

Operational Plan

1989–90



**COMMONWEALTH SCIENTIFIC AND INDUSTRIAL
RESEARCH ORGANISATION**

**OPERATIONAL PLAN
1989-90**

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1. INTRODUCTION

1.1 THE CSIRO PLAN

The CSIRO Plan comprises three interrelated CSIRO planning documents.

The first is the **Strategic Plan** which is required by law and sets out CSIRO's broad objectives together with a broad outline of the policies and strategies to be pursued by the Organisation to achieve those objectives. It will cover the key performance areas of research, technology transfer, funding, human resource development, communications and corporate development. The Strategic Plan accordingly provides the framework for detailed planning and budget allocations at the Corporate/Institute/Division levels. It is a public document widely disseminated among government and business leaders and organisations associated with the operation of CSIRO. It is proposed that the current Strategic Plan, covering the period 1988 to 1992, will be superseded in 1990 to cover the period to 1996.

The second is the three-year **Corporate Management Plan** which is prepared for the internal use of corporate managers to meet the requirements of the Commonwealth budget cycle. It will be prepared annually on a three year rolling basis and will present strategies and actions for each key performance area in the light of the proposed budget and its allocation for each of the planning period covered.

The broad directions for CSIRO's research are shaped by the Board, the Chief Executive and the Directors of the Organisation's six research Institutes and given expression through the Strategic Plan and Corporate Management Plan.

The annual **Operational Plan** is the third of the three corporate-level planning documents. It meets the requirements of section 35 of the Science and Industry Research Legislation Amendment Act 1986 for CSIRO to formulate an annual operational plan. It gives effect to the Strategic Plan in a particular year and its preparation is the responsibility of the Chief Executive. The Corporate level operational plan integrates the programs/projects of the Organisation and presents projected outcomes. It sets out details of:

- . the strategies the Organisation proposes to pursue;
- . the activities the Organisation proposes to carry out; and
- . the resources the Organisation proposes to allocate to each such activity.

A related document is the **CSIRO Directory of Research Programs**. Published each financial year, it provides a detailed, non-technical account of research in progress. It emphasises the purpose of the research and the main Australian beneficiaries. A further level of detail is maintained on the Organisation's research management information system, a significant subset of which is publicly available through AUSTRALIS.

1.2 CORPORATE OBJECTIVES AND STRATEGIES

As expressed in the **CSIRO Strategic Plan 1988-92**, CSIRO has three crucially important strategic goals:

Strategic Goals

Carry out strategic research which can be applied by Australian industry or by Government for community benefit;

Collaborate with other institutions and industry to strengthen the research effort and ensure the transfer and application of that research; and

Lead and promote an expanded science and technology effort in Australia.

To achieve these objectives CSIRO will continue to support Australian industry and the community through a broad spectrum of multi-disciplinary research.

The corporate goals as expressed in the CSIRO Corporate Management Plan 1988-91 are as follows:

Corporate Goals

Research Priorities and Funding

Strengthen mechanisms for determining research priorities and resource allocation across the Organisation in order to maximise the contribution of CSIRO research to national economic and community benefit.

Research Sectors

Enhance the efficiency, international competitiveness, and growth of Australia's industries: information and communications, manufacturing, minerals and energy, rural production and processing, and construction.

Provide the scientific knowledge required for the effective management and conservation of Australia's natural resources and environment.

Improve human wellbeing and community health in Australia.

Research Management Support

Provide support to facilitate the conduct of efficient and effective research by the Organisation.

In pursuing these goals the Organisation has identified six key areas in which it will be assessing its performance. These are:

- Research
- Technology Transfer
- Funding
- Communication
- People Management
- Corporate Development

The activities in each of these areas are dealt with in detail throughout the body of this document. In particular activities in the areas of research, funding and technology transfer are primarily found in sections 2-8 and 10, whilst activities in communication, people management and corporate development are primarily found in section 9.

Major strategies for each of these areas are contained in the body of the document. Corporate-level strategies and activities are briefly summarised below:

Corporate Strategies/Activities

Research

Articulate CSIRO scientific research priorities in accordance with stated and perceived national priorities;

Determine strategic directions for CSIRO for inclusion in the Strategic Plan for the 1990-95 period.

Technology Transfer

Demonstrate increased adoption by industry and the community of the results of CSIRO research;

Release CSIRO's new commercialisation policy; and

Seek to increase income from intellectual property in real terms.

Funding

Seek to increase the percentage of non-appropriation funds in the total CSIRO budget consistent with a 30% target by June 1991;

Seek to influence the Government to at least maintain the Organisation's appropriation budget in real terms (relative to 1988-89) in accordance with the recent Cabinet decision; and

Seek to increase the value of research contracts in real terms during 1989-90.

Communication

Produce and release initial communication planning documents - Promotional Communication Plan, Internal Communication Plan and an Industry/Stakeholders Communication Plan;

Update and release CSIRO policy concerning public statements by CSIRO employees; and

Prepare a major environmental display at the Environment 90 Exhibition (Darling Harbour, Sydney) and subsequently at the Powerhouse Museum describing CSIRO's contribution to the Australian environment.

People Management

Prepare an integrated human resources management strategy;

Prepare a comprehensive tenure agreement covering all staff classifications to provide improved career opportunities; and

Introduce career planning for senior managers.

Corporate Development

Prepare a statement of the vision for CSIRO;

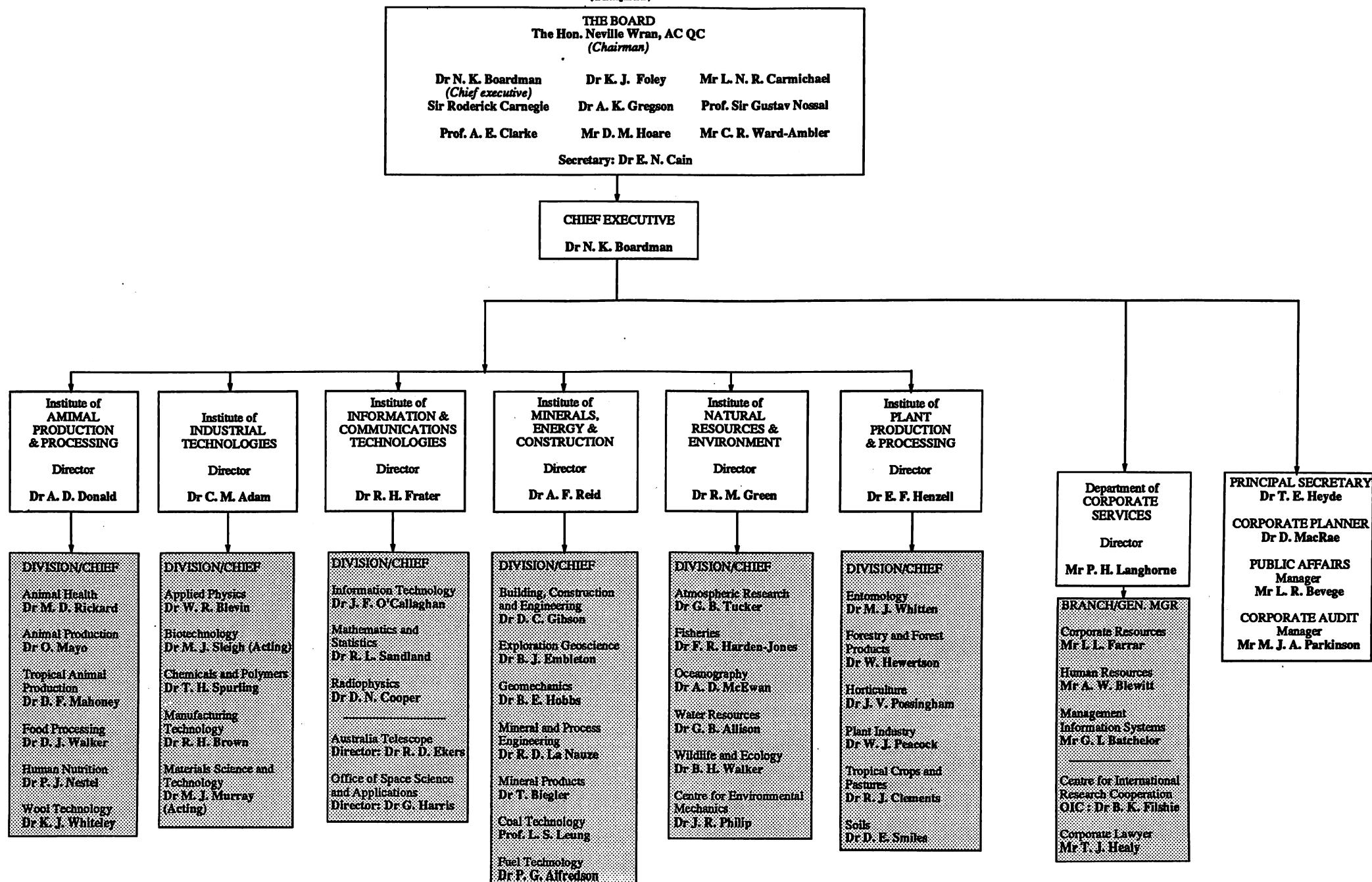
Further development of performance assessment measures for Directors, Chiefs, program managers and senior administrative staff; and

Further develop and maintain corporate information systems and complete installation of CSIRO's integrated voice and data network.

1.3 CORPORATE STRUCTURE

CSIRO policy is determined by a Board. Research is carried out in six research Institutes, each relating to a major sector of industry or community interest sector. Within the Institutes there are Divisions, each corresponding to a particular industry or areas within these sectors. The Corporate Services Department supports the Chief Executive and provides services and advice to Institutes at the corporate level. The Chief Executive is supported in the Corporate Centre by the Principal Secretary and Office of the Chief Executive, the Corporate Planner, the Manager of Public Affairs and the Manager, Corporate Audit. The relationships between these groups are shown in Figure 1.

FIGURE 1 CSIRO ORGANISATIONAL STRUCTURE
(As at August 1988)



1.4 RESOURCES SUMMARY

The research activities of CSIRO are described in sections 2 to 10 of this Plan.

Table 1 summarises the resource allocated to Institutes and the Corporate Centre for 1989–90 in terms of estimated expenditure. Some allocations are not shown in detail in the plan; eg contributions to research bodies such as the Commonwealth Agricultural Bureaux, International; CSIRO post-doctoral fellowship, and legal fees.

TABLE 1 CSIRO ESTIMATES 1989–90

INSTITUTE	\$Million			
	APPROP ANNUAL	APPROP CAPITAL	SPONSORED RESEARCH FUNDS	TOTAL FUNDS
Animal Production and Processing	60.30	1.79	37.53	99.62
Industrial Technologies	55.56	2.30	11.00	68.86
Information and Communication Technologies	33.86	4.74	4.53	43.13
Minerals, Energy and Construction	56.04	1.28	20.00	77.32
Natural Resources and Environment	50.24	1.26	12.71	64.21
Plant Production and Processing	74.45	1.53	19.20	95.18
Corporate Centre	25.20	1.43	1.10	27.73
– Specific Purpose Funds:	26.60	–	–	26.60
– Corporate Centre PCEK Redundancies	0.35	–	–	0.35
To be Allocated	0.22	–	–	0.22
TOTAL	382.82	14.33	106.07	503.22

Note: The figures in Table 1 represent initial allocations for 1989–90 and may not correspond to final appropriation figures. There are some variations from these in the individual Institute's Summary of Resources tables in the body of this Plan. These are due to revised provisions resulting from, among other things, revenue earned.

In the following pages please note:

- In each statement, specific objectives are set out in boldface print. Alongside each objective are Statement(s) of planned outcome(s) during the reporting period. The percentage of resources committed to each objective is recorded immediately after each objective.
- At the end of each statement the total budget and appropriation allocation of funds to the unit is given, together with the percentage of funds estimated to come from external sources. Major capital developments are identified as a footnote and aggregated for each Institute in the summary table.

2. CORPORATE CENTRE

2.1 OFFICE OF THE CHAIRMAN AND BOARD SECRETARIAT

Objective

Provide advice and administrative support to the Chairman and Board members in performing their functions under the Science and Industry Research Act 1949 and the Ministerial Guidelines issued on 2 June 1988.

Specific Objectives (Percent Resources)

Provide briefings for the Chairman on:

- . policy issues affecting CSIRO and Australian science;
- . matters for current or future consideration by the CSIRO Board;
- . all correspondence, requests for meetings, visits etc. (50%)

Interaction with the Minister's office, relevant Departments, and senior CSIRO officers (particularly in the Office of the Chief Executive and in Institutes) on matters involving the Chairman, Board Members and/or CSIRO corporate issues. (15%)

Provide advice, information and assistance for Board Members in performance of their CSIRO duties. (10%)

Draft Board meeting agendas and perform Secretariat functions for the Board, including arrangement of Board meetings and functions, attendance of visitors at Meetings and production of Board Minutes; prepare certain agenda papers. (25%)

Total Budget: \$604,200

Appropriation Allocation: \$604,200

2.2 OFFICE OF THE CHIEF EXECUTIVE

Objective

To provide support to the Chief Executive and enable the effective functioning of the Executive Committee, enhancing the effectiveness of CSIRO's external liaison and internal interaction.

Strategy

The Office will provide effective and efficient support for the Chief Executive and the Executive Committee, in a range of interactions with the CSIRO Board, Ministers, government, industry and the tertiary education sector.

The Office will maintain effective liaison with Institute, Divisional and Corporate Centre staff, co-ordinating action and providing professional assistance with issue analysis and the development of policies as required. Staff will also facilitate the interaction of outside bodies with the Organisation.

The Office will maintain awareness of relevant scientific, social and political developments in Australia and overseas identifying issues relevant to CSIRO and science and technology generally. It will participate in developing procedures for promoting awareness of the value of science and technology in government, industry and the community.

Specific Objectives ***(Percent Resources)***

Planned Outcomes

To facilitate the interaction of the Chief Executive with Institutes and Divisions, Parliamentarians and senior government offices, industry, and the tertiary education sector. (30%)

Assistance will be provided with the Chief Executive's visit and meeting programs, correspondence, speeches and briefings.

To enhance the efficiency of Executive Committee meetings and the effectiveness of papers to be presented to the Executive Committee and by the Chief Executive to the Board. (25%)

Assistance will be provided as required in the presentation of papers; follow-up action will be promptly defined, systematically monitored and facilitated.

To gather information, delineate issues and prepare relevant papers. (10%)

Papers will include some for the Executive Committee and the Board; discussion papers for circulation within CSIRO; surveys to assist analysis of current activities and development of policy; and support for the involvement of CSIRO in ventures such as the Multifunction Polis.

To enhance CSIRO's interaction with Ministers and their staff. (5%)

Assistance will be provided for the Chief Executive and senior executives through advice, strategies and briefing on matters of political or public importance to CSIRO.

To draft or co-ordinate advice, submissions and responses to the Minister responsible for CSIRO and for Parliamentary, government and other external inquiries and activities. (15%)

To assist the interaction of government departments and agencies, industry and the tertiary education sector with the Organisation. (10%)

To keep abreast of developments in science and technology including national and international policy issues. (5%)

The Office will co-ordinate communication with the Minister, including Ministerial briefings, ensuring that these are both topical and well drafted. Corporate submissions and responses will be co-ordinated or developed in consultation with the appropriate areas in CSIRO.

The Office will support the activities of the joint CSIRO/AVCC (Australian Vice-Chancellors) committee, facilitate liaison with the Australian Research Council, and assist the interaction of Institutes and Divisions with AUSTRADE and appropriate areas of Departments such as Industry, Technology and Commerce, and Primary Industries and Energy.

The Office will monitor the literature for relevant developments in Australia and overseas, including OECD literature, and draw the attention of senior management to issues which are relevant to CSIRO and to science and technology generally.

Total Budget: \$1,055,700

**Appropriation Allocation: \$975,700
(includes salary and operating expenses for Chief Executive)**

Specific Purpose Funds: \$80,000

2.3 CORPORATE AUDIT

Objective

The objective of the internal audit function is to assist managers at all levels in the efficient and effective discharge of their duties by furnishing them with appraisals, analyses, information, assurances, opinions and recommendations.

Strategy

The scope of internal audit encompasses the evaluation, the adequacy and effectiveness of the Organisation's system of internal control, and of the performance of organisational programs and functions. This comprehends:

- (i) *the reliability and integrity of information;*
- (ii) *compliance with policies, plans, procedures, laws and regulations;*
- (iii) *the safeguarding of assets;*
- (iv) *the economical and efficient use of resources;*
- (v) *the accomplishment of establishment objectives or goals; and*
- (vi) *reassurance that organisational risks have been addressed.*

Corporate Audit does not take responsibility for the systematic assessment of the scientific effectiveness of research programs and policies. The Board has established review and other processes which are designed to fulfil this requirement. This review process may itself be the subject of Corporate Audit review.

Specific Objectives (Percent Resources)

Planned Outcomes

To provide a comprehensive audit coverage to the organisation providing useful advice and information at research unit, division and institute levels. (50%)

To perform comprehensive reviews of 12 Divisions covering all six Institutes. To perform reviews of those EDP systems assessed at more than 23 risk points in the EDP Audit Strategic Plan. To perform reviews of the most significant administrative functions. To identify in excess of \$1M in reduced risk and increased efficiency.

To maintain and increase as required the level of involvement of internal auditors in the development of administrative systems. (15%)

To participate in the design of all major systems developed during 1989/90, including the machine-independent administrative systems, and revision of financial directions.

Provide a high quality consultancy service. (10%)

Provide assistance to Divisions as requested, commencing projects within 30 days of request.

Identify potential efficiency savings or reduced risk in excess of \$100,000.

To enhance systems of internal control within the Organisation. (5%)

Implement formal Devolved Compliance Checking within 16 Divisions. Implement Centralised Continuous Monitoring on Payroll and Receivables systems. To contribute to the reduction of the Organisation's external audit fee.

To enhance internal audit management with particular emphasis, as resources permit, on a quality assurance programme and documentation of standards and audit packages, and on improving the coordination of information coming from audit assignments. (5%)

Perform formal quality assurance reviews of all three units within the group. Review and reissue the Internal Audit Manual.

To establish and extend, as resources permit, the automation of audit documentation and audit management information on the Group's microcomputers and their use as audit tools in their own right. (2%)

Pilot study the use of portable computers in the field by auditors.

As opportunities become available, to maintain the programme of exchanges of auditors and research unit staff to further their experience of each other's environment. (3%)

Continue exchange of information with DSIR Internal Audit including a short posting of CSIRO officer in New Zealand.

To provide training programmes to improve skills in the following areas:

- . auditing practice (especially in an accrual accounting environment), comprehensive audit techniques and systems analysis for all auditors;
 - . EDP auditing for field auditors, including techniques for audits of microcomputer-based systems;
 - . auditing on-line database management systems for EDP auditors;
 - . interviewing skills for all auditors; and
 - . a combination of formal courses and work experience for Trainee Internal Auditors.
- (10%)

All staff to receive 12 days of formal training.

Total budget: \$857,400

Appropriation allocation: \$857,400

2.4 CORPORATE PLANNING OFFICE

Objective

Establish and maintain CSIRO corporate-level planning processes which will assist the Chief Executive, Directors and the Board to determine the organisation's strategic directions and priorities.

Strategy

Develop the means for CSIRO to drive corporate-level planning processes.

Specific Objectives
(Percent Resources)

Planned Outcomes

Assist the Board Sub-Committee on National Research Priorities to determine strategic directions and broad priorities for CSIRO. (15%)

Establish a framework for the allocation of resources between major sectors and/or technologies for interpretation by the Chief Executive and Directors in corporate-level planning processes.

Provide planning assistance to the Chief Executive and Directors. (25%)

This includes the provision of

- . secretariat support to –
 - Strategic Planning Workshops,
 - Planners' Group,
 - Inter-Institute study groups, as required;
- . a watching brief on external studies;
- . advice on corporate-level planning processes and planning methodologies;
- . assistance in retrospective evaluation and prospective appraisal of research as required by Directors; and
- . assistance in preparation of Institute business plans as required by Directors, eg sector "outlook" reports.

Prepare the CSIRO PLAN comprising the following corporate-level plans. (60%)

Strategic Plan (1991–96) by June 1990;

Corporate Management Plan (1991–94) by August 1990;

Annual Operational Plan (1990–91) by June 1990; and

assessments of the external and internal environment in support of these plans.

Total Budget: \$474,700

Appropriation Allocation: \$474,700

2.5 PUBLIC AFFAIRS

Objective

To gain recognition within Government, industry and the general community of CSIRO as a scientific and technical research organisation of excellence and dynamism which generates significant returns on the funds allocated to it by Government or committed to it by partners from the private sector.

Strategy

Public Affairs works closely with Institutes and Divisions to meet these objectives. The focus of this interaction is the Communication Working Group (CWG) on which Institute Public Affairs and Communications Managers and the Offices of the Chairman and of the Chief Executive are represented.

Through the CWG, major events, announcements and publicity opportunities are planned in advance. Stakeholders are identified and avenues of communication are developed in order to reach these stakeholders and to gain their support.

Liaison on day to day public affairs activities, and Institute and Divisional input to corporate publications, are obtained through frequent working interactions outside the formal sessions of the CWG.

Specific Objectives
(Percent Resources)

Generate positive media coverage of CSIRO which presents CSIRO as an Organisation critical to the future of Australia, worthy of public support and interest and which "decisionmakers" want to be seen to be supporting. (40%)

To ensure a consistent and co-ordinated approach to CSIRO's external relations throughout the organisation. (40%)

To ensure that details of CSIRO's activities and structure are made available on public record. (20%)

Planned Outcomes

Developments in CSIRO's research and commercial activities will be publicised by media releases, public appearances of senior officers and targeted seminars and information mail-outs to key stakeholders and potential collaborators. Collaborative promotions with industry will also be pursued.

Further development of CSIRO's corporate identity will be pursued by seeking to co-ordinate CSIRO's external corporate publications and displays and by promoting increased correct usage of CSIRO's logo on a range of materials. Meetings and contact with Institute and Divisional communicators will be held and the Communication Working Group will be used to co-ordinate announcements and to promote internal communication. A monthly staff magazine, CoResearch, will be published.

Regular publications such as the annual report to Parliament, strategic plan and Guide to CSIRO will be published to a high standard of quality and disseminated to stakeholders and the community at large. Other publications will be produced to meet special needs. Descriptions of CSIRO will be submitted or updated in a wide variety of published Directories.

Total Budget: \$960,000

Appropriation Allocation: \$835,000

Specific Purpose Funds: \$10,000

Sponsored Research Funds: \$115,000

3. INSTITUTE OF ANIMAL PRODUCTION & PROCESSING

Objective

To improve the economic and social wealth of Australia by helping the animal and food industries to develop a wider range of quality products, and by enhancing the efficiency and international competitiveness of these industries.

Strategy

The Institute is working to enhance the performance of Australia's livestock industries, to improve the quality and marketability of animal products, and to develop new value-added products and processes. Generic research for the food industry and research into human nutrition for the benefit of the Australian community also form part of the Institute's work. It works in close collaboration with the rural and manufacturing industries, to ensure that research results are translated into benefits for all Australians.

The Institute is the major body performing longer-term research in Australia for the animal and food industries. The main commodities for which research is undertaken are wool, beef, sheep meats and dairy products. Research covers many areas from pastures through animal health, production and harvesting, to processing and products, including by-products. For chicken meat and egg production, research is mainly in poultry breeding and health. Particular emphasis is placed on processing and marketing and the transfer of research results to users.

The Institute's primary customers are Australian livestock producers; wool, meat and dairy marketing authorities and processing companies; manufacturers of vaccines and other veterinary products; and the world-wide wool processing and textile industry. Others include Departments of agriculture and community health authorities.

Researchers collaborate with State Departments and Universities in order to achieve effective integration of the national research effort, and maintain links with other countries in many research areas, particularly textile research through the International Wool Secretariat.

The Institute's research contributes to increasing:

- . Producers' productivity and profitability*
- . Australia's export market share and earnings for wool, meat and dairy products*
- . Meat and dairy product consumption, while at the same time helping to reduce nutrition-related diseases through the development of appropriate product characteristics.*
- . The proportion of rural products processed or part-processed in Australia where this will capture more net value in Australia.*
- . Product diversification.*

The Institute encompasses the following Divisions:

Division of Animal Health

Headquarters and Animal Health Research Laboratory, Parkville, Vic
 Maribyrnong Experiment Station, Maribyrnong, Vic
 Werribee Field Station, Werribee, Vic
 McMaster Laboratory, Glebe, NSW
 McMaster Farm, Badgery's Creek, NSW
 Pastoral Research Laboratory, Armidale, NSW
 Australian Animal Health Laboratory, East Geelong, Vic

Division of Animal Production

Headquarters and Ian Clunies Ross Animal Research Laboratory, Prospect, NSW
 Ryde Laboratory, North Ryde, NSW
 McMaster Field Station, Badgery's Creek, NSW
 Pastoral Research Laboratory (at Chiswick Research Centre and University of New England), Armidale, NSW
 Arding Field Station, Armidale, NSW
 Longford Field Station, Armidale, NSW
 Biotechnology Section, Clayton, Vic
 Minerals Unit, Floreat Park, WA
 Yalanbee Field Station, Bakers Hill, WA

Division of Food Processing

Headquarters and Food Research Laboratory, North Ryde, NSW
 Dairy Research Laboratory, Highett, Vic
 Biochemistry and Microbiology of Cheese and Fermented Milk Products Group, University of Melbourne, Vic
 Meat Research Laboratory, Cannon Hill, Qld
 Extension Officers at Division of Animal Health, Parkville Vic; Hawkesbury Agricultural College, Richmond, NSW; and Department of Agriculture, South Perth, WA

Division of Human Nutrition

Headquarters and Adelaide Laboratory, Adelaide, SA
 Glenthorne Laboratory, O'Halloran Hill, SA

Division of Tropical Animal Production

Headquarters and Long Pocket Laboratories, Indooroopilly, Qld
 Amberley Field Station, Amberley, Qld
 Tropical Cattle Research Centre, Rockhampton, Qld
 National Cattle Breeding Station, Rockhampton, Qld
 Nutrition Group, Davies Laboratory, Townsville, Qld

Division of Wool Technology

Textile Physics Laboratory, Ryde, NSW
 Textile Industry Laboratory, Belmont, Vic
 Protein Chemistry Group, Parkville, Vic

The Institute Headquarters is at North Ryde, NSW.

INSTITUTE OF ANIMAL PRODUCTION AND PROCESSING

SUMMARY OF RESOURCES

<u>Division</u>	<u>Prof Staff</u>	<u>Total Staff</u>	<u>Approp Allocation (\$000s)</u>	<u>Estimated Budget (\$000s)</u>
Animal Health (including AAHL)	97 32	353 169	16,369 9,648	23,679 10,348)
Animal Production	118	324	9,634	16,791
Food Processing	118	268	10,675	16,045
Human Nutrition	41	105	4,414	5,147
Tropical Animal Production	50	168	6,638	10,131
Wool Technology	128	375	9,770	23,237
Institute Headquarters	8	20	2,824	2,824
Total	560	1,613	60,324	97,854

Capital Works (not included) \$1.25 M towards the relocation of the Hides, Skins and Leather Group of the Division of Wool Technology to Rokeby Street.

3.1 DIVISION OF ANIMAL HEALTH

<p style="text-align: center;"><u>Objective</u></p> <p><i>To discover and develop methods for the diagnosis, control or eradication of the major endemic diseases of farm livestock in temperate Australia, and to collaborate with industry in the development and application of disease control products.</i></p> <p style="text-align: center;"><u>Strategy</u></p> <p><i>Exploit skills in microbiology, parasitology and immunology, combined with modern methods in molecular biology, to develop new diagnostic tests, sub-unit vaccines and vaccine delivery systems for a range of bacterial, viral and parasitic diseases.</i></p>

<u>Specific Objectives (Percent Resources)</u>	<u>Planned Outcomes</u>
Develop methods for the diagnosis, control or eradication of important bacterial diseases of farm livestock. (23%)	A promising immunological test kit for the diagnosis of bovine tuberculosis (towards eradication) is undergoing field trials. Commercial assessment of a mastitis vaccine has been successfully completed and the industrial partners are expected to proceed with registration in the near future. A recombinant vaccine for sheep footrot is in the final phase of commercial development and similar technology is being utilised in a collaborative project on a "pink eye" vaccine for cattle. The research phase for a universal bacterial vaccine vector is also underway.
Improve the control of internal parasites of domestic ruminants through advances in chemotherapy and strategies based on the understanding of the population biology and genetics of parasites. (20%)	An <i>in vitro</i> assay for field diagnosis of anthelmintic resistance in sheep nematodes will be further developed to the stage of commercial evaluation with an industrial partner.
Isolate and identify plant and plant-associated (fungal and bacterial) toxins that cause disease in livestock, determine how these toxins act, and develop methods for preventing or treating the diseases they cause. (11%)	Implement the use of an intranuminal controlled release capsule containing a benzimidazole anthelmintic in worm control schemes in collaboration with commercial partners.
Reduce reliance on chemotherapeutic agents for the control of important parasitic infestations of sheep by the development of vaccines or by genetic manipulation of host or parasite genomes. (27%)	An immunoassay for determining the level of the phomopsin mycotoxins in lupin products will be commercialised. Commercial production of the phomopsin mycotoxins by an Australian company will also be achieved. Preliminary field testing of a synthetic vaccine to protect sheep from lupinosis will be completed. Genes encoding enzymes capable of destroying the corynetoxins responsible for annual ryegrass toxicity (ARGT) will be isolated, and synthesis of an immunogen capable of inducing an immune response against the ARGT toxins will be completed.
	Isolation, cloning and expression of parasitic antigens will be well advanced. Recently developed gene and antibody probes will be used to facilitate fundamental studies of the ruminant immune system on mechanisms of parasite rejection, adjuvant action and reasons for hypo-responsiveness in young animals. RFLP analysis of genetically selected flocks will be completed.

Develop vaccines and diagnostic tests and principles for their efficient application to control the economically important disease of commercial poultry; develop vectors to deliver genes for vaccine molecules or molecules of economic benefit to poultry. (20%)

The production by recombinant DNA technologies of the protective protein of infectious bursal disease virus in yeast will be scaled up to commercial quantities and the protein formulated into an oil-adjuvant vaccine for breeding hens. The amino-acid sequences of several sporozoite antigens of *Eimeria tenella* (coccidiosis) will be obtained and oligonucleotide probes prepared to isolate the encoding genes from DNA libraries. The differential diagnostic monoclonal antibodies developed against infectious bronchitis virus will be used in studies of outbreaks of respiratory disease in vaccinated commercial flocks. The recently isolated endemic strain of chicken anemia agent will be used to develop screening assays for the industry. The research team developing viral vectors to deliver vaccine molecules to poultry will be expanded substantially as a result of a recent agreement with a commercial partner.

Total Budget: \$13,331,000

Appropriation Allocation: \$6,721,000

Excluding Aid Projects (\$2,600,000), contributory funding represents approximately 30% of total resources.

3.2 AUSTRALIAN ANIMAL HEALTH LABORATORY

	<u>Objective</u>
<i>To enhance Australia's capability and preparedness to combat exotic livestock disease outbreaks.</i>	
	<u>Strategy</u>
<p><i>To develop a diagnostic capability and effective control methods for those exotic diseases that represent the greatest threat to Australia. In carrying out its functions of diagnosis, research, training, and vaccine development and testing, the Laboratory complements the activities of State and Commonwealth disease control authorities.</i></p>	

Specific Objectives (Percent Resources)	Planned Outcomes
Develop standard and improved tests for the diagnosis of animal diseases exotic to Australia. (23%)	AAHL will develop and, where necessary, improve tests for the diagnosis and surveillance of exotic animal diseases.
Develop improved procedures for the diagnosis and control of bluetongue. (15%)	Rapid methods will be developed to confirm and characterise bluetongue virus in infected animals and insect vectors. Vaccine development will focus on the production of attenuated strains of Australian bluetongue viruses and the synthesis, by recombinant DNA technology, of viral protein antigens which will be tested for their efficacy as vaccines in sheep.
Develop carrier viruses as vectors for vaccines. (16%)	Recombinant fowlpox viruses carrying vaccine genes of exotic and endemic disease agents will be tested for their efficacy as vaccines in poultry. Vaccinia virus recombinants expressing bluetongue virus antigens will be constructed and tested in laboratory animals. Modified vaccine antigens of rotaviruses and bluetongue virus designed to enhance responses in animals will be tested in experimental vaccine studies.
Study and use improved tests for investigating the epizootiology of, and the immune response of animals to foot-and-mouth disease. (14%)	Enzyme immunoassays developed by AAHL have significantly improved the diagnosis of FMD. Modifications to these tests will be used to study key aspects of FMD control, such as strain differentiation within virus serotypes, serological responses to infection, and immunisation and testing for FMD vaccine quality, in a country where the disease is endemic.
Discover methods for rapidly pathotyping isolates of Newcastle disease virus and develop alternative vaccination strategies. (16%)	Antibodies are being produced to enable strain differentiation and pathotyping of isolates of Newcastle disease virus. Antigens being used for antibody production are virulent and non-virulent strains of virus and synthetic portions (peptides) of the membrane glycoproteins which differentiate between pathotypes. Antibodies are being investigated as reagents for characterisation of viruses in Australia and overseas.

Develop and carry out tests to establish and maintain microbiological security and safety at AAHL. (12%)

Continue development and testing of methods and procedures relating to maintaining microbiological security. Specific Objectives include analysis of improved air filtration techniques and comparison with air incineration, the use of ionizing radiation to sterilize biological materials before their removal from the Laboratory, and the development of procedures and innocuity tests to validate the purity of vaccine seed stocks for use outside of AAHL.

Train veterinarians in the early recognition of exotic diseases of livestock. (4%)

Post-graduate courses for field and laboratory veterinarians will be conducted to improve awareness, and the procedures used in diagnosis, of exotic animal diseases.

Total Budget: \$10,348,000

Appropriation Allocation: \$9,648,000

The Laboratory receives matched contributions of \$4,819,800 each from the Department of Primary Industries and Energy and CSIRO's Appropriation, and the remaining 7% from other external sources.

As part of CSIRO's restructuring, the Australian Animal Health Laboratory recently became a laboratory of the Division of Animal Health, but its programs have not yet been integrated with those of the rest of the Division.

3.3 DIVISION OF ANIMAL PRODUCTION

<u>Objective</u>
<i>To improve the efficiency of livestock production and the quality of derived animal products.</i>
<u>Strategy</u>
<i>To concentrate on solving livestock problems of national significance, especially for the sheep industry, by developing and applying new scientific principles so as to achieve substantial gains in livestock productivity.</i>

<u>Specific Objectives (Percent Resources)</u>	<u>Planned Outcomes</u>
Develop and evaluate an alternative method for wool harvesting. (5%)	The goal is to introduce biological wool harvesting to industry by 1992. All trials on EGF (dose rates, withholding periods for rams and ewes, fertility of offspring of treated animals) should be completed by July 1990. Trials on analogues await supply from Cooper Pitman Moore.
Develop vaccines for enhancing body and wool growth, reproductive potential and quality of meat and fibre. (14%)	We are evaluating, in collaboration with the Division of Tropical Animal Production, a prototype for a commercial vaccine for regulating sexual activity in cattle. Registration trials on anti-LHRH 2-dose vaccines will be nearing completion, and oil drop micro-encapsulation (necessary for a single dose vaccine) should have been achieved. Polyelectrolyte adjuvants identified as promising should be substantially characterised.
	Technical feasibility of Multivac, a new multi-steriod based vaccine to increase fecundity in sheep with particular application to Merinos, has been demonstrated. A commercial partner should have been selected and a commercial path plotted.
Integrate genetic and physiological data to improve selection criteria and breeding opportunities for enhancing livestock productivity. (23%)	The potential use of immunisation against monoclonal antibody-derived ovine inhibin to increase calving rate is being examined. Recombinant inhibins and fragments will have been screened and a small peptide epitope suitable for antigen construction determined.
Develop new methods for the genetic improvement of livestock with biotechnological techniques. (15%)	Complex examination of the significance for fleece quality of changes in the distribution and diameter of primary and secondary fibre populations in selected flocks on experiment stations.
Modify the rumen microflora to improve the efficiency of feed use and the quality of animal products. (6%)	Initial modified growth hormone construct evaluation in sheep will be completed by September 1989. Evaluation in progeny born in June 1990 should be completed by December 1990. The CysK and CysE genes isolated from <u>E. coli</u> have been microinjected into sheep embryos. Initial evaluation in transgenic sheep born in July/August should be completed. Clearing the rumen of fungi in order to assess the impact of introducing large quantities of specific fungal types should be achieved.

Evaluate and improve the nutritive value of forages and supplements to increase production and quality of animal products. (15%)

Sub-clover strains which differ significantly in digestibility will be evaluated in field trials.

A strain of forage sorghum with a reduced cyanide content will be tested under commercial conditions.

Major contracts for sheep meat with a 'mild' flavour that is acceptable to overseas consumers should be signed by commercial partners.

Increase the efficiency of fertilizer use for livestock production. (6%)

Remote sensing data-based fertiliser status maps and supporting microcomputer package will be tested by district advisers of NSW Department of Agriculture and Fisheries.

Develop controlled release devices for administering bio-active materials to ruminants to enhance productivity. (3%)

An albendazole anthelmintic capsule (produced in collaboration with CSIRO Division of Animal Health) and already commercially released in France, will be launched in Australia.

Study the pattern and control of follicle development in skin. (4%)

Promising agents for non-surgical mulesing have been identified and provisionally patented. Evaluation of stress levels of the new treatment in comparison with mulesing should be completed, and field testing initiated.

Apply computer technologies to improve the nutritional management of livestock. (2%)

The Australian Feeds Information Centre (AFIC) has published a new edition of tables summarising the nutritive value of feedstuffs. AFIC videotex packages are being developed and commercially released.

The incorporation of an expert system into AUSPIG (a computer software package to improve the management and productivity of pig producers) has been carried through successfully, and the package will be released commercially. Negotiations on the overseas sale of AUSPIG will be completed.

Diagnose trace mineral deficiencies and develop technologies to reduce or eliminate the problems they cause. (7%)

Mineral supplementation is being commercialised as a short to medium term solution to some of the problems of mineral deficiency. SIROMIN was launched on 7 July 1989.

The role of selenium in influencing the production and staple strength of wool is being investigated, with particular emphasis on the effect of selenium on wool quality. A modified selenium bullet with longer lasting action will be tested in field trials. An alternative mode of administration of selenium has been shown to be successful in Western Australia. Commercial possibilities will be investigated.

Total Budget: \$16,791,000

Appropriation Allocation: \$9,634,000

The Division expects to receive 43% of the total budget from external sources.

3.4 DIVISION OF FOOD PROCESSING

<p style="text-align: center;"><u>Objective</u></p> <p><i>To develop ways to handle, process and add value to foods, that improve efficiency, maintain or improve quality and safety, and minimize or utilize wastes.</i></p> <p style="text-align: center;"><u>Strategy</u></p> <p><i>To extend knowledge of the chemical, physical and biological properties of foods, and apply this to improving their handling, processing and storage, and developing new process technology and value-added products.</i></p>
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Specific Objectives (Percent Resources)	Planned Outcomes
Extend understanding of the properties of foods that are central to their use, either fresh or in manufactured products. (23%)	Expected outcomes are (a) definition of the physiological importance of tocotrienols in food components; (b) characterisation and distribution of pyridinoline crosslinks in meat collagen; (c) definition of factors in post-mortem muscle which are important in specialized meat products; and (d) increased understanding of functionality in whey proteins.
Improve the quality, preservation, storage and transport of foods. (8%)	The main goals are (a) improvements to transport of fresh lamb to the Middle East; (b) introduction to commercial trials of cheese starter cultures carrying plasmid-mediated resistance to bacteriophage; and (c) specification for container transportation to export markets of an expanded range of horticultural products.
Develop new processes, equipment and product that will add value to foods, utilize by-products and increase efficiency of food processing. (36%)	Achievements expected are (a) transfer to commercial use of a process for the recovery of highly functional protein from whey; (b) commissioning of the first commercial prototype of a novel beef cattle slaughtering and dressing system; (c) finalization of commercialization phase of cheddar cheese production by the Sirocurd process; (d) transfer for commercial development of new technology for de-acidifying and de-bittering of fruit juices; (e) medium-scale production of secondary metabolites of cultured plant cells prior to commercial-scale operation.
Describe and control the interactions between lipids, proteins, polysaccharides and water that are responsible for structure, integrity and sensory properties in manufactured foods. (5%)	Initiate collaborative studies with commercial partners on production of specialist manufactured meat products.
Describe and manipulate food components responsible for flavours and odours and those which may be involved with tainting of foods. (9%)	Forecast achievements are (a) more detailed information on the requirement for lipid fractions in production of desirable meat odours and flavours; and (b) acquisition of information leading to objective specification of those sensory characteristics of foods most desired by ethnic communities.

**Increase understanding of factors which threaten the safety and nutritional quality of food.
(13%)**

The program should achieve (a) definition of the potential mycotoxin status of some foods of tropical origin; (b) definition of the potential for mycotoxin production in rations fed to pigs in Australia; (c) evaluation of the status of Australian meat with respect to *Listeria monocytogenes*; and (d) further definition of the potential for introducing immunological control of fat deposition in meat animals.

**Transfer information and technology to consumers, the food manufacturing industry and relevant Government bodies.
(6%)**

The aim is to develop (a) closer working relationships with State Government agencies which promote the interests of the food industry; and (b) closer relationships with the National Industry Extension Services, the Bureau of Rural Sciences, the Department of Industry, Technology and Commerce.

Total Budget: \$16,045,000

Appropriation Allocation: \$10,675,000

The Division expects to receive 33% of the total budget from external sources.

3.5 DIVISION OF HUMAN NUTRITION

Objective

To improve human well-being and community health and reduce the incidence of diet-related disease in Australia by nutritional means, including assisting the food industry to provide appropriate foods.

Strategy

To develop an understanding of those nutrition-related disorders that account for the greatest morbidity and mortality within the Australian community; to encourage and actively collaborate with the food industry to produce novel foods to extend choice; to define the factors that lead to optimal growth and development; to conduct national surveys of the patterns of food consumption; to develop techniques for increasing nutritional knowledge in the community.

Specific Objectives
(Percent Resources)

To develop nutritional strategies for the prevention of cardiovascular diseases (coronary heart disease and hypertension) which will include the development with industry of fat-modified and fibre-enriched foods. (7%)

To isolate, synthesize and test specific growth factors (IGF) for the treatment of disorders of protein catabolism and for their manufacture as cell culture ingredients. (20%)

To define the influence of nutrients on the biology of hypertension with a view to improve its clinical management and to identify new pharmacologically active agents. (11%)

To monitor the nutritional status of Australians and survey the psychosocial and behavioural determinants which give rise to patterns of eating and selection of food products. (8%)

To define dietary factors associated with cancer formation and through which cancers, including some that are occupation-related, may be prevented. (19%)

Planned Outcomes

New food products in the edible oil, fish, cereal and dairy industries will be tested in collaboration with food industry, for their plasma lipid and blood pressure lowering effects. The mechanisms responsible for beneficial effects will be defined and exploited for further developmental work.

Naturally occurring and synthetic peptides will be tested for their biological efficacy in appropriate animal models. The synthesis of substantial amounts of these peptides will be developed through recombinant technology. The commercialization of growth factors as cell culture ingredients will be initiated.

The effectiveness of candidate nutrients, sodium and specific fatty acids will be tested in elderly or hypertensive subjects. The biological bases for nutrient-related effects will be established experimentally. Collaboration with the pharmaceutical industry will continue to develop new strategies for treating hypertension.

Major surveys of food and nutrient intakes will be undertaken for the food industry and for Government authorities. Specialized intervention programs will be devised and tested for the wider implementation of nutrition policies.

Novel techniques will be developed to test mutagenic damage and means for preventing this. Relationships between nutrients and biological markers of cancer will be established to monitor intervention trials of antioxidants in precancerous disorders, including those induced by sunlight.

To prevent sudden cardiac death secondary to dysrhythmias by optimising dietary fatty acids. (20%)

Physiological and biochemical mechanisms underlying cardiac arrhythmias will be defined and modified through the experimental and clinical use of various fatty acids. Strategies will be tested to minimize myocardial damage induced by free radical formation and eicosanoid generation.

To evaluate the nutritional benefits of dietary fibre and to collaborate with food industry to develop appropriate fibre-rich products. (10%)

Active constituents of dietary fibre will be identified, chemically analysed and tested for their biological advantages to assist in the formulation of food products conducive to good health.

To develop nutritional strategies for Aboriginal people to improve their standard of health. (6%)

An intervention program will begin to overcome childhood under-nutrition as a guide to future health policy. The causes for the high prevalence of premature cardiovascular disease will be defined and suitable measures assessed.

Total Budget: \$5,147,000

Appropriation Allocation: \$4,414,000

The Division expects to receive 14% of the total budget from external sources.

3.6 DIVISION OF TROPICAL ANIMAL PRODUCTION

Objective

To develop ways to increase the efficiency of production of grazing livestock, particularly beef cattle, in tropical areas of Australia.

Strategy

To improve productivity of genotypes that already have elevated levels of resistance to stress, by developing techniques to increase reproduction and growth rates, either by manipulation of physiological characters or by selection and manipulation of outstanding individuals; by developing safe vaccines to reduce or eliminate disease stress; and by boosting the utilization of the available wet and dry season forages.

Specific Objectives
(Percent Resources)

Produce effective sub-unit vaccines against ephemeral fever and other arboviruses. (9%)

Produce non-living vaccines against ticks and tick toxins, babesiosis and anaplasmosis, and maintain chemical control of ticks. (31%)

Produce vaccines against the larvae of the sheep blowfly and the adult stages of the buffalo fly. (13%)

Develop advanced selection technology for beef cattle that takes into account conflicts between resistance to stress and productivity. (4%)

Planned Outcomes

Analysis of the immunochemical properties of the G protein will be completed and the analysis of another structural protein will begin. The G protein will be cloned in an expression vector. An antigenic probe will be prepared to supplement virus assay methods. Epitope mapping will be completed. Continue series of protection experiments using subunits prepared by biochemical techniques. Continue development of activated lymphocyte detection as alternative to trials in cattle for assay of immunity.

Development of the vaccine against *Boophilus microplus* will concentrate on two areas. Firstly, the use of the existing antigen will be optimised by continuing to test different recombinant constructs and adjuvant and dose treatments. This information will be applied in the first field trials of a vaccine in summer 1989-90. Secondly, the isolation of further protective tick antigens will continue with the aim of increasing vaccine efficiency. Trials of adjuvant for the genetically-engineered vaccines against Babesia will be completed, as will new trials for cross-species protection, immunisation regime, and a multiple antigen cocktail, and field trials will begin. Work on a vaccine against *Anaplasma*, another organism causing tick fever, has begun. One or more protective fractions will be isolated and a genomic expression library constructed. The Australian Paralysis Tick toxin has been purified and sequence data obtained; an immunogen will be produced via *E. coli* or by chemical synthesis.

The significance of new chemical-resistant cattle tick strains will be examined as they emerge from the field, and potential alternative acaricides will be evaluated.

Continue to isolate and test potential antigens from blowfly and buffalo fly for antifly activity using *in vitro* and *in vivo* bioassays.

The development of new selection technology for beef cattle began in 1984, and is scheduled to occupy ten years. Experiments on selection for weight gain, reproduction, feed intake and heat tolerance are running on schedule.

Application of DNA technology to livestock breeding and improvement. (5%)

Single and multigenic traits of economic importance are being identified using DNA marker techniques. A primary bovine gene map is being developed. Carriers of Pompe's gene (causing an enzymic deficiency and resulting in early deaths of calves) will be identified and a commercial protocol for testing established. Work will begin on physically mapping and identifying the linkage for twenty new gene locations.

Exploit the phenomenon of hybrid vigour to produce cattle more suited to the tropics and sub-tropics than those currently available. (8%)

There is a joint venture with industry to import new breeds for crossbreeding from Africa. Embryos of the Boran and Tuli breeds have been implanted into Australian cattle on Cocos Islands Quarantine Station. Calves will be born in 1989 and airlifted to Australia if they pass health tests.

Develop technologies to increase calving rate of female cattle and to regulate the onset of puberty in male and female cattle. (4%)

The dose of gonadotrophin releasing factor (GnRF) and the effect of prepubertal steroid immunization required to overcome post-partum anoestrus should be known. The response of bulls and heifers to new formulations of the GnRF vaccines will be characterized, and new injection protocols will be developed. Registration trials for GnRF immunization for application in cull cows will begin.

Manipulate the metabolic processes associated with weight change in cattle grazing pastures that vary markedly in quality and quantity. (14%)

New compounds that reduce metabolic rate and increase protein accretion by hitherto unexplored mechanisms have been identified. An immunological procedure to reduce protein breakdown is being explored. The potential of trenbolone acetate to reduce weight loss in the dry season will be established.

Develop techniques to achieve better reproduction and growth in Northern cattle, sheep and buffaloes through dietary manipulation and improved use of forages. (12%)

Techniques for correcting nutritional deficiencies by improving fibre use, by making better use of legumes, and by feeding will be refined. Areas of sodium deficiency will be mapped and field studies to determine responses to salt supplementation will begin. Studies will also be initiated on lamb survival and wool growth in response to the establishment of legumes on clay soils.

Total Budget: \$10,131,000

Appropriation Allocation: \$6,638,000

The Division expects to receive 34% of the total budget from external sources for 1989-90.

3.7 DIVISION OF WOOL TECHNOLOGY

<p style="text-align: center;"><u>Objective</u></p> <p><i>To increase worldwide demand for Australian wool, wool products, hides, skin and leather.</i></p> <p style="text-align: center;"><u>Strategy</u></p> <p><i>To develop new and innovative products and to enhance the appeal and performance of existing products. To apply new techniques and measurement systems to reduce costs of marketing, processing and manufacture.</i></p>

<u>Specific Objectives</u> <i>(Percent Resources)</i>	<u>Planned Outcomes</u>
Develop technology and other knowledge aimed at increasing consumer demand for products made from Australian wool. (42%)	Evaluate a new, environmentally safe method for shrink resisting wool sliver prior to full-scale industrial trials.
	Weave light-weight worsted fabrics to extend the product range of pure wool in the spring/summer season.
	Complete tests on new anti-pilling treatments for wool knitwear with European manufacturers.
	Release to industry details of two new methods for controlling the hygral expansion of wool fabrics.
	Complete feasibility study of a new machine for fusing interlinings to wool garments.
	Complete tests on a range of treatments designed to alleviate prickling caused by wool garments in active wear situations.
	Complete a feasibility study relating to the establishment in Australia of a wool grease refining plant based on CSIRO technology for producing pesticide-free lanolin.
	Complete tests on newly developed stainblocking systems.
	Finalise negotiations for the manufacture and marking of ultraviolet absorbers that inhibit photodegradation of wool.
<u>Insect Proofing</u>	
a) Complete the screening and evaluation of compounds, including surface active agents, as alternatives to commercially available insecticides.	
(b) Complete the taxonomic classification of keratin-consuming insects (with Division of Entomology).	
(c) Determine the egg-laying behaviour of wool moths and the mechanism of attraction of moths to wool substrates.	
(d) Isolate and purify cysteine lyase from <i>T. Bisselliella</i> .	
Demonstrate that wool fabrics are cool to touch.	
Develop a prototype fabric shear hysteresis tester.	
Develop a laboratory test procedure for fabric wrinkling.	
Complete investigation of a novel yarn colouration system.	
Complete first commercial prototype of a carpet tile printer.	

Improve the efficiency of conversion of raw wool to end products. (32%)

Complete industrial trials comparing multistage scouring (SIROSCOUR) with conventional scouring.

Complete negotiations for the manufacture and installation in an Australian mill of a carding machine which incorporates design features derived from CSIRO carding research.

Complete trials on the commercial utilisation of recently developed carding lubricants.

Transfer to the International Wool Secretariat the prototype yarn setting device for further evaluation.

In collaboration with the Australian Wool Corporation, complete study of the effects of high-density pressing of exported wool on the efficiency of subsequent mechanical processing.

Install prototype machine for removing coloured contaminants from scoured wool at an Australian mill.

Complete negotiations with a chemical manufacturer for the commercialisation of a new low-temperature dyeing process.

Complete negotiations with a dye-stuff manufacturer for the commercialisation of an anti-setting agent to be used in wool dyeing processes.

Commercialise the use of surface active polyamines in low temperature dyeing.

Enzyme Technology

- a) Identify enzymes involved in the biological degradation of permethrin.
- (b) Determine the effect of Candida cylindracea lipase on wool grease and wool scour effluents.
- (c) Prepare sufficient ligninase to allow an assessment of the potential for seed and burr removal from wool.

Develop new or improved processes for the handling, marketing, preservation and conversion of hides and skins into leather products. (9%)

Following the successful implementation of the Sirolime process by two Australian tanneries, introduce it widely to the Australian industry.

Complete agreement for commercialisation of the "Wool-Fill" product derived from waste Australian woolskin leather.

Define a new tanning system based on complexing of aluminium compounds.

Develop and implement techniques to completely specify raw and semi-processed wool so as to enable the introduction of marketing wool by description (sale by description) and the prediction of processing performance. (9%)

Demonstrate computer-aided valuation system (CAVS) to industry firms/associations by placing systems in their premises.

Complete commercial prototype for objective measurement of raw wool style and type and organise preliminary proving trials with AWTA Ltd.

Validate and demonstrate dark fibre risk scheme to woolgrowers, brokers and exporters.

Complete inter-laboratory trials with N.Z. Wool Board on fibre length and bulk compression measurements of scoured wool.

Increase the accuracy of staple length and staple strength measurement.

Commission pilot plant for woollen processing at Ryde Laboratory.

Develop new or improved textile filter media filtration processes and related instrumentation for the benefit of Australian industries. (6%)

Develop a model to predict the "micron rating" of non-woven filter fabrics.

Develop filter fabric capable of withstanding high gas velocities.

Total Budget: \$23,237,000

Appropriation Allocation: \$9,770,000

The Division expects to receive 58% of the total budget from external sources, primarily from the Wool Research and Development Fund.

4. INSTITUTE OF INDUSTRIAL TECHNOLOGIES

Objective

The Institute aims to increase the international competitiveness, efficiency and scope of Australia's manufacturing industries. Emphasis is placed on technologies that are broadly applicable to the development of new products, processes and services.

Strategy

In view of relatively slow growth of world prices for commodities, and considering our current account trade deficits, Australia's position in world markets during the next decade will rely increasingly on export of value-added manufactured products.

The Institute strategy is to develop Australian technology into successful local manufacturing enterprises which are internationally competitive and export oriented. Basic research in areas of national importance will not be neglected.

By increasing its amount of collaborative research CSIRO aims to intensify its interaction with international manufacturing companies, thereby facilitating the flow of knowledge and technology enabling the finer focusing of research on Australian industry problems, or areas where special opportunities exist for local manufacturing companies. CSIRO will improve the skills and practices that are necessary for this enhanced interaction while at the same time building in industry the scientific knowledge and skill base necessary for advanced industrial development in increasingly competitive international markets.

The Institute's customers primarily comprise companies involved in:

- materials production and fabrication (metals, ceramics, chemicals, polymers and composites)***
- electrical and mechanical products***
- scientific and industrial instrumentation***
- integrated manufacturing systems***
- veterinary and pharmaceutical products***

To encourage innovation in the sector the Government has introduced several assistance schemes, including the formation of Management Investment Companies (MICs), 150% tax deduction for research and development, the Grants for Industry Research and Development (GIRD) and the National Industry Extension Service (NIES). The Institute is committed to working extensively with private-sector companies to facilitate the transfer of advanced technology using these assistance schemes.

The Institute encompasses the following Divisions:

Division of Applied Physics

Headquarters and Laboratories, Lindfield, NSW
Adelaide Laboratories at Woodville North, SA
Melbourne Laboratories at Clayton, Vic

Division of Biotechnology

Melbourne Laboratories at Parkville and Clayton, Vic
Sydney Laboratories at North Ryde, NSW

Division of Chemical and Polymers

Headquarters and Laboratories, Clayton, Vic
Water and Wastewater Experimental Station at Lower Plenty, Vic
Lucas Heights Laboratory at Menai, NSW

Division of Manufacturing Technology

Headquarters and Melbourne Laboratories at Preston, Vic
Adelaide Laboratories at Woodville, SA
Sydney Laboratories at Lindfield, NSW
Brisbane Laboratories c/- University of Queensland, St Lucia

Division of Materials Science and Technology

Headquarters at Clayton, Vic
Melbourne Laboratories at Clayton, Vic

The Institute Headquarters is in Clayton, Melbourne, Vic

INSTITUTE OF INDUSTRIAL TECHNOLOGIES

SUMMARY OF RESOURCES

<u>Division</u>	<u>Prof Staff</u>	<u>Total Staff</u>	<u>Approp Allocation (\$000s)</u>	<u>Estimated Budget (\$000s)</u>
Applied Physics	122	300	17,800	20,400
Biotechnology	75	191	10,400	12,400
Chemicals and Polymers	79	163	8,500	11,300
Manufacturing Technology	64	127	6,900	8,500
Materials Science and Technology	90	162	9,700	12,500
Institute Headquarters	5	8	2,400	2,400
Total	435	951	55,700	67,500

4.1 DIVISION OF APPLIED PHYSICS

Objective

To assist in the development of Australian industry and in the solution of important community problems by undertaking applied research in the physical sciences and related technologies.

To establish, maintain, and disseminate Australia's physical standards of measurement, including those required under the National Measurement Act 1960.

Strategy

The Division undertakes strategic and short-term R&D in physics and engineering with emphasis on developing new or improved products, industrial measuring techniques and manufacturing processes. Particular attention is paid to collaboration with Australia's scientific and medical instrument industry. As a basis for uniform measurement throughout Australia, the Division maintains the national standards of measurement, provides a first-level calibration service, and collaborates with national and international organisations concerned with measurement and testing.

Specific Objectives
(Percent Resources)

Develop electrotechnology of current or potential value to Australia industry and provide standards and calibration services for electrical potential and impedance, and for time interval and frequency. (20%)

Develop magnetoelectronic technology of current or potential value to Australian industry, and provide standards and calibration services for ac electrical quantities, high voltages, magnetic quantities and dielectrics. (19%)

Develop plasma, thin film and thermometric technologies of current or potential value to Australian industry, and provide standards and calibration services for temperature. (21%)

Develop acoustical and ultrasonic technology of current or potential value to Australian industry, and provide standards and calibration services for acceleration, acoustics, dimensional metrology, hardness, mass and related quantities. (21%)

Planned Outcomes

A prototype magnetometer based on SQUIDs made from films of high-temperature ceramic superconductor will be developed; ion-beam modified prostheses developed in the Division will be field-tested: a new joint-venture company will be formed with identified commercial partners to manufacture and market internationally a range of scientific instruments originating in the Division.

Commercial production of rare-earth magnets for high technology motors will commence as part of a joint venture with commercial partners; contract research on the current rating of aerial bundled conductors will be completed; a range of industrial microwave equipment will be developed for industry; the development of acoustic emission techniques for locating coal/rock interfaces will be completed.

A three-year collaborative investigation of stratospheric chemistry and its application to ozone depletion will commence; production of environmentally-stable optical coatings for the Sydney University Stellar Interferometer will be completed. Continuing investigations include: application of plasma technology to manufacturing processes and mineral processing; development of thin-film techniques for hard-coating of tools and dies, high-quality optical coatings, optical data storage and biomedical applications; industrial thermometry.

A novel system for measuring hardness, developed and constructed in the Division, will be marketed in Australia and the USA. Continuing investigations will include: application of ultrasound to industrial non-destructive examination and sedimentation; development of novel flowmeters; application of coordinate measuring machines to industrial dimensional metrology.

Develop optical and electro-optical technology of current or potential value to Australian industry, and provide relevant standards and calibration services for length, optical quantities, photometry and optical radiometry. (19%)

Application of holography to visual displays will be commercialised; commercial development of instrumentation for non-contact profile measurement will commence; commercial production and testing of high-precision optical components and devices will continue; the development of a laser-measurement system for the optical path compensator in the Sydney University Stellar Interferometer will be completed; the development of a shape recognition technique using hybrid image processing will be completed.

Total Budget: \$20,400,000

Appropriation Allocation: \$17,800,000

The Division expects to receive 16% of this total budget from external sources, including 3% from fees for calibrations.

4.2 DIVISION OF BIOTECHNOLOGY

Objective

To explore and exploit the capabilities of biological systems and their components to develop manufacturing opportunities in Australian industry.

Strategy

To integrate strategic and applied research activities as a basis for development of:

- . *new pharmaceuticals, biomaterials, vaccines and other agents for the manipulation of biological function with applications in agriculture and human health care*
- . *new industrial processes based on biological catalytic systems.*

**Specific Objectives
(Percent Resources)**

To devise new pharmaceutical agents, therapeutic and diagnostic strategies based on structural analysis and engineering of proteins integrated with molecular modelling techniques. (25%)

To integrate analysis of nucleic acid structure, nucleic acid–protein interactions and genetic regulatory mechanisms to provide strategies for the development of new pharmaceutical agents and for manipulation of biological function for application in agriculture and human health care. (16%)

To develop vaccines against diseases of importance for animal and human health and to devise new strategies for production, manipulation and delivery of antigenic proteins and peptides to enhance the immune response and disease resistance. (20%)

To develop pharmaceuticals, biomaterials and biosensors from an understanding of the interaction between cells and their environment and of the signalling processes by which information is transmitted in biological systems. (17%)

Planned Outcomes

Continue analysis of neuraminidase structure, of engineered anti-neuraminidase antibodies and of other viral components to design pharmaceuticals and other therapeutic strategies to combat influenza.

Complete 3-dimensional structure of turnip yellow mosaic virus and of the bean storage protein phaseolin.

Develop technology for antibody humanisation.

Continue studies of nucleic acid structure and DNA–protein interactions as determinants of biological function. Develop new projects on the use, engineering and inhibition of nucleic acid binding proteins for design of antiviral agents and other pharmaceuticals and therapeutic strategies.

Complete comparisons of anti-sense RNAs, ribozymes ("gene shears") and targeted gene inactivation as strategies for manipulation of biological function in model systems and commence work on specific applications and delivery approaches.

Complete development of a vaccine against infectious bursal disease virus of chickens. Identify and produce antigens for potential vaccines against sheep parasites and pink eye of cattle. Test microencapsulation methods of antigen delivery and engineered multi-component antigens for their ability to generate an enhanced immune response. Complete studies on diagnosis of plant virus disease and initiate work on engineering viral resistance in plants.

Establish collaborative ventures to develop specific applications of collagen-based biomaterials. Complete initial phase of work on biocompatible vascular grafts and commence a broader study on the requirements for biocompatible materials. Complete initial assessment of inhibitors of UV-induced damage to cells and cell proteins and assess potential for a broader study. Integrate computer image analysis and studies on antibody–antigen interaction for application to biosensor design based on biological signalling mechanisms.

To design and develop industrial processes and generate valuable products using naturally-occurring or engineered biological catalytic systems (enzymes, bacteria, insect cells, animal cells etc). (22%)

Develop applications of naturally occurring proteases in industrial processes. Commence work to design and engineer proteases with new activities for specific requirements. Continue assessment of ability of microbial systems to generate valuable products from dairy wastes and other cheap source materials. Develop improved technology for production of valuable proteins during fermentation processes.

Total Budget: \$12,400,000

Appropriation Allocation: \$10,400,000

The Division expects to receive 16% of the total budget from external sources.

4.3 DIVISION OF CHEMICALS AND POLYMERS

Objective

To develop new technologies to support the growth in Australia of the chemical, polymer and water treatment industries which are competitive in domestic and international markets.

Strategy

The Division seeks opportunities to apply its research results and to utilise its expertise in chemical synthesis, chemical processing, polymer chemistry, and surface and colloid chemistry, to develop new products and processes for Australian manufacturing. The Division also seeks to utilise its expertise in biological and physical processes to develop new water and wastewater treatments for the Australian water technology industries. An important feature of this strategy is that research projects are undertaken in collaboration with industry at as early a stage as possible.

Specific Objectives (Percent Resources)

To generate novel biologically active chemicals for evaluation in crop protection and against viral activity. Pre-industrial scale production of these new chemicals is investigated to determine optimum conditions for maximising outputs. This research aims to support Australian-based agricultural chemical and pharmaceutical industries in supplying world markets. (41%)

To develop separation membranes for processes associated with chemical production, catalysis and gas separation, and to develop novel surface active chemicals which are used to produce thin films including in a polymerisable form, that are aimed to give specific end-use effects. (15%)

To develop a new polymer matrix and means to achieve interfacial adhesion in high performance, low cost, carbon fibre-based composite materials for aircraft, and to develop polymeric biomaterials for medical devices by means of polymer synthesis or surface modification. (23%)

Planned Outcomes

Scheduled synthesis of range of new compounds based on computer design and new structures, for evaluation as insecticides, herbicides and fungicides, or as drugs to combat the HIV and Hepatitis B viruses. Staged development of process chemistry for the synthesis of compounds in quantities sufficient for field or pre-clinical trial.

Pilot plant scale-up of a higher yielding chemical process utilising a membrane-based separation stage. Study of surfactant cleaning action on specific surfaces, and development of surfactant aggregates based on the properties of ordered surfactant layers, and polymerisable surfactants aimed at particle coatings or use of optical or electrical properties.

Development of new, impact-modified plastics and their blends for the polymer matrix in composites, and plasma coating of the surface of polymers now used in medical devices to improve biocompatibility.

To develop processes based mainly on the use of magnetic particles for treating water, sewage and industrial wastewater, plus product recovery from waste streams. Other aims are to develop microbial processes to remove nutrients from sewage and industrial effluents for inland disposal, and disinfection of water by generation of ozone by UV irradiation of oxygen. (21%)

Pilot plant development of process for treatment of "sewage concentrate" using magnetite, and of process for biological removal of phosphorus and nitrogen compounds from sewage, plus lab-scale development of processes to recover zinc from waste streams, and chromium from electroplating rinsewaters.

Total Budget: \$11,300,000

Appropriation Allocation: \$8,500,000

The Division expects to receive 24% of the total budget from external sources.

4.4 DIVISION OF MANUFACTURING TECHNOLOGY

Objective

To develop new and improved products and processes which will increase the competitiveness of Australian manufacturing in the metals and related industries, particularly those that are export oriented.

Strategy

To achieve these objectives, the Division seeks opportunities to apply its skills in electronic, materials and mechanical engineering and computer science, to assist the Australian manufacturing industry with the development of new products and processes. Research projects are conducted in collaboration with industry at as early a stage as possible.

Specific Objectives
(Percent Resources)

Improve arc welding processes and equipment by developing a greater understanding of the factors controlling metal transfer in the consumable electrode arc, and the mechanical properties of the weld metal deposit. (15%)

Develop new electric arc devices, based on our new insights, for applications such as high power materials treatment reactors. (15%)

Collaborate with local industry in the development of integrated manufacturing systems to improve products and processes. (15%)

Develop flexible manufacturing systems, robotics, industrial lasers, industrial vision systems, machine tool control, factory communication, computer aided design and process modelling and simulation for Australian industrial use. (30%)

Planned Outcomes

A new range of flux-cored pulse welding electrode formulations is being developed. New welding process technology includes the development of high productivity welding systems covering areas of mechanisation, automation, and the application of robots for achievement of optimum fabrication.

New types of electric arc reactors are being developed for waste destruction, ceramic spraying applications, and materials treatment.

A collaborative project to introduce "cellular" manufacturing principles and to integrate the planning supply, and manufacturing activities in a large automotive manufacturing plant will continue. Computer-aided design tools developed to support this work will be commercialised.

Products which will be the subject of collaborative R&D projects include: manufacturing cell and robot controller; a high-speed industrial vision system for quality control; software for computer-aided design and analysis; an expert system for electronic fault diagnosis; and an integrated layout and cutting system for leather pattern pieces; and specialised laser drilling and processing technology.

Improve manufacturing productivity of, and enhance processes in, foundry technology, die casting, process simulation and control, materials forming and processing, tools and dies, materials joining, and surface modification. (25%)

The immediate focus of the work is the establishment of collaborative arrangements with Australian companies in the commercialisation of several "products" arising from work in the above areas. These are: a computer-based shape measurement device for control of processes requiring surfaces of predetermined curvature or flatness, a metal/ceramic bonding process for applications in the mining and agricultural industries, a software package for modelling the solidification process as an aid in casting design and die casting process.

Total Budget: \$8,500,000

Appropriation Allocation: \$6,900,000

The Division expects to receive approximately 17% of the total budget from external sources.

4.5 DIVISION OF MATERIALS SCIENCE AND TECHNOLOGY

<p style="text-align: center;"><u>Objective</u></p> <p><i>To assist Australian industry by developing new and improved materials, as well as relevant processes and instruments.</i></p> <p style="text-align: center;"><u>Strategy</u></p> <p><i>To meet these objectives the work of the Division has been grouped into four major programs; Alloys Research, Ceramics, Solid State Science and Advanced Materials Synthesis. The Division will maintain an appropriate mixture of strategic research, instrumental development and collaborative work with industry.</i></p>

Specific Objectives (Percent Resources)	Planned Outcomes
Develop and assist industry in the exploitation of advanced alloys; provide facilities, based on our previous materials expertise, to produce pilot quantities of novel materials suitable for commercial application in generic high technology industries. (20%)	Operate a medium scale vacuum (controlled atmosphere) casting facility for use with a prototype strip caster for aluminides, for medical implant alloy development, and for collaborative work on superalloy evaluation. Continue collaborative projects on X-ray instrumentation and on the application of optically variable devices.
Develop novel advanced ceramics with improved properties, or new ceramic components or devices in order to create manufacturing opportunities for Australian industry and to provide expanded markets for Australian materials. (30%)	Reach agreement to commercialise advanced refractories, and to re-establish links with Australian users and producers of refractories. Demonstrate an ability to manufacture high quality silicon carbide components. Evaluate the suitability of diamond-ceramic composites for industrial applications.
Develop collaborative projects based on advanced scientific and analytical instrumentation, which will lead to the establishment of embryonic businesses, and to solving important problems in materials analysis and processing. (20%)	Expand facilities for corrosion testing and research, and develop techniques for the evaluation of susceptibility to crevice corrosion. Complete design and feasibility study for image correction optics for 3.9m Anglo-Australian Telescope. Modify solid state NMR spectrometer for imaging studies. Flight test atmospheric pressure sensor optical system.
Apply chemical and chemical engineering skills to the preparation and utilisation of inorganic materials, especially catalytic materials and the processing of polymeric materials. (25%)	Commission synthesis facilities for large-scale inorganic materials. Establish carbon fibre processing activities and define pitch refining and rheology technology control.

To collaborate with the Victorian Government and other sponsors in the operation of the National Advanced Materials Analytical Centre, the Industrial Materials Design Centre, and the Australasian Corrosion Centre, within the Division of Materials Science and Technology. (5%)

Exploit NAMAC microscopes and analytical accessories in collaboration with industry, continue consultancy for the IMDC and expand interaction with the Australasian Corrosion Centre.

Total Budget: \$12,500,000

Appropriation Allocation: \$9,700,000

The Division expects to receive 24% of the total budget from external sources.

5. INSTITUTE OF INFORMATION & COMMUNICATIONS TECHNOLOGIES

Objective

The Institute aims: –

- . ***to be a leader in strategic research on information and communications technologies for the benefit of Australia.***
- . ***to help increase the international competitiveness and export orientation of the Australian information, telecommunications and space industries.***
- . ***to assist other industry sectors to improve their competitiveness through the use of advanced computer, communications and space systems.***

Strategy

The Institute conducts its research programs in collaboration with other CSIRO Institutes, academic institutions and industrial research groups, and encourages education and training in the information and communications technologies.

The Institute plans to exploit the results of its research through joint ventures, collaborative research, development projects and consultancy with Australian industry.

The Institute will maintain itself at the forefront of international research on information and communications technologies to ensure the continued excellence of its technology.

The Institute hosts the Australia Telescope in recognition of its strategic importance for the development of key technologies relevant to the Australian information, telecommunications and space industries.

Research groups in the Institute will be built-up to a size that will ensure their viability and maximise the impact of their work. (This involves the capacity to carry out a substantial amount of long-term strategic research while at the same time attracting and managing large amounts of external funding).

The Institute will encourage pre-competitive R&D in Australia, particularly in conjunction with groups of companies. This is especially pertinent at present because of the short-term focus and fragmented effort of the majority of relevant private sector research and development.

Australia faces a critical shortage of skilled people in the computing and engineering areas. Consequently, it is vital that the Institute works together with active research teams possessing complementary skills in academic and other research establishments. To this end joint research centres will be established in conjunction with tertiary educational institutions. The Institute will also become involved in education and training, both undergraduate and postgraduate.

The growth of the Institute will take place by evolution from existing areas of strength since this maximises the commercial impact of the Institute's work.

Activities

The Institute operates the Australia Telescope as a national research facility and manages CSIRO's Cyber 205 supercomputing facility. The Institute is responsible for the CSIRO Information Technology Program, managing the CSIRO Space Technology and Application Fund, and the Research Aircraft Facility.

Selected areas of endeavour are:

- *microwave and millimetre-wave communications systems for ground, satellite, and satellite ground station use including Australian-made GaAs devices;*
- *advanced signal processing and digital image processing;*
- *design of electronic and micro-electronic systems, supported by VLSI component development;*
- *software engineering products for the design, construction and maintenance of computer-based systems;*
- *decision support systems involving knowledge-based engineering;*
- *parallel computer architecture and algorithmic analysis for advanced computing;*
- *computer communications based on OSI standards;*
- *information systems involving spatial database technology;*
- *advanced graphics systems and user interfaces;*
- *value-added software products for resource management;*
- *instrumentation for space systems;*
- *mathematical and statistical modelling of industrial processes; and*
- *statistical methods in quality assurance*

The Institute encompasses the following Divisions and Units.

Division of Information Technology	Headquarters and Sydney Laboratories, North Ryde, NSW Centre for Spatial Information Systems, Acton, ACT Melbourne Laboratories, Carlton, Victoria
Division of Mathematics and Statistics	Headquarters, North Ryde, NSW Sydney Laboratories, Lindfield, NSW Melbourne Laboratories, Clayton, Victoria Adelaide Laboratories, Unibrae, South Australia Western Australian Laboratories, Floreat Park, WA
Division of Radiophysics.	Headquarters and Sydney Laboratories, Marsfield, NSW
The Australia Telescope	Headquarters and Sydney Laboratories, Marsfield, NSW The Parkes Observatory, Parkes, NSW The Paul Wild Observatory, Culgoora, NSW
CSIRO Office of Space Science and Applications (COSSA)	Barton, ACT Research Aircraft Facility, Marsfield, NSW

The Institute Headquarters is at North Ryde, Sydney, NSW

INSTITUTE OF INFORMATION AND COMMUNICATIONS TECHNOLOGIES**SUMMARY OF RESOURCES**

<u>Division</u>	<u>Prof Staff</u>	<u>Total Staff</u>	<u>Approp Allocation</u> (\$000s)	<u>Estimated Budget</u> (\$000s)
Information Technology	44	69.5	5,592	6,522
Mathematics & Statistics	45	58.5	3,783	4,283
Radiophysics	69	167.5	8,908	11,008
COSSA	6	13.5	2,465	2,965
Institute Headquarters ⁽¹⁾	3	9.5	4,134	4,334
<hr/>				
Total	167	318.5	24,882	29,112

(1) Includes Information Technology Fund

National Research Facility: The Australia Telescope

Construction Associated Operation – \$ 304,000
 Operation – \$6,272,500
 External – \$ 300,000

Staff: 113 (including 46 professional staff).

Cyber 205 Facility – \$2,400,000

Staff: 5 professional staff

Capital – \$4,739,000

5.1 DIVISION OF INFORMATION TECHNOLOGY

Objective

To extend and apply computer and communications technologies for the benefit of the Australian information industry.

To assist establish industries to improve their competitiveness through the use of advanced computer and communications systems.

Strategy

The Division works in concert with the Australian information industry, with other Divisions of CSIRO who have established relationships with the industries they serve, and with active research teams in the relevant disciplines in academic and other government research establishments in Australia and overseas.

Specific Objectives (Percent Resources)

Planned Outcomes

Computer Communications

Assist manufacturers and users to exploit the opportunities afforded by internationally agreed standards for the interconnection of computer systems and improve the computer networking infrastructure within Australia. (30%)

Install and develop facilities to provide mail gateways between different communications networks. Complete the design and commence the implementation of Electronic Directory Services software with our GIRD grant partners. Complete the UNIX implementation of the OSI file transfer, access and management (FTAM) standard. Examine an Office Document Architecture (ODA) toolkit for OSI-based multi-media communications. Investigate issues in standardisation of network management and security facilities.

Spatial Information Systems

Evaluate and develop novel techniques and tools applicable to geographically and spatially referenced data and assist users and manufacturers exploit the techniques and tools in their own environments. (35%)

Establish the feasibility of a commercial operation which will support, develop and market image processing and other spatial information systems emanating from the Division. Further develop a generic image processing kernel and apply it to research on visualisation and parallel processing techniques for image processing and display. Develop decision support systems through collaborative projects, exploiting hybrid models based on numerical, artificial intelligence and distributed techniques. Extend SIRO-DBMS in its spatial model, image processing integration and distributed capabilities according to industry needs and data systems.

Knowledge-Based Systems Engineering

Develop methods and tools for the engineering of systems of which knowledge is a central component. (30%)

Extend and commercialise techniques and tools for the engineering of expert systems and knowledge represented in a structured way such as rules of hypertext. Develop knowledge-based processing techniques including the commercialisation of a content-addressable memory. Develop techniques for the engineering of software specifications, particularly for data-oriented information systems. Initiate research on intelligent user interfaces to communicate knowledge and information in natural languages.

Parallel Computation

Develop and make available to industry techniques for the application of parallel computation and computer architectures. (5%)

Complete and evaluate a prototype of a parallel processor based on the dataflow model. Develop and evaluate algorithms for computation-intensive processes on a number of parallel computation techniques accessible to industrial and commercial users of computing.

Total budget: \$6,522,000

Appropriation allocation: \$5,592,000

The Division expects to receive 14% of its total budget from external sources.

5.2 DIVISION OF MATHEMATICS AND STATISTICS

Objective

To extend the knowledge and techniques of mathematics and statistics and apply them for the benefit of Australian industry, with increasing emphasis on the information, communications and service sectors.

Strategy

The Division was substantially reorganised on 1 July 1988 to enable it to meet its new objective.

The Division will strengthen its direct interaction with Australian industry, both with a range of individual companies and with industrial groups such as AMIRA and MTIA. In its involvement with industry the Division searches for collaborative projects which help increase Australia's international competitiveness and in which its skills-base can be used to best effect. Tactical work will continue to be undertaken through the Division's Joint Venture Agreement with SIROMATH Pty Ltd. The Division will also collaborate with other CSIRO Divisions when the resulting multidisciplinary project team is the most effective way of meeting Divisional and industrial objectives.

Specific Objectives (Percent Resources)

Assist Australian industry improve particular industrial processes through mathematical modelling, providing efficient computational algorithms for these models and carrying out strategic research. (28%)

Improve quality control and quality technology in Australian industry by integrating statistical thinking into quality improvement programs. (18%)

Improve the design and operation of manufacturing processes by developing novel methodologies for their statistical modelling and evaluation. (15%)

Planned Outcomes

Mathematical modelling of optical systems and of damage to wound coils, modelling SQUID design and placement on a biomagnetometer, developing software for 3-D modelling of solidification of castings, network modelling, and optimisation of the sound characteristics of industrial fans will be undertaken. A Mathematics-In-Industry Study Group will be held. A Divisional capability in operations research will be developed.

Acceptance and integration of statistical thinking into quality improvement programs will be achieved by delivering focused courses to companies, by long-term involvement in company quality programs and by carrying out strategic research into the methodology of quality improvement.

DMS will work collaboratively with companies and with the Division of Manufacturing Technology to develop statistical methods for modelling process performance and identifying sources of product variability. Modelling of wear processes, prediction of product reliability, modelling of surface roughness, analysis of image data to classify and monitor process defects, sampling from continuous streams and statistical modelling of QEM and SEM data will be undertaken. Strategic research in computer-intensive statistical methods will be carried out to anticipate the future needs of Australian industry and to maintain the Division's technological capability.

Develop new methodology and software tools for the processing and analysis of digitally coded images, including remotely sensed data. (20%)

Major activities will include collaboration with companies and CSIRO Divisions requiring special purpose solutions for the use of image data, and developing methods for the classification of images using texture or high-dimensional spectral data. Strategic research will be carried out into methods for the analysis of remotely sensed and image data.

Develop new methods for modelling, analysis and extraction of signals observed with correlated noise and implement these methods with suitable algorithms. (9%)

Signal extraction methods using both spline and Fourier methods will be developed, and methods for the analysis of spectroscopic data will be investigated in collaboration with Division of Exploration Geoscience. The level of collaboration with individual companies will be increased.

Improve the quality and scope of statistical and mathematical software used in the Division; develop a productive computing environment for the Division's research activities. (10%)

The computer network between CSIRO and other research institutions will be developed. Developmental work will continue on the Division's product ACE, a high level environment for statistical graphics.

Total budget: \$4,283,000

Appropriation allocation: \$3,783,000

The Division expects to receive 11% of its total budget from external sources.

5.3 DIVISION OF RADIOPHYSICS

Objective

To extend and apply the knowledge and techniques of radiophysics, electronic and communications engineering for the benefit of Australian industry and the community.

Strategy

The Division seeks collaborative projects with industry and with tertiary educational institutions where its skills-base in antennas, microwave techniques and signal processing can be used to best effect. This includes the establishment of joint venture companies where appropriate.

The Division will maintain itself at the forefront of international research in electronic and communications engineering to ensure the continued excellence of its technology.

The Division will maintain strong collaborative links with the Australia Telescope and international radio astronomy institutions in recognition of their strategic importance for the development of key technologies relevant to the Division's work.

**Specific Objectives
(Percent Resources)**

To develop the appropriate expertise and technology for the design and manufacture of satellite earth station antennas and microwave and millimetre-wave communications systems. To support feed-system development for the Australia Telescope. (14%)

To develop techniques for the design and manufacture of shaped-beam antennas and microwave feed networks for on-board satellite use. To develop multiple beam antennas for both ground station and on-board satellite applications. To interact with Australian firms towards the establishment of a viable spacecraft antenna industry in Australia. (6%)

Planned Outcomes

Design of earth-station antennas in conjunction with Macdonald Wagner Pty Ltd, structural engineers, will continue to support the requirements of OTC and Department of Defence. A collaborative R&D program with OTC is looking at developments for future earth-station antennas. Antenna developments and measurements for government and industry, and for the Australia Telescope, will also be undertaken. A research program in millimetre-wave antennas and propagation, and a collaborative project with DSTO on millimetre-wave links have commenced.

International contracts with space communications agencies such as Intelsat and Inmarsat and aerospace companies will be pursued, in conjunction with industry whenever possible. Design and implementation contracts will be undertaken with AUSSAT, Hughes Aircraft Co., Department of Defence, MITEC and other commercial organisations.

To develop advanced GaAs-based semiconductor devices and monolithic integrated circuits incorporating them and to apply this technology to the development of novel, fully-integrated communications systems operating at microwave, millimetre-wave and optical wave lengths. (27%)

To develop techniques for image formation and related technologies for digital image single processing and apply them in areas such as remote sensing, geophysics, medical diagnostics, radar, telecommunications and astronomy. (40%)

Collaborative work will be undertaken with the Division's joint-venture commercial partners Triune Pty Ltd to provide research and development support for the company's expanding product capability and to refine their business plan; initially in the microwave and millimetre-wave range and, later, in optoelectronic technology.

Major effort will be directed towards real time processing for video applications, adaptive beam forming for radar and medical imaging and image processing for geophysical applications. Collaborative projects will be undertaken with a range of commercial partners and tertiary educational institutions.

Total budget: \$11,008,000

Appropriation allocation: \$8,908,000

The Division expects to receive 19% of its total budget from external sources.

5.4 CSIRO OFFICE OF SPACE SCIENCE AND APPLICATIONS

Objective

Maximise the economic, social and scientific benefits from the design, manufacture and utilisation of space-related technologies across a range of Australian industries.

Strategy

Identify space-related technologies and applications arising from CSIRO's existing scientific and technological base. Co-ordinate and, where appropriate, manage these activities within the national framework to form a CSIRO space program directed towards the support and development of viable and competitive Australian industries which provide or utilise space-related products and services.

Specific Objectives *(Percent Resources)*

Develop and maintain an appropriate space-related science, technology and applications base in CSIRO, including the operation of special facilities and the provision of specialist services including commercial services. (40%)

Develop knowledge of, and confidence in, Australian expertise in utilising and providing space-related technologies across several industrial sectors. (10%)

Assist Australian communications, information, electronic and manufacturing industries to achieve a high level of participation in the program of space-related technologies. (20%)

Assist a range of industries to enhance the utilisation of space-related technologies, thereby increasing the competitiveness of several sectors of the economy, including the primary and service industries. (20%)

Planned Outcomes

Manage the CSIRO Space Fund; manage, operate and develop the CSIRO Research Aircraft Facility; co-ordinate and assist CSIRO responses to relevant announcements of opportunity; and, support planning for validation and calibration of data from ERS-1 and other satellite initiatives.

Maintain a space information resources program, including seminars, displays, publications, press releases; represent CSIRO at selected space-related conferences and represent CSIRO on relevant private and public sector committees.

Liaise with CSIRO Divisions and space-related industries, academia and government; co-ordinate technical development of reception of MOS-1 data; participate in management, and co-ordinate technical development, of interdivisional projects involving space technology: Radiosastron, Atmospheric Pressure Scanner and precision antennas for reception of data from remote-sensing satellites.

Co-ordinate utilisation of MOS-1 data; co-ordinate development and marketing of new airborne remote sensing instruments.

Enhance Australian participation in international space-related activities, on the basis of CSIRO expertise, and develop an increased awareness of the technological opportunities such participation presents for the export of space-related products and services. (10%)

On CSIRO's behalf, negotiate and conclude international agreements on space-related activities; arrange CSIRO representation at relevant international meetings.

Total budget: \$2,965,000

Appropriation allocation: \$2,465,000

COSSA expects to receive 17% of its total budget from external sources.

5.5 THE AUSTRALIA TELESCOPE (A NATIONAL RESEARCH FACILITY)

Objective

To operate and develop the Australia Telescope as a National Research Facility and conduct research in radioastronomy and astrophysics.

Specific Objectives **(Percent Resources)**

To complete the installation of electronic hardware in the Australia Telescope and to conduct commissioning tests needed to become operational as a National Research Facility for radioastronomy in 1990. (49%)

Planned Outcomes

After the opening of the Australia Telescope in September 1988, the main emphasis has been on commissioning the instrument for the commencement of observations as a National Research Facility in 1990. The first image was obtained using 3 antennas at 6cm in June 1989. By the end of 1989 5 antennas will be operating with spectral line and polarisation capability using baselines to 3km. During 1990 and 20cm systems and the 5km and MOPRA antennas will become operational.

To pursue a program of research in astronomy and astrophysics using primarily radio techniques which will complement the role of the Australia Telescope as a National Research Facility. (51%)

The Parkes radiotelescope is leased to NASA until August 1989, for telemetry from the Voyager spacecraft during its encounter with the planet Neptune, limiting opportunities for observations on other programs during this period. A major program of surveying the continuum emission of the Magellanic Clouds and selected radio galaxies will be undertaken. Searches for millisecond and other short-period pulsars in globular clusters, supernova remnants and in the plane of our Galaxy will continue. The Parkes telescope will be used in conjunction with other telescopes in Australia and overseas for high resolution long-baseline interferometry observations of both continuum and spectral-line sources.

Budget: Operation: \$6,248,300

Construction associated operation: \$304,000

6. INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

Objective

The Institute aims to help increase international competitiveness, expand earnings and increase the gross domestic product and the value of the services provided by Australia's minerals, energy and construction industries through R&D and technology transfer directed to:

- . the better location, definition, extraction and processing of mineral and energy products;*
- . more efficient and cost effective practices, procedures and products in the building, construction and related engineering industries;*
- . maximising the Australian input to support technologies and services used by the minerals, energy and construction industries;*
- . improving product quality and specification to meet market needs;*
- . developing value-adding processes particularly in simply transformed manufactures which will capture additional value in Australia;*
- . diversifying into products and services with market potential;*
- . protecting the environment and promoting a better understanding of the socioeconomic aspects of these industries.*

In setting priorities and developing and applying strategies to meet these objectives, the Institute will cooperate closely with industry and industry organisations, commodity councils and boards, research organisations, and relevant State and Federal Government agencies.

Economic Context

The minerals, energy and construction sectors play a vital role in the Australian economy. The three sectors provided \$18.7 billion of export revenue in 1987/88, and four of the five top export commodities are from the minerals and energy sector. They also contributed around 20% of Australia's gross domestic product in 1986/87.

The Australian minerals and energy industry is among the most competitive, environmentally responsible and safest in the world. However, it is under extreme competitive pressure from the development of large, rich mineral and energy resources in developing countries and from advances in technology by its established competitors. The industry requires constant technological innovation in product and process improvement in order to maintain its competitive position in world markets. It also needs sophisticated exploration techniques capable of sustaining an adequate resource base for future growth, as well as value-adding technologies to maximise benefit to Australia from our resources.

Within Australia, mineral, energy and construction sector has indirect impact upon the rest of the economy. The products of the sectors are fundamental inputs to other production processes. In 1982/83, 58% of the sectors' products were used as inputs to other sectors of the economy. The mining industry has also played a major role in developing Australia's outback areas, contributing over \$3 billion to industrial and social infrastructure in the last five years.

Further growth in export volumes for minerals and energy and significant increases in the further processing of some major minerals is forecast to result in substantial growth in the value of the exports from these sectors. Greatly increased imports of crude oil and petroleum products is expected, owing to projected strong growth in demand. However, growth in exports from other energy commodities will maintain Australia's position as a net energy exporter.

The construction sector faces increasing international competition, but local industry secures between around 70-90% of all design, building, construction and engineering contracts in Australia. Forecasts show a maintenance of current levels of activity in the sector in the medium term.

Strategy

a) Minerals

The Institute, in collaboration with industry, is concentrating on raising productivity, economic return and international market share. Efforts to discover and delineate concealed ore bodies and deposits, as well as research into improving the efficiency and yields from mining, beneficiation, and smelting techniques, will continue to be supported.

Research into simply transformed manufactures will be increased, with the aim of enhancing Australian enterprises based on higher value-added products. Strategic alliances will be developed with the major Australian companies to support their developing a position of technological and market leadership in basic metals and industrial minerals.

Environmental impact will also continue to be investigated, with cost-effective monitoring and control techniques being a focus for research.

b) Energy

The Institute will, through collaborative research with industry and government agencies, continue to support the energy sector by concentrating on improved better characterisation and extraction of Australian coals, and by expanding their use, so as to increase export potential and enhance the effectiveness of domestic use. Research into alternative fuels, including the conversion of natural gas and oil shale, will continue to support longer-term national strategic considerations. Activities intended to reduce Australia's total fuel usage, including large building climate control, and fuel and power efficient facilities, will also continue.

Particular attention will be focused on the understanding of the relative contributions of human activities to the Greenhouse Effect. This work will be set in the overall context of responsible use of energy resources, and the development of the necessary technologies, in order to sustain a viable economic future for Australia.

c) Construction

The Institute will develop close linkages with the diverse segments of the industry, and will focus on increasing cost effectiveness, quality control and efficiency output. The integration of research with testing and industry accreditation services will provide a breadth of support to industry, which improves feedback from the marketplace to the research and development effort. Socioeconomic issues will be addressed, in the context of the national impact of the industry.

The Institute encompasses the following Divisions.

Division of Coal Technology	Headquarters and Laboratories, North Ryde, NSW
Division of Building, Construction and Engineering	Headquarters and Laboratories, Highett, Vic
Division of Exploration Geoscience	Headquarters and Laboratories, Floreat Park, WA
Division of Fuel Technology	Headquarters and Laboratories, Lucas Heights, NSW
Division of Geomechanics	Headquarters and Laboratories, Syndal, Vic
Division of Mineral and Process Engineering	Headquarters and Laboratories, Clayton, Vic
Division of Mineral Products	Headquarters and Laboratories, Port Melbourne, Vic

The Institute Headquarters is at North Ryde, NSW.

INSTITUTE OF MINERALS, ENERGY AND CONSTRUCTION

SUMMARY OF RESOURCES

<u>Division</u>	<u>Prof Staff</u>	<u>Total Staff</u>	<u>Approp Allocation (\$000s)</u>	<u>Estimated Budget (\$000s)</u>
Building, Construction and Engineering	131	336	17,400	21,000
Coal Technology	59	128	6,100	9,000
Exploration Geoscience	77	164	7,600	10,300
Fuel Technology	40	74	5,800	7,200
Geomechanics	43	90	4,500	8,300
Mineral and Process Engineering	114	191	7,700	11,500
Mineral Products	81	142	6,300	8,100
Institute Headquarters	4	8	1,300	1,300
 <hr/>				
Total	549	1,133	56,700	76,700

Note: Direct Appropriation allocation excludes major items of equipment, repairs and maintenance, and new initiatives funding, revenue and Sirotech retainer.

6.1 DIVISION OF BUILDING, CONSTRUCTION & ENGINEERING

<u>Objective</u>
<i>To facilitate more efficient, profitable and competitive activity in Australia's building, construction and related engineering industries.</i>
<u>Strategy</u>

Develop strong collaborative research ties with the major industry associations, government agencies and private companies serving our industries, and establish efficient communication links with the many small companies and individuals that service the industries at a professional and sub-professional level.

<u>Specific Objectives (Percent Resources)</u>	<u>Planned Outcomes</u>
Improve the life cycle performance of materials and components for constructed facilities. (25%)	Materials under examination include plastic water pipes, roofing tiles, reinforced concrete, aggregates and novel cements.
Improve the commissioning, operation and refurbishment of engineered products, components and services. (24%)	Activities span advanced fans, heat exchangers and pulsed combustion systems; plumbing and hydraulic elements, thermal models of buildings and building materials.
Guide the design profession and construction industries in optimising the competing requirements of safety, functional performance and cost. (16%)	Develop prototype microwave and visual scanners for sorting and grading structural timber; construct analytical and statistical models of loads due to bulk solids in bins and silos.
Improve planning and management in the building and construction sector. (19%)	Potential of ice-storage systems to reduce maximum electricity demand will be determined; a commentary on the Building Code of Australia will be published; the BOMA project on building operation and maintenance will be completed; route optimisation software will be developed for the VFT.
Reduce the risks and costs of life and property losses through fire. (16%)	Fabricate and commission furniture calorimeter; determine fire performance of timber beams and their connectors; determine fire spread in corridors.

Total Budget: \$21,000,000

Appropriation Allocation: \$17,400,000

The Division expects to receive 17% of its total budget from external sources.

6.2 DIVISION OF COAL TECHNOLOGY

Objective

Increased efficiency in the production, utilisation and marketing of Australian coal.

Strategy

Scientific and engineering skills are applied to enhance the competitiveness of the coal industry in the production, use and marketing of coals, with due regard to protection of the environment and the processing/utilisation of by-products.

Important elements of the strategy are:

- ***to establish and enhance the quality and value of Australian coal through improved characterisation, testing, preparation and utilisation technologies, and alleviation of the environmental impacts;***
- ***to develop value-adding processes and new/improved products, particularly for export and for import-substitution;***
- ***to commercialise research findings through partnerships and joint ventures with the private sector;***
- ***to co-ordinate coal research activities within CSIRO and other research institutions, in collaboration with industry.***

Specific Objectives (Percent Resources)

Planned Outcomes

Coal Characterisation and Testing

To lead and co-ordinate in a national research effort on coal characterisation and the development of improved test procedures to determine coal quality and utilisation behaviour. (20%)

The PMRTA apparatus for determination of thermoplasticity of coals is expected to be commercialised; other techniques such as thermal analysis, NMR, FTIR, two colour pyrometry and predictive methods for spontaneous heating of stockpiles, will be researched or further developed; data base systems for better presentation of coal quality information in research and industry will be well developed.

Coal Preparation and Value-Added Processing

To increase the quantity and quality of coal recovered in preparation plants and to generate new and improved products from coal. (20%)

Superclean and ultraclean coal (and later selectively upgraded coal and coal-water mixtures) will be produced from demonstration plants; briquettes and briquetting technologies are expected to be developed for major export markets; initiatives on industrial carbon products (active carbons, anode carbons, and carbon fibres), and on chemicals and other coal derivatives should become established.

Coal Combustion and Carbonisation

To co-ordinate and play a leading role in national research efforts on coal utilisation, with regard to improving efficiency in electricity generation and metal production. (20%)

Research findings will assist the marketing/ utilisation of low volatile and high-salt coals and of coal for injection to blast furnaces, and will help optimise coke and char utilisation in metal production; the ASHUT joint venture should progress towards realising some of the commercial potential for utilisation of flyash and other coal by-products; collaborative research on the utilisation of high purity coal in advanced power cycles is being initiated.

Environmental Protection

To assess, model, predict, and control the effect on land, water resources, and the atmosphere of particulate, dissolved and gaseous pollutants arising from the power, mining, and related industries and to quantify the benefits arising from improved preparation and more efficient utilisation technologies. (23%)

Services to industry will continue and be more integrated; water management research will place greater emphasis on water treatment; initiatives on acid gas emissions from coal and the role of coal in the greenhouse effect will become established; the universal smog monitor AIRTAK will be marketed internationally; efforts to develop new generation dewatering machines and tanks are expected to gain momentum.

Other Research Areas

To play a major role in the national research program to develop a new process for natural gas conversion to liquid fuels. (12%)

The economic viability of the process will be established; novel catalysts are likely to be developed and patented.

To apply Divisional expertise to products and services with market potential that contribute to Australia's economic development, especially in the manufacturing sector. (5%)

Industry-funded projects will continue on the development and application of:

- (i) electrostatic technologies, for coating of food, pharmaceuticals and metal powders
- (ii) neutron attenuation techniques for oil refineries, coal liquefaction plants, and electrostatic precipitators
- (iii) NMR methods for determination of grease and moisture in scoured wool
- (iv) water treatment to remove chromium from wool dyehouse effluents
- (v) electro-dewatering of sewage sludge.

Total Budget: \$9,000,000

Appropriation Allocation: \$6,100,000

The Division expects to receive 32% of its total budget from external sources.

6.3 DIVISION OF EXPLORATION GEOSCIENCE

Objective

Create and improve methods for locating new mineral and energy resources.

Strategy

The Division concentrates on developing concepts and techniques for exploration in Australia's unique weathered terrain and for the location of concealed deposits. Emphasis is placed on geophysical, mineralogical, geochemical and remote sensing techniques and on developing commercial products, including instrumentation, for exploitation by the manufacturing industry.

Specific Objectives
(Percent Resources)

Planned Outcomes

Develop remote sensing equipment, data acquisition systems and interpretational methodology for application in mineral exploration and for the management of renewable resources. (21%)

Major industry funding (16 companies) through AMIRA (3–years) for gold exploration in Western Australia, together with AMIRA sponsorship of technology transfer and training workshops in remote sensing techniques with application to renewable and non-renewable resource management exploration.

Develop concepts and techniques for mineral exploration in areas of deep weathering and transported overburden. (21%)

Includes the geochemistry of laterites and distribution of gold and associated elements in the weathered profile.

This collaborative R&D program funded by 40+ companies (AMIRA) support a major activity in gold and precious metals exploration research.

Improve methods for the selection of prospective terrain using mineralogical, isotopic, geophysical and petrophysical techniques. (28%)

Support via six 3-year AMIRA projects (30+ companies) contribute to mathematical and electromagnetic modelling, enhancing the interpretation of radiometric surveys, improving geological interpretation of magnetic survey data and to the mineralogy and geology of banded iron formations and associated ore deposits.

Develop methods to improve the detection of deep (blind) ore-bodies including those with negligible surface expression. (9%)

Includes geochemical halo and trace element studies to establish a suite of pathfinder minerals as a basis for exploration.

Research also features platinum group elements, nickel and gold ore-zone petrology and deposit characterisation. The genesis and evolution of greenstone belts are studied in relation to mineral potential. Director company support on projects with time scales 6 months to 2 years.

Develop new methods for petroleum exploration based on microprobe analysis, organic chemistry and organic petrological techniques. (15%)

New isotopic methods (based on radiometric and stable elements) have been introduced to study the thermal evolution of hydro-carbon bearing sedimentary basins and the porosity history of the source, reservoir and trap sequences. Improved recovery techniques based on microbiological processes have also been developed.

1 year AMIRA, 3 year NERDDC and company sponsorship support all projects in this area.

Develop very advanced analytical methods in support of ongoing research in the Division. (6%)

The heavy ion analytical facility (HIAF) provides ultra-trace element information from in situ analysis. In addition, automated raman spectral methods are also being developed for in situ analysis, eg of fluid inclusion composition and maturation characteristics in dispersed organic matter.

Further developments with HIAF include the use of radiogenic cosmoisotopes to study the evolution of weathered terrain. AMIRA, NERDDC and company sponsorship support analytical developments.

The Division will continue to give emphasis to the establishment of multi-client sponsorship such as achieved through AMIRA. Currently, 15 AMIRA projects are funded with plans to commence a further two. Priority allocation of resources recognise the significance of gold exploration research and the rebuilding of remote sensing for application to renewable and non-renewable resource exploration. Developments in methods to help maintain the Division at the leading edge of analytical procedures, especially those that are non-destructive, are also given high priority.

The Division's links with industry, the tertiary sector and state government departments are being strengthened through the establishment of jointly-funded research positions.

The Division is planning major participation in Centres of concentration for industry specific R&D consortia and for the development and application of specialist research techniques. The Centre for Isotope Studies has been established at North Ryde together with support from nine universities and the ARC. During 1989/90 the Centre will promote and accelerate the development and application of isotope geochemistry to fundamental studies of earth materials, mineral and petroleum exploration and to environmental issues. The Division's remote sensing branch in the Perth laboratories will be a major participant in a planned WA Centre for earth systems science – focusing on remote sensing in education, R&D in industrial applications and with aims to develop export markets for remote sensing products. 1989/90 will be a critical year for formalising arrangements between the tertiary education sector, CSIRO, industry and the WA State Government to ensure the Centre's future development.

Total Budget: \$10,300,000

Appropriation Allocation: \$7,600,000

The Division expects to receive 26% of the total budget from external sources.

6.4 DIVISION OF FUEL TECHNOLOGY

Objective

To develop new or improved processes for the production and use of liquid and gaseous fuels and their alternatives in order to maintain the maximum economic level of Australian production and self-sufficiency.

Strategy

Chemical and engineering skills are applied to create new process routes and to improve and modify overseas fuel technologies and processes to better suit them to Australian feedstocks and to identify possibilities for new technological approaches. Techniques for monitoring adverse health and environmental impacts of the production and use of energy and mineral resources are also being developed or enhanced.

Specific Objectives
(Percent Resources)

Planned Outcomes

Develop and improve methods for increasing the oil yield and producing transport fuels from Australian oil shales. (34%)

Major NERDDP and industry-funded collaborative research contracts will continue in 1989/90.

Establish factors that determine product selectivity in processes for converting synthesis gases and natural gas to liquid fuels. (23%)

NERDDP, GIRD and industry-funded projects will continue in 1989/90.

Devise better methods for natural gas storage in vehicles to increase their driving range. (9%)

NERDDP and industry-funded support for laboratory demonstration in 1989/90.

Measure trace elements in coal products and power station wastes to determine the environmental consequences of coal use. (11%)

NERDDP and Electricity Commission of NSW – funded projects to continue in 1989/90.

Develop analytical techniques for monitoring pollution of natural waters by mining and industrial operations. (7%)

AWRAC and industry-funded projects to continue in 1989/90 with commercialisation of instruments in 1989/90.

Develop improved techniques for biologically monitoring exposure of workers in the mining and energy industries to toxic materials. (7%)

Techniques expected for field trials in 1989.

New emphasis is being placed on exploiting the Division's extensive analytical chemistry expertise for specialised contract services and the development of instrumentation for manufacture and export by the Australian scientific instrument industry.

Total Budget: \$7,200,000

Appropriation Allocation: \$5,800,000

The Division expects to receive 19% of the total budget from external sources.

6.5 DIVISION OF GEOMECHANICS

Objective

Our Mission is to undertake research aimed at increasing the efficiency, productivity, safety and international competitiveness of the Australian mining, hydrocarbon and civil engineering industries.

Strategy

The Division concentrates on developing geo-engineering procedures, systems, and devices to monitor rock and soil under applied load; fundamental studies of the structures, properties and mechanics of geological materials; developing techniques for characterising the quality of mineral ores and other natural resources by in-situ geophysical methods; developing methods of modelling geologic systems under load; and field studies of rock masses and of structures in and on various geological structures.

Specific Objectives
(Percent Resources)

Planned Outcomes

Improve efficiency and safety in coal mining by developing techniques and equipment for predicting geological structure and strength in rock and coal, computational modelling of rock stresses and mine support, mine support methods and monitoring of strata and longwalls at the mining face and in long-term roadways, and a prototype remote control mine emergency survey vehicle. (20%)

Four major NERDDP-funded projects on these problems for industry continue in 1988/89.

Develop and evaluate new slope design methods for surface metal mining. Improve the prediction and control of rock mass displacements in deep underground metal mines. Apply numerical and computational methods to the design of rock support and reinforcement. Measure in-situ rock mass behaviour and develop appropriate techniques to model this behaviour in high and low stress environments. Develop techniques for monitoring blast vibration. (15%)

Funded by individual companies and by AMIRA.

Assist the industrial development of design and construction concepts for piled foundations for both offshore and onshore structures, through the development and application of cement grouting technology and through the artificial cementation of weak porous sediments. (10%)

Improve the effectiveness and efficiency of the cement grouting of rock masses, through the development and application of cement grouting technology.

Develop new, more efficient techniques for controlled cutting and drilling of rock, for rock fragmentation and for the assessment of fragmentation processes through fragment size/shape classification using image analysis. (10%)

Application of these techniques to mining, rock excavation, civil engineering foundations, dimension stone production and mine processing.

The approach to these problems is through a fundamental understanding of solid mechanics of geologic materials achieved by rock testing, optical and electron microscope studies and numerical modelling.

Rock cutting and fragmentation research currently at the development stages. Fragment size/shape rock testing being funded through several industry-funded activities.

Computer codes are being developed capable of modelling complex mechanical behaviour including coupled mechanical/thermal/fluid/chemical problems.

Several industry and NERDCC-funded activities and Division-funded basic research activities will continue in 1988/89.

Develop and apply structural integrity techniques based on acoustic emission procedures for the monitoring, structural integrity evaluation, remnant life estimation and failure prediction of dams, pipelines, pressure vessels, bridges, geological formations, mines and industrial processes using a variety of sensors which includes specialised acoustic emission transducers, hydrophones, geophones, accelerometers and ultimeters. (10%)

The interpretation involves special data processing and artificial intelligence techniques.

Present funding is from a number of industry collaborations basically in the pipeline pressure vessel industry.

Facilitate the transfer to industry of computational stress analysis techniques for design of underground excavations, by developing pre- and post-processing programs which are menu-driven and employ state-of-the-art graphics. (10%)

Funding is being provided by NERDCC, AMIRA and several individual mining companies.

Assist the establishment of a coal-bred methane extraction industry in Australia. (15%)

This will be achieved through the provision of operational and research activities. Operational support to operators, comprises site selection, evaluation of exploration wells using CSIRO's unique facilities, and reservoir modelling. Research activities include site selection using geological and geophysical techniques, permeability of coal beds to methane and water, and the optimal hydrofrac geometries to enhance permeability.

NERDCC and industry funded (commercial associations have been formed with Australian and US firms).

Develop geophysical in-situ methods of analysis including borehole logging and surface sensing for: investigations of ore and rock chemistry; development of technologies benefiting the mining and civil engineering industries in exploration, site examination, mine and quarry development, and production; and monitoring variations of salinity concentrations in water bores as part of Australia's research programs into salinity control. (10%)

Funding is by NERDDC and individual companies.

A current issue of importance to the Division is the large increase in research activity associated with extraction of methane from coal seams. A number of projects are being carried out in Queensland, NSW and Western Australia.

Total Budget: \$8,300,000

Appropriation Allocation: \$4,500,000

The Division expects to receive 46% of the total budget from external sources.

6.6 DIVISION OF MINERAL AND PROCESS ENGINEERING

	<u>Objective</u>
<i>To increase the international competitiveness of mineral, energy, base-metal and process industries in Australia.</i>	
	<u>Strategy</u>
<p><i>Skills in engineering and science are applied through theoretical, experimental and application studies, in conjunction with industry, to the stages of processing and beneficiation that offer the most cost effective returns or means of improvement for the industry. Particular emphasis is placed on instrumentation and control; material handling; ore and mineral beneficiation; and smelting and base metal production.</i></p>	

Specific Objectives (Percent Resources)

Develop new smelting procedures for basic metal products with the potential for cost reduction and improved environmental impact. (30%)

Develop improved methods of alumina and aluminium production. (10%)

To understand and improve the beneficiation minerals through measurement, modelling and control of processing steps such as grinding, crushing, flotation, agglomeration and sintering. (5%)

Develop sensors for analysis of coal, minerals and oil to provide accurate and timely information for process control strategies. (25%)

Improve basic understanding of fluidized-bed processes of combustion of coals, waste materials and the processing of ores. (10%)

Planned Outcomes

Further large-scale commercial developments of SIROSMELT with significant new research support from MIM are expected in 1989. The Hismelt ferrous direct smelting process should enter the demonstration phase with the Division providing basic research effort for CRA Ltd.

Investigation of modelling and control of the Bayer process for alumina will be expanded. A business plan will be developed by Comalco Ltd for high purity aluminium production based on the Division's process.

Continuing assistance to the industry is anticipated both at bench and pilot-scale through the study of iron ore sintering. Evaluation of new crushing techniques will continue. Research on understanding of the mechanisms of flotation of sulphide ores will be enhanced through industry support. Results from research into the processing steps for a mineral sands deposit will provide input into an economic evaluation.

Prototype testing of microwave techniques will be completed for moisture determination of coal and carbon in fly-ash. Process control techniques for coal processing plants will be extended to minerals processing. Further sales of the QEM*SEM minerals analyser (APR Ltd), COALSCAN coal ash analyser (MCI Ltd) and the interface gauge (AMDEL) are expected.

A decision by the Joint Venture to build a power plant burning coal waste is expected in 1989. Support for coal exports will continue. A major collaboration in minerals processing is anticipated.

Total Allocation: \$11,500,000

Appropriation Allocation: \$7,700,000

The Division expects to receive 33% of its total budget from external sources.

6.7 DIVISION OF MINERAL PRODUCTS

Objective

To develop products and processes that will generate added value and new markets for Australian mineral resources.

Strategy

By collaborating with industry and maintaining excellence in key chemical and mineral sciences, the Division selects and undertakes projects that can lead to new mineral resource-based enterprises or to improved efficiency, productivity and competitiveness of existing enterprises. Successful projects are commercialised through collaborative development arrangements with industry.

Specific Objectives
(Percent Resources)

Planned Outcomes

Develop downstream processing routes for a range of products, including magnesium metal based on Australian magnesite ore. (13%)

Complete evaluation of pilot plant parameters for high purity magnesium chloride production; optimise conditions for dead burnt and caustic magnesia production.

Assist in developing titanium mineral resources and associated downstream processing. (10%)

Determine processing conditions for titanium minerals from the WIM-150 and Bayfield deposits; establish factors that control quality of synthetic rutile product in relation to ilmenite properties.

Improve technology for extraction and recovery of precious metals from ores. (18%)

Optimise extraction of gold, platinum and palladium from Coronation Hill and other ores; test selectivity and cycling behaviour of new gold resin; determine behaviour of gold during roasting of arsenopyrite; assess pressure oxidation and microwave pretreatments of refractory gold ores.

Improve lead/acid battery manufacture and performance and expand markets for lead products in battery applications, especially remote area energy storage systems. (12%)

Determine relevant properties of lead oxides in battery plates and apply this knowledge to improved plate curing and formation processes; continue monitoring of battery performance in the laboratory and in installations of remote-area power systems; test new alloy compositions for battery plates.

Investigate and assess the 'cold fusion' phenomenon as a potential new energy source. (5%)

Construct electrochemical apparatus and detection equipment for testing the cold fusion reaction; test innovative methods of inducing cold fusion.

Demonstrate the feasibility of continuous production of zinc by electrowinning at high current density. (7%)

Complete determination of operating parameters of a cell; evaluate operation of 35 amp cell; design, construct and evaluate a 1,000 amp cell.

Develop processes for producing zirconia-based alloy powders and chemicals. (8%)

Continue process improvement and new product development for ICI's commercial operation which started operation in 1988 using joint CSIRO-ICI research; transfer technology to pilot plant and commercial plant.

Improve contaminant control and reagent recovery in the Bayer process for producing alumina. (5%)

Complete study on properties of desilication product minerals; design and carry out an experimental program on solid-liquid reactions occurring in Bayer process residue washing.

Develop processes to increase the market value of gemstones and industrial minerals. (2%)

Determine parameters needed in heat treatment of sapphires to improve colour, and commercialise the process; develop a technique for healing cracks in opal.

Support the commissioning of a new process to regenerate caustic liquors produced in paper pulp manufacture. (4%)

Establish the chemical behaviour of compounds formed in the process; show how behaviour depends on process conditions and properties of the industrial mineral used as a reactant.

Develop speciality oxide products from Australian raw materials. (2%)

A new research program will be developed.

Improve solid/liquid separation steps in mineral processing operations. (5%)

Complete floc characterisation and modelling in several industrial thickeners; define optimum conditions for a new process to clarify industrial liquors.

Develop a process for production of titanium diboride. (4%)

Select a process route and reactor design; develop and apply the reactor technology to produce batches of titanium diboride for testing in aluminium smelting cells.

Develop processes using microwave energy to add value to minerals and materials. (3%)

Develop and construct equipment for control of temperature and atmosphere during microwave heating; apply microwave heating to gold, monazite and zirconia treatment.

Establish the nature of surface reactions that control the flotation separation process of sulphide minerals. (2%)

Carry out electrochemical and photo-electron spectroscopic experiments on surface reactions on pyrite, chalcopyrite and galena.

Total Budget: \$8,100,000

Appropriation Allocation: \$6,300,000

The Division expects to receive 22% of its total budget from external sources.

7. INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT

Objective

Provide the scientific knowledge required for the effective management and conservation of Australia's natural resources and environment, particularly in relation to the conservation and protection of natural heritage and sustainable use by dependent industries.

Strategy

Research will deal with improving our understanding of the physical, chemical and biological processes which govern the state of our natural resources and the industrial and recreational impact on environmental quality. This understanding will be an essential input to the relevant government agencies and industries formulating management strategies for the various components of the Australian environment.

Australia, because of its geographical position and its relative affluence and political stability, has the pre-eminent international responsibility for the physical and biological environment of the southern hemisphere. Australia has an important role to play using its expertise to contribute to the solution of environmental issues of global concern in meteorology, ecology and oceanography. CSIRO research can make a major contribution to meeting these international obligations.

Methods of scientific observation and experimentation are continually being improved through the advent of technology. The Institute intends to foster these developments, particularly in the applications of remote sensing, decision support systems, supercomputing in relation to atmospheric modelling, instrumentation and biotechnology. Their development will help to improve and expedite the practical application of much of our environmental research.

Work in the Institute's Divisions will be structured so as to maintain a continuing effort in gaining new knowledge while at the same time allowing for the assembly of project teams from various disciplines to work on practical problems of immediate importance. Two inter-Divisional programs will commence in 1989/90 - Climate Change and Land and Water Care. The latter program is a joint effort with the Institute of Plant Production and Processing.

The Institute is aware of the activities of related organisations working in this field and will liaise closely with them to ensure the Institute's activities are complementary and supportive.

The Institute encompasses the following Divisions and Units.

Division of Atmospheric Research	Headquarters and Melbourne Laboratories, Aspendale, Victoria
Centre for Environmental Mechanics	Headquarters and Canberra Laboratories, Canberra, ACT
Division of Fisheries	Headquarters and South and Southeastern Regional Laboratory, CSIRO Marine Laboratories, Hobart, Tasmania North and Northeastern Regional Laboratory, CSIRO Marine Laboratories, Cleveland, Brisbane, Qld West and Northwestern Regional Laboratory, CSIRO Marine Laboratories, Marmion, Perth, WA (relocating to Floreat Park)
Division of Oceanography	Headquarters and CSIRO Marine Laboratories, Hobart, Tasmania CSIRO Marine Laboratories, Marmion, Perth, WA (relocating to Floreat Park)
Division of Water Resources Research	Headquarters and Perth Laboratories, Floreat Park, WA Black Mountain Laboratories, Canberra, ACT Waite Laboratories, Urrbrae, SA Griffith Laboratories, Griffith, NSW
Division of Wildlife and Ecology	Headquarters and Canberra Laboratories, Gungahlin, ACT Rangelands Research Centre, Deniliquin, NSW (relocating to Gungahlin) Centre for Arid Zone Research, Alice Springs, NT Tropical Ecosystems Research Centre, Berrimah, NT Tropical Forest Research Centre, Atherton, Qld Western Australian Laboratory, Helena Valley, WA

The Institute Headquarters is at Canberra, ACT

INSTITUTE OF NATURAL RESOURCES AND ENVIRONMENT

SUMMARY OF RESOURCES

<u>Division</u>	<u>Prof Staff</u>	<u>Total Staff</u>	<u>Approp Allocation</u> (\$000s)	<u>Estimated Budget</u> (\$000s)
Atmospheric Research	67	118	5,860	7,860
Fisheries	87	151	9,570	14,290
Oceanography	49	85	4,475	5,605
Water Resources	108	220	11,790	14,340
Biometrics Unit	6	6	415	415
Wildlife and Ecology	96	228	11,205	13,055
Centre for Environmental Mechanics	16	30	1,680	2,130
Institute Headquarters	4	8	1,350	1,350
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Total	433	846	46,345	58,740
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Capital Works: \$1,118,000 for refurbishing laboratories at Floreat Park, WA and major items of research equipment.				
<hr/>				
National Facility				
(O.R.V. Franklin)	6	11	3,895	3,895

7.1 DIVISION OF ATMOSPHERIC RESEARCH

Objective

To improve understanding and to solve significant practical problems concerning the physics, dynamics and chemistry of the atmosphere of the Australian region, and of the globe insofar as it affects the Australian region.

To provide the best possible advice on problems and issues involving the atmosphere.

Strategy

Research is focused on three types of problem:

- . ***those which are fundamental stumbling blocks to the forecasting of weather, climate and atmospheric pollution;***
- . ***those practical problems which are relevant to community concerns; and***
- . ***those which bear importantly on primary and secondary industry.***

Much of this research is focused on a series of applied problems; studied in collaboration with operational agencies wherever possible. A core strategic program is maintained in a number of areas so as to preserve an ability to re-focus on new problems as they arise. In addition commercial exploitation of techniques and instrumentation derived from this research is pursued in joint developments with manufacturing industry.

Specific Objectives
(Percent Resources)

Investigate the past, present and future sources, sinks and budgets of trace gases and aerosols in the global atmosphere in order to provide the basis for an assessment of future trends and likely climatic impact. (17%)

Assess likely future climate change caused by changing atmospheric composition. (28%)

Planned Outcomes

Continue the analysis of the historical changes (past ~150 years) of air composition from Antarctic ice cores. Studies of the isotopic composition of present-day CO₂ are expected to assist in determining the response of the global biosphere and the role of the oceans in relation to rising CO₂ levels. Global budgets for chlorofluorocarbons and methane to be examined in relation to the ozone depletion issue and the identification of the source of current increases in atmospheric methane.

Scientific support for the Australian Baseline Air Pollution Station is continuing.

A core research program to study global atmospheric change using general circulation models is now in place and is being expanded with Commonwealth funding. An applied program to assess regional climate change has also commenced on part Commonwealth funding with State by State funding of regional assessments now being negotiated. Research on dynamical behaviour of the atmosphere with respect to ozone depletion is still scaled down due to funding constraints.

Develop a testable model for assessing the forecasting of drought. (5%)

The research is now in the final stage as regards the "proof of concept" concerning the development of a testable drought forecasting scheme. Earlier stages have demonstrated that large-scale droughts in Australia can be simulated by inserting sea surface temperature anomalies appropriate to El Nino events in a complex atmospheric model, and the development of a simple model of the Pacific Ocean capable of predicting El Nino sea surface temperature anomalies has met with encouraging success. The final stage involves using these predicted anomalies in the atmospheric model. Research is being expanded to consider sea surface temperature anomalies in other oceans, anti-El Nino situations and improving the model.

Examine regional air quality problems and develop a framework for the general understanding of the factors contributing to such problems. (9%)

A number of projects are following up on the now completed Latrobe Valley Airshed Study (CSIRO/EPAV/SECV). Specific research on problems such as sea-breeze effects on existing or planned power station sites, as well as studies of regional precipitation chemistry (acid rain) are continuing. Research on visibility and oxidant precursors has been extended to the Melbourne Air Shed. See also the Tarong Power Station study below.

Develop models for flow in the lower atmosphere for the explanation and accurate prediction of phenomena such as pollutant dispersion and bushfire behaviour, and regional modulation of synoptic weather patterns. This work includes precipitation studies. (20%)

Field data for testing theoretical models of transport and dispersion of pollutants in the lower atmosphere were gathered during a NERDDP funded observational study of the Tarong Power Station plume. Phase II will take place in August 1989. Laboratory studies of these phenomena are supported by a SECV research fellowship, which is now in its third year.

In conjunction with an MMBW funded cloud-seeding consultancy, a field experiment examining the properties of winter storms over SE Australia is being conducted (the Australian Winter Storms Experiment: AWSE), while analysis of a previous experiment over Northern Australia (EMEX) is being completed. New instruments are being developed during 1989 for use in the next field phase of AWSE.

Develop innovative remote sensing instruments and methods, apply these methods to increasing efficiencies and reducing costs in the Australian environmental, agricultural and industrial sectors and to reducing uncertainties in water forecasting and climate change models. (20%)

New models and methods of analysis will improve commercial and research products from the Division's remote sensing facility considerably. A completed prototype instrument for measuring surface pressure from a satellite will undergo aircraft trials towards further space qualification, if satisfactory. New models for obtaining more accurate land and sea surface temperature will be developed. Laser radar techniques for monitoring industrial plume spread and a new laser radar, should be ready for commercial exploitation. Cloud properties obtained from the strategic laser radar program will be applied to models of weather and climate.

Public communication, advice to Federal and State Governments and lobbying for external funding. (2%)

In 1989/90 our role in informing the policy-makers and the general public of major environmental issues (greenhouse effect, ozone depletion, drought) will continue. This effort is an essential part of getting our 'results' to the 'users', and is now part of our funding agreements with various State governments. Feedback from "users" is helping to focus our research, particularly on the potential impact of the greenhouse effect.

Total Budget: \$7,860,000

Appropriation Allocation: \$5,860,000

The Division expects to receive 25.4% of the total budget from external sources.

7.2 DIVISION OF FISHERIES

Objective

To maintain, develop and improve Australia's fisheries, with particular reference to the rational exploitation of the resource and the interests of the catching sector, the quality and value of the product; to give support and advice to mariculture interests when appropriate and to respond to problems of marine environmental protection likely to affect the fisheries.

Strategy

The Division concentrates on problems of economic importance, especially in the Australian Fishing Zone, by investigating the distribution, abundance and population dynamics of commercial and potentially commercial fisheries through studying the effects of fishing and environmental factors. The Division advises on the management of marine fisheries, and the catching, processing and mariculture sectors of industry when appropriate.

<u>Specific Objectives (Percent Resources)</u>	<u>Planned Outcomes</u>
Maintain, develop and improve the Australian fisheries by providing the research base for advice to management agencies. (30%)	Surveys of the western deepwater resources; and development of plans for assessment of south-eastern resources. Liaison with DPIE/BRR.
Determine the factors affecting recruitment to the commercial fisheries, with special reference to the southern bluefin tuna, northern prawn stocks, western rock lobster, and Bass Strait scallops. (48%)	Work on southern blue fin tuna larvae and northern prawns. Conversion and commissioning of FRV "Southern Surveyor".
Improve the quality and value of the fish and fishery products in the Australian seafood industry. (4%)	Industry liaison, advice and, where appropriate, research.
Develop cost effective ways for fishermen to locate paying quantities of fish, with particular reference to the application of space science technology to the pelagic fisheries (for example, tunas and mackerels). (5%)	The application of remote sensing techniques to pelagic fisheries (sea surface temperature data from satellites, and the use of air borne radar to detect fish shoals).
Develop projects relating to mariculture. (3%)	Development of proposal for mariculture research, with rock lobster; support industry with microalgae supply service and training workshops; and advance research into nutritional quality of microalgae.

Develop and apply methods which rehabilitate and protect the marine environment, with particular reference to the coastal area and needs of public and private sector customers.
(10%)

Baseline study of seasonal and interannual variability in habitats and species of Jervis Bay, NSW; survey ballast tanks of vessels entering Australian harbours for biological contaminates; research into seagrasses and methods to rehabilitate depleted areas and to extend existing meadows.

Total Budget: \$14,290,000

Appropriation Allocation: \$9,570,000

The Division expects to receive 33% of the total budget from external sources.

7.3 DIVISION OF OCEANOGRAPHY

Objective

To advance understanding of the seas and oceans of the Australian region, in relation to the needs of all forms of national maritime activity and to the effect of these waters on global climate.

To promote the development and application of oceanographic instruments, techniques and expertise to assist industry and public agencies with marine interests.

Strategy

The Division carries national responsibility for physical and chemical oceanography, which therefore requires the accumulation of diverse information on the structure, composition and dynamical variability of regional waters. Observations using ships, satellites, surface and subsurface moorings and fixed stations are combined with analysis, interpretation and numerical modelling. New techniques and instrumentation are developed and applied.

Work is usually concentrated in major experimental projects of duration from months to years, which proceed in parallel. Projects are selected for their perceived relevance to maritime applications, and for scientific importance and achievability. Industry and other national agencies are involved, and close interaction with international bodies and programs is maintained, wherever appropriate.

Specific Objectives
(Percent Resources)

Characterise the structure and variability of the main dynamical features of open waters of the Australian region, including the basic processes of mixing and circulation. (20%)

Investigate the thermal structure of regional oceans and their role in influencing interannual climate variability and longer-term climate change. (23%)

Planned Outcomes

Analysis and publication of results from the Leeuwin Current Interdisciplinary Experiment (LUCIE), including "Structure and Variability of the Leeuwin Current 1986-7"; use of inverse models of tracer fields to infer mean oceanic circulation; in conjunction with the University of New South Wales, first divisional use of satellite altimeter data (GEOSAT) to investigate the surface circulation in eastern Indian Ocean in relation to the Leeuwin Current; "TECASAS" cruise to investigate the effects of the East Australian Current on the eastern temperature continental shelf.

Analysis and interpretation of air/sea heat exchange observations in the western Pacific and eastern Indian Oceans to identify the role of heat fluxes in El Nino/Southern Oscillation cycles; study of the role of major zonal and western boundary currents in the regional heat budget; direct measurement of surface heat fluxes in the region for a second time using RV *Franklin*; arrange for satellite transmission of XBT data to the Global Telecommunication System, with at least partial support from external sources; extension of XBT network to mid latitudes for Greenhouse research program; preparation of a joint Australian/Japanese temperature mooring in western equatorial Pacific; design and optimisation of the global XBT network for second half of TOGA decade; develop systems for continuous underway measurement of pH and *in situ* fluorescence, for deployment on research vessels to provide data on the carbon dioxide cycle in the surface layers of the ocean; conduct bathymetric and hydrographic survey near Heard Island as first phase of program to determine feasibility of measuring global ocean temperatures using long-range acoustics.

Measure and characterise dissolved and particulate chemical constituents of marine waters and sediments, and interpret these data in relation to physical, chemical and biological processes and anthropogenic activities. (18%)

Survey waters of Port Davey, Tasmania to measure concentrations of trace metals, organic compounds and nutrients, which will help establish baseline values for these parameters in other Tasmanian waters such as the Derwent Estuary and Macquarie Harbour, which are subject to anthropogenic inputs; in collaboration with the DSIR Division of Marine and Freshwater Science, describe the oceanography of the sub-tropical convergence zone around the south of New Zealand using data from cruise FR 7/89; assist the mariculture and fishing industries by providing nutritional information on marine microalgal feedstocks and polyunsaturated fatty acids in marine products; develop chemical markers for assessing sewage and hydrocarbon pollution in marine waters; apply organic geochemical techniques to petroleum exploration in Australia, and particularly in Tasmania.

Develop theoretical and numerical models of the oceanographic characteristics of Australia's continental shelves in order to provide information on currents, tides and waves relevant to maritime industry and environmental needs. (14%)

Complete the study of the circulation characteristics of Jervis Bay; continue strategic research on development of 3 dimensional, stratified models of circulation on continental shelves; contract proposals have been submitted in the following areas: application of 3-D models to water quality characteristics for the Sydney Deep Water Outfall program; 3-D modelling to determine circulation of the north coast of Tasmania for water quality studies associated with effluent discharge; modelling of estuaries for Tasmanian Baseline Environmental Study; circulation and wave study of Newcastle Harbour.

Promote the development, marine application, and transfer to Australian industry of relevant technology such as satellite remote sensing, instrumentation, computer software, chemical techniques and marine hardware. (11%)

Continue development of new directional wave buoy; pursue establishment of high bit-rate satellite reception facility in Hobart in conjunction with the University of Tasmania and COSSA; supply satellite-derived sea surface temperature and vegetation index products to a range of government and private users; test and deploy a programmable sediment trap for studies of chemical fluxes in coastal waters; calibrate and deploy a new pH electrode system developed by the Division to investigate the variation of carbon dioxide with depth in the ocean.

Operate the oceanographic research vessel Franklin as a national facility for the benefit of Australian oceanography generally and for the programs of the Division. (14%)

Franklin will be operating in eastern and northern Australia water during this period.

Total Budget: \$5,605,000

Appropriation Allocation: \$4,475,000

The Division expects to receive 20.2% of the total budget from external sources.

7.4 O.R.V. FRANKLIN (A NATIONAL FACILITY)

Objective

Research time on the vessel is allocated to scientists from within and outside CSIRO by a Steering Committee on the basis of project proposals and external assessment by leading local or overseas scientists in the field. Steering Committee is appointed by the Minister for Science and Small Business and operates independently of CSIRO in accordance with the recommendation of the Australian Science and Technology Council (ASTEC) contained in its report 'Guidelines for the Operation of National Research Facilities'.

Operations

During the fiscal year 1989/90, Franklin will operate in eastern and northern Australian waters. Projects included in the program by the National Facility Steering Committee are:

- . *Mixing in the outflow from the Bass Strait Cascade*
- . *Testing of micro-scale turbulence sensors on the Bunyip towed body*
- . *Test cruise for the EZ Net and other ORV equipment*
- . *Ocean transport in the Tasman Sea*
- . *Ecology of rock lobsters of the genus Jasus*
- . *Temperate Eastern Continental Shelf Advection Study (TECSAS)*
- . *The sub-tropical convergence in the Tasman Sea: biological oceanography and fisheries investigations of the frontal systems in surface waters*
- . *Topographic control of shelf circulation*
- . *Deep sea sediment transport, Queensland Trough – Bligh Canyon*

CSIRO staff have been allocated 76% of project days on the vessel (up from 12% in 1988/89).

Total budget: \$3,895,000

7.5 DIVISION OF WATER RESOURCES

Objective

To conduct and transfer research which will enable public agencies and the private sector to develop improved methods for the definition, use and management of Australia's water resources. Of particular importance is the maintenance of the quantity and quality of urban, rural and industrial water supplies.

Strategy

The Division will study the processes involved in the interactions between the atmosphere, plants, land and water, and translate these findings into practical techniques which will assist agencies in managing natural resources to meet community and environmental needs. We will consult with the water "industry" and develop collaborative research with user agencies. Our research is often multidisciplinary and concentrates on solving problems at a system level.

Specific Objectives
(Percent Resources)

Planned Outcomes

Predict the hydrologic response of water resource catchments to changes in water and land management. (26%)

Completion of artificial recharge experiment and preparation of computer program package for technology transfer.

Reporting of results of recharge studies of effects of various land uses in the Swan Coastal Plain.

Implementation of detailed planning of soil conservation practices based on research into hillslope water balance research.

Continuing commitment to the realisation of the commercial potential of software in the fields of topographic modelling, recharge and aquifer performance and image processing and remote sensing.

Develop, apply and transfer methods for predicting the sources, behaviour and yield of water, sediment and salt from the surface and subsurface over time periods appropriate to generally large areas. (15%)

Estimate the rate of return to the Murray River of irrigation tail water disposed of at Noora.

Determine the applicability of hydrochemistry, including stable isotopes, for typing different waters.

Show whether or not radionuclides and mineral particle magnetics provide consistent evidence of sediment sources in large catchments.

Derive or select a regional groundwater recharge-discharge model and develop data synthesis techniques for existing surface water models, to predict the impact on water resources of climate change.

Measure and predict the movement of aqueous contaminants and salts with particular application to groundwater. (20%)

Develop and assess techniques for the determination of regional recharge in the western Murray Basin.

Apply groundwater modelling techniques to assess the impact of land management strategies being carried out to reduce salinisation in catchments in the wheatbelt in Western Australia and in South Australia.

Assess the impact of horticulture on surface and groundwater quality.

Investigate controls over leaching of nitrate to groundwater, to provide a sound basis for strategies to minimise groundwater contamination.

Develop techniques for more efficient monitoring of groundwater contaminants from point sources, and to quantify the potential impact of sources of organic pollution in urban areas.

Develop land use strategies in irrigation areas for the long term management of water tables to minimise salinisation, improve productivity and maintain water quality of rivers in the Murray Basin. (10%)

Develop relationships for capillary rise from shallow water tables for different soil types; compile basic geographic, soil and groundwater data for a chosen irrigation system study area; begin testing of water use, soil water movement and groundwater models in the study area.

Complete testing of low cost image analysis system and use it to develop an optimal vegetation index; combine salinity survey data of study area with aerial images.

Complete evaluation of different soil amelioration techniques on deep percolation; assess the longevity of gypsum enriched slots; establish the effect of lime enriched slots on the productivity of vines growing in acid soils.

Produce a review on the strategies for reducing water use in rice production and assess the impact of soil modification on deep percolation.

By ecological research promote environmentally safe management of surface waters. (14%)

Protect wetlands and surface water quality by promoting appropriate water and land management practices.

Evaluate the role of natural wetlands in protecting water quality and develop the use of artificial wetlands for the treatment of wastewaters. Evaluate the water requirements of wetlands.

Investigate the physiology of aquatic weeds, and research methods for their management in irrigation agriculture and open water systems.

Determine the origin, fate and importance of pollutants (especially pesticides, odours and toxins and nutrients) in open water systems, and develop automated remote monitoring systems.

Develop, evaluate and apply decision support systems and other techniques of institutional, social, economic and environmental analysis to water resource problems. (15%)

Expand the prototype expert system developed for integrated catchment planning and development control in the Onkaparinga catchment, and effect technology transfer to user agencies.

Develop an expert system for land use management of the Puckapunyal Army Base.

Assess the commercial viability of the QUEENSBERRY intelligent data base, through consulting applications and market research.

Produce reports on (i) consumer preferences regarding water supply reliability and quality standards, and (ii) public perceptions of the role of the water industry in Australia.

Secure support for a major research initiative in dam safety and flooding in Australia.

Evaluate the impacts of Alpine recreation on stream water quality and human health.

Produce a report on urban planning economics in relation to groundwater protection in Perth.

Total Budget: \$14,340,000

Appropriation Allocation: \$11,790,000

The Division expects to receive 17.8% of the total budget from external sources.

7.6 DIVISION OF WILDLIFE AND ECOLOGY

<u>Objective</u>
<p><i>To improve the management and conservation of Australia's rangelands, wildlife and land resources.</i></p>
<p><u>Strategy</u></p> <p><i>The Division operates mostly in collaboration with agencies responsible for the management and conservation of Australia's rangelands, wildlife and land resources, but it also adopts an innovative approach to exploring the potential for utilising the unique features of Australia's biota. Its approach is to develop multidisciplinary, integrated programs, using and developing modern ecological and biological techniques.</i></p>

<u>Specific Objectives (Percent Resources)</u>	<u>Planned Outcomes</u>
<p>To determine, and help apply, the ecological principles needed to manage the nation's range-land resources to increase production efficiency while maintaining productive potential and preserving future land use options. (18%)</p>	<p>Develop methods for determining ecologically sound stocking rates for controlling rangeland species composition through management practices and for restoring degraded landscapes.</p>
<p>Identify the critical elements involved in the functioning of the tropical forest and savanna ecosystems of northern Australia and determine the biological and ecological principles upon which management and conservation should be based. (18%)</p>	<p>Analyse the effects of disturbance and change in tropical ecosystems, evaluate the stability of forest fragments and the viability of species within them, and develop procedures for the restoration of damaged ecosystems.</p>
<p>Provide a scientific basis for the management and control of vertebrate species, native and introduced, which are detrimental to agricultural productivity and environmental values. (14%)</p>	<p>Develop effective integrated control strategies based on analysis of population dynamics and the assessment of control methods, for pests such as rabbits, mice and feral animals associated with livestock disease.</p>
<p>Determine and measure the environmental factors that impinge on Australia's vertebrate fauna, determine how wildlife communities operate, how they may be managed and effects of different management strategies on their community dynamics; and determine the genetic diversity and uniqueness of Australian birds and mammals. (30%)</p>	<p>Field studies of wildlife communities and observations on individual animals to provide information on effects of environmental factors; and use physiological, biochemical and genetic techniques to determine behaviour patterns and response of species.</p>

Establish the ecological principles by which remnant vegetation systems may be selected and managed to maintain regional biological diversity. Determine the relative importance of different patterns and processes in forest communities to assist conservation management of flora and fauna. (12%)

Test the effects of isolation and patch size on biological diversity in forested and agricultural areas, and studies of sets of patches to establish how animals use them as a system. Produce statistical models predicting the environmental and geographical distributions of eucalypt and arboreal marsupial species and their diversity.

Develop, demonstrate and transfer computer-based decision-support systems to managers, planners and other decision-makers responsible for inventory, evaluation, allocation and operational management of Australia's natural resources at a range of scales. (8%)

Use geographical information systems with internally developed and external data sets to bring together and analyse relevant information.

Continue research on relationships between animals, plants and weather in the temperate, arid and semi-arid zones.

Total Budget: \$13,055,000

Appropriation Allocation: \$11,205,000

The Division expects to receive 14.2% of the total budget from external sources.

7.7 CENTRE FOR ENVIRONMENTAL MECHANICS

Objective

To solve problems in hydrology, environmental quality, industrial processes and plant productivity through understanding physical processes in the natural environment.

Strategy

Research focuses on perceived gaps in our scientific understanding required for effective management of hydrological, environmental and agricultural resources, and on the development of techniques, analyses, and instruments to expedite the practical application of our work. Results, developed in the context of the natural environment are applied where possible to related industrial processes. The choice of problems is determined by their assessed solubility and by inputs from users in Federal and State agencies, and from industry and consulting firms.

Specific Objectives
(Percent Resources)

Planned Outcomes

Devise physically based realistic mathematical description of fluid flow in porous media occurring in the natural environment, agriculture, and cognate industrial processes; develop new techniques for measuring important hydrological properties in the field and apply them for better management. (30%)

Continue externally funded projects on techniques for characterizing soil topography and for measuring the water content of coal. Initiate research on describing flow in layered soils. Start project on water content of wheat.

Develop an adequately verified theoretical description of wind flow over topography and in plant canopies, with specific reference to pollutant dispersion, wind engineering, erosion, and evapotranspiration. (30%)

Complete extension of wind tunnel for testing flow over hill model. Execute 2nd field phase of NERDCC Tarong Power Station and analyse data. Start NSCP Funded work on nutrient loss in agricultural lands due to wind erosion. Plan and execute Moga field experiment in connection with work developing a proper parameterization of the surface layer for GCMs.

Develop a better understanding of the effects of physical processes in soil, water, plants and the atmosphere on the growth and productivity of plants concentrating on terrestrial nitrogen cycle, evapotranspiration in plant and forest canopies, and the solar radiation climate of plant communities. (15%)

Continue externally funded collaborative project on soil evapotranspiration and crop water use. Develop technology for measuring atmospheric CO₂ fluxes using fast response sensor. Apply and use it to test predicted field crop responses to increased CO₂ (Greenhouse effect). Initiate investigations of physical factors influencing nitrogenous fertilizer efficiency in sugar cane.

Provide an experimentally verified physical description of those physical processes in freshwater bodies which set the boundary conditions for biological processes affecting water quality and determine efficiency in irrigated agriculture. (10%)

Analyse data from first season of billabong measurements. Pursue theoretical investigations of physical determinants of algal growth and biological productivity in billabongs (collaboration with MDFWRC). Start preliminary investigations on physical bases for the optimal design of saline water evaporation basins.

**Communicate results of
Division's research to users in the
community, industry, and
government agencies. (15%)**

Licence TDR for commercial manufacture. Communicate results of Division's research to users in the community, industry, and government agencies. Transfer technology of Surface Disc Permeameter to professional practitioners. Provide practical assistance with instrumentation and advice to other CSIRO Divisions on processes and mechanisms operating in the natural environment.

Total Budget: \$2,130,000

Appropriation Allocation: \$1,680,000

The Division expects to receive 21.1% of the total budget from external sources.

8. INSTITUTE OF PLANT PRODUCTION AND PROCESSING

Objective

The Institute's overall objective is to benefit Australia through research which improves and sustains the productivity and the profitability of industries based on field crops, pastures, horticulture and forests, and improves knowledge of Australia's soils, plants and insects.

Strategy

The Institute's key strategies are to

- . *Give priority to research that either enhances exports or results in import replacement.*
- . *Maintain a critical level of effort in areas of basic science and encourage and strengthen areas of generic science and technology, especially molecular biology.*
- . *Improve product quality, specification, packaging and storage to meet market needs and preferences.*
- . *Foster diversification by developing products with good market potential.*
- . *Focus processing research on adding value in ways that will benefit Australia.*
- . *Improve production efficiency within the context of sustainable agricultural systems.*
- . *Develop practices and systems which result in sustained production with acceptable levels of environmental damage.*
- . *Examine the impact of changing atmospheric composition and climate on the production of field crops, sown pastures, horticultural crops and forests.*
- . *Develop practices that minimise use of harmful chemicals and reduce contaminants in plant foods, animal feeds, wool and the environment.*
- . *Restructure and revitalise CSIRO temperate and Mediterranean pasture research with a focused strategic input from CSIRO and an increased proportion of tactical research financed by industry.*
- . *Undertake more systematic appraisal of research proposals and evaluate regularly the benefits accruing from research.*
- . *Undertake national responsibilities for the National Herbaria, the National Insect Collection, plant genetic resources, soil classification and bushfire research.*

The main businesses served by the Institute are those concerned with wheat, coarse grains, grain legumes, oilseeds, sugar, cotton, timber and horticultural crops, including new and emerging crops in these categories. The work on pastures and insect pests serves the wool, beef and sheep meat industries.

Specific Activities

- *Develop inter-Divisional land and water care program in collaboration with the Institute of Natural Resources and Environment.*
- *Develop bio-control program to develop non-chemical methods of pest and disease control with particular emphasis on reducing use of pesticides and examining the environmental impact of their use.*
- *Interact with industry bodies with a view to gaining acceptance of the need to restructure CSIRO pasture research in Mediterranean and temperate regions.*
- *Develop gene shears program and initiate process to enhance the application of molecular biology skills.*
- *Initiate a working group to examine the potential impact of climate change on the production of field crops, shown pastures, horticultural crops and forests.*
- *Evaluate current decision support models for nitrogen and water balance with a view to developing generic software kernels.*
- *Conduct workshops to establish a collaborative program on ornamental and post-harvest horticulture.*
- *Examine the Institute's role with respect to Australia's plant quarantine needs.*
- *Develop new project costing practices to reflect the true costs of research and participate in developing practices which separate employment conditions from funding sources.*
- *Undertake cost-benefit study of Institute research over the past decade in collaboration with ABARE.*
- *Improve the Institute mechanism for the redeployment, retraining and out-placement of staff engaged in projects due for termination.*
- *Develop more effective practices for the management of projects involving external funding.*

The Institute of Plant Production and Processing encompasses the following Divisions and Units.

Division of Entomology

Headquarters and Canberra Laboratories, ACT
 Myall Vale and Wilton, NSW
 Long Pocket Laboratories, Indooroopilly, Qld
 Highett Laboratories, Highett, Vic
 Tasmanian Regional Laboratory, Hobart, Tas
 WA Laboratories, Perth, WA
 Tropical Cattle Research Centre, Rockhampton, Qld
 Darwin Laboratories, NT
 Adelaide Laboratory, Urrbrae, SA
 Dung Beetle Research Unit, Spain
 Biological Control Unit, France
 Biological Control Unit, Mexico
 Biological Control Unit, South Africa
 Screw-worm Fly Unit, New Guinea

Division of Horticulture

Headquarters and Adelaide Laboratory, Urrbrae, SA
 Merbein Laboratory, Vic
 Darwin Laboratories, NT
 Brisbane Laboratories, St Lucia, Qld
 Post-harvest Group, North Ryde, NSW

Division of Plant Industry

Headquarters and Canberra Laboratories, ACT
 Cotton Research Unit, Myall Vale, NSW
 Cotton Fibre Testing Unit, Geelong, VIC
 Wheat Research Unit, North Ryde, NSW
 Dryland Crops and Soils Research Unit, Floreat Park, WA
 Queensland Regional Station, Atherton, Qld

Division of Soils

Headquarters and Canberra Laboratories, ACT
 Adelaide Laboratory, Urrbrae, SA
 Davies Laboratory, Townsville, Qld
 Dryland Crops and Soils Research Unit, Floreat Park, WA
 Cotton Research Unit, Myall Vale, NSW

Division of Tropical Crops and Pastures

Headquarters and Cunningham Laboratory, St Lucia, Qld
 Davies Laboratory, Townsville, Qld
 SE Region Field Stations, Samford, Qld
 Cooper Laboratory, Lawes, Qld
 Narayan Research Station, Mundubbera, Qld
 Lansdown Pasture Research Station, Townsville, Qld
 Darwin Laboratories, NT
 Katherine Research Station, NT
 Kimberley Research Station, Kununurra, WA

Division of Forestry and Forest Products

Headquarters, Clayton, Vic
 Highett Laboratories, Highett, Vic
 Yarralumla, ACT
 South Queensland Forest Research Group, Cunningham Laboratory, St Lucia, Qld
 Tasmanian Forest Research Group, Hobart, Tas
 Plantation Forest Research Centre, Mt Gambier, SA
 WA Forest Research Group, Floreat Park, WA
 National Bushfire Research Unit, Yarralumla, ACT

The Institute Headquarters is at Canberra, ACT

Division of Plant Protection

Massachusetts Inst. of Technology, Cambridge, MA
 Cornell Research Unit, Ithaca, NY
 Cotton Fiber Testing Lab, Georgia, GA
 Wool Research Unit, North Ryde, NSW
 Drying Color and Style Research Unit, Forest Park, WA
 Measurement Research Project, Atlanta, GA

INSTITUTE OF PLANT PRODUCTION AND PROCESSING

Division of Soils

Soil Conservation Service, Washington, DC
 Soil Survey Division, Washington, DC
 Soil Survey Laboratory, Beltsville, MD
 Soil Survey Staff, Washington, DC
 Cotton Research Project, Atlanta, GA

SUMMARY OF RESOURCES

Division	Professional Staff	Total Staff	Approved Capital Allocation (\$000s)	Estimated Capital Budget (\$000)	Division of Projects
Entomology	111	290	12,667	17,753	
Forestry and Forest Products	142	294	12,917	15,854	
Horticulture	42	87	4,455	5,220	
Plant Industry	164	422	19,415	25,453	Division of Pest Control and Projects
Soils	81	185	10,181	11,618	Projects
Tropical Crops and Pastures	76	241	10,873	13,810	
Institute Office	0	759	759	759	
Other Institute#	0	0	3,302	3,302	
Total*	619	1,528	74,569	93,769	The Institute's budget reflects its full budget, including CABI.

* Excludes Capital Works and Services: \$1.5M

Other Institute:

Includes \$0.535M administered on behalf of all Institutes (CABI)

Includes \$2.767M administered on behalf of Divisions. The majority of which will be allocated to Divisions during 1989-90.

8.1 To the DIVISION OF ENTOMOLOGY

The Division's main areas of interest are those that affect agriculture, animal health and man. It also has a major role in the control of pests and diseases of stored grain.

Major research topics being pursued at present include:

To devise ways of controlling insect and related pests of crops, crop products, livestock and man, and to understand the role of insects in the environment.

Strategy

The Division places emphasis on exploiting skills in the disciplines of taxonomy, biology, ecology, physiology, behaviour, genetics, pathology, molecular biology, physics, mathematics and chemical engineering to improve existing control methods and to develop novel techniques that lessen reliance on chemical methods. The Division collaborates with industry and other bodies in the development and application of appropriate pest management strategies.

Major research topics being pursued at present include:

Specific Objectives

(Percent Resources) (Percent Resources)

Planned Outcomes

Develop strategies for the eradication or control of insects and related arthropod pests of livestock and man, that are either in Australia or threaten to enter the country. (18%)	Control of sheep blowfly by genetic suppression techniques.
	Control of the bush fly by the introduction of exotic predators and dung burying beetles.
	Integrated control of buffalo fly in northern Australia.
	Maintain a screw worm fly breeding facility in Papua New Guinea to enable genetic control of this pest in the event of it reaching Australia.
	Develop strategies for the control of European wasp in Australia.
Develop methods to improve control of insect pests of plants and timbers. (16%)	Study insects and certain other arthropod pests of crop, pasture and plantation ecosystems and insects that damage trees, timber and building materials in order to improve our understanding of their biology, ecology, behaviour and, hence, potential control by natural enemies and other non-chemical methods.
	Develop management strategies that minimise the use of insecticides so as to reduce both the environmental impact and overall costs of control.
Find and assess potential biological control agents for important introduced and native weeds in Australia. Subsequently to release, establish and evaluate selected control agents. Integrate biological and other methods of weed control in order to improve the level of overall control in agricultural and conservation areas. (20%)	Develop strategies for biological control of skeleton weed, common heliotrope, nodding thistle, slender thistle, scotch and related thistles, St John's wort, doublegee, mimosa, sida, Bitou bush and certain aquatic weeds.
	Maintain the high security quarantine facility in Canberra as the primary quarantine for the introduction of pathogens or agents with special requirements.
	Develop the Montpellier laboratory as a more versatile research base in Europe for initial testing and assessment of control agents for insect pests and weeds of European origin.
	Collaborate with State and Territory groups.
Develop pest and commodity management strategies for stored grain and similar products. (15%)	Develop low residue or residue-free techniques for stored grain such as fumigation, heat disinfection and controlled atmospheres.
	Evaluate techniques for pesticide use that seek to minimise health risks to consumers. Develop cost-effective ways of maintaining grain quality through procedures such as drying and cooling.

Devise parameters for the receipt of high moisture content grain in order to extend the grain harvest and receipt season in Australia, with potential subsequent reduction in storage and handling costs to the grain industry.

Develop integrated approaches to stored grain pest management.

Develop methods that will lessen Australia's current dependence on residual grain protectants.

Document, describe and improve the understanding of Australia's insect and mite fauna with special emphasis on those groups that are of economic, social or scientific or social/environmental importance. (12%)

Develop and enhance taxonomic methodologies.

Play an increasing role in the coordination of taxonomic research on the Australian fauna, in conjunction with the Bureau of Flora and Fauna, the Australian Entomological Society, state museums and state departments of agriculture and forestry.

Maintain and develop the Australian National Insect Collection and make its resources available to other scientists and to the community.

Promote a greater awareness of the environmental, cultural and aesthetic significance of Australia's rich and diverse fauna, which is a major component of the nation's natural and modified ecosystems.

Conduct taxonomic research on selected groups of environmentally sensitive indicated species, and provide identification guides for use in environmental impact studies.

Develop environmentally sound technologies for pest control as adjuncts or alternatives to chemical pesticides, especially by means of behaviour-modifying chemicals and insect pathogens. (10%)

Study the taxonomy, epizootiology and mechanisms of pathogenicity of natural and introduced pathogens such as bacteria, viruses, fungi and nematodes, in order to identify ways of improving such organisms.

Study the chemistry, physiology and biology of Lepidopteran sex pheromones especially with regard to the control of those pests that occur in Australia.

Study the behavioural mechanisms of host selection in economically important insects in order to develop appropriate countermeasures to such host selection.

Study the physiology, biochemistry and ultrastructure of pest insects.

Maintain a "state of the art" capability for the identification and quantification of biologically active trace compounds by mass spectrometry and other instrumentation in order to assist in the development of biological control techniques for insect pests.

Undertake strategic and applied research into the molecular biology of insect development, reproduction and pathology. Conduct research into the development and exploitation of gene transfer technologies in insects, along with their associated bacteria and viruses so as to develop new ways of controlling insect pests with minimal environmental disruption. (9%)

Total Budget: \$17,753,000

Appropriation Allocation: \$12,667,000

The Division expects to receive 29% of its total budget from external resources.

8.2 DIVISION OF FORESTRY AND FOREST PRODUCTS

Objectives

To serve Australia through research to

- . increase the quantity and value of wood supply***
- . increase resource value through improved processing***

commensurate with acceptable environmental practices.

Strategy

Improve the scientific basis of forestry and wood utilisation through research on tree breeding, nutrition, diseases, pest and fire management, forest operations, and wood properties and processing.

Develop strategies and techniques for management of forests for wood production whilst having regard to the value of forests for other purposes.

Develop technologies for increasing the profitability of forest-based industries through efficient use of wood resources and the development of new products.

Specific Objectives (Percent Resources)

Planned Outcomes

Develop strategies for high and sustainable yield and improving wood quality of Pinus radiata by understanding key biological processes especially concerning genetic manipulation, and nutrient and water availability in soils. (16%)

Synthesise and apply the main results from the first phase of a major industry-sponsored project on the dynamics of organic matter and nitrogen between crop rotations of radiata pine; commence the second phase.

Strengthen methodology for early selection criteria in pines. Follow up on the lead now obtained on the relationship between stem growth in early seedlings and later-age performance in certain families.

Develop a research plan and seek collaboration with industry to investigate the genetics of wood properties and pulp quality using mature clones of radiata pine.

Evaluate the multipurpose potential of Australia's tree flora and its genetic diversity and supply seed for research for national and international afforestation programs. (16%)

Establish seed production areas of species of potential value for tropical afforestation.

Assess potential to propagate Eucalyptus nitens by tissue culture.

Establish facilities for and undertake genetic 'fingerprinting' of key tree species.

Describe key biological processes, such as microbial interactions, nutrient dynamics and stand development, relevant to sustained wood production in native forests. (13%)

Extend field testing of ectomycorrhizal fungi including inoculation methods in cooperation with industrial partners and state agencies.

Improve the basis of the genetic manipulation of ectomycorrhizal fungi.

Complete the installation of field trials in the Silvicultural Systems Project, Gippsland, in cooperation with the Department of Conservation, Forests and Lands.

Complete major publications on ecology and pathogenic variability of Phytophthora cinnamomi in native forests.

Develop strategies for intensive management of eucalypts in temperate regrowth forests and plantations, based on understanding of genetic diversity and ecophysiology, and stand development and forest operations. (14%)	Complete writing up of Esperance project. Establish strategic research trial directed to nutritional management of eucalypt plantations in Tasmania.
	Complete the final report for Young Eucalypt Program. Formulate and implement further research plans for intensive management of regrowth stands.
	Undertake field planting of hybrid <i>E. globulus</i> and <i>E. nitens</i> obtained from a 3-year controlled crossing program. Expand studies of manipulation and management of flowering and seed production of commercial eucalypt species.
Develop production systems for high yielding plantations of subtropical eucalypts, especially <i>Eucalyptus grandis</i> based particularly on an understanding of the ecophysiology of the species. (7%)	Conclude cooperative studies of response of <i>E. grandis</i> to intensive cultural practices at Gympie (with Queensland Department of Forestry and Shell Australia). Explore possibility of presenting results of 'Soil, Trees and Grass' project (STAG, Brisbane) through suitable workshop.
Improve the prediction of bushfire behaviour in important fuel types - determine the damage done and provide an efficient system of extending fire danger information. (4%)	Initiate fire behaviour studies in young regrowth stands of eucalypts and investigate the mechanisms causing fire damage to trees. Develop a micro-computer based model to graphically illustrate fire spread across the terrain.
	Review statistical models of interpolating wind velocities in complex terrain.
Improve the efficiency of the Australian timber and wood products industry. (15%)	Improve technology for harvesting, grading and drying timber to maximise recovery of high grade products. Establish the basic characteristics and properties of wood in relation to its utilisation and performance.
	Develop processes for the utilisation of forest and mill residues in the manufacture of value added products; to examine the causes and means of preventing wood degradation and to establish techniques for the preservation of existing and future timber products.
Improve the profitability of the Australian industry using wood as a fibre source with technology which is environmentally acceptable, and to enhance knowledge of wood as a raw material as an aid to decision-making for the forestry, pulp and paper, and reconstituted wood industries. (15%)	Assess the potential of specific forest resources for pulp and paper manufacture. Develop improved processes, taking into account the impact on the environment, for pulping wood and bleaching pulp for paper manufacture. Improve adhesive performance for reconstituted wood products. Attract industrial collaboration for new ventures (regenerated cellulose, inorganic coatings, inclusion chemistry).
	Explore opportunities to extend the application of wood fibre/organic composites.
Total Budget: \$15,854,000	
Appropriation Allocation: \$12,917,000	
The Division expects to receive 18.5% of its total budget from external resources.	

8.3 DIVISION OF HORTICULTURE

Division of Horticulture is already well developed in Australia and has a variety of horticultural crops to meet the growing demand for quality produce.

Objective
Improve crop quality, efficiency and sustainability of horticultural production on-farm, and improve product specification and postharvest handling off-farm for Australian crops of the temperate, subtropical and tropical zones.

Strategy

Emphasis is placed on developing new techniques for the selection and breeding of improved horticultural crops, understanding the complex interaction between plant performance and the environment, understanding the factors limiting the shelf-life of horticultural products, and developing improved post-harvest handling techniques.

Objectives and resources allocated to non-crop activities

Specific Objectives
(Percent Resources)

Develop varieties and rootstocks of grapevines and citrus better adapted to Australian growing conditions. (21%)

Develop novel methods to detect and control viruses in horticultural species. (5%)

Develop techniques for inserting single gene characters into premium grape varieties. (12%)

Ensure consistent cropping of selected subtropical and tropical fruit crops by development of improved varieties and management techniques. (17%)

Planned Outcomes

Commence salinity treatment of sultana rootstockscion combinations and assess vine performance.

Field establishment of progeny arising from the grapevine breeding program and in-ovulo embryo culture.

Assess grapevine rootstock hybrids and varieties with low potassium accumulation for quality wine production.

Commence studies on lime tolerance of citrus.

Commence studies on albedo breakdown in oranges.

Make PVR application for new mandarin variety.

Evaluate a new biochemical indexing method for leafroll disease.

Measure frequency of infection with GUS reporter gene and effectiveness of virulence genes of Agrobacterium with Ti plasmids.

Identify parameters affecting the formation of stable transformation centres in the fragmented shoot apex culture system.

Commence work aimed at isolating the gene for polyphenol-oxidase, purify grape polyphenol-oxidase and attempt to raise antibodies.

Complete isozyme analysis of macadamia varieties.

Continue studies on the chemical induction of flowering in mango and control of tree size.

Continue cashew hybridisation and tree management studies.

Develop methods for the rapid propagation of cashew.

Continue study of pollination factors limiting yield in lychee; complete study of pollination factors controlling seediness in mandarin.

Commence research on the role of plant growth substances in regulating flowering in coffee.

Identify environmental and plant factors limiting productivity of horticultural crops. (10%)

Determine the cause of reduced photosynthesis in woody plants exposed to windy sites and other stress conditions.

Develop treatments to control growth and flowering of native ornamental species.

Develop techniques to investigate the role of the cytoskeleton in controlling chloroplast division.

Identify factors controlling ripening, senescence and postharvest disorders of horticultural crops to enable development of improved postharvest storage procedures. (19%)

Continue development of humidity control and methods to control gas composition in storage.

Initiate new work on minimising postharvest losses due to pathogens and reducing reliance on chemical treatments.

Investigate postharvest disinfestation of quarantinable pests in exportable commodities by non-chemical means.

Continue evaluation of storage life and quality of vegetable and melon cultivars.

Modify the ripening characteristics of commercial fruits by the introduction of chimaeric genes with promoters responsive to environmental signals. (12%)

Isolate and characterise endopoly-galacturonase genes from tomato and peach.

Construct chimaeric gene.

Develop reliable transformation and regeneration techniques for tomato.

Total Budget: \$5,220,000

Appropriate Allocation: \$4,455,000

The Division expects to receive 15% of its total budget from external sources.

8.4 DIVISION OF PLANT INDUSTRY

Objectives

To develop new opportunities and technologies for plant improvement and for management of agricultural production and processing in Australia, and to provide a basis for the more effective utilisation and management of the Australian flora and vegetation.

Strategy

The Division pursues its objectives through research in a broad range of basic and applied plant science, with emphasis on introduction of new technologies into agriculture and its associated production, processing and service industries. Research and development goals are furthered through close coordination and collaboration with other bodies servicing the Division's target industries and national objectives.

Specific Objectives (Percent Resources)

To develop new technologies for plant improvement and to produce advanced germplasm, breeding lines and new varieties of crop and pasture plants with performance and quality characteristics better suited to productive sustainable agriculture. (45%)

Planned Outcomes

Complete the screening of linseed lines for tolerance to aluminium and manganese in acid soils.

Evaluate nodulation and growth of *Parasponia* under controlled environment tropical field conditions (with the Division of Soils).

Determine the program of expression of pyruvate Pi dikinase in *Flaveria bidentis*, a C4 species, and in *F. pringlei*, a C3 species.

Determine regulatory DNA sequences responsible for effects of plant hormones and gene transcription.

Construct genes encoding Potato Leaf Roll Virus coat protein and commence engineering plant transformations.

Prepare range of ribozymes effective against plant viroids and commence tests in tobacco protoplasts, *arabidopsis* and tomato.

Regenerate lupin, subterranean clover, and an Australian cultivar of lucerne from tissue culture.

Transform cotton callus with gene for resistance to 2-4D.

Isolate sunflower gene for high sulphur protein and re-engineer for expression in leaves.

Screen collections of *Triticum tauschii* for new resistance genes for cereal cyst nematode, stripe, leaf and stem rusts and Septoria.

Enter a contract with Bresatec for the production of non-radioactive probes for detecting rye chromosome segments in wheat varieties.

Achieve introgression of cereal cyst nematode resistance from rye into a wheat chromosome using cell culture.

Determine the physical and chemical properties of the chemical signal by which roots in inhospitable soils influence leaf growth and hence yield.

Determine variation in the D-genome of wheat in tolerance of salinity and ability to exclude sodium.

Evaluate potential edible-oil linseed (linola) cultivars in interstate yield trials.

YATOUQ Field test the Division's new phalaris cultivar.

<p>To develop objective farm management systems and diagnostic kits for optimising plant production. (38%)</p>	<p>Complete commercial testing and release of a number of new Siokra and Sicala cotton varieties.</p> <p>Complete the multiplication for germplasm storage and duplicate shipment of <i>Glycine</i> accessions from 1987 and 1988 collecting expeditions in IBPGR and its clients.</p> <p>Make test crosses to determine effective genetic approaches to direct changes in dough properties of cereal grains.</p>
<p>Determine minimum population sizes of rhizobia below which seed inoculation is required for maximum nitrogen fixation in peas, beans and lupins.</p>	<p>Complete work on the diagnosis of the phosphorus status of linseed, rapeseed and Indian mustard and on the role of boron in flower and seed development in sunflowers.</p> <p>Field test inhibitors of nitrification and soil urease activity to assess their ability to improve the efficiency of recovery of urea fertiliser.</p> <p>Develop a rapid and simple test for the sulphur status of crops and pastures.</p>
<p>Evaluate straw-based inoculant preparation technologies for heterotrophic nitrogen-fixing bacteria to be applied to crop residues.</p>	<p>Determine minimum population sizes of rhizobia below which seed inoculation is required for maximum nitrogen fixation in peas, beans and lupins.</p>
<p>Select the most active cyanoacrylate herbicides from the Division's chemical synthesis program for more detailed glasshouse and field trials.</p>	<p>Evaluate straw-based inoculant preparation technologies for heterotrophic nitrogen-fixing bacteria to be applied to crop residues.</p>
<p>Survey incidence of Subterranean Clover Stunt (<i>Vinibacter</i>) in six areas of southern Australia, and estimate effects on yields in field experiments to determine optimal control measures for this disease.</p>	<p>Select the most active cyanoacrylate herbicides from the Division's chemical synthesis program for more detailed glasshouse and field trials.</p>
<p>Evaluate methods of measuring the early growth of wheat by the capacitance pasture meter and remote sensing.</p>	<p>Survey incidence of Subterranean Clover Stunt (<i>Vinibacter</i>) in six areas of southern Australia, and estimate effects on yields in field experiments to determine optimal control measures for this disease.</p>
<p>Measure the carbon and nitrogen accumulated during early growth of wheat and its redistribution during grain filling in the field.</p>	<p>Evaluate methods of measuring the early growth of wheat by the capacitance pasture meter and remote sensing.</p>
<p>Measure the rate of production and movement of nitrate in deep sandy soils using ^{15}N-labelled fertiliser.</p>	<p>Measure the carbon and nitrogen accumulated during early growth of wheat and its redistribution during grain filling in the field.</p>
<p>Commercially release GRAZFEED and LAMBALIVE, two components of GRAZPLAN, and establish a divisional scientist in South Australia to test and refine the GRAZPLAN system under mediterranean climate conditions.</p>	<p>Measure the rate of production and movement of nitrate in deep sandy soils using ^{15}N-labelled fertiliser.</p>
<p>Release a microcomputer version of the irrigation-scheduling component of SIRAGCROP for testing under farm conditions.</p>	<p>Commercially release GRAZFEED and LAMBALIVE, two components of GRAZPLAN, and establish a divisional scientist in South Australia to test and refine the GRAZPLAN system under mediterranean climate conditions.</p>
<p>Release for restricted testing a non-computer decision-support system for tactical application of nitrogen fertiliser on dryland farms.</p>	<p>Release a microcomputer version of the irrigation-scheduling component of SIRAGCROP for testing under farm conditions.</p>
<p>Formulate plans and seek additional resources for a program to compare the sustainability of perennial and annual pastures under high-output grazing systems.</p>	<p>Release for restricted testing a non-computer decision-support system for tactical application of nitrogen fertiliser on dryland farms.</p>
<p>Tune and test the basic pest management system in the cotton management program SIRATAC Plus.</p>	<p>Formulate plans and seek additional resources for a program to compare the sustainability of perennial and annual pastures under high-output grazing systems.</p>
<p>Plan GOTMAN—an integrated suite of stand-alone microcomputer-based decision-support systems replacing SIRATAC Plus.</p>	<p>Tune and test the basic pest management system in the cotton management program SIRATAC Plus.</p>
<p>Complete economic optimisation of irrigation scheduling and pest management decisions within the SIRATAC framework.</p>	<p>Plan GOTMAN—an integrated suite of stand-alone microcomputer-based decision-support systems replacing SIRATAC Plus.</p>
<p>Build a management model for mites in cotton, incorporating sampling, population development, action thresholds and strategies for use of specific acaricides.</p>	<p>Complete economic optimisation of irrigation scheduling and pest management decisions within the SIRATAC framework.</p>

To develop sites of mining leases to enable complete field testing of *Dianthonia richardsonii* in collaboration with industry partner for full commercialisation.

Develop seedling standards to enable commercial propagation and production protocols using bromegrass for *Chamaaucium uncinatum*.

Develop prototype tests for organophosphate residues in grain.

Evaluate the Wheat Research Unit's new serum test for coeliac conditions.

Finalise design of equipment and software to determine dough properties of small flour samples.

Finalise development and evaluation of laboratory methods for wheat-varietiy identification.

To provide a basis for development of management strategies for natural resources important for agricultural production systems and for our native vegetation. (9%)

Identify the Division's capacity for expanding research on emerging environmental priority areas such as greenhouse effect, ozone layer and sustainable agriculture.

Determine the effect of ultraviolet B radiation on key photosynthetic activities.

Determine whether the long-term changes in the photosynthetic capacity of leaves of pea and soybean plants grown in elevated levels of CO₂ are significant in terms of growth response.

Using CO₂ as the prime variable, trace the responses in growth and yield of three modern wheat genotypes with contrasting backgrounds and examine the interactions induced by temperature, one of the other globally changing climatic factors.

Use the cotton crop model OZCOT to make a preliminary assessment of the 'greenhouse' effect on cotton production.

Complete a prototype of an interactive computer key to rain forest trees of northern Australia.

Complete the establishment of Uluru National Park herbarium.

Identify user groups to support external funding of research on *Eucalyptus*.

Establish population sampling strategies for rare and threatened plant species.

Develop monitoring systems for plant species in experimental catchments and develop prescribed burning guides for regrowth eucalypt forest in the Eden region.

Complete and publish monographic revision and flora treatment of Lauraceae.

Complete evaluation of the quality of linola oil and meal for commercial use.

Obtain genes for low levels of glucosinolate in mustard seed oil.

Patent waxy barley (Waxiro) and finalise the contract with a food manufacturer for its utilisation.

Determine the relative contributions to dough properties of the various gluten proteins with respect to their subunit composition and degree of aggregation.

To improve the value of farm products by improving market-related quality features and processing technologies. (8%)

Compare the relative contributions of starch and protein to the noodle-processing quality of wheat.

Finalise study of the relative contributions of amylases, proteases and oxidases to problems of processing sprouted grain.

Characterise polypeptides synthesised following heat shock of wheat plants.

Define gluten sequences that are 'coeliac-toxic' in T-cell assays.

Total Budget: \$25,453,000

Appropriation Allocation: \$19,415,000

The Division expects to receive 24% of its total budget from external sources in 1989/90.

8.5 DIVISION OF SOILS

Objective

To contribute to the profitable and sustainable management of Australia's soil and land resource, by studying the distribution, properties and behaviour of soils in Australia and by encouraging the application of this knowledge.

Strategy

The Division will:

- . undertake research to anticipate and manage soil problems of national significance***
- . develop collaborative and contractual interactions to ensure that research is relevant to national need, and that information so generated, is applied***
- . seek external funding for specific projects, and where opportune, will develop commercial opportunities which arise from its research***
- . ensure Australia benefits from, and contributes to international developments in soil science***
- . expand formal and informal communications with other scientists decision makers and the public***
- . maintain publicly accessible information about Australian soils***
- . actively encourage the training of soils scientists by involvement in lecturing, supervise students and sponsor post-graduate students***
- . organise its work within programs, each with specific program objectives which will be revised each year.***

Specific Objectives (Percent Resources)

To provide practical strategies for (a) measuring, predicting and controlling the impact of agricultural, urban, mining and industrial land use management on soils and landscapes and (b) rehabilitating degraded land. (14%)

Planned Outcomes

Complete, report and publish an experimental description of transport of the multiple exchanging cations through soils.

Publish experimental and mathematical descriptions of the transport of bacteria through soils.

Commence collaboration with the University of Florida to validate models for multiple-species cation transport through soils.

Complete a major field experiment investigating the potential environmental hazards of land application of Canberra sewage sludge.

Complete a major project investigating the effects of the irrigation of soils near the Ranger Uranium Mine with retention pond water, and report the findings to the Office of the Supervising Scientist for the Alligator Rivers Region.

Complete and publish research on the partitioning of runoff generation between surface and subsurface flow on an instrumented hillslope and its effects on the transport of colloids and associated nutrients.

Publish improved methods for measuring field soil hydraulic properties.

Commence a study of the effect of changing land use on the transport of colloid and associated nutrients from hillslopes by surface and sub-surface flow.

2.1 Determine the role of mycorrhizal infections and nutrient cycling in existing re-vegetation trials on engineered landforms.

Report on the distribution of bacterial and fungal assemblages in mine soils in relation to re-vegetation strategies.

Establish field trials on a tailings dam to confirm laboratory measurements of consolidation.

To evaluate the effects of acid rain on the stability of re-vegetated landforms.

Investigate the effects of weathering on the stability of waste rock dumps in a humid environment.

Investigate properties affecting the weathering, consolidation, and leaching of acid tailings.

Commence an investigation of the effects of fertilizer practice and liming, crop rotations, tillage practice and soil characteristics on cadmium uptake by cereals and pastures.

Commence a study of the usefulness of soil tests for predicting cadmium in cereals and pastures.

Initiate a study on the retention and transmission of arsenate and chromate in Australian soils.

Report on the mobilization of the aluminium in potentially acid sulphate soils resulting from changes in oxidation status produced by modified agriculture.

Commence, in collaboration with Land Care groups and the South Australian Department of Agriculture, studies in four sub-catchments of soil, hydrological and landscape processes leading to induced dryland salinity.

Commence and complete a study to identify processes of iron and manganese mobilization and movement associated with forest floor leachates within selected soil landscapes in the Warren Reservoir catchment in South Australia.

Complete and publish maps of chemical and morphological properties associated with salinisation in a micro-catchment at Keyneton, South Australia.

Complete and publish a preliminary investigation of mineralogical and chemical properties of two acid sulphate soils formed as a result of dryland salinity in the Mount Torrens and Harrogate catchments, South Australia.

Isolate and identify the hydrolysis and decomposition products of the herbicide GLEAN.

Identify the specific soil components that favour either stability or decomposition of the herbicide GLEAN.

Prepare for initiation of a new project on soil and water contamination by organic chemicals, including pesticides and herbicides, and their decomposition products.

Develop methods to describe and to manage the structure and structural stability of soils in order to minimise water and wind erosion, to enhance agricultural productivity, and to improve land management.

Establish projects that consolidate research at the Canberra and Adelaide Laboratories into the causes, extent and means of repair of the principal forms of soil structural decline that result in poor crop establishment and reduced production in the cereal/pasture region of south-eastern Australia.

Coordinate research in the semi-arid topics at Townsville on control of soilless under both grazing and cropping through the development of land management strategies for this region. Consolidate effective collaboration be QDPI, NTCC, NTDPIF AND CSIRO.

Publish new knowledge of the role of rain induced transport of sediment.

Publish new information on the role of fire on the susceptibility of soil to erosion.

Publish preliminary evaluation of improved morphological methods in the assessment of structural condition.

Describe the impact of grazing on soil infiltration properties.

Describe changes to macropore space following amelioration of a sodic soil with gypsum.

Evaluate current erosion models EPIC, PERFECT, GUESS AND ARFC at DTRF for the semi-arid tropics and the semi-arid tropics zone.

Initiate an investigation into the nature, causes and amelioration of soil structural decline in the cereal/sheep belt of south-eastern Australia.

Initiate an evaluation of the manipulation of earthworm populations to improve structural conditions of soils in the south-eastern Wheat Belt.

Develop methods and strategies for the control of plant nutrition and diagnosis and amelioration of acid sulfate soils of the Magela area of the Pilbara.

Complete and publish a detailed description of the genesis and distribution of actual and potential acid sulfate soils of the Magela area of the Pilbara.

Initiate a project on the effects of nitrate leaching on the development of soil acidity.

Further develop ion chromatographic techniques to speciate A1 in soil solutions.

Complete and publish a study of redox conditions in soil profiles in relation to profile hydrology.

Complete analyses of boron in samples collected in a soil survey in the area of the Kapunda (1:100,000) mapsheet and to relate the data to defined land units with special reference to sodicity.

Sample the variation in boron and salinity in a sub-catchment at Rhynie in soils developed from single (high-boron) parent material.

Sample the short-range variation in boron and salinity in soils of the coastal plain at Two Wells developed in alluvium of the Gawler and Light Rivers.

Convert all files in programs and databases on boron toxicity and deficiency from the PDP 11 computer to operation on a micro-VAX system, and to establish an enhanced database management system to support the compilation of a compendium of results.

Complete a survey of boron levels in St Arnaud grain as an indicator of the extent of high-boron soils in Victoria.

Develop IMA filters during 1989 to provide guidelines for identifying Kipiro soils.

Complete co-supervision of a Ph.D. student investigating the genetics of boron tolerance in wheat.

Field test lines of Schomburk wheat backcrossed with genes for boron tolerance in a high-boron soil.

Examine the potential for boron deficiency in light textured soils of the Murray-Mallee and Byrnes Peninsula by pot experiments and analysis of field soils.

Investigate boron tolerance in selected species and varieties of pasture and medics in solution culture.

Investigate the effects of rainfall on leaching of boron from leaves of wheat under field conditions.

Examine the relation between P supply and Fe supply on plant growth in soil-less media.

Further develop a nitrogen-drawdown test for soil-less media.

Study the time sequence of changes in concentrations of trace elements after addition to soil-less media to ensure that diagnostic analyses can be interpreted accurately.

Aim to produce Cu and Zn toxicities in plants in soil-less media and to relate symptoms to levels of extractable Cu and Zn.

Determine how much protection from Fe deficiency at high pH is provided by including soil in otherwise soil-less mixtures.

Refine the interpretation of data for Mn concentrations in DTPA extracts of soil-less media taking into account pH, temperature and redox conditions.

Describe the flow of nitrogen in legume-cereal rotations conducted on a rhodoxeralf under contrasting tillage regimes.

Describe and quantify the processes of organic residue decomposition and nitrogen mineralisation in soils in terms of C and N turnover through the microbial biomass as influenced by soil physico-chemical properties with special reference to soil texture and (micro) structure.

Utilize changes in the soil microbial biomass as a sensitive indicator of changes in energy flow, as induced by new or established management practices (rotation, tillage, N fertilizer application, crop residue return, amelioration of acid soils).

Use an amino acid racemization technique to determine the relative biological stability of amino acid C and N in soil and to investigate the mechanism(s) of N stability in biological processes.

Perform experimental and theoretical studies to design a prototype delivery system for subsurface trickle irrigation.

Complete monitoring of field trials on amelioration of soil acidity by liming, and to continue writing up of the completed project in collaboration with S.A. Department of Agriculture.

Collaborate with S.A. Department of Agriculture in extension activities to publicise the results of a completed project on the amelioration of soil acidity.

Reduce losses from root diseases and enhance associations between plant roots and soil organisms to improve the productivity of crops, pastures and forests, and to facilitate revegetation of degraded soils. (25%)

Initiate collaborative field trials with S.A. farmers to evaluate a new sowing point for improved soil properties and reduction of root diseases caused by *Rhizoctonia*.

Complete identification and pathogenicity evaluation of *Pythium spp.* isolated from across the S.A. cereal belt.

Develop 'DNA finger-print' techniques for identifying *Rhizoctonia* and *Pythium spp.* in soil.

Initiate, in collaboration with the S.A. Wheat Committee, a project to define the effect of herbicide residues on fungal root diseases of cereals.

Complete a study to evaluate the efficacy of *Pasteuria penetrans* as a biocontrol agent of the root knot nematode.

Initiate, in collaboration with Monsanto U.S.A., a project to investigate the effect of soil edaphic factors on the biological control of take-all of cereals using Pseudomonads and Trichoderma.

Carry out a microbiological assessment of the effect of crop rotation and tillage on soil at two sites (Avon and Kapunda) in S.A.

Complete a study of the ultrastructure of soil fractions from Kapunda and Northfield defining the relationship between the distribution of the biomass and organic matter in and between microaggregates.

Complete a study on the ultrastructure of worm casts in relation to their mechanical stability.

Initiate a study to define at the ultrastructural level interactions between plant roots, root pathogens and biocontrol agents.

Complete research on the isolation and characterisation of different *Frankia* strains from nodules of *Casuarina*.

Complete studies on the relationship between haemoglobin concentration, hydrogenase activity and the efficiency of nitrogen fixation in *Casuarina* symbioses.

Commence duties on the distribution of *Frankia* of *Elaeagnus*, *Gymnostoma* and *Casuarina* in north Queensland forest soils.

Commence studies on the synthesis of ectomycorrhizas with *Acacia* spp. and VA mycorrhizas with selected north Queensland cabinet-timber species.

Continue a survey to determine the size, distribution and composition of earthworm populations in S.A. soils.

To improve soil management and to facilitate interaction with users of research results by increasing knowledge of the properties, mineralogy, behaviour and distribution of Australian soils. To disseminate this knowledge through models, databases, classification, mapping systems and research papers. (29%)

Establish the framework for studies of land degradation in the upper Burdekin catchment via commencement of remote sensing and reconnaissance survey, and to commence studies of soil processes significant to land management in the same area. Specifically to select sites for detailed study in the same area. Specifically to select sites for detailed study in collaboration with the Dalrymple Land Care Committee and to make available a library of high resolution spectral reflectances of various soil and vegetation components in the Upper Burdekin Catchment (Project S01).

With respect to studies (Project S02) of dryland salinisation, structural decline, erosion, self-mulching and soil magnetic properties in the mid-North and Mt. Lofty Ranges of S.A., specifically to:

- commence, in collaboration with Land Care groups and the S.A. Dept. of Agriculture, studies in eight sub-catchments of soil, hydrological and landscape processes leading to soil degradation
- complete and publish maps of morphological properties and magnetic properties associated with a highly degraded microcatchment at Keyneton, S.A.
- complete and publish a preliminary investigation of physical, mineralogical and micromorphological properties of highly abrasive soils in Australia
- complete and publish several papers relating to pedogenic and synthetic iron oxide formation and transformation
- complete and prepare for publication an evaluation of the McKeague system for describing and interpreting soil macrostructure
- develop and begin testing a system for describing and interpreting soil profile morphology appropriate to Australian conditions
- prepare for publication the results of studies of soil degradation of degraded and undergraded soils in 3 paired catchments near Adelaide.

Define the crystalline swelling of a range of smectites in Ca and Mg solutions and to investigate the use of new software for the resolution of mixed layer clays, to investigate the structure of such clays using SEM/TEM methods, to start work on improved methods of quantifying XRD data from soils. To integrate the above laboratory studies into the Division's field research projects investigating soil structural decline in S.A. and N.S.W. (Project S03).

Synthesise naturally occurring minerals to demonstrate that induced hydrolysis uses conditions prevalent in natural environment. To make precursors of known industrial catalysts using induced hydrolysis reactions and to test minerals against those produced by other techniques (Project S04).

Purchase and install a new image analysis workstation linked to a digitising system and to develop further image analysis software developed in collaboration with the Division of Information Technology. To apply image analysis techniques to soil structural/agronomic problems being investigated in Program M (Project S05).

Complete the profile data-base and formalise procedures for input, access and availability of data. To produce a data-base listing of what is available. To complete the first stage of testing the new national soil classification (Project S06).

Write up drafts of completed field investigations. To develop new initiatives regarding land degradation investigations in the arid zone (Project S07).

Complete project data-base, and finalise drafts of research results. To organise a field meeting for data users, cotton growers etc. to convey major project findings (Project S08).

Total Budget: \$11,618,00

Appropriation Allocation: \$10,181,000

The Division expects to receive 12% of its total budget from external sources.

8.6 DIVISION OF TROPICAL CROPS AND PASTURES

Objectives

For northern Australia, to improve the efficiency of livestock production from legume-based pastures, to maintain the productivity and stability of the native grasslands and woodlands (excluding the arid rangelands), and to improve field crop productivity.

Strategy

Project teams with a range of scientific skills have been assembled to attack recognised problems in the pastoral, sugar and grain crop industries. Priorities are set in consultation with representatives of rural industries, State Departments servicing agriculture, the Bureau of Sugar Experiment Stations, and Universities. The Division's research is being increasingly integrated with that of the other research groups.

Specific Objectives (Percent Resource)

Planned Outcomes

A. Pasture Research

The Division's policy on pasture research is based on reviews and external advice. The relevant zone is the region of Australia north of 30°S latitude that receives at least 500mm rainfall a year. The research involves collaboration between scientists working in plant introduction and genetic resources, plant breeding and genetics, pasture agronomy and ecology, plant nutrition, legume bacteriology and the assessment of land use and management options. The major objectives, important goals for 1989/90, and resource allocations are presented below.

Develop and test new pasture legumes to improve the efficiency of cattle production in the tropics of 25°S latitude. (11%)

Commence widespread evaluation of new accessions of *S. hamata*.

Release a new variety of *S. scabra* bred for resistance to anthracnose disease.

Develop and test new pasture legumes to improve the efficiency of beef cattle production in the sub-tropics (25°S – 30°S latitude). (14%)

Assess the variation in the Siratro rust organism and screen the Division's rust resistant Siratro lines against a representative collection of rust races.

Commence breeding lucerne for resistance to the fungal disease acrocalymm.

Develop management systems for native grasslands and woodlands in northern Australia (including the introduction of legumes) to maintain or enhance their productivity, and protect them from degradation. (17%)

Initiate a major new Land and Water Care Program for Northern Grazing Lands, comprising research into animal production/stocking rate relationships on native pastures, the role of tree clearing in pasture systems, the use of improved pastures in sustainable management systems, and the development of management support systems for land care.

Commercialise band-seeding technology (developed jointly by the Division and QDPI) for low cost establishment of improved pastures.

Breed and select pasture grasses with improved adaptation, seed yield, feeding value, and tolerance to heavy grazing. (6%)	Complete research on the effects of defoliation on native and introduced grasses by publication of results and by making them available to researchers concerned with grass selection and improvement, and pasture management.
	Establish two major new grazing experiments designed to investigate the establishment, stability, and productivity of low-cost legume/native grass pastures in the subtropics.
Reduce the problem of declining productivity in tropical grass pastures based on sown grasses. (5%)	Commence research (based on the Davies Laboratory, Townsville) into grazing-tolerant grasses for use in rehabilitating degraded grasslands.
Use rumen biotechnology to accelerate the degradation of dietary fibre and resolve toxicity problems in forage legumes. (3%)	Evaluate a high-quality selection of <u>Digitaria</u> for milk production in collaboration with QDPI.
	Commence a WRDF-funded Project to evaluate new, high quality selections of buffel grass for grazing by sheep.
Specify beef requirements for the Japanese and south-east Asian markets, and develop and deliver technology that will allow profitable production without feedlots of beef of the specified quality. (2%)	Complete long-term field studies on the nitrogen economy of crop-pasture production systems at the Narayen Research Station.
	Conclude negotiations with AMLRDC and establish a major AMLRDC-funded inter-institutional Project aimed at increasing the efficiency of dietary fibre breakdown through the development and use of modified rumen micro-organisms.
B. <u>Crop Research</u>	
The Division's policy on crop research is based on a number of recently completed reviews. The relevant zone is the lands with soils and climates suitable for crop production that lie to the north of 30° South latitude. The research has five major objectives, on which scientists in the disciplines of agronomy, physiology and the genetics and breeding of crops are collaborating, and also drawing on expertise in modelling production systems, and in land use assessment. The major objectives, important goals for 1989-90, and resource allocations are presented below.	Develop, in collaboration with AMLC, AMLRDC and others, major inter-institutional AMLRDC funded Project that addresses this research area.
Improve and extend the range of tropical crop varieties. (10%)	Complete a pilot study at the Samford Research Station on grain feeding to cattle at pasture.
	Confirm the high productivity of newly-developed tropical soybean varieties.
	Provide expert advice to CSR on the future direction of sugar cane breeding.

Reduce the limitations to crop yield imposed by environmental and physiological factors. (10%)	Assess the improvement in yield of dryland sorghum achieved through increasing the level of osmotic adjustment, and pass the technology for increasing osmotic adjustment to the QDPI sorghum breeding program.
Develop and evaluate new farming systems for tropical Australia. (17%)	Complete the farming systems research at Katherine, NT, and evaluate and publish field results of this ten-year project. Initiate a new farming systems research project in the subtropics.
Develop decision support systems for Australian tropical/sub-tropical agriculture. (3%)	Intensify research on the prediction of seasonal rainfall.
Assess land use options and crop production potential. (4%)	Initiate a major new research project in Vanuatu.

Total Budget: \$13,810,000

Appropriation Allocation: \$10,873,000

The Division expects to receive 21% of its total budget from external sources.

9. CORPORATE SERVICES DEPARTMENT

Objective

Assist the Organisation to reach its research objectives. Promote the optimal management of resources by institutes. Support the Chief Executive in the development, implementation, and coordination of policy relating to corporate management. Provide a focal point for CSIRO's international relations. Provide corporate legal services to CSIRO.

Strategy

The Department's strategy is to encourage the development and maintenance of strong, decentralised operational management at the institute and divisional level.

The Department's priority is to focus on support of the line management structure in CSIRO. The Department is working closely with the Chief Executive, the Board, Institutes and Divisions to develop and implement corporate policy in the key areas of human and financial resource management, information systems and services and revenue generation.

The planned outcomes for each of the following units are detailed in the Corporate Services Department Operational Plan.

The department is formed from the following branches, units and service groups

Office of the Director, Canberra ACT, incorporating	Corporate Legal Services Corporate Library and Information Service
Centre for International Research Coordination, Canberra ACT	
Management Information Systems Branch	Operations Unit, Canberra ACT and Melbourne VIC Systems Design Unit, Canberra ACT and Melbourne VIC User Support and Education Section, Canberra ACT, Sydney NSW, Melbourne VIC, Perth WA and Brisbane QLD Planning Section, Canberra ACT
Human Resources Branch	Employee Development Unit, Canberra ACT Employee Relations Unit, Canberra ACT Employment Conditions Unit, Canberra ACT Consultative Council Secretariat, Canberra ACT
Corporate Resources Branch	Finance and Services Unit, Canberra ACT Information Services Unit, Melbourne VIC, Sydney NSW, Adelaide SA, Perth WA and Canberra ACT Property Management and Planning Unit, Canberra ACT, Melbourne VIC and Sydney NSW Research Data Office, Canberra ACT

CORPORATE SERVICES DEPARTMENT**SUMMARY OF APPROPRIATION RESOURCES**

<u>Branch/Unit</u>	Total Staff ⁽¹⁾	Approp Allocation (\$000s)	Specific Purpose Funds Approp (\$000s)	Sponsored Research Funds (\$000)
Corporate Resources Branch	167.0	11,726.1	15,826.2 ⁽²⁾	588.3
Human Resources Branch	40.0	3,114.8	2,577.2	164.0
Management Information Systems Branch	62.0	5,275.8	7,114.8 ⁽³⁾	—
Centre for International Research Cooperation	5.0	269.4	251.8	260.0
Corporate Legal Service	6.8	324.5	480.0	—
Corporate Library and Information Service	4.0	207.9	—	—
Office of Director	2.5	269.7	—	—
Corporate Centre PCEK Redundancies	—	354.8	—	—
Total	287.3	21,543.0	26,250.0	1,012.3

Notes: (1) Total staff of 287.3 to be achieved by 30 June 1990;

(2) Includes Chief Executives contingency, COMCARE premium, 3% super benefit, fuel excise; and

(3) Includes funding for the ASUs and CSIRONET computing charges.

9.1 MANAGEMENT INFORMATION SYSTEMS BRANCH

Objective

Provide administrative, information and communication systems to support CSIRO.

Strategy

The Branch will continue to use the skills of Information Systems personnel and the systems they develop as agents for change in CSIRO's operational practices. Priority will be given to developing systems with maximum functionality and controls that are commensurate with acceptable risk. The Branch's primary focus will be on utilizing rapidly developing computing technology, particularly communications which support CSIRO's research activities.

Specific Objectives (Percent Resources)

Work towards an environment that motivates and rewards creative self starting systems professionals. (2%)

Maintain existing systems and provide all users with timely and well analysed systems updates. (15%)

Produce and implement high quality information systems that are responsive to the specific needs of users. (27%)

Sustain and enhance the high quality education service and documentation to ensure optimum use of Information Systems in CSIRO. (16%)

Provide users with responsive professional support services and aggressively communicate the capabilities available and the benefits to be derived from creative use of the systems. (13%)

Maintain the hardware/software and communications operational environment to provide stable and efficient computing facilities. (22%)

Plan for the future needs of CSIRO's communications (Voice and data) commensurate with CSIRO's evolving needs. (5%)

Appropriation Allocation: \$5,275,800

Specific Purpose Funds: \$6,218,000

9.2 CORPORATE RESOURCES BRANCH

Objective

To assist CSIRO meet its research objectives through the development of financial, commercial, information service and property management policies and strategies. To add value to CSIRO's research effort by providing information and communication services tailored to the users needs.

Strategy

The Branch utilises a wide range of financial, communication, planning and management skills to provide responsive services to senior and line management. In the development of policies, the Branch collaborates closely with the users of its services and with relevant external agencies.

Specific Objectives (Percent Resources)

To provide an operational framework of resource budgeting and financial policy that assists managers meet the objectives of the organisation and ensure compliance with relevant legislation and standards. (30%)

Assist and advise institutes and divisions in achieving corporate goals through the acquisition and communication of scientific and technical information. (30%)

Assist the Chief Executive, Directors and the Board in the development of CSIRO policies and the coordination of these with national priorities for the compilation, storage and dissemination of scientific and technical information. (10%)

Add value to CSIRO by assisting the decision processes involved in conducting, utilising and allocating resources to research through the provision of information and communication services. (20%)

Develop and implement policies for the strategic planning and management of CSIRO's property assets and to support the divisions through arranging technical and professional services associated with financing, design, construction, maintenance and security measures. (9%)

To encourage the integration of commercial considerations into all phases and at all levels of CSIRO research management.

Appropriation Allocation: \$11,726,100

Specific Purpose Funds: \$15,580,200

9.3 HUMAN RESOURCES BRANCH

Objective

To provide human resource policies and practices that attract and retain high calibre staff and optimise staff contribution towards achieving CSIRO's objectives.

Strategy

In undertaking its policy development and advisory responsibilities, the Branch consults widely within and outside the Organisation.

The need to attract to the Organisation high calibre staff and to retain and develop those staff, continues to provide a major focus for policy initiatives. Management and skills training will be given a high priority. Key initiatives will be to negotiate and implement tenure and award restructuring agreements, develop an integrated human resources strategy, and introduce a career planning program.

**Specific Objectives
(Percent Resources)**

Develop and assist with the implementation of employment practices that are conducive to optimising staff recruitment, performance and reward. (30%)

Ensure that all staff work in a safe occupational environment. (15%)

Ensure compliance throughout the Organisation with relevant legislation and standards in human resource management. (5%)

Provide industrial relations support and training for line management. (15%)

Develop consultative mechanisms with employee associations to enhance their understanding of CSIRO objectives and priorities. (5%)

Develop and implement policies and procedures to enhance the knowledge, skills, abilities and productivity of all staff.(20%)

Ensure that professional management expertise is maintained to provide specifically for the replacement of senior management staff at all times and in all facets of the Organisation's work.

Appropriation Allocation: \$3,114,800

Specific Purpose Funds: \$1,827,200

9.4 CORPORATE LEGAL SERVICE**Objective**

To provide CSIRO with high quality legal services and advice on legislative affairs.

Strategy

The section provides legal services to CSIRO, using its own and outside resources.

Specific Objectives
(Percent Resources)

Provide timely and appropriate responses to requests from top management for advice and assistance on legal issues and in policy matters with a significant legal component. (20%)

Provide or arrange high quality legal services to institutes, divisions and the corporate centre. (60%)

Monitor the status of CSIRO's legal affairs and provide advice and recommendations to managers at all levels as appropriate. (10%)

Assist managers throughout the Organisation to improve their handling of matters involving legal issues by providing information and training in the elements of law. (10%)

Appropriation Allocation: \$324,500

Specific Purpose Funds: \$480,000

9.5 CENTRE FOR INTERNATIONAL RESEARCH COOPERATION

Objective

To develop corporate policy on international matters in accordance with CSIRO's statutory responsibilities and to provide a focus for international relations for the Organisation.

Strategy

The Centre networks with Australian and overseas bodies, facilitates formal linkages at the organisational level and acts as the main point of contact and coordination for CSIRO's input to overseas development assistance programs.

The Centre works closely with CSIRO International Consulting divisions in identifying opportunities for consulting and project work, and manages the placement of overseas trainees in CSIRO laboratories.

**Specific Objectives
(Percent Resources)**

Advise the Office of the Chief Executive, institutes and divisions on current Government policy on international matters and its impact on CSIRO. (20%)

Provide a contact point on behalf of CSIRO, for information and liaison on the Organisation's international activities. Coordinate visits by overseas delegations and follow up action arising from these visits. (30%)

Maintain and develop, where appropriate, formal linkages between CSIRO and overseas institutions. (10%)

Through close liaison with CSIRO's International Consulting, assist institutes in identifying opportunities in overseas consulting work. (10%)

Manage and develop opportunities for training programs and attachments for overseas trainees. (25%)

Provide Australian representation on the Commonwealth Science Council. (5%)

Appropriation Allocation: \$269,400

Specific Purpose Funds: \$251,800

9.6 CORPORATE LIBRARY AND INFORMATION SERVICE

Objective

Firstly to provide a library and information service that keeps the corporate centre and institute staff aware of Australian and international trends in science and technology policy, administration and R&D/general management.

Secondly, as part of the National Information Network, to satisfy general enquiries from the public.

Strategy

The Library's strategy is to meet the needs of users with a fast and responsive service. Its reference service covers loans from the library's own collection, inter-library loans, on-line literature searches, television and radio monitoring and Scanfile – a weekly abstract bulletin covering issues in science and technology policy, management and administration.

Specific Objectives (Percent Resources)

Provide appropriate resources including books, journals, directories, databases, multi-media materials and CSIRO information leaflets. (60%)

Provide reference services. (25%)

Maintain Scanfile abstract bulletin to provide current awareness in science policy/management to corporate centre managers. (8%)

Liaise with user groups and develop ways to promote the Library. (2%)

Maintain and develop relationships with other CSIRO libraries and with other members of the National Information Network. (5%)

Appropriation Allocation: \$207,900

10. SIROTECH LIMITED

Sirotech Limited is a company under the control of CSIRO and limited by guarantee. Its main income is derived through work done for CSIRO. Its role is defined below.

Objective

To create new opportunities for business and increased competitiveness in Australian industry based on new or improved technologies from CSIRO and to generate funds for CSIRO by facilitating transfer of its research results.

Strategies

Sirotech will carry out this objective by continuing to provide a service to CSIRO through a team of competent professionals, well trained and experienced in the role of technology transfer. Sirotech's advice will help CSIRO structure its commercial relationships with Australian industry in such a way as to facilitate commercial success and in addition to ensure that CSIRO obtains fair market value for contributions it makes to these business opportunities. As appropriate, a venture capital perspective will be adopted because in many respects private and CSIRO research resources devoted to collaborative projects resembles seed venture capital inputs. The skills available within Sirotech ensure that a full spectrum of commercial arrangements can be embarked upon, and embrace patents, intellectual property, legal, financial and general commercial skills.

Services Offered

- . *Commercial and professional evaluation and advice, in relation to intellectual property, particularly patents;*
- . *Creation and maintenance of the CSIRO patent portfolio and other CSIRO intellectual property;*
- . *Help commercialise identified areas of CSIRO activity by most appropriate means;*
- . *Creation and maintenance of CSIRO Agreements and intellectual property data bases;*
- . *Identify industry research needs through increased decision-level contact;*
- . *Market assessment of research results to ascertain commercial viability;*
- . *Maintenance of market and company data base;*
- . *Location and evaluation of commercial partners;*
- . *Negotiation of agreements;*
- . *Advice on financial/legal implications of technology transfer arrangements;*
- . *Management of joint ventures on behalf of CSIRO;*
- . *Licence audit and collections;*
- . *Assist in defining commercial objectives for improved project management; and*
- . *Commercial training workshops.*

Budget:

Patents: \$1,200,000 (to be negotiated)
 Running Costs: \$3,800,000

