheep

The suspension of live sheep exports to Saudi Arabia in August 1989 highlighted the impact that bluetongue could have on the Australian sheep industry. There have been no cases of bluetongue disease in our national flock, but eight types of bluetongue virus have been found in Australia. At least one of these is capable of killing sheep. In some Mediterranean countries, the death rate from bluetongue has been as high as 70 per cent.

Rapid detection would be essential for the control of a bluetongue outbreak in Australia.

26



The biting midge *Culicoides brevitarsis* is most widely implicated in the transmission of bluetongue virus in Australia.

However, until recently it took between two and three weeks to detect and confirm the presence of bluetongue virus in blood from infected animals.

Scientists from the Division of Animal Health's Australian Animal Health Laboratory (AAHL) have now developed tests that can detect the virus in samples within 24 hours. The tests can also distinguish between the different types of bluetongue virus.

A requirement of international trade in both sheep and cattle is that approved tests are carried out to ensure the animals are free of bluetongue antibodies. Current test procedures can give false results that lead to an unwarranted disruption of trade. The AAHL scientists have developed a new test that uses a monoclonal antibody to the virus and a bluetongue virus protein made in yeast. Other countries have developed similar tests but they use live viruses; the CSIRO test eliminates the need for such infectious material.

The CSIRO test method is currently being evaluated at laboratories in the UK, Canada and the US for incorporation into the repertoire of international tests for bluetongue.

Improving reproductive performance in Northern cattle Researchers from CSIRO's Division of Tropical Animal Production, the Queensland Department of Primary Industries and James Cook University have confirmed that the calving rate in cattle can be increased greatly by improving the nutrition of the breeding cow. This joint research is part of the Northern Australia Program of the Meat Research Corporation.

Poor reproduction is a major contributor to the less than optimal performance of the cattle industry in northern Australia. The problem arises because the Brahman cow, the mainstay of the northern cattle industry, is an excellent mother. When she gets additional feed, the benefits flow as extra milk to the calf rather than being used to build up the cow and prepare her for renewed breeding.

The collaborative CSIRO research has attacked this problem in two ways: by removing the calf altogether and thus stopping milk production, or by reducing the calf's demand for milk by giving it some of its feed as concentrates. The results show that both systems improve calf production, but early weaning is preferred. Reproduction may not improve if the cow weighs too little when the calf is weaned, but supplementary feeding can help overcome this.

Developments

Commercialisation of AUSPIG

AUSPIG is a software system developed by the Division of Animal Production to aid decision-making in the pig industry. It is being commercialised internationally in collaboration with the BP Nutrition group, which is using it in its internal operations in the USA, Holland, Belgium, France, Spain and the UK. The system was launched commercially in Australia in June 1990, has won a pig industry award for innovation, and is being used by educational institutions, government instrumentalities, industry consultants and commercial piggeries.

New laboratory for fly vaccine research

The Les Bett Research Laboratory, which houses the fly vaccine research of the Division of Tropical Animal Production, was officially opened in Brisbane on 13 March 1991. Mr Bett, a retired grazier, who died in August 1990, made a major financial contribution towards the Division's research on blowfly vaccines and his will provides funds to allow the research to continue.

Software for assessing worm resistance

The Division of Animal Health has released a computer software package that provides a simple, standardised way of assessing the level of resistance present in worms to various chemical treatments designed to kill them. The package was sponsored by Syntex Animal Health.

'Trees for Rural Australia'

TV personality Mr Neil Inall launched the book 'Trees for Rural Australia' in Canberra on 27 November 1990. A vital link in the campaign to re-establish trees in the Australian landscape, the book provides essential advice on what to plant and where. It was written by authors from CSIRO and other organisations and is published by Inkata Press.

Environmental Prize

In 1990 the Division of Entomology won the Eureka-Pol Prize for Environmental Research. This was for its successful work on biological control of weeds such as heliotrope, skeleton weed, Paterson's Curse and water hyacinth.

Minerals and energy industries

Achievements

Major savings for North West Shelf project

Collaboration between the Division of Mineral Products and Woodside Offshore Petroleum Ltd has had a major impact on the design of the new \$1.6 million Goodwyn A gas platform for Australia's North West Shelf.

The improvements are the result of research into a corrosion problem encountered with the North Rankin A platform. The well head there delivers a mixture of natural gas and light crude oil. The oil, called condensate, contains some water. The company must remove most of this water before the condensate is pumped ashore because it causes serious corrosion once it reaches the main pipeline. Maintenance on the 130-kilometre long pipeline is limited by its inaccessibility, and replacement costs many millions of dollars.

Water is usually removed from condensate by equipment called a coalescer. On the North Rankin A platform the coalescers were not performing to specification. This had serious implications for the design of the new Goodwyn A platform, where condensate throughput would be greater.

CSIRO researchers found that the corrosion inhibitors being added to the condensate were causing the deterioration in performance. They suggested a different type of inhibitor along with a new design for the coalescer, which saves 65 tonnes in weight, \$0.5 million in

capital costs and \$75,000 a year in operating costs. However, the major savings come from a lowered risk of corrosion in the pipeline and increased production capacity.

Diamond exploration

Diamond explorers can now assess prospective areas and exploration targets rapidly and cheaply with a simple technique developed by the Division of Exploration Geoscience.

The method involves the analysis of trace nickel in garnets separated either from rocks that may contain diamond or from stream sediment and soil samples collected during exploration programs. It distinguishes between prospective and barren areas and also gives a semi-quantitative estimate of potential diamond grade.

The nickel content of garnet gives a reliable estimate of the temperature at the time it was picked up by the volcanic magma. This nickel thermometer can then provide an estimate of the depth of origin of each grain, a vital factor in the formation of diamonds.

Application of the nickel thermometer requires analysis of only a small number of garnets rather than a statistically large sample. The potential savings from avoiding bulk testing of clearly barren prospects are very large, especially when compared with the cost of the analyses. At present, the Division's Heavy Ion Analytical Facility proton microprobe is the only instrument capable of producing trace element data with the necessary accuracy.

The development of this technique was supported by several companies who, together with other diamond explorers in Australia and overseas, are now using the nickel thermometer in their exploration programs.

Mine safety with NUMBAT

A remotely controlled vehicle has been developed by CSIRO for use in underground coal mine emergencies such as fires or explosions.

NUMBAT operates in conjunction with rescue teams as they enter a mine after an emergency. It moves under remote control through the mine towards the emergency site. Once there, video or infra-red images of the area, as well as data on the atmospheric conditions, are transmitted to a surface control station. Rescue planners at the surface then relay this information to the underground rescuers entering the mine up to two kilometres behind NUMBAT.

Such information has never been available before. It can speed up

the rescue process and decrease the danger to rescue teams by preventing their exposure to unknown, potentially hazardous conditions. Faster and more appropriate rescue operations also mean that the mine can be rehabilitated more quickly once the rescue has finished.

NUMBAT has potential applications in other hazardous environments, such as nuclear facilities or industries dealing with toxic materials. CSIRO is currently negotiating with Australian manufacturers about the production of a commercial version for worldwide sales.

The project was initiated and managed by the Division of Geomechanics. It has been a major cross-Institute and industry project, with subsystems being produced by the Divisions of Radiophysics and Coal and Energy Technology, together with Evans Deakin Industrial and Kel Aerospace.



The nickel thermometer: a new tool for diamond exploration.

Modelling of underground coal seams

CSIRO is helping to evaluate whether a new geophysical technique may be of use in defining the structure of coal seams.

The technique, called the Radio Imaging Method or RIM, uses medium frequency electromagnetic radiation to provide images of geological structures. It can provide important information for resource assessment in the late stages of exploration and for mine planning during operations.

The initial system was developed for the coal industry by Stolar Inc, a US company. Further development is now being funded in Australia by the National Energy Research, Development and Demonstration Program.

The research partners are the CSIRO Division of Radiophysics (imaging), Stolar Inc (antennas and associated electronics), the Australian Coal Industry Research Laboratories Ltd (project management and trial logistics) and the Centre for Geophysical Exploration Research at Macquarie University (numerical modelling).

A primary goal of the project has been to enable the relevant experts to formulate hypotheses and use these to produce computer models. Advanced methods of displaying and manipulating images have been developed and tested successfully to provide a sophisticated, user-friendly system.

The next phase of the project will be to apply RIM techniques in areas of mineral exploration other than coal. This work has started in conjunction with METS, an Australian company offering RIM as a commercial service.

Natural gas conversion

Natural gas may become a viable alternative to oil as a transport fuel if current CSIRO research is successful.

Australia has very large reserves of natural gas but these are usually a long distance from urban and industrial areas where the gas is required. If the gas could be converted to liquid at source, it would become cheaper and safer to transport and hence more viable as an alternative to fuels made from petroleum.

The commercial plants that convert natural gas to liquid fuels all use indirect methods, which are expensive. The CSIRO Division of Coal and Energy Technology is investigating some cheaper, direct conversion methods.

One of these is oxidative coupling, in which natural gas and oxygen are passed over complex metal oxide catalysts to produce ethane and ethylene, which can be converted into the required transport fuels. The Division has been working with The Broken Hill Proprietary Company Limited to improve the catalysts and develop better process systems to improve the conversion rates.

New research has started into another conversion route known as direct partial oxidation, which converts natural gas directly to methanol. This method could be cheaper than oxidative coupling.

Developments

WA Remote Sensing Centre

The Western Australian Government has agreed to a planning and design study for the Western Australian Remote Sensing Industry Development and Education Centre. The Centre will boost Australia's capability to develop new remote sensing technology for a world market worth about \$2 billion. This development flows from a Memorandum of Understanding signed by the CSIRO Chairman and the Premier of Western Australia in 1988. Construction work for the Centre will begin in October 1991 with completion estimated for late 1992.

WA Rock Mechanics Research Centre

A Rock Mechanics Centre was officially opened on the campus of the University of Western Australia in August 1990. The new Centre, part of the Division of Geomechanics, will conduct research into mine design and mining systems, mine stability and environmental geomechanics for near-surface mineral deposits.

Centre for Advanced Technologies, Brisbane

Construction has begun at the new CSIRO Centre for Advanced Technologies in Brisbane. The Centre will provide a focus for CSIRO minerals and energy research in Queensland. It results from an agreement between CSIRO and the Queensland Government that provides for the development by the State Government of the \$16.5 million Centre on CSIRO land at Pinjarra Hills; relocation of the headquarters of the Division of Geomechanics from Syndal (Victoria) to the Brisbane site; and development of an advanced computer facility in the Centre.

Isasmelt/Sirosmelt technology

Mount Isa Mines is close to commissioning a \$65 million lead smelter based on its ISASMELT version of the CSIRO Sirosmelt technology (described in 1989-90 Annual Report). The company also has plans to install a \$100 million copper smelter. Another Sirosmelt licensee, AUSMELT, has announced a tin smelter in Holland, three zinc fumer/slag cleaning furnaces in Korea and a nickel/platinum group metals smelting plant in Zimbabwe.

Manufacturing industries



The Optical Surface Profiler creates high-resolution relief maps of surfaces of dies and other tools used to manufacture coins.

Achievements Measuring money

The Australian Mint now has one of the world's most advanced coin production methods, thanks to an instrument it developed jointly with CSIRO to help improve quality control.

The Division of Applied Physics developed the Optical Surface Profiler (OSP), an instrument that produces high-resolution relief maps of the surface of dies and other tooling. The Mint is using the instrument to assess the quality and design of master tooling, to see how faithfully coin designs are transferred from the die to the coin blank and to assess deformation and wear in coining dies.

The OSP can measure all the dimensions of a coin mould in about 15 minutes, a process that

takes traditional surface measuring equipment many hours.

The OSP uses structured light to create a picture of the surface of coins and dies. Special software analyses the data to produce quantitative reports and contour relief maps that can detect any departure from the die specifications.

Several overseas Mints are showing interest in buying an OSP, which sells for about \$250,000. The instrument could also be used in other areas of industry, for example in the measurement of parts for cars and aeroplanes.

New vision processor

CSIRO expects to release a new high speed vision processor in late 1991 as a result of joint work with Atlantek Microsystems of Adelaide.

The new system will be faster, cheaper, more versatile and give a higher resolution than CSIRO's current commercial high speed processor, the APA512. This was produced in prototype form by the Division of Manufacturing Technology and engineered for production in 1987 by Vision Systems Limited. It can track several hundred objects in a video picture and determine the nature, location and orientation of each one of them.

Many leading US government and industrial laboratories have bought the APA512. It is used at Cape Canaveral, where it monitors relative movement between a space shuttle and the launch tower for robot manipulation of umbilical cables before lift off.

The new system, APA-2, has been completely redesigned. The Division of Manufacturing
Technology has carried out the development and simulation of new processing algorithms with Atlantek, who is also doing the detailed circuit design. The improved processor will have potential for use in many high-speed inspection or tracking tasks in industrial and other applications.

Narrow gap welding

The Division of Manufacturing Technology is working on several projects that focus on product and process developments in welding technology.

Its researchers have made significant progress in developing a novel, multi-process narrow-gap welding system. This is part of a project on high productivity welding, supported by the Grants for Industry Research and Development (GIRD) scheme.

Narrow-gap welding is a technique for joining heavy sections of metal. It has advantages over more traditional methods because it uses a minimum volume of welding consumables; joints may be completed more quickly; there is lower distortion of the structural elements; there is less dilution of the weld metal; and the finished joint has improved mechanical properties.

Though narrow-gap welding technology is well established in several overseas countries, it is used very little in Australia because the equipment needed is so expensive. CSIRO's development uses different concepts from those typical of overseas equipment and is therefore potentially much less expensive.

CSIRO is now trialling the system for commercial use. An early

prototype is being used in the production of heavy wall valve bodies by John Valves Pty Ltd of Ballarat, Victoria. Interest is also being shown in its use for making components used in the mining and mineral processing industries.

Gear geometry

Machinery for the Australian mining and agricultural industries uses some very expensive and large gears, sometimes up to eight metres in diameter.

The performance and life of these gears depends critically on their geometry. Accurate measurements of geometry are now possible with



Portable instruments can measure geometry of gears to improve their performance.

a set of portable instruments developed by the Division of Applied Physics, in collaboration with industry.

An axial pitch instrument measures the left and right alignment errors of a gear without needing the careful adjustments required by previous instruments.

A flank tracing instrument measures the profile errors of a complete tooth flank. Profile errors can cause vibration and high tooth stress and prevent proper lubrication of a gear drive. The instrument is accompanied by software that handles data analysis, database management, instrument error compensation and instrument control. Results can be represented graphically and measurements made under computer control with a minimum of operator intervention.

There are at least five major manufacturers of large gears in Australia, supplying operations such as mines and sugar mills. The CSIRO instruments will help them to be confident of the performance of the new gears they produce, and their customers will be better able to identify causes of poor performance.

Low temperature dyeing of wool

Damage caused to wool during dyeing can now be minimised by a new CSIRO treatment developed from research into the structure of wool fibre.

Wool is usually dyed in a bath containing boiling water and dye. The boiling water fixes the dye onto the wool but can also damage the wool fibre. Lower temperature dyeing methods cause less fibre damage but have not been commercially successful because they require very careful choice of dyestuffs and much longer dyeing times.

Scientists at the Division of Wool Technology approached this problem by studying the pathways through which dyes enter wool fibres. What they found has fundamentally changed our understanding about how dyes penetrate wool.

This knowledge helped the team identify a chemical that allows wool to be dyed at 85–90°C. This chemical modifies the structure of the wool fibre and improves the uniformity of dye uptake, the dyeing rate and degree of penetration.

The dyed product suffers less yellowing (which means that pastel shades can be created without pre-bleaching), the yarn has a higher strength and the woven fabric a greater resistance to abrasion.

ICI Australia Ltd is the licensee of this new technology and a product called 'Sirolan LTA' should be available by the end of 1991.

Packaging for export

Delivering fresh Australian food and plants to overseas markets can involve a lot of time and money. Many products suffer loss of quality during storage and transport for a variety of reasons.

New packaging materials and techniques developed by CSIRO can now reduce these problems, extending the shelf life of products. Exporters can increase the range of their products, establish completely new markets and in many cases replace air transport by sea transport. The Divisions of Food Processing, Horticulture and Materials Science and Technology have developed a variety of new plastic packaging film concepts, including:

- controlled respiration film, which permits produce to respire at a slow rate to prolong lifetimes and quality by modifying the oxygen and carbon dioxide levels in the package;
- oxygen-removing film, which scavenges oxygen and can also be made to release carbon dioxide to prevent rancidity and colour change, particularly in oily and fatty foods;
- water-controlling film, which regulates the humidity caused by temperature fluctuations that result in condensation in the package and on the food;
- ethylene-removing film, which absorbs the plant gas ethylene (which promotes ageing in flowers, fruit and vegetables) and thus extends the life of the produce;
- sulphur dioxide-producing film, which provides controlled amounts of the gas sulphur dioxide to prevent microbial spoilage, especially in dried fruits, grapes and wine casks;
- special purpose films: a variety of films can now be made to detect, improve, remove or add special materials (such as fungicide) to benefit the long-term storage of a particular product.

Collaboration with commercial partners is under way to develop some of these packaging films.

A premium export market exists for supplies of good quality chilled meat. However, it is especially difficult to give some forms of chilled lamb products a long shelf life.

It has long been known that carbon dioxide inhibits microbial growth. Now scientists in the Division of Food Processing have developed a packaging technique that capitalises on these inhibiting properties. Chilled lamb is stored in sealed positive-pressure bags whose air is completely evacuated and replaced with carbon dioxide gas that has a maximum oxygen level of 0.15 per cent.

This packaging inhibits the growth of micro-organisms and extends the storage life of chilled lamb carcases to twelve weeks. This provides enough time for sea transportation, repackaging and sale to consumers.

Commercial fats that lower cholesterol

New fats for use in foods prepared outside the home could help lower the national heart attack rate.

Nutritionists and consumer groups have raised concerns about the high content of 'saturated' fats in conventional commercially-prepared foods. Scientists in the Division of Human Nutrition are collaborating with a major Australian margarine company to produce alternative fats that will still produce acceptable quality and taste in baked foods, cereals etc., but that lower plasma cholesterol levels rather than raise them.

These new fats have been tested successfully in clinical trials in men with moderately-raised plasma cholesterol levels. The 27 men ate each of four diets in random order. The control diet resembled their usual food intake; the three test diets, each lasting for four weeks, were identical except for the nature of the fat supplement.

One supplement contained fats rich in saturated fatty acids, and resembled the type and amounts of fat eaten by the majority of Australians. The other two supplements were a mix of hardened oils and unhardened polyunsaturated fatty acids. Both of them had the technical characteristics needed for commercially-prepared foods but the clinical trial proved that they lowered plasma cholesterol significantly.

Developments

Real-time colour imaging commercialised

CSIRO's real-time colour imaging system, developed by the Division of Forest Products and described in last year's Annual Report, is now on the market. The licensee, Bio-rad Laboratories Pty Ltd Australia, launched the product in the form of a 'COLOR' unit that can be added to almost any modern scanning electron microscope.

New method for making rayon

The Division of Forest Products is negotiating with potential licensees for industrial development of a new process to make rayon. The Division has overcome three major problems in the existing technology and has applied for patents for its process.

Casting technology

The Division of Manufacturing Technology has established a casting technology enterprise, which has a network of software sales outlets in the USA. The Division has contracts from most of the Australian diecasters and is in the process of arranging networks in parts of Asia and Europe.

Kodak fine chemicals

The Division of Chemicals and Polymers and Kodak Australasia Pty Ltd have signed an agreement for joint research that they hope will lead to the manufacture of fine chemicals in Australia. Fine chemicals are high-value products such as agrochemicals and the intermediate materials for pharmaceutical products. The program will include work on the development of commercial-scale microwave reaction processes.

International markets for UMIS

The Division of Applied Physics has signed an international distribution agreement with Microscience Inc (USA) to distribute the Ultra Microhardness Indentation System (UMIS) instrument world-wide. The development of UMIS, which measures the hardness and electric properties of surfaces and thin films, was described in last year's Annual Report.

Bovine tuberculosis test

The gamma-interferon test for bovine tuberculosis jointly developed by the Division of Animal Health and the Commonwealth Serum Laboratories has been accredited for official use in Australia. It has also been sub-licensed for manufacture in the USA and is being evaluated for use in Ireland and New Zealand.

Commercialisation of IBDV vaccine

A ceremony in November 1990 marked the beginning of the commercialisation phase for a vaccine against infectious bursal disease virus in poultry, described in CSIRO's 1988-89 Annual Report. The vaccine, jointly developed by the Divisions of Animal Health and Biomolecular Engineering, is one of the world's first genetically engineered single-component viral vaccines. Industry partner, Arthur Webster Pty Ltd, expects annual sales of about \$5 million when the vaccine is marketed overseas in the next two to three years.

Low cholesterol eggs

The Division of Food Processing has developed a process for removing nearly all the cholesterol from eggs and dairy products. The Division has signed a licence agreement with a consortium of Alim Fresh Pty Ltd, Gourmet Organics Pty Ltd and Ringal Valley Pty Ltd to produce low-cholesterol egg products.

Information and communications industries

Achievements

Mobile telecommunications systems

The second generation of AUSSAT satellites to be launched in 1992-93 will give Australia the world's first dedicated mobile satellite communications system, Mobilesat. The system will provide voice and data communications, such as phone and paging services, that will reach cars, trucks and coastal shipping anywhere in Australia.

The Division of Radiophysics has developed a low cost antenna for users of Mobilesat to attach to their vehicles. It remains locked to the AUSSAT satellite by electronic tracking and, being compact, will be suitable for cars and trucks as well as larger vehicles.

CSIRO is negotiating with several Australian companies who could manufacture, further develop and market the antenna and its ancillary equipment. The Division will support this technology by continuing with design improvements and developing testing techniques and facilities. It will talk with overseas operators who are designing their own satellite mobile systems and who have shown considerable interest in the CSIRO antenna concept.

Developments

Centre for Spatial Information Systems

In April 1991, the Minister for Science and Technology, the Hon. Simon Crean, officially opened the Division of Information Technology's Centre for Spatial Information Systems on the ANU campus in Canberra. The Centre houses CSIRO's new massively parallel computer, the MasPar MP-1, purchased from Digital Equipment Corporation (Australia) with funds granted to CSIRO from the 1989 May Science Statement. The opening of the new laboratory was accompanied by an announcement of further R&D and infrastructure funding for the Division from DEC.

GIRD grant for parallel image processing and display

The Industrial Research and Development Board has awarded a \$1.37 million grant to the Parallel Image Processing and Display Systems (PIPADS) project. PIPADS aims to develop algorithms, software and hardware to improve the performance of image processing operations. It is a collaborative project involving staff from the Division of Information Technology, BHP Research and New Technology, the University of Newcastle and the Australian Defence Force Academy.

Environment

Achievements

The impact of climate change

The CSIRO Climate Change Research Program, started in 1989, involves the Divisions of Atmospheric Research, Fisheries, Oceanography, Plant Industry, Water Resources, Wildlife and Ecology, and the Centre for Environmental Mechanics.

This inter-disciplinary research program is aimed at assessing climate changes caused by the greenhouse effect and evaluating their impacts.

There is an increasing demand for estimates of probable regional climate change. In response, the Climate Impact Group in this program has so far produced annual reports for the New South Wales, Northern Territory, Victorian and Western Australian Governments.

The reports contain information about possible changes in temperature, rainfall, sea level and weather phenomena. The influence of these changes on activities such as agriculture, water supply, snow fields, fire danger, floods and temperature extremes is being examined.

Information from a variety of sources is used to prepare these reports, including results from local and overseas general circulation models for the Australian region; from limited-area models that simulate specific meteorological phenomena; and analyses of historical records and palaeoclimatic information.

The work of the Climate Change Impact Group is funded by the Department of Arts, Sport, the Environment, Tourism and Territories; various State and Territory Governments; and CSIRO.

Sydney air quality study

The release of the Sydney Air Pollution Study report in December 1990 attracted much media and public attention and marked the beginning of a more detailed understanding of the air quality issues for Sydney's urban development and pollution management.

The report was commissioned by the New South Wales State Pollution Control Commission from CSIRO (Division of Coal and Energy Technology) and Macquarie University (School of Earth Sciences). The work was sponsored by the NSW Department of Planning and the Commonwealth Department of Transport and Communications.

The new study showed that high photochemical smog levels continue to occur in Sydney's west and southwest and these levels have not responded to the more stringent emission control regulations that have been introduced.

Pollution, mainly from vehicles in the metropolitan area, is blown inland during the day, coming to a halt as it is becalmed at the western foothills. As the air moves west, sunlight causes the nitrogen oxides and hydrocarbons within the air to produce ozone gas. New CSIRO smog prediction techniques demonstrate that, without increased pollution controls, the urban growth expected over the next 15 years will increase ozone levels by up to 50 per cent.

This finding has serious implications for the urban planning

of Sydney, particularly when the west and southwest are areas targeted for major residential and industrial growth.

Mediation in forest disputes

In November 1990, the Divisions of Wildlife and Ecology and Forestry and Forest Products gave a public demonstration of SIRO-MED, a decision support system for mediating conflicts between competing interests in forest land use.

Researchers spent three months assembling a database from the Batemans Bay forestry region that would allow interested parties, such as conservation groups and the timber industry, to identify areas of varying values for conservation and forestry.

About 50 representatives of interested groups, including government bodies, attended a workshop in Canberra to experiment with SIRO-MED. Teams were formed for mock negotiating sessions in which it proved possible for both sides to define areas of obvious usage, and to negotiate towards a balanced plan.

The SIRO-MED system has since been demonstrated to various Federal and State government ministers and its approach has been commended by the Resources Assessment Commission. It could be of particular value for solving possible conflicts on the north coast of New South Wales, where timber and conservation values are greater than in the highly-publicised south-east forests.

SIRO-MED provides a practical way to show people how they can use all the data that scientists and others produce.

Environmental decision support system

The complex information needed by environmental managers is often stored in different databases, computers and locations. Finding a way of integrating all these information sources is presenting a challenge to system designers.



The Environmental Decision Support System (EDSS) brings together varied information to improve management of the environment.

One solution is demonstrated by the Environmental Decision Support System (EDSS) developed by the Division of Information Technology in collaboration with other CSIRO Divisions and the Environmental Resources Information Network of the Australian National Parks and Wildlife Service.

EDSS provides a user-friendly computer system for people who are not specialists in using geographic information systems. It can integrate many forms of data and can incorporate specialist modelling and analysis packages.

A prototype EDSS has been tested with data from Tasmania. It contains information on rare or threatened native plants, world heritage areas and river systems, and maps of vegetation and rainfall. Users can interactively interpret information from maps, satellite images, photographs, tables of data, abstracts and full texts.

The bringing together of this variety of information into one system will enable environmental managers to visualise problems better and make decisions based on all of the information available.

Use of germs to clean water

Bioremediation — the use of micro-organisms to clean up polluted groundwater — may prove to be very effective in repairing past environmental damage.

A \$2 million research project is being undertaken jointly by the CSIRO Division of Water Resources, The Broken Hill Proprietary Company Limited and the University of Canberra, to investigate bioremediation of soil and groundwater contaminated by previous land uses. The work will be funded over five years.

The scientists will evaluate the potential of various micro-organisms to deal with pollutants and will try to increase their activity to reduce contamination quickly. They will also develop computer-based modelling techniques for controlling the bioremediation process and in situ monitoring techniques to provide information on what is happening.

CSIRO's input will focus on ways in which traditional borehole monitoring might be combined with new techniques in geophysics and computer modelling to determine the extent of a pollution problem.

The Division's researchers will also look at the behaviour of commonly-

used volatile organic contaminants that pollute groundwater, for example chlorinated solvents and petroleum hydrocarbons. They will also investigate the capacity of soils to assimilate nitrate and phosphate that could have come from fertilisers leached from nearby fields or lawns.

Disposing of saline groundwaters

Researchers from the Centre for Environmental Mechanics have investigated the relative contributions of evaporation and seepage to the disposal of saline groundwater at the Wakool/Tullakool Sub-surface Drainage Scheme, one of 90 groundwater disposal basins designed to reduce salinity in the fields of the Murray-Darling River basin.

The results of the project, while providing information of benefit for future disposal basins, raise questions about the efficiency of the Wakool system, and suggest ways to improve such schemes. They also provide valuable data on measurement techniques, enabling scientists in other locations to compare readings and equipment, and most importantly, to improve our understanding of the working of saline water evaporation and storage.

Working in association with other Divisions, the Centre has suggested an exciting alternative to the creation of artificial disposal basins. This is to use natural salt lakes as sites for the disposal of saline groundwater. These naturally occurring sites would be cheaper to use than man-made alternatives and would not alienate arable land.

This proposal raises a crucial



Dr Ian White, of the CSIRO Centre for Environmental Mechanics, investigates saline groundwater disposal at the Wakool evaporation ponds, NSW.

question. Will the addition of saline groundwater disturb the equilibrium of these salt lakes and release the megatonnes of salt accumulated in the sediments below them over the last 30,000 years?

The CSIRO researchers are now using mathematical modelling, laboratory simulations and field measurements in an attempt to answer this question.

Developments GASLAB

GASLAB, the Global Atmospheric Sampling Laboratory, was opened at the Division of Atmospheric Research in November 1990. The laboratory will provide new information about the composition of the atmosphere to improve our understanding of the greenhouse effect and depletion of the ozone layer.

Rangelands laboratory opened

The Minister for Primary Industries and Energy, the Hon. John Kerin, opened the Rangelands Laboratory at the Division of Wildlife and Ecology in Canberra in March 1991. The Laboratory houses a team researching the ecology and management of Australia's rangelands, in co-operation with a similar team based in Alice Springs, Northern Territory.

Tropical Remote Sensing Unit

Federal Member for Herbert, Mr Ted Lindsay, opened the CSIRO Tropical Remote Sensing Unit in Townsville on 22 April 1991. The Unit will analyse information from satellites for use in mapping soils, assessing land resources and isolating degraded soils.

Imaging spectrometer project

CSIRO and BHP have agreed to design and construct an advanced airborne scanner called an imaging spectrometer. It will be 20 to 40 times more powerful than the current satellite instruments, able to identify objects only five metres apart on the ground. The project, coordinated by the CSIRO Office of Space Science and Applications, involves 14 CSIRO Divisions.

Pulp mill research contracts

Contracts worth \$3.8 million over four years have been let for research in the first phase of the National Pulp Mills Research Program, managed by CSIRO. The Program's focus is on the effluent produced by large-scale pulp mills and its effect on the environment. CSIRO Divisions are involved in most of the contracts.

New satellite station for Hobart

In June 1991, the Australian Space Office provided \$1 million towards the construction of the Tasmanian Earth Resources Satellite Station (TERSS) in Hobart. This station, which will receive remotely-sensed data from the new earth resources satellites to be launched during the 1990s, will enable Australia to improve environmental research and monitoring.

Participants in the project are CSIRO's Division of Oceanography, the University of Tasmania, the Australian Space Office, the Australian Centre for Remote Sensing, the Bureau of Meteorology and the Antarctic Division. The \$2.5 million Station is expected to be running by June 1992.

Infrastructure, services and advancement of knowledge

Achievements BCAider

CSIRO has released a user-friendly expert PC software package, called BCAider, to help building industry professionals interpret, apply and comply with the new Building Code of Australia introduced in 1991.

The software was developed at the Division of Building, Construction and Engineering with the backing of the Australian Uniform Building Regulations Co-ordinating Council, Jennings Housing and Butterworth-Heinemann.

BCAider is the world's first fully commercial expert system for building codes. It runs under industry standard software and presents the Code in



The BCAider software package helps building professionals interpret, apply and comply with the Building Code.

computer-based format, with menus, help facilities, colour graphics and error checking. There are two versions: one for home building and a full version for all classes of buildings.

Residential and non-residential construction worth more than \$20 billion each year is carried out in Australia, so the package is attracting wide industry interest.

Demonstration of volcanic ash detector

CSIRO has recently taken out a patent for an instrument that will warn an airline pilot of volcanic ash on the flight path ahead.

Major volcanic eruptions in the past few years have caused several serious incidents involving planes whose engines stalled when they entered a volcanic dust cloud. These events occur because current aircraft instruments cannot tell the difference between rain clouds and ash clouds, and pilots do not change their flight path for normal rain cloud conditions.

The Airborne Volcanic Ash Detector System (AVADS) was developed by the Division of Atmospheric Research. It exploits the fact that the difference between clouds bearing water and those bearing ash can be measured at specific infra-red wavelengths of light. The system has to be highly sensitive because ash clouds themselves often contain large amounts of water vapour.

A proof-of-concept instrument was tested successfully in March 1991 on the slopes of the Sakurajima volcano in Japan, in trials carried out by CSIRO's Division of Atmospheric Research, its Office of Space Science and Applications and the Bureau of Mineral Resources, in collaboration with Kyoto University.

These early trials were funded through CSIRO and the Department of Industry, Technology and Commerce under a bilateral agreement with Japan.

The Australia Telescope National Facility

In the past year, the emphasis in research at the Australia Telescope National Facility (ATNF) has been on improving the quality of its images.

The Australia Telescope's first full configuration image was a picture of the luminous radio galaxy PKS 2356-61.

In March 1991, three months ahead of schedule, astronomers used all six antennas to detect a transient radio source near the galactic centre and to observe supernova 1987a. This supernova, a star that exploded in 1987, has been one of the most exciting events in modern astronomy. The improved resolution of the Australia Telescope allowed astronomers to form images of the supernova rather than seeing it just as a point.

The ATNF has strong international links. In 1990, it was one of twelve partners in a joint project that confirmed the discovery of an 'Einstein ring'. This is an extremely rare phenomenon, in which light from a distant source is bent into a ring by the gravity of a closer galaxy.

The ATNF is already much sought after by international researchers. In 1990, forty per cent of the research teams using the facility had members from overseas.

Developments

CSIRO hosts space VLBI meeting

CSIRO, through the Australia Telescope and the Division of Radiophysics, hosted a week-long international meeting on space-based Very Long Baseline Interferometry in April 1991. Delegates from twelve nations attended and discussed, amongst other things, the USSR's Radioastron satellite mission (1994) and Japan's proposed VSOP mission (1995).

Co-operative Research Centres

CSIRO will be a partner in all 15 of the first-round Co-operative Research Centres (CRCs) announced by the Commonwealth Government in March 1991.

Under the CRC Program, initiated by the Government in May 1990, up to 50 CRCs will be established with total funding rising to \$100 million a year by 1995.

The CRC Program's objectives are

- to support long-term, high quality research which will contribute to national objectives;
- to capture the benefits of research and to strengthen links between research and its users by involving research users in the work of the CRCs;
- to encourage concentration of research by promoting co-operative research;
- to stimulate education and training.

A university must feature in each application, with partners from CSIRO, State Departments and industry wherever possible.

The first round of the CRC Program attracted 120 proposals for funding. CSIRO was involved in 68 of these applications, each of which was assessed to ensure that it was consistent with research priorities determined by CSIRO and that an appropriate commitment of resources could be made during the period of the program.

In March 1991, after referees' reports had been considered and interviews carried out, 15 proposals were accepted for funding. CSIRO is a partner in 14 of these CRCs and will become involved in the 15th, Aerospace Structures, at a later stage.

The areas covered by the CRCs are:

Aerospace Structures; Antarctic and Southern Ocean Environment; Australia's Petroleum Industry; Cellular Growth Factors; Eye Technology; Extractive Metallurgy; Intelligent Decision Systems; Mining Technology and Equipment; Plant Science; Robust and Adaptive Systems; Soil and Land Management; Temperate Hardwood Forestry; Tissue Growth and Repair; Tropical Pest Management; and Waste Management and Pollution Control.

Early indications are that CSIRO will be a partner in about 50 of the second round proposals, assessment of which begins in July 1991.

International relations

The Hon. Simon Crean, Minister for Science and Technology, attended the inaugural meeting of the Commonwealth Science Ministers held in Malta in 1990. With him was the proposer of the meeting Dr Barry Filshie, Officer-in-Charge of the CSIRO International Relations Centre (CIRC) and Australia's representative on the Commonwealth Science Council. Developing member countries strongly supported the Minister's urgings that they capitalise on opportunities offered by new technologies.

CSIRO Chief Executive, Dr John Stocker, signed an Arrangement with Italy's National Research Council (CNR) in Rome in April. The Arrangement will help scientific exchange visits and research collaboration between these two major research bodies. While overseas, Dr Stocker visited the British Technology Group in London and Dutch research organisation TNO.

In the People's Republic of China, two major facilities were completed. Both are parts of projects funded by the Australian International Development Assistance Bureau and managed by the CSIRO Division of Animal Health.

The Beijing Laboratory Animal Research Centre was opened in July by His Excellency David Sadlier, Australia's Ambassador to China, and Chinese officials from the Ministries of Health and Agriculture. China's national Specific Pathogen Free (SPF) Poultry Facility at Harbin was opened in October by the Australian Ambassador and Mr Liu Jiang, the



Representatives of the Science Council of Japan, led by their Vice-President, Professor Y Oishi, visited CSIRO in September. The visit, to promote mutual understanding in science, was the first of its kind by the Council.

Chinese Vice Minister for Agriculture. The facilities will provide SPF

poultry, germ-free laboratory animals and eggs for producing vaccines and immuno-diagnostic reagents for human use.

A notable visit to CSIRO headquarters this year was made by a party led by Professor Paolo Fasella, Director General of the Commission of the European Communities Directorate General for Research, Science and Development. They discussed with Dr Stocker and senior CSIRO staff possible Australian involvements in the European Community's research and development projects.

Dr John Begg, Assistant Chief of the Division of Plant Industry, and Dr Barry Filshie of CIRC represented CSIRO on a Department of Industry, Technology and Commerce delegation to India in April. During the visit, a Memorandum of Understanding between the Department and its Indian counterpart was signed to smooth the way for scientific exchanges.

Awards

CSIRO Medals

The 1990 CSIRO Medals were presented on 27 November 1990 by Sir Gustav Nossal, CSIRO Board Member.

The Medals were awarded to:

- the specialty polymers group, Division of Chemicals and Polymers, for developing innovative methods of preparing polymeric materials (Dr E. Rizzardo, Mr A. F. Faux, Dr M. N. Galbraith, Dr D. G. Hawthorne, Dr G. F. Meijs, Dr C. R. Strauss, Dr S. H. Thang, Dr P. Cacioli, Dr D. H. Solomon);
- the bovine tuberculosis research group, Division of Animal Health, for developing a diagnostic test for bovine tuberculosis
 (Dr P. R. Wood, Dr L. A. Corner, Mrs C. Costopoulos, Dr T. Fifis, Ms H. Jacobe, Mrs J. Krywult,

Ms K. M. Lund, Dr A. J. Radford, Mrs J. L. Ripper, Mr J. S. Rothel, Ms K. Kopsidas);

- Dr G. Poulton and Dr T. Bird of the Division of Radiophysics for the development of the Western Australian antenna system for AUSSAT-B;
- Dr C. Fandry of the Division of Oceanography, Dr R. E. Johannes of the Division of Fisheries, and Dr P. Nelson of the Division of Forestry and Forest Products, for scientific contribution to the national debate on pulp mills.
- the Jameson flotation cell research team, for development of the Jameson flotation cell (Professor G. Jameson, Dr G. M. Evans, Mr J. Richards, Dr N. W. Johnson, Mr P. D. Munro, Dr E. V. Manlapig, Mr J. P. Andreatidis, Mr C. Kaiser, Dr R. Espinosa-Gomez, Mr R. W. Greenelsh, Dr N. Ahmed, Mr J. Gubbins, Mr J. H. Fewings, Mr T. R. Farrugia, Mr D. Hughes).



Back row, left to right, Dr John Stocker, Sir Gustav Nossal, Professor Graeme Jameson, Dr Peter Nelson, Dr Chris Fandry, Dr Bob Johannes, and Dr Paul Wood. Front row, left to right, Dr Ezio Rizzardo, Dr Geoff Poulton, and Dr Trevor Bird.

Sir Ian McLennan Achievement for Industry Award

Joint winners of the Award in 1990 were:

- Dr Bill Denholm, from the Division of Mineral and Process
 Engineering, for his contribution to the development of the SIROSMELT system of smelting non-ferrous metals;
- Dr Graham Price, from the Division of Geomechanics, for resolving foundation problems of the gas platforms on the North West Shelf Development project of Australia.



Dr Bill Denholm (right) is pictured with the Director of CSIRO's Institute of Minerals, Energy and Construction, Dr Alan Reid, and Dr Rob La Nauze, Chief of the Division of Mineral and Process Engineering.



Dr Graham Price (centre) is flanked on the left by the Assistant Chief of the Division of Geomechanics, Dr Adrian Williams, and on the right by the Manager of Civil Engineering, Woodside Offshore Petroleum Pty Ltd, Dr Mohamed Korshid,

CSIRO has increased the vigour and effectiveness of its efforts to transfer its technology, whether in the form of information to anchor the environment debate in fact, or in the creation of profitable industrial products or processes.

Technology is transferred at Institute and Division levels with assistance from SIROTECH, CSIRO's technology transfer company.

SIROTECH LTD

SIROTECH was restructured this year to cement its place as the corporate and commercial adviser to CSIRO. A new Chief Executive, Dr D. Gibson, took up office, and a new Board identical to CSIRO's was appointed so that the two bodies now have the same priorities.

Highlights

— Tasmanian Earth Resources Satellite Station (TERSS): For this

project (see p 44), SIROTECH provided commercial and legal advice and assistance to CSIRO during the feasibility stages, selection of the project manager and negotiation of agreements with the project manager sub-contractors.

— The Intelligent Interface (I²): CSIRO's Division of Water Resources and AUSSAT are investigating means of commercialising I², a device which allows remote data logging equipment to be continuously monitored and controlled from a central location using a satellite-based communication system.

SIROTECH has worked with the CSIRO–AUSSAT project management group in drawing up the Memorandum of Understanding and collaborative agreements, and in providing commercial and marketing advice.



Chief Executive Dr John Stocker (centre) receives a cheque for the Tasmanian Earth Resources Satellite Station (TERSS) from Dr Bruce Middleton (right) executive director of the Australian Space Office. With them is Professor Garth Paltridge of the University of Tasmania. — DISIMP: The Division of Information Technology has worked with Sun Microsystems in developing DISIMP (Device Independent Software for Image Processing), sophisticated image processing software for processing satellite and other images.

A licence agreement was negotiated with Clough Engineering for DISIMP during 1990–91. SIROTECH provided commercial and marketing advice, negotiated the agreement and provided the necessary legal back-up.

— SiroFAST: Fabric Assurance by Simple Testing (FAST) is a simple objective system for measuring fabric properties (see last year's Annual Report).

SIROTECH has helped CSIRO's Division of Wool Technology and the Australian Wool Corporation in the commercialisation of FAST in a number of ways: through pilot commercialisation, which has seen the sale of 30 FAST sets; the identification and contracting of a suitable marketer/distributor for full commercialisation; the negotiation and writing of commercial agreements; the writing of business plans; patent and trademark applications; and specialist commercial and supporting advice to the FAST Management Committee.

Support services

SIROTECH acted this year as legal adviser to CSIRO in the formation of seven of the recently established Co-operative Research Centres (CRCs).

A suite of Standard Form Agreements has been prepared for use by CSIRO in negotiating technology transfer arrangements. The suite will be launched and its use explained through a series of in-house seminars during 1991-92.

SIROTECH continued to monitor CSIRO's 390 licence agreements and ensured receipt of more than \$2 million in royalty payments during 1990-91.

SIROTECH also assumed responsibility for managing CSIRO's equity portfolio during 1991. CSIRO holds equity in nine companies other than SIROTECH (see p. 19). SIROTECH reports annually to the CSIRO Board on the strength of each company and makes recommendations on whether CSIRO should maintain or divest itself of each equity holding.

CSIRO's current policy is to hold only a minority equity position in ventures based on CSIRO technology, and to rely on licence agreements instead to ensure a reasonable return on its research investment.

Intellectual property SIROTECH filed 183 provisional patent applications during 1990-91.

The company laid greater emphasis on intellectual property protection and education: a new computer system was installed; seminars were held; the importance of carrying out patent searches during research programs was stressed; and the SIROTECH booklet *Intellectual Property Services and Guidelines* was circulated throughout CSIRO.

Institutes and Divisions

CSIRO Institutes and Divisions use a number of mechanisms to promote the transfer of information and technology. They range from the use of print and electronic media, staff exchanges, the provision of the latest technical information to industry and the community through specialist staff, participation in industry committees and workshops with industry groups, to fully-fledged commercial partnerships.

An example of a major technology transfer activity this year involved CSIRO's role in the water industry. The Division of Water Resources has established NATCOM, a national database of water industry professionals. The database provides the industry with a guide to sources of expertise and a means by which specialised information and audiences can be matched. NATCOM is now installed in all major water authorities in Australia. The Division routinely uses the database to target its information.

In November the CSIRO Board endorsed a recommendation that CSIRO scientists become more involved in agricultural extension — the process of getting the results of their research applied on Australian farms — and that they should work with State and private agencies at the beginning rather than at the end of the research process.

Almost all Divisions employ a business manager whose task it is to work with business — to see that any matter involving or likely to involve commercial use of research results is handled effectively. The tasks of the business manager include arranging patent protection and negotiating collaborative and licence agreements, with the assistance of SIROTECH, depending on the complexity of the case.

How industry and CSIRO can work together

A commercial arrangement with CSIRO can be:

- a research contract, consultancy agreement or technical services agreement, where a company pays CSIRO to do research with defined objectives; the company meets the total costs of the project and retains full rights to the results;
- a collaborative research and development agreement, with the costs and benefits shared by CSIRO and the company involved;
- an umbrella arrangement for a company to support research across an area of strategic business interest, with objectives defined as progress is made;
- a project that has been funded by CSIRO and a commercial partner sought relatively late in the innovation process.

Funding

During the year, significant work was done on a range of issues which have an impact on CSIRO's present and future resource requirements.

Triennium funding

The financial year 1990-91 was the final year in the Organisation's first triennium budget, which the Government had introduced as part of its decisions on CSIRO funding following the Australian Science and Technology Council study in 1985. The increased certainty about Government appropriations to CSIRO afforded by the triennium has allowed the Organisation to plan resource shifts with greater confidence.

The CSIRO Board considers triennium funding to be such an important management development that it decided to propose to the Government that the arrangements continue indefinitely. In January 1991 the Minister for Science and Technology responded by announcing the continuation of triennium funding for CSIRO.

Infrastructure funding

The development of CSIRO's Capital Investment Strategy during the previous financial year, and the decision that a constant proportion of the replacement value of the Organisation's capital assets amounting to \$35 million at current prices be committed to replacement, refurbishment and repairs and maintenance, also provided CSIRO with an opportunity to approach the Government with a new initiative about infrastructure funding for the science agencies in the Industry, Technology and Commerce Portfolio.

Both these matters — triennium funding and infrastructure funding — were developed into a single submission with the results to be announced in the 1991–92 Commonwealth Budget.

Accrual accounting

The Organisation has decided to place its internal financial procedures onto a full accrual basis by July 1993. This decision brings CSIRO into step with modern business practice and will bring considerable benefits to the Organisation in the form of an ability to appreciate the full cost of its activities. The decision is also consistent with the stated aims of the Government's Financial Management Improvement Program.





Planning

Research priorities

During 1990–91 CSIRO successfully developed and implemented a method of determining its research priorities — of rating and funding the areas of CSIRO research on the basis of which ones can deliver the best social, environmental and economic returns to the nation. In February, the broad outlines of the new priorities were released; in June, the first round of projects for priority funding was announced.

The priority assessment exercise was conducted in three stages:

- the identification of national research priorities;
- the determination of the appropriate CSIRO response to those national priorities;
- the re-allocation of resources from lower to higher priority areas.

Methodology

The methodology that CSIRO developed for priority setting uses a slightly modified version of the national research classification developed by the Australian Bureau of Statistics (ABS) and referred to as the socioeconomic objectives sub-divisions of the interim Australian Standard Research Classification.

For planning purposes, CSIRO modified these sub-divisions to reflect the major industry sectors in Australia to which its research is directed. The result is a set of 17 research purposes whose main objectives are economic development, national welfare or national security (see p 22).

These research purposes were assessed in terms of their possible return to Australia from research and development (R&D). That return was determined by assessing two factors: attractiveness to Australia and feasibility. Scores for these factors were arrived at by combining the scores for two criteria for each factor. Attractiveness was determined by multiplying the score for potential benefits of research by that for Australia's ability to capture those benefits. Feasibility was determined by multiplying the score for R&D potential by that for R&D capacity.

The priorities methodology is fully documented in the CSIRO publication *CSIRO priority determination 1990 — methodology and results overview*.

Following this assessment, role statements were developed for each of the 17 research purposes, setting out the national research priority rating, CSIRO's response and strategy, and its decision on the focus of future research. The conclusions reached will be summarised in the CSIRO Strategic Plan for the period 1991–96. The role statements are documented in the CSIRO publication, *CSIRO priority determination 1990*— role *statements*.

Implementation

CSIRO has developed a mechanism to stimulate re-allocation of funding from lower to higher priority areas at all levels. Initially, three per cent of appropriation funds for 1991-92 will be used to redirect the research effort. This level of change will be adjusted as necessary.

The intention is to re-allocate an

additional \$10 million to strategic research in minerals and an additional \$10 million to the environmental aspects of economic development over the triennium 1991–92 to 1993–94.

The first re-allocation of funds to specific proposals prepared in line with priority decisions is shown in the box below. CSIRO will continue to re-align its research programs to the identified priorities and to review those priorities regularly.

Planning documents

During 1990-91 substantial progress was made on CSIRO's next Strategic Plan which covers the planning period from 1991-92 to 1995-96. It will be submitted to the Board for approval early in the new financial year.

The 1990-91 Operational Plan was released by the Organisation in August 1990. The 1991-92 Operational Plan, approved by the Board in June 1991, includes

Allocation of funds to research priorities in 1991-92

In line with the decisions made on national and CSIRO research priorities for the next three years, CSIRO will give increased emphasis to strategic research to benefit Australia's minerals industries and research on environmental aspects of economic development. These two areas will each receive around one third of the funds made available for redirection in 1991–92 through a reserve of 1.5 per cent of appropriation funds applied pro rata across the Organisation. The remainder will be distributed between other research purposes. The allocation for 1991–92 is as follows:

Research Purpose	\$ million
Minerals Industry	1.448
Economic Development — Environmental Aspects	1.265
Rural-Based Manufacturing	0.401
Environment	0.368
Manufacturing Industries	0.353
Information and Communications Industries	0.280
Plant Production and Primary Products	0.266
Energy Resource and Supply Industries	0.256
Animal Production and Primary Products	0.189
Commercial Services	0.070
Total	4.896

These funds will be matched by recipient Institutes through the redirection of resources from lower priority areas.

planned outcomes in the key performance areas of research, technology transfer and funding at the Institute and Divisional levels. It will be released in early September 1991 following finalisation of the Budget.

The 1990-91 Evaluation Plan was submitted to the Department of Finance in November 1990.

Planning processes

The priorities exercise described above was the year's major exercise.

Streamlining the preparation of planning and related documents also began in 1990–91. This is an attempt to improve the integration of planning processes at the Corporate, Institute and Divisional levels, as well as within each level, and involves rationalisation of the structure of plans and co-ordination of the input of information from each level of the Organisation. This process will continue in 1991–92.

Two papers were prepared for the Commonwealth Government's Management Improvement Advisory Committee. They were *Performance measurement and evaluation in CSIRO* (October 1990) and *Setting priorities and planning for outcomes in CSIRO* (April 1991). Presentations based on these papers were made to workshops sponsored by the Department of Finance in Canberra and Melbourne.

Planning services

During 1990–91, a number of priority setting workshops were conducted where corporate planning expertise was made available to Institutes and Divisions to help them to conduct planning, priority setting and research evaluations with the scientists who are responsible for managing and carrying out research.

In addition, economic evaluation of a range of research programs and projects was undertaken. The results indicate that investment in CSIRO research has been very worthwhile.

A priorities setting workshop involving the Planning and Advisory Committee and senior scientists of the Division of Animal Health has been documented in a case study report for distribution as a model study. Reports were also prepared for economic evaluation of research programs and projects for the Division of Tropical Animal Production (four studies) and the Division of Animal Health (two studies).

The Corporate Planning Office was contracted by the Department of the Arts, Sport, the Environment, Tourism and Territories to organise and develop the themes and structure for a national workshop on the economics of climate change. The Proceedings were reported in a paper entitled *Economic analysis for responding to greenhouse climate change* (April 1991).

Distribution of research effort

CSIRO's distribution of research effort for the year is shown in the figure on the next page.

The data are cash expenditure from all fund sources and continue to be presented using the socioeconomic objectives sub-divisions of the interim Australian Standard Research Classification. This component of the Classification describes the purpose for carrying out research in terms of economic and community interest objectives. For presentational purposes, some sub-divisions have been aggregated and others sub-divided.

Changes in the distribution from 1989–90 are minor and generally within the margin of error for the analysis or are a direct result of improvements in data quality control implemented during the year. The impact of the priorities exercise conducted during the year, recorded elsewhere in this report, will not become evident in the distribution of research effort analysis until 1991–92.

During 1990–91, efforts were made to improve the quality of the data on which the distribution analysis is based in order to reduce the error margin. This would allow smaller movements within sub-divisions to be detected and provide more effective information for planning and management purposes. Following the improvements to the classification scheme reported last year, a set of guidelines for research managers has been prepared. The guidelines are intended to support decisions about apportioning research effort to the categories of the Classification.

It was also decided that classifications would be made at project level within CSIRO's research management structure where it was expected that a more realistic assessment of the purpose for undertaking the research could be made. Previously, classifications had been made at program level. Expenditure information by project was also required for the analyses. New software was developed for the Organisation's management information systems to enable the distribution analyses to be prepared from the increased levels of data that resulted from these changes.

More detailed information on the distribution of research effort may be obtained from the *CSIRO Data Book*, a pocket-sized compendium of key information on the Organisation's research effort and its financial and human resources.

CSIRO distribution of research effort 1990-91



Finance

In January 1991 the Minister for Science and Technology announced the continuation of triennium funding for CSIRO. As well as giving this commitment to maintaining the Organisation's budget in real terms, the Government recognised that a 30 per cent external earnings target for CSIRO should be viewed flexibly, to allow the quality and relevance of the research output and general community benefit to be considered.

Internally, it was decided that accrual accounting principles would be adopted, with the implementation being fully phased in on a Divisional basis prior to the beginning of the 1993–94 year. This will provide more accurate costing of research, a crucial input to priority setting and pricing policies.

A revised banking agreement was negotiated with Westpac and an improved and more cost effective banking structure is to be implemented.

Westpac and Bankers Trust were engaged to provide professional investment services to improve the returns on invested funds.

A range of insurances (property, professional indemnity and public liability) was introduced following a risk management review. These also included an in-house motor vehicle scheme.

Use of the Australian Government credit card began throughout the Organisation.

Development of the Australian Standard Research Classification continued with the Australian Bureau of Statistics. Data relating to socioeconomic objectives and the distribution of research effort were provided as input to the research priorities exercise.

Internal Audit

In 1990-91 three types of review were carried out: of Divisional management, of organisational functions across multiple Divisions, and of computerised information systems. These reviews were complemented by continuous monitoring of the financial transactions of the Organisation.

Nine Divisions and administrative units (including their scientific and administrative computing functions) and four major functions were reviewed. Information papers covering such issues as corporate asset management, registries and information security and fraud handling were also produced.

The Corporate Audit Group provided advice to other CSIRO units and worked with the Management Information Systems branch in developing new computerised information systems.

Legal services

Certain major institutions have expressed interest in investing substantially in CSIRO research and development, encouraged by the Government's 150 per cent tax concession. Examination of those proposals has continued.

A new partner, Johnson & Johnson Pty Limited, joined the consortium to develop Gene Shears technology. CSIRO and Groupe Limagrain Pacific Pty Limited are the other members. CSIRO is continuing to explore the possibility of the introduction of a new Australian participant.

CSIRO will be a participant in all 15 first round Co-operative Research Centres. These Centres are sponsored by the Commonwealth Government and are intended to promote co-operation between universities, Government research institutions and industry. Extensive negotiations were conducted with other participants and the Commonwealth to ensure that this aim was reflected in the Centre agreements.

Management information systems

CSIRO's mainframe computing services have successfully been contracted out to Fujitsu Australia Ltd under a Facilities Management Agreement, in line with Government policy of supporting the local information technology industry. Response times for users Australia-wide improved by 70 per cent, and the move is saving CSIRO \$2 million a year.

As a national organisation, CSIRO relies totally on its internal telecommunications networks to deliver data and voice information successfully. The value of the networks has been increasingly understood, and considerable savings have been made with the sharing of digital band-width, least-cost call routing and gateways to external networks. Many CSIRO sites have been added to the Australian Academic Research Network (AARNet), in which CSIRO is a major shareholder. The network's facilities have been expanded and its band-width increased for imaging.

Expenditure on systems development has led to savings and efficiencies in many parts of the Organisation. New accounting systems will enable Divisions to use a range of hardware platforms. The design of these systems accommodates full accrual accounting, to be introduced next year.

CSIRO has introduced new information retrieval products in recognition of the strategic role of information in business today. The products link different kinds of hardware and software, and provide the scope for business analysis and the receipt of better quality data for improved decision-making.

CSIRO uses computer-based training packages in implementing these new applications to increase understanding and acceptance of what management information systems offer.

Property

Major work begun this year included:

 three building projects funded by CSIRO: for the Division of Forestry's Forest Research Group in Hobart, for the Divisions of Information Technology and Mathematics and Statistics at Macquarie University in New South Wales, and for the Division of Human Nutrition in Adelaide;

- three child care centres: at Black Mountain in the ACT (scheduled for completion in August 1991); at North Ryde in NSW (November 1991); and at Clayton in Victoria (January 1992);
- a laboratory complex for the Division of Geomechanics at Pinjarra Hills, Queensland. The Queensland Government supplied \$13 million funding.

At the planning stage are a \$100 million self-funding redevelopment of CSIRO's major metropolitan site at North Ryde in Sydney, and other major projects at Lucas Heights in New South Wales and Parkville and Aspendale in Victoria.

Subdivisional rezoning and development planning for the site at Bradfield Park, New South Wales reached a satisfactory stage. Actual sale should take place in mid-1992.

Negotiations recommenced for the development and sale of parts of CSIRO sites at Marmion, Western Australia and Glenthorne, South Australia.

Award restructuring

A highlight of CSIRO's year was the implementation of the Organisation's award restructuring package. Structures, rewards, performance appraisal and employment conditions have been dramatically reshaped to position CSIRO for the nineties and beyond.

The new award package came into force in October 1990 after a major work value case had been presented to the Industrial Relations Commission in September.

The new CSIRO Officer (Salaries and Conditions of Service) Award 1990 reduced the many existing CSIRO classification levels to just nine levels embracing all staff except the Chief Executive and Institute Directors. The average salary increase was 12.1 per cent, with a high for some scientists of 19 per cent.

The salary increases are just one component of an integrated package. Other key elements are the Enhanced Merit Promotion Scheme and Performance Planning and Evaluation.

The Enhanced Merit Promotion Scheme will provide three basic reward options: merit promotion to a higher level; accelerated advancement for staff who have sustained high performance over several years; and a cash incentive payment for outstanding achievement. (This last option is subject to IRC and Government funding supplementation.)

Under Performance Planning and Evaluation, salary increments will be tied to performance, as will promotion. Staff will plan annual work objectives, measure their performance against those objectives and relevant competencies, and plan



Ms Josephine Tiddy, South Australian Commissioner for Equal Opportunity, presented an award recognising CSIRO's initiative in promoting greater equality to Mr Peter Langhorne, Director of CSIRO's Corporate Services.

short and longer term career development.

Along with the revised salary and classification structure, these schemes will help to provide better rewards and career structures and improved training and career development opportunities for all staff.

Human Resources Plan

The Human Resources Plan for CSIRO was released in January 1991 after extensive collaboration between CSIRO staff, management and unions. The Plan provides the strategic framework for all CSIRO human resources planning activities and sets out goals and strategies that provide guidance and direction for CSIRO's employment practices.

Equal Employment Opportunity During the year line managers and staff were comprehensively briefed on Equal Employment Opportunity (EEO) policy and practices. A program of seminars covering the legislative requirements underpinning equity in employment practices, grievance-handling and conflict resolution techniques was provided for approximately 500 staff from all designations and classifications. The seminars also provided training for EEO Contact Officers.

Most Chiefs of Divisions subsequently requested briefings on anti-discrimination legislation for their senior and line managers. As a result of this information-sharing, the EEO Contact Officer network now numbers 110, with scientists increasingly taking up this responsibility.

CSIRO's award restructuring agenda specifically sought to improve career opportunities and eliminate any residual discriminatory practices. The introduction of minimum pay points for three- or four-year degrees and PhDs was part of this agenda.

The Scholarship and Training Scheme for senior secondary school students with physical disabilities, centred at the Division of Soils in Glen Osmond, South Australia, received an EEO Achievement Award from the SA Equal Opportunity Commission.

The Scheme also continues to operate successfully in Townsville, Queensland, supporting Aboriginal and Islander students with their secondary education and providing work experience.

Eight students have so far benefited from the Scheme.

CSIRO is a leader in the public sector in establishing three work-based child care centres. Centres at Black Mountain, ACT, and North Ryde, NSW, are due to begin operation during 1991. Construction has begun on a centre at Clayton, Victoria.

Occupational Health and Safety Approximately 350 health and safety committee members and representatives attended a training course to develop their awareness of the roles and responsibilities of management and union representatives under the Occupational Health and Safety Agreement signed last year. The participants gained a basic understanding of hazard awareness and preventive strategies relating to occupational injury and illness; CSIRO's OHS policies; and common law and statutory requirements.

New legislation covering Occupational Health and Safety in Commonwealth employment was passed in March placing statutory responsibility on CSIRO to maintain a safe workplace using approved codes of practice. Whilst the legislation does not come into effect until 6 September 1991, CSIRO has already instituted arrangements similar to those required.

CSIRO's 1990-91 workers' compensation premium rate has been reduced by 38 per cent for the 1991-92 year. This represents a reduction from \$4.45 million to \$2.77 million and is a major achievement given that the average reduction across other Commonwealth agencies was only 8 per cent. This trend highlights the effectiveness of CSIRO's health, safety and rehabilitation programs.

Employee development

Throughout 1990-91 a pilot career development scheme provided a group of talented individuals with skills and competencies needed for success in key management positions in CSIRO. In March 1991 the Executive Committee agreed to continue the scheme with minor modifications including a name change to 'CSIRO Leadership Development Program'. The objectives of the program are to identify those senior research and corporate managers with a high potential for future leadership roles and to improve their effectiveness and leadership capabilities.

Two Research Leadership courses for program managers were conducted during the year. Divisions and Regional Training Committees continued to provide opportunities for professional, technical and trades skills development.

The implementation of Award Restructuring was a major employee development activity during 1990-91. Divisional implementation teams were given help to develop plans and processes for introducing key elements of the changes brought about by the new Award. In a series of workshops, subject experts provided information packages and a planning process to the Divisional teams in a form they could use for further dissemination throughout each Division.

The elimination of impediments to career progression and broader recognition of on-the-job skills have been major components of award restructuring.

Human resource information system Human resources analysis, reporting and management will benefit from a fully integrated management information system now being developed. In particular the new system will improve access to information on training, qualifications and skills, and help with performance planning and evaluation and career planning for CSIRO staff. Specifications are being drawn up for various modules to be implemented in 1991–92.

Consultative Council

The Consultative Council continued to operate as the peak forum for consultation between management and staff in CSIRO. Made up of an equal number of representatives from management and staff associations, the Council formally meets in April and October each year with continuing work being carried out by various sub-committees. The Council is chaired by CSIRO's Chief Executive and the current deputy chairperson is the President of the CSIRO Officers Association.

During the year the Council closely examined its structure and agreed to some major changes in its direction and the issues it should deal with. The revised structure consists of three sub-committees, one dealing with training and development, one with human resources policy and one with organisational policy and communication. The last-named sub-committee will enable the Council to expand its focus from the traditional human resources issues to issues such as budgeting. communication and research priorities and their impact on staff.

The Council played a major role in the development of the Human Resources Plan. Other main issues considered in the past year included progress with industrial participation, EEO and the development of the next employee development strategy.

Public affairs

The major communication activity for the year was Project Ambassador, a campaign involving all members of staff in explaining to Government, industry and the community the ways in which CSIRO delivers an excellent return on investment.

A corporate publication, *Contribution to the nation*, backed up the campaign with concrete dollars-and-cents evidence of benefits to Australia from CSIRO research.

Apart from a perceptible heightening in its profile in the general print and electronic media, CSIRO research enjoyed wide coverage in a radio series and in regular columns in suburban newspapers. The chief television event was the ABC's *Quantum* special program 'Sheer Genius' on Gene Shears technology. A media training program for scientists and managers was established. CSIRO took science to the general community through its participation in public events, most notably the Sydney Royal Easter Show, Open Days in Hobart, the Biota Festival in Canberra, and the nation-wide travelling exhibition 'Science for Survival'. Planning for another major travelling public exhibition, on genetic engineering, began during the year.

Efforts to work more closely with industry included a business breakfast meeting — the first of an intended diverse series — about Australia's future energy needs, held in conjunction with *Business Review Weekly*, and a promotional booklet jointly sponsored by a number of industry partners and distributed nationally in the *Financial Review*.

All Institutes and Divisions employ communication professionals to publicise and promote their particular areas of research.



Division of Fisheries scientist Dr Clive Stanley demonstrates the 'Fishery Management Model' at the Hobart Open Day

Communication



A selection of CSIRO publications

Information and library services CSIRO's information and library services provide CSIRO staff and the general public with access to scientific and technological information. The information produced and managed is disseminated through print, film, video and computer systems.

Thirty monographs were published this year, including landmark productions such as *CSIRO Atlas of Hardwoods, Nature Conservation* and *Sustainable Agriculture.* Redesigned and expanded, the science-and-theenvironment magazine, *Ecos*, was re-launched in June, continuing CSIRO's role as honest broker in the environment debate.

'CSIRO Business', a monthly feature introducing CSIRO technology to business, was launched in October 1990 as an insert in *Business Review Weekly*. Reader research showed it was widely read and well received. The 1990-91 edition of the *Directory of CSIRO Research Programs* appeared in a much improved format, and the thirteen Australian Journals of Scientific Research maintained their critical and commercial success rate as Australia's major publisher of quality science.

Sales of books, magazines and journals, aided by improved business systems, reached \$2.3 million, up 20 per cent on last year.

Success in the television and video markets came from such productions as the food segments on ABC's *Everybody* program and the *Down to Earth* soils and gardening video.

CSIRO's network of 45 libraries benefited from the processing of 9,000 serial subscriptions worth \$4.4 million. A revamping of the network's exchange program will save \$200,000 when the process is complete.

Management of information also



Visiting students test the sugar content of a solution at the Adelaide CSIRO Science Education Centre

benefited from more effective records disposal and preservation methods and more enhancements to on-line searching of CSIRO and overseas electronic databases.

The National Information Network handled over 30,000 enquiries from industry and the general public.

Science and careers education CSIRO's Double Helix Club continues to grow. Membership rose from 12,000 to 15,000, and the circulation of its magazine *The Helix*, now in a new 36-page full-colour format, has jumped to over 25,000.

Part-time Double Helix Club officers in each capital city ran 287 'events' — presentations, excursions and laboratory visits. In addition, 25 regional chapters of the Club stage events outside capital cities. There are also over 200 school groups of the Club. BHP sponsorship of \$150,000 a year has been gained for a further two years and Double Helix is continuing with its national experiments supporting CSIRO research programs. The Club presented hourly science shows on the CSIRO stand at the Royal Easter Show in Sydney.

CSIRO Science Education Centres (CSIROSECs) now operate in all capital cities except Canberra. Visitors were mainly school groups, but more in-service courses are being conducted for teachers to develop skills in presenting hands-on science in the classroom. With support from IBM, the CSIROSECs made tours to non-metropolitan centres in four states.

The CSIRO Student Research Scheme will operate nationally, thanks partly to sponsorship from the Institution of Engineers and the Department of Industry, Technology and Commerce. Over 220 students worked for six months with scientists on research projects related to the scientists' real work. CSIRO provided most of the scientists who took on this extra task but many other institutions were also involved.

The 1990 BHP Science Awards, jointly organised by CSIRO and BHP, attracted over 600 student entries and many strong teacher submissions. More than 300 prizes were awarded.

The CSIRO Women in Science Project continued to operate at a low level. The Project will ultimately be replaced by a program aimed at all students. A careers pamphlet has been produced.

The CSIRO Equal Employment Opportunity Scholarships continue to provide financial support for two years' schooling and 12 months' employment for four Aboriginals in Townsville and four disabled students in Adelaide.

A poster and activities page about radioastronomy were produced by the Science and Careers Education group, CSIRO Public Affairs and the Division of Radiophysics. They were published and distributed in over 700,000 copies of the Sydney *Sunday Telegraph* in April. Posters on other subjects are planned.
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 3-8, 20-21 and 51-69);
- 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 77-96);
- the Auditor-General's report on these statements (see page 78).

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

Science and Industry Endowment Fund

In 1990–91, fourteen grants totalling \$11,550 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 through amateur naturalists to school science 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, five Fellowships were awarded in 1990–91, totalling \$145,562. They were given to support eminent overseas scientists selected to work for a period in CSIRO Divisions in furthering research in animal health, horticulture and water resources.

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 p50.

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 1991, CSIRO received 11 requests under the *Act*. Of these, four requests were granted in full, two were granted in part, two were withdrawn and three were refused.

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

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 225 DICKSON ACT 2602

Appendix 1: CSIRO Research Programs for 1990-91

INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING Division/Unit

Animal Health Control of bacterial diseases Control of parasitic infections Plant associated toxins Avian diseases International aid consultancies Australian Animal Health Laboratory Diagnosis and epidemiology of exotic diseases New approaches to disease diagnosis Molecular virology and vaccine development Animal Production Sustainable and productive grazing systems Efficiency of the rumen ecosystem Minerals and nutrition Reproductive technologies Sheep breeding Wool biology Growth and stress Food Processing Value-added products Process technology Meat quality Technical services Energy management Abattoir operations Dairy research Industry and consumer liaison Microbiology and food components Process engineering and preservation technology Sensory studies Human Nutrition Diet, heredity and high blood pressure Regulation of protein and energy metabolism Influence of dietary fats on heart function Social nutrition, epidemiology and health Nutritional control of cardiovascular disease Nutrition and cancer

Tropical Animal Production Immunology, epidemiology and pathogenic significance of indigenous viruses Ticks and tick-borne diseases of cattle Cattle genetics and reproduction Improving growth in tropically adapted cattle Animal nutrition Fly vaccines Molecular parasitology Wool Technology Wool product technology Wool processing technology Raw wool marketing Sheepskin processing Systems development INSTITUTE OF INDUSTRIAL TECHNOLOGIES Division/Unit **Applied Physics** Electrotechnology Applied electricity and magnetism Plasmas, thin films and thermometry Acoustics and mechanics Optical technology **Biomolecular Engineering** Protein structure Protein engineering Gene structure and regulation Virus replication and assembly Cell surface receptors and cytokines Biomaterials and biosensors Recombinant vaccines and disease control Chemicals and Polymers Fine chemicals Industrial chemicals Polymers Water and wastewater treatment Pharmaceutical chemicals Manufacturing Technology Manufacturing processes and materials Integrated manufacture Materials Science and Technology Alloys research Ceramics Solid state science Advanced materials synthesis

INSTITUTE OF INFORMATION SCIENCE AND ENGINEERING Division/Unit

Australia Telescope National Facility Astrophysics Information Technology High performance computing and communications Knowledge-based systems Spatial information systems Mathematics and Statistics Applied and industrial mathematics Applied and industrial statistics Signal and image analysis Computing, software and networks Radiophysics Signal and imaging technology Ultrasonics Solid-state devices Electromagnetics and optics Industrial projects COSSA Space-related science and engineering

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION Division/Unit

Building, Construction and Engineering Construction materials Engineered products and services Structural engineering Planning and management systems Fire technology Coal and Energy Technology Coal preparation, storage and transport Coal characterisation and structure Coal combustion Alternative fuels Environment protection and monitoring **Exploration Geoscience** Exploration Geomechanics Metalliferous mining Civil engineering Oil and gas extraction Geophysics Coal mining Coal bed methane

Mineral and Process Engineering Mineral characterisation and beneficiation Basic metal products Mineral Products Energy use and systems management Industrial minerals Advanced materials

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT Division/Unit

Atmospheric Research Global atmospheric change Atmospheric pollution and bushfire meteorology Radiation and climate Water resources **Environmental Mechanics** Physical ecology Micrometeorology Soil physics Physical limnology Applied mechanics Fisheries Population dynamics and fish stock assessment Phytoplankton resources South and southeast fisheries resources North and northeast fisheries resources West and northwest fisheries resources Biological oceanography Environmental management and protection Oceanography Climate Environment Resources Technology Water Resources Water balance studies for determining the hydrologic consequences of catchment land use Hydrologic processes at a regional scale Estimation of the impacts of contaminants and salts within hydrologic systems Management of water and salinity in irrigated areas Pollution and conservation of surface waters Water resources policy and management systems

Appendixes

Wildlife and Ecology
Ecology and management of arid and
semi-arid rangelands
Ecology and conservation management
of tropical forests and savannas
Biology, ecology and management of
Australia's fauna and vertebrate pests
Ecology and conservation of temperate
forests and woodlands
Decision support systems for natural
resources management
TRICITY THE OF DY ANT DRODY COTTON
INSTITUTE OF PLANT PRODUCTION
AND PROCESSING
Division/Unit
Entomology
Taxonomy and general biology
Stored grain research
Pathology and benaviour
Insect pests of livestock and humans
Insect pests of plant and timber
Molecular biology and physiology
Biological control of weeds
Forestry and Forest Products
Softwood plantations
Australian tree resources
Hardwood plantations
Fibres and chemicals
Wood science and technology
Horticulture
Crop improvement/biotechnology
Crop environment interaction
Post-harvest horticulture
Molecular crop improvement
Plant Industry
Sustainable pasture systems
Photosynthesis and plant productivity
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
Soil organisms and plant growth
Properties and distribution of Australian soils
Tropical Crops and Pastures
Crop improvement and management
Pasture management and livestock
production
Pasture plant improvement
Agricultural systems and land resource management
Applications of biotechnology 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. 34002) or by consulting the CSIRO Index on the AUSTRALIS database.

Corporate publications during the year have included:

- CSIRO Annual Report 1989-90;
- CSIRO Research Program Directory 1990;
- CSIRO's Contribution to the Nation;

- Australian Science, Australia's Future (insert to the *Financial Review*);
- *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. 5: *The Australian beef industry: facing up to the future;*
- CSIRO Data Book;
- CSIRO priority determination 1990 – methodology and results overview;
- CSIRO priority determination 1990 – role statements.

In brief

CSIRO's audited financial statements for the year are presented on the following pages.

The total revenue earned by CSIRO amounted to \$604m (1990 \$521m).

Of this amount, \$414m (69 per cent) came from funds appropriated directly to CSIRO by Parliament. Another \$168m (28 per cent) revenue came from research activities and user charges, mainly from industries and government agencies. The remaining \$22m (3 per cent) came from other revenue such as sale of publications, profit on sale of non-current assets, interest and royalties earned and contributions from the Department of Primary Industries and Energy for its half-share of the operation of the Australian Animal Health Laboratory.

The year's total expenditure for salaries and general operating expenses was \$524m (1990 \$466m).

Australian National Audit Office Medibank House Bowes Street Woden ACT 2606

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION AUDIT REPORT ON FINANCIAL STATEMENTS

I have audited the financial statements of the Commonwealth Scientific and Industrial Research Organisation for the year ended 30 June 1991 in accordance with the Australian National Audit Office Auditing Standards, which incorporate the Australian Auditing Standards. The statements comprise:

- statement of activity;
- statement of capital accumulation;
- statement of financial position;
- statement of sources and applications of funds;
- notes to and forming part of the financial statements and
- · statement by Board members

In accordance with sub-section 51(1) of the *Science and Industry Research Act* 1949, I now report that the attached 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;
- the statements show fairly the financial transactions for the year ended 30 June 1991 and the state of affairs of the Organisation 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 Guidelines for Financial Statements of Commonwealth Entities which require compliance with Statements of Accounting Concepts and applicable Accounting Standards.

P. U. Fanelly

P A Farrelly Group Director Australian National Audit Office CANBERRA 25 November 1991

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

Statement of activity for the year ended 30 June 1991

	Notes	1991 \$'000	1990 \$'000
Operating revenue			
Parliamentary appropriations Parliamentary appropriations for capital		414 360	375 161
items transferred to statement of capital accumulation	1.4	15 457	12 154
	-	398 903	363 007
Other revenue Revenue from research activities and	2	21 547	18 312
user charges	1.13	167 825	128 477
Total operating revenue		588 275	509 796
Operating expense Research programs			
Animal Production and Processing		112 349	98 419
Industrial Technologies		73 008	64 077
Information Science and Engineering		28 148	24 462
Minerals, Energy and Construction		79 981	71 414
Natural Resources and Environment		71 607	58 128
Plant Production and Processing		107 363	93 187
Research support		39 335	46 129
National facilities		12 695	9 809
		524 486	465 625
Operating surplus before			
abnormal items		63 789	44 171
Abnormal items	4	430	9 759
Operating surplus (deficit) before unfunded charges		64 219	53 930
Aggregate amount of unfunded charges	5	47 062	50 979
Operating surplus		17 157	2 951
Accumulated deficits at beginning of financial year	1.4	(76 467)	(79 418)
Accumulated deficits as at 30 June		(59 310)	(76 467)

The accompanying notes form part of these statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

Statement of capital accumulation for the year ended 30 June 1991

	Notes	1991 \$'000	1990 \$'000
Balance at beginning of financial year	1.4	735 574	699 158
Parliamentary appropriations for capital items transferred from statement of activity	1.4	15 457	12 154
Assets received free of charge	1.5	2 350	24 262
Balance as at 30 June		753 381	735 574

The accompanying notes form part of these statements.

Finance

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION Statement of financial position as at 30 June 1991

1990 \$'000
75 038
20 048
95 086
2 205
738 476
741 871
836 957
79 484 41 620
121 104
56 746
177 850
659 107
735 574
(76 467)
659 107

The accompanying notes form part of these statements.

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

Statement of sources and applications of funds for the year ended 30 June 1991

	Notes	1991 \$'000	1990 \$'000
Sources of funds	Notes	\$ 000	4 000
Funds from operations Inflow of funds from operations	13	407.005	400 477
Revenue for research activities and user charges Other revenue		167 825	128 477 17 962
Proceeds from sale of non-current assets Parliamentary appropriations — Recurrent		6 289 398 903	5 924 363 007
		591 916	515 370
Outflow of funds from operations		527 697	473 102
		64 219	42 268
Parliamentary appropriations – capital items Assets recieved free of charge	1.4 1.5	15 457 2 350	12 154 24 261
Reduction in assets Current assets			
Cash		63 494	_
Non-current assets Property, plant and equipment		4 683	11 731
Investments		385	150
Increase in liabilities Current liabilities Creditors		_	15 131
Total sources of funds		150 588	105 695
Applications of funds			
Increase in assets Current assets			
Cash Beceivables		85 021	35 644
		05 021	1 300
Non-current assets Property, plant and equipment		53 938	66 856
Investments		599	1 629
Decrease in liabilities Current liabilities			
Creditors		11 030	
Total applications of funds		150 588	105 695
The accompanying notes form part of	f these sta	atements.	======

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH
ORGANISATION
Notes to and forming part of the financial statements

	Note Number	Page Number
Summary of Significant Accounting Policies	1	84
Other Revenue	2	88
Operating Surplus	3	88
Abnormal Items	4	88
Unfunded Charges	5	89
Cash	6	89
Receivables	7	89
Investments	8	90
Property, Plant and Equipment	9	91–92
Creditors	10	92
Provisions	11	92
SIROTECH Ltd	12	92
Sources and Application of Funds	13	93
Commitments	14	93
Resources Provided Free of Charge	15	94
Monies Held in Trust	16	94
Contingent Liabilities	17	95
Auditor's Remuneration	18	95
Board Members' Emoluments	19	95

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION

NOTES TO AND FORMING PART OF THE FINANCIAL STATEMENTS

Note 1 Summary of significant accounting policies

1.1 Basis of accounting

The financial statements have been prepared in accordance with the Guidelines for Financial Statements of Commonwealth Entities approved by the Minister for Finance, and comply with accounting standards issued by the Australian accounting bodies.

Except where stated, the financial statements have been prepared on an accrued basis using historical costs. The accounting policies adopted are consistent with those of the previous year.

1.2 Property, plant and equipment

Except where stated, all property, plant and equipment are valued at historical cost. The capitalisation threshold limit is \$3 000. Assets costing less than the threshold limit of \$3 000 were expensed in the year of purchase.

The valuation of buildings and leasehold improvements was performed by the Department of Housing and Construction and CSIRO officers in June 1986. Building valuation includes plant, fixtures and fittings which form an integral part of the building.

Land has been valued by CSIRO's registered valuer in June 1986. Computer software, scientific glassware, experimental prototype equipment, and library monographs and serials are not capitalised as fixed assets owing to either their uncertain useful lives or the uncertainty of benefits to be derived from their development.

Property, plant and equipment totalling \$7 130 551 (1990 \$7 755 068) which are purchased from sponsored research funds and where their sale proceeds are refunded to the sponsors under the terms of the sponsorship agreements, have been expensed during the year of purchase. Separate records for these assets have been maintained and are disclosed in Note 15.

1.3 Depreciation and amortisation

Depreciation on plant and equipment, except land, buildings and leasehold improvements, is calculated on a straight line basis, so as to write off their cost or valuation less estimated residual value progressively over their estimated useful lives.

The valuation or cost of buildings and leasehold improvements is depreciated/amortised over their estimated useful lives or the unexpired period of the leases, whichever is the shorter.

1.4 Capital accumulation and accumulated deficits In accordance with the 'Guidelines for the Financial Statements of Commonwealth Entities' issued by the Department of Finance in June 1990, prior years' capital accumulations have been restated to disclose 'Capital Accumulations' and 'Accumulated Deficits' separately . Accumulated Deficits as at 1 July 1990 represent four years' accumulated deficits since the introduction of accrural accounting in 1987. Operating surpluses or deficits prior to 1987 were reflected in the balance of Capital Accumulation when accrual accounting was adopted. The parliamentary appropriations for capital items represent Appropriation Bills 2 and 4 which are essentially for capital works and services and major items of equipment over \$250,000.

1.5 Assets received free of charge

During the year buildings valued at \$2 350 000 have been transferred from the Victorian Government to CSIRO free of charge. Last year land and buildings owned by the National Building Technology Centre and plant and equipment owned by the Ultrasonics Institute of the National Acoustic Centre valued at \$ 23 701 000 and \$560 400 respectively were transferred to CSIRO when the Commonwealth amalgamated their activities with CSIRO.

1.6 Consumable stores

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

1.7 Employee entitlements

Provisions for recreation and long service leave are calculated by multiplying the leave entitlements of employees by their current pay rates. Long service leave is provided for those employees with more than five years service.

1.8 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 eligible employees. 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.

The amount of employer contributions paid in respect of 1991 was \$33 733 292 (1990 \$30 730 880) representing 14.6% (1990 15.4%) of superannuable salaries.

An actuarial review was performed during the year and an interim rate of 14.6% (excluding the 3% productivity superannuation benefit) was

applied from 1 July 1990. The rate was based on an estimate of the percentage of CSS members expected to transfer to the PSS scheme. From 1 July 1990 CSIRO had periodically met its liability for the 3% productivity superannuation benefit on a pay as you earn basis to Commonwealth PSS, CSS and other approved superannuation schemes.

1.9 Investments

Interest in companies (including associated companies) other than SIROTECH Ltd (Note 12) are shown as investments at cost or Board Members' valuation (Note 8). Associated companies are companies in which CSIRO exercises significant influence by holding shares and participating in financial and operating policies.

1.10 Research and development

Research and development costs are expensed as incurred, except where benefits are expected, beyond any reasonable doubt, to equal or exceed those costs.

1.11 Finance and operating leases

CSIRO has elected not to account and disclose finance and operating leases because the amount involved is not material. This is in accordance with the Australian Accounting Standard AAS 17 'Accounting for Leases' (Paragraph 23).

1.12 Sponsored research

CSIRO has entered into various agreements with external parties for the research and development of technologies, products and scientific know-how. Details of the ownership of intellectual properties vary from agreement to agreement. These agreements do not involve sharing in common of liabilities and interests in assets, other than assets represented by intellectual properties to which CSIRO does not attribute any value in the accounts.

All costs incurred on research and development under the terms of the agreements have been expensed in accordance with Note 1.10 above. Where CSIRO received licensing fees and/or royalties from sale of products or technologies developed under agreements, these have been brought to account when earned.

1.13 Revenue from research activities and user charges

Revenue from research activities and user charges represents revenue received from sources outside Parliamentary Appropriations and includes interests earned of \$7 972 478 (1990 \$7 102 415) on revenue from external sources. Research revenue received in advance represents unearned revenue and research debtors represent revenue earned but not yet received by CSIRO.

1.14 Foreign currency

Revenue and expenditure relating to overseas transactions are converted to Australian currency at the exchange rates prevailing at the dates of transactions and all foreign currency balances are converted to Australian currency at the exchange rate prevailing at balance date. Non-current assets are converted at exchange rates at the dates of acquisition or covered by fully hedged contracts.

1.15 Workers' compensation

CSIRO's workers' compensation liability is covered by COMCARE.

1.16 Reporting by segments

CSIRO principally operates in the field of scientific and industrial research and development in Australia. It is therefore considered that for segment reporting, it operates in one industry and one geographical location.

1.17 Insurance

CSIRO has adopted a risk management policy and taken out external insurance for selected liabilities.

1.18 Income tax CSIRO is not subject to income tax.

1.19 Comparative figures

Where applicable, prior year comparative figures have been restated to reflect the current year's format of financial statements.

Note 2 Other revenue			
		1991	1990
		\$'000	\$'000
Department of Primary Industries and			
Australian Animal Health Laboratory		5 307	4 878
Interest		3 712	4 236
Rovalties		1 967	2 066
Sale of publications		2 366	1 999
Sale of produce and livestock		833	744
Profit on disposal of non-current assets		2 648	350
Miscellaneous		4 714	4 039
		21 547	18 312
		======	======
Note 3 Operating surplus			
	Notoo	1991	1990
	notes	\$ 000	\$ 000
Operating surplus has been determined after charging as expense:			
Loss on sale of non-current assets		1 042	4 456
Wages and salaries		267 384	240 386
Long service and recreation leave			
paid in lieu		9 145	8 784
Superannuation	-	41 082	31 688
Unfunded charges	5	47 062	50 979
Note 4 Abnormal items			
		1991	1990
		\$'000	\$'000
Prior period net adjustment relating to		015	(1.0.40)
Change in legislation on the 3% Commonwealth		815	(1 343)
Superannuation funding (Note 1.8)		_	11 662
Land associated with the sale and write-off of			
investment		(385)	(560)
		430	9 759
		=====	=====

Note 5 Unfunded charges	1991 \$'000	1990 \$'000
Provision for long service leave Provision for recreation leave Provision for superannuation benefit Provision for doubtful debts Provision for diminution in value of shares Depreciation	6 597 3 969 (948) 75 500 36 869	5 741 4 477 6 201 181 34 379
	47 062	50 979 ======
Note 6 Cash	1991 \$'000	1990 \$'000
Cash at bank and on hand Deposits at call	9 800 1 744	74 803 235
	11 544 ======	75 038 =====
Note 7 Receivables	1991 \$'000	1990 \$'000
Bank endorsed bills and treasury notes Research debtors Advances — SIROTECH Ltd — Other Other debtors Prepayments	77 549 18 251 1 031 390 1 650 6 473	13 418 300 136 1 264 5 205
Provision for doubtful debts	105 344 350	20 323 275
	104 994 ======	20 048

Note 8 Investments (Note 1.9)			
	%CSIRO	1991	1990
Shares — at cost	interest	\$ 000	\$ 000
Other		8	6
Shares — at Board members' valuation			
Associated companies			
Australian Magnet Technology Pty Ltd		_	275
Bio-Coal Briquette Pty Ltd	17.2	88	80
Gene Shears Pty Ltd	34.7	501	500
Dunlena Pty Ltd	45.2	386	365
Preston Group Ltd	20.7	495	495
Gropep Pty Ltd	50.0	1	1
Other companies			
Austek Microsystems Pty Ltd		_	100
Incor Ltd		_	10
Queensland Metals Corporation NL		1 867	1 303
Mineral Control Instrumentation Ltd		260	260
Debentures and unsecured notes-at cost		3	—
		3 609	3 395
Provision for diminution in value		500	_
		3 109	3 395
		======	======

Mineral Control Instrumentation Ltd and Queensland Metals Corporation N.L. are public listed companies. As at 30 June 1991 the total market values of these quoted shares were \$272 000 and \$3 758 541 respectively.

CSIRO is a minority shareholder (less than 5%) in 'Other companies' listed above. Shares in Austek Microsystems Pty Ltd and Incor Ltd have been written down during the year to \$10 each.

Note 9 Property, plant and equipment (Notes 1.2 and	d 1.3)	
	1991	1990
	\$'000	\$'000
Land (a)		
At cost	5 820	4 569
At valuation	94 750	94 750
	100 570	99 319
Buildings	10.000	10 700
At cost	46 360	43 / 33
At valuation	460 741	438 478
	507 101	502 211
Accumulated depreciation	(80 407)	(63 343)
	426 694	438 868
Work in progress — at cost	7 869	942
	404 500	400.010
	434 563	439 810
Leasehold improvements		
At cost	894	894
At valuation	17 180	17 485
	18 074	18 379
Accumulated amortisation	(7 227)	(6 091)
	10 847	12 288
Plant and equipment		
Equipment — at cost	233 012	204 043
Research vessel 'Southern Surveyor' — at cost	16 753	14 777
	249 765	218 820
Accumulated depreciation	(99 378)	(87 470)
	150 387	131 350
National facilities		
Oceanographic research vessel 'Franklin' — at cost	14 775	14 622
Australia Telescope — at cost	49 320	48 1/1
	64 095	62 793
Accumulated depreciation	(9 600)	(7 084)
	54 495	55 709
Total property, plant and equipment	750 862	738 476
rotal property, plant and equipment	=======	=======

(a) Includes Crown land and land held in Commonwealth title totalling \$12 075 000 (1990 \$12 075 000). Negotiations are continuing between CSIRO, the Commonwealth Govern-ment and ACT Government to have leases issued in CSIRO's name.

Finance

Note 9 Property, plant and equipment (cont'd)		
	1991	1990
	\$'000	\$'000
Total property, plant and equipment (Summary)		
At cost	374 803	331 751
At valuation	572 671	570 713
	0/2 0/1	010110
	947 474	902 464
Accumulated depreciation and amortisation	(196 612)	(163 988)
Accumulated depreciation and amonisation	(100 012)	(100 000)
Total written down value	750 862	738 476
Total written down value	750 002	
Nata 10. Oraditaria		
Note 10 Creditors	1001	1000
	1991	1990
	\$'000	\$'000
Accrued expenses	8 920	7 797
Trade creditors	6 193	13 895
Research revenue received in advance	53 341	57 792
	68 454	79 484
	======	======
Note 11 Provisions for employee entitlements		
(Notes 1.7 and 1.8)	1991	1990
	\$'000	\$'000
Current		
Provision for recreation leave	36 903	32 934
Provision for long service leave	8 530	7 738
Provision for superannuation benefits		948
	45 433	41 620
Non-current		
Provision for long service leave	62 551	56 746
	107 984	98 366

Note 12 SIROTECH Ltd

SIROTECH Ltd was established by CSIRO, is limited by guarantee and governed by a Board of Directors who are also Board members of CSIRO. It was incorporated on 15 November 1984. SIROTECH's main source of revenue comes from service fees paid by CSIRO to cover day to day commercial and intellectual property advice. During the year fees received from CSIRO totalled \$3 930 130 (1990 \$3 428 030). SIROTECH's net assets as at 30 June 1991 amounted to \$738 056 (1990 \$727 196). Having considered SIROTECH's commercial activities and its immaterial effect on CSIRO's financial statement, CSIRO has, in accordance with the Australian Accounting Standard, AAS24 (paragraph 16), elected not to consolidate its accounts.

Finance

Note 13 Sources and application of funds

	Notes	1991 \$'000	1990 \$'000
Reconciliation of operating result with funds from operations:	Notes	000	¢
Operating Surplus Add: Unfunded charges	5	17 157 47 062	2 951 50 979
		64 219	53 930
Less: Change in legislation on 3% Commonwealth superannuation funding		_	11 662
Funds from operations		64 219	42 268
Note 14 Commitments Commitments for expenditure not brought to account in the statement of financial position as at 30 June	nt 1991 were:		
		1991 \$'000	1990 \$'000
Capital Property, plant and equipment		18 770	3 607
Lease Plant and equipment		9 819	12 091
Other Service contract		1 510	2 013
		30 099	17 711
Due and Payable:			
Not later than one year		18 991	6 637
Later than two years but not later than two years		6 585	3 148
		30 099	17 711

	Land (a) \$'000	Buildings \$'000	Plant and equipment \$'000	Total 1991 \$'000	Total 1990 \$'000
At valuation or cost Accumulated	22 754	22 998	39 858	85 610	72 350
depreciation	_	4 034	15 850	19 884	17 211
	22 754	18 964	24 008	65 726	55 139

Note 15 Resources provided free of charge (Note 1.2)

(a) Includes lands \$10 766 293 (1990 \$10 816 000) which have been purchased out of sponsored research monies and are in CSIRO titles. In accordance with the sponsored research agreements, any sales proceeds from disposal of these assets shall be refunded to the sponsors.

Note 16 Monies held in trust

Trust funds are represented by the following investments at cost and cash at bank:

Investments	1991 \$'000	1990 \$'000
St George Building Society	104	80
State Electricity Commission of Victoria	12	12
Canberra Advance Bank	186	303
Commonwealth Bank of Australia	2 350	2 143
Westpac Banking Corporation	15	20
	2 667	2 558
Cash at bank	90	177
	2 757	2 735
	=====	======
The components of trust funds are as follows:		
William McIlrath Trust Fund	191	167
David Rivett Memorial Lecture Fund	74	82
FD McMaster Bequest	2 356	2 379
Sir Ian McLennan Achievement for Industry Award	136	107
	2 757	2 735
	=====	======

Note 17 Contingent liabilities

Contingent liabilities for which no provision has been provided in the accounts as at 30 June 1991 were:

a) Performance quarantee	1991 \$'000 143	1990 \$'000
 b) Estimated common law claims which are pending but not admitted and will be defended. 	1 200	870
	1 343	870

Note 18 Auditor's remuneration

The total amount paid and payable to the Commonwealth Auditor-General for the audit of CSIRO amounted to \$366 740 (1990 \$204 910). No other benefits were received by the Auditor-General.

Note 19 Board members' emoluments

Emoluments or other benefits received or due and receivable directly or indirectly by fulltime and part-time Board members were as follows:

	1991 \$'000	1990 \$'000
Full-time members Part-time members	208 124	243 117
	332	360

The number of Board members whose total emoluments (including 3% superannuation, recreation and long service leave payouts on termination) fall within the following bands were as follows:

\$	1991 Number	1990 Number
1— 10 000	1	—
10 001— 20 000	7	8
20 001— 30 000	1	1
40 001- 50 000	_	1
200 001—210 000	1	1

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 1991;
- the operating result for the year ended 30 June 1991; and
- the sources and applications of funds for the year ended 30 June 1991.

The statements have been made out in accordance with Statements of Accounting Concepts and applicable Accounting Standards.

Signed at Canberra this nineteenth day of November 1991 in accordance with a resolution of the Board Members.

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Neville K. Wran Chairman

John W. Stocker Chief Executive and Board Member

Index

agriculture/CSIRO research biological control agents, 25 cattle, 27-28, 37-38 dairy products, 38 pigs, 28 poultry, 38 sheep, 26 trees viticulture, 26 wool dyeing, 35 air quality Sydney, 40-41 atmospheric sampling, 43 auditor's report, 78 AUSPIG, 28 AUSSAT satellites, 39 Australia Telescope National Facility (ATNF), 46 Australian Animal Health Laboratory (AAHL), 27 Australian Broadcasting Corporation (ABC), 66 AUSTRALIS database, 22, 76 award restructuring, 4, 7, 63, 64, 65 awards, 28, 49-50, 68 BCAider, 45 biological control agents, 25 bioremediation, 42 blowfly vaccine, 28 careers in science, 1, 4, 67-69 cattle calving rate, 27-28 Chairman's foreword, 3-5 Chairman's Medal, 4 Chief Executive's review, 6-8 child care, 4, 62, 64 climate change, 40 Contribution to the nation, 66 Co-operative Research Centres (CRCs), 4, 47 CSIRO Directory of Research Programs, 22, 76 **CSIRO** audit, internal, 60 charter, 9 communication, 66-69 company interests, 19 corporate development, 58-62 financial statements, 77-96 functions, 9 funding, 4, 7-8, 54, 60 goals & objectives, 20-21 human resources development, 63-65 information and library services, 67 legal services, 60-61 management information systems, 61 mission, 20

organisational structure, 12, 14–15 planning, 55–57 powers, 9 property, 5, 7–8, 61–62 publications, 67, 76 staff *see* separate heading Strategic Plan, *3*, 6, 55, 56 structure, 13 technology transfer, 51–53

disabled assistance, 64, 72 Double Helix Club, 5, 67–68

Ecologically Sustainable Development Working Groups, 6 Environmental Decision Support System (EDSS), 41-42 environmental research see research, environment Equal Employment Opportunity, (EEO), 63– 64, 65 scholarships, 68–69

forest industry mediation, 41 Freedom of Information (FOI), 72

GASLAB, 43 genetic engineering, 26, 38, 66 Grants for Industry Research and Development (GIRD), 34, 39 Greenhouse Effect, 40, 43 groundwater salinity, 42–43

imaging spectrometer, 44 industrial relations, 7, 65 Industrial Relations Commission (IRC), 7, 63 industry/CSIRO research, 4, 6, 53 building, 45 chemicals, 37 cholesterol lowering fats, 36-37 coal mining, 31, 32 coin production, 33 colour imaging, 37, 39 CSIRO company interests, 19 diamonds, 29-30 diecasting, 37 energy needs, 66 fine chemicals, 37 food packaging, 35-36 forest industries mediation, 41 gears, 34-35 mine safety, 30 natural gas, 29, 31 oil, 29 pulp mill effluent, 44 rayon manufacture, 37

Index

Sirosmelt technology, 32 Ultra Microhardness Indentation System (UMIS), 37 use of business managers, 53 vision processor, 33–34 welding, 34 wool dyeing, 35 international meetings, 46 international relations, 48

Land and Water Care Program, 6 letter of transmittal, 1 Linola, 25

Mobilesat, 39 molecular biology, 25–26

NUMBAT, 30

Occupational Health and Safety (OHS), 64 oil fuel alternative, 31 Optical Surface Profiler (OSP), 33 ozone layer, 43

Parallel Image Processing and Display Systems (PIPADS), 39 Parliament, Federal Inquiry into Genetically Modified Organisms, 6 patent applications, 11 pig industry aid for decision-making, 28 plant diseases, 25-26 pollution air, 40-41 water, 42 Prime Minister's Science Council, 6 Project Ambassador, 6, 66 Public Accounts Committee, 6 public relations, 6, 66, 67, 69 see also Project Ambassador publications, 67, 76 publicity see public relations

Quantum, 66

Radio Imaging Method (RIM), 31 rangelands research, 43 remote sensing, 32 research see also CRCs achievements & activities, 22–46 environmental, 28, 40–44, 56 expenditure, 4, 58–59 information and communications, 39, 56 infrastructure, services and advancement of knowledge, 45–46 listing on AUSTRALIS, 22

manufacturing, 33-38, 56 minerals & energy, 29-32, 56 objectives, 20-21 priorities, 3-4, 6-7, 55-56 programs, 73-75 rural, 25-28, 56 tax deductibility, 8 vessels, 28 salinity, 42 satellite information, 44 schools science education, 68 student assistance, 64 Science Education Centres, 5, 68 see also Double Helix Club sheep bluetongue virus, 26 international trade, 26 SIRO-MED, 41 SIROTECH, 4, 12, 16, 19, 51-52 smog, 40-41 spatial information systems, 39 staff, 12 Consultative Council, 65 development, 63, 64-65 Enhanced Merit Promotion Scheme, 63 numbers, 11 Performance Planning and Evaluation (PPE), 4, 7, 63 salaries, 7, 63 senior staff, 16-18 training, 63, 64 statutory reporting requirements, 70 Strategic Plan, 3, 6, 55, 56 sustainable development, 1, 4

Tasmanian Earth Resources Satellite Station (TERSS), 44 tax deductibility research and development, 8 technology transfer, 51–53 *Trees for Rural Australia*, 28 Tropical Remote Sensing Unit, 43–44 trust funds, 71

unions, 63

viticulture, 26 volcanic ash detector, 45–46

weed and pest control, 25, 28 women in science, 68 worms chemical treatment, 28

