Computer-aided molecular modelling plays an important part in medical chemistry research which is an important component of the University's Bioactive Molecules Research Program. The photograph, taken off the computer screen, shows one of the heterocyclic molecules being studied by Professor John Bremner and colleagues for the development of new selective medicinal agents of potential use in the treatment of benign prostatic hyperplasia.
UNIVERSITY OF WOLLONGONG

RESEARCH REPORT 1993

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  Asia and Pacific Development Studies
  Australian Flora and Fauna
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THE UNIVERSITY of Wollongong continues to advance its research activity through the application of its Research Management Plan - a course of action that is constantly evolving. Its underlying aim, however, remains unchanged, that of consolidating and furthering the research effort of the University by providing an environment, par excellence, for cooperative and collaborative interdisciplinary research. An equally important focus is the provision of high-quality postgraduate training in both fundamental and industry linked research - together with, where appropriate, considerations of the associated social implications.

The University sees itself building on its current research strengths by an aggregation of staff interests and expertise, with a clear focus of objectives, regular evaluation of progress, widespread dissemination of results, cost-control and increasing development of the skills of the staff involved.

The Graduate Faculty within the University allocates all intramural resources for research, associated scholarships and equipment support. Funding is available for high-quality research under the categories of University Small Grants, Project Grants, Development Groups, Research Groups and Research Programs.

Project Grant funding is available for particular research being undertaken by individual staff members or a small group of academic staff, where it is not appropriate for such member(s) to form a Research Group or Research Program. Research Groups and Development Groups are the formations by which new or smaller groups of researchers are supported while consolidating their research. A Research Program is an aggregation of areas of research which, in terms of their research performance, rank highly within the University. An important aspect of the Research Management Plan is the weighting given to collaboration with individuals and organisations outside the University. This is evidenced throughout this report where associate members’ inputs are alluded to.

While support for individual researchers remains an essential component of the University’s Research Management Plan, the present thrust is towards the establishment of interdisciplinary Research Institutes in areas of special strength and natural advantage. Research Institutes consist of Research Programs and/or Research Groups forming an intellectually and thematically coherent and compatible grouping. The Research Institutes will be reported on fully in the University’s Research Report for 1994.

I invite you to look through this Research Report 1993, and judge for yourselves the quality and the success of our University’s research endeavours.

Ken McKinnon
Vice-Chancellor and Principal
March 1994
Steel is one of the more commonplace, yet most advanced of materials. R & D on steel design and processing form the natural focus of this program.

Advanced Materials and Surface Engineering
Co-ordinator: Professor Druce Dunne (tel 042 21 3012)

The field of advanced materials and materials processing is as wide-ranging as it is important and relevant to modern manufacturing. The Advanced Materials and Surface Engineering Program consists of nine project areas and places a major emphasis on ferrous metallurgy, welding and joining of steels, and composite materials based on steels. This emphasis is in keeping with the strength of the ferrous metallurgical industry located at Port Kembla. Several of the projects are being funded through the CRC for Materials Welding and Joining and much of the research and development is being carried out with the collaboration of BHP’s Steel Divisions.

The Iron and Steel Processing project group (Professor Dunne, Doctors Chandra, Samandi, Spinks and Members Mr Geoffrey Brooks, Dr Tara Chandra, Associate Professor Gordon Delamore, Associate Professor Noel Kennon, Ms Sharon Nightingale, Dr Masoud Samandi, Dr Geoff Spinks, Dr David Wexler Brooks) covers steel design, arc and spot welding of steels, thermomechanical processing of microalloyed steels and pyrometallurgical refining. These activities involve collaboration with the Illawarra Technology Centre (ITC), BHP-SPPD, BHP-SCPD, Bisalloy Steels and CSIRO (Manufacturing Technology). Major projects are under way on the warm rolling of ferritic steels with the aim of producing ‘hot rolled’ drawing steels; and the hot rolling response of titanium oxide particle modified steels. Both these projects are being conducted in collaboration with BHP-SPPD.

The Surface Engineering group led by Dr Samandi is focused mainly on treatment of steels for wear, thermal and corrosion resistance using PVD processes, thermal spraying and plasma immersion ion implantation. An extensive network of collaborators has been established which includes BHP-SCPD, Ansto, Ashbolts Pty Ltd, David Brown Gears, Royal Australian Mint and CSIRO (Applied Physics). Two of the most significant current investigations are (i) a collaborative project with David Brown Gears involving nitriding of micro-alloyed steels for gear applications, as a potential replacement for conventional carburising and induction hardening methods; and (ii) nitrogen implantation of die steels used for coin making at the Royal Australian Mint.

Zinc and zinc-alloy coatings on sheet steels are also being investigated, as well as liquid metal degradation of steel rolls used in hot-dip coating. Improvements in ductility and corrosion resistance of zinc-aluminium alloys would have important ramifications for BHP-SCPD and downstream users and an ongoing project concerns the addition of small amounts of other elements.

The Metallic Glasses and Rapidly Solidified Metals project (Associate Professor Delamore, Dr Wexler and Professor Dunne) involves the detailed investigation of rapidly solidified iron and cobalt-based magnetic alloys and is moving into the area of melt-spun nanocrystalline materials. Very-fine-grained materials can exhibit unexpected and attractive physical and mechanical properties, which have the potential for exploitation in commercial products.

A project on the Structure and Properties of Shape Memory Alloys (Professor Dunne and Associate Professor Kennon) has been concerned with a range of non-ferrous alloys with recent emphasis on low-cost iron-based alloys which are suitable for heat-shrinkable couplings for pipe and tube joining. Several new corrosion-
resistant alloys based on the iron-manganese-silicon ternary system have been developed which offer both lower cost and improved corrosion resistance compared with commercially available alloys. The thermal-mechanical training of new alloys is currently being investigated to optimise their shape memory capacity.

Interphase Engineering of Polymer Metal Interfaces (Dr Spinks) is a newly established project area concerned with the structure and properties of polymer/metal interfaces associated with coated sheet steel. The project incorporates CRC-funded studies of adhesive bonding of sheet steels and the adhesion of organic paint coatings to zincalume (sponsored by BHP-SCPD). The latter project has generated a wealth of information regarding the existing coil coating operation used by BHP for the production of Colorbond. Deviation from standard practices has been shown to have adverse effects on the degree of adhesion between the paint and the substrate and this finding provides operational guidelines, along with information as to how the paint systems and surface pretreatments can be modified to improve adhesion.

The Ecomaterials research program (Professor Worner and Dr Brooks) is also a recently initiated research direction intended to address both ecological and economic aspects of materials processing, production and usage. Work on economic uses of steelworks waste is under way in partnership with the ITC. In addition, research on welding fume generation is about to begin as a CRC (Materials Welding and Joining) project in conjunction with the CSIRO Division of Manufacturing Technology.

Other project areas include composite materials (Drs Chandra and Spinks) and ceramic materials and microwave processing (Ms Nightingale and Dr Samandi). Microwave processing provides a particularly promising method for sintering of zirconia and other advanced ceramics, and for joining of ceramic materials to other ceramic and metallic materials. A collaborative project with the CSIRO and Solid Oxide Fuel Cell Corporation has been undertaken with the aim of investigating the possible advantages of using microwave sintered zirconia for electrolytes in fuel cells. Work involves optimisation of microwave sintering processes for a range of zirconia powders, and assessment of the mechanical and electrical properties of the samples.

The Program in 1993 consisted of nine core research members, four associates and 39 postgraduate students. A high point of 1993 was the success in obtaining grants which enabled significant improvement in the equipment infrastructure available to support Program research activity. Equipment to the value of approximately $700,000 has been installed or is on order. Included are a new Leica scanning electron microscope, a Hille 100-ton rolling mill, a UMS 2000 mechanical properties microprobe and a rapid-quench dilatometer. Overall, external research funding for 1993 exceeded $1,150,000 – more than $100,000 for each researcher involved in the Program.
ReasearcH Prograrns

High-performance local and wide-area networks
Multi-media communications and collaborative workplaces
Image coding, speech coding and speech recognition

Advanced Telecommunications

Co-ordinator: Professor Gary Anido (tel 042 21 3065)

The Advanced Telecommunications Research Program is focused on technology that will enable tomorrow's telecommunications systems to be effective in terms of both cost and performance. Nine members of academic staff are involved in four main research themes: Switched Networks Research; Multi-media Communications; Voice Coding; and Image Coding.

The Program had a highly successful year. Industry support was strong, with close to $2,000,000 in new external funding contributed in 1993. An additional $310,000 of competitive funding (from ARC and ATERB) has also been won. A total of 13 refereed journal papers, seven international conference papers, and 34 national conference papers were published. Twenty-eight postgraduates, engaged in telecommunications research activities, are supervised by members of the Program. Since 1989, seven PhD and 14 Honours Masters students have graduated from the Program.

To encourage more collaborative telecommunications research across the University, an Institute of Telecommunications Research has been established. This Institute is based on the Advanced Telecommunications Research Program, and will incorporate some of the activities of the Software Engineering Group and the Computer Security Program. The vision of this Institute is the development of the network and customer premises technologies needed to support advanced telecommunications applications.

Switched Networks Research Centre

The Switched Networks Research Centre was formally established in May 1990 as a Telecom Australia Centre of Excellence with over a million dollars of funding. In March 1992 the funding base of the Centre was expanded with a half-million dollar grant from Ericsson Australia. Earlier this year a $650,000 research contract with AWA was finalised which supports two leading-edge projects in high-performance local area network design. Another project was started later this year under a $160,000 research agreement with DSTO (the Defence Science and Technology Organisation) to study the use of ATM (Asynchronous Transfer Mode) technologies for defence purposes. Two competitive grants from ATERB were also won on the basis of projects being undertaken by researchers in the Centre.

These grants and research contracts have enabled the Switched Networks Research Centre to establish a laboratory in which inter-operability studies involving emerging networking technologies can be undertaken. The Centre carries out research into the design and performance of advanced telecommunications networks and services such as ISDN, Broadband ISDN and Intelligent Networks. An important research topic currently being investigated by the Centre is the use of a technique known as Intelligent Burst Multiplexing for handling high-speed bursty data in ATM networks. A patent for this technique has been applied for by Professor Anido, and further R&D is currently being undertaken. The Centre conducts its work in collaboration with the University of Technology, Sydney, and includes ten research students, one postdoctoral researcher, and four academic staff.

The Centre is now seen as Australia's premier site for advanced networks research work (The Australian, 11 October 1993). Its reputation has been enhanced as a result of its recent acquisition of a Syn-Optics
ATM Switch. As such, the Centre is the first site in the Southern Hemisphere to have a research platform capable of undertaking inter-networking experiments with multi-vendor ATM switches.

The work of the Centre, which included hosting the 1993 Australian Conference on Telecommunications Software and the 1993 Australian Broadband Switching and Services Symposium, has received engendered national and international recognition. The Centre forms the backbone of the new Institute for Telecommunications Research.

**Multi-media communications**

Multi-media communications research includes the development of suitable architectures for CPE (Customer Premises Equipment), to suit multi-media applications over broadband networks, and the implications of such applications on the performance of broadband networks. The multi-media applications being studied and developed are shared (or collaborative) document preparation environments, and multi-media databases (such as imaging databases).

Multi-media work being undertaken was responsible for the winning of a $120,000 research contract from the Defence Science and Technology Organisation (DSTO) to study multimedia technologies for defence purposes. Won also was a competitive grant from ATERB. In July the Program hosted the Third Australian Multi-media Communications Applications and Technology Workshop.

Telecommunications services, over the next five years, will make increasing use of video and imagery. The trend towards multi-media applications, graphical computer-aided design systems, high-resolution desktop publishing and so on, will make the development of efficient visual and image data compression techniques imperative.

**Voice coding**

Voice coding activities have focused on the development of low bit rate coders for use in mobile communications systems, spread spectrum techniques for mobile radio systems and the design and analysis of intelligent speech and a novel Digital Audio Power Amplifier based on the use of DSP techniques. Funding for the low-rate coding activities has come from a $300,000 GIRD grant which was secured earlier this year in conjunction with the University of South Australia.

Coding of wideband audio signals is an area of great interest, particularly with the possibility for transmission via networks such as ISDN. The research activity has mainly been concerned with the Optimum Coding in Frequency coder (OCF) and the forthcoming international ISO/IEC standard MPEG/Audio, both utilising psycho-acoustic weighting to mask the noise.

**Image Coding**

Image coding research has concentrated on techniques for reducing the enormous bandwidths normally required for image and video communications. Work is under way to develop transform coding techniques which will meet internationally specified requirements.

The thrust of research in image coding is the unification and better understanding of Subband coders and Orthogonal Transform coders. This is evident in the amount of published work dealing with Lapped Orthogonal Transform (LOT) coding, Perfect Reconstruction (PR) filter bank design and Wavelet Transform coding. Group research is geared towards a better understanding of the coding gain of transforms and filter banks. A generalisation of the degree of overlap in LOTs is also being pursued, with the aim of producing trade-offs in their usage in a network environment.

The problem of enhancing noisy images arising from medical imaging is also being addressed by the Image Coding group. So too is the use of non-linear filtering techniques.

**Research projects with Industry**

The Advanced Telecommunications Research Program has been working closely with industry. Co-operative projects include:

- Research contracts with Telecom for switched networks and image coding.
- ISDN signalling network research sponsored by Ericsson Australia.
- High-speed local area network design for AWA Communications.
- ATM and multimedia technologies for DSTO.
- GIRD Grants for speech coding and transmission.
- Image Processing and Reconstruction – BHP Engineering.
- Non-contact measuring systems – BHP Research and Technology Centre.
RESEARCH PROGRAMS

Understanding and modelling economic phenomena and fluctuations in order to improve resource allocation, economic policy and predictions

Applied Economic Modelling

Co-ordinator: Associate Professor Tran Van Hoa (tel 042 21 3659)

In Economics, there is some truth in the proposition that if one does not understand the past one cannot properly manage the present and reasonably forecast the future. Since Economics is concerned chiefly with the behaviour of individual units (such as consumers and producers) at the micro level or the behaviour of the whole country in such areas as the recession, unemployment, the living standard, social welfare issues, and external debts at the macro level, it is clearly important that, to formulate better economic policy to manage current businesses or to plan for the future, the corporates, the institutions or the government require a thorough understanding of the fluctuations of these economic activities in the past.

The Applied Economic Modelling research has been initiated in the Department of Economics to look precisely at the ways in which various economic activities have behaved in a historical context. The research looks at the industrialised and developing countries and aims to report strategies that may help policy makers to perform better in major economic decisions affecting shareholders, members of the institutions and electorates.

During 1993, the Program's members were involved in eight projects covering a wide range of economic activity in such diverse geo-political regions as Europe, the Sub Continent, the Middle East and the Asia-Pacific.

The activity includes the impact of energy on the macroeconomic aggregates in Australia, Indonesia, the United Kingdom, and Thailand (Harvie, Sootkuson, Thana, Tran Van Hoa), the relationship between the state of the economy and corporate bankruptcy (Harvie and Levy), economic growth and development in general and in food production and food shortage in particular in Bangladesh, Sri Lanka, and Thailand (Chaudhri, Chowdhury, Perera, Tran Van Hoa), external debts and debt rescheduling issues (Lee, Tran Van Hoa, Wilson), and advances in the econometric methodologies relevant in a scientific sense to issues such as estimation of economic behaviour and forecasting economic activity in applied economic modelling.

The economics of energy

In the case of energy studies, Harvie and Tran Van Hoa built an oil-related econometric model—a different modelling approach proposed earlier by Tran Van Hoa. They found a strong co-integration or long-term relationship between oil output and oil price and many macroeconomic aggregates: gross domestic product, current account, exchange rates, real wages, capital stock, manufacturing production in Australia and the UK. Similar findings have also been obtained for Indonesia.

Tran Van Hoa further found that, in Thailand, the impact of energy consumption on growth and inflation is positive cautioning: thus the cost-benefit dilemma of energy management in developing countries. Some of these results have been reported in international journals specialising in energy and oil research as well as in

Members

Associate Professor
D P Chaudhri, Dr Khorshed Chowdhury, Dr Charles Harvie, Dr Boon Lee,
Associate Professor Amnon Levy, Dr Nelson Perera,
Mr Ed Wilson
A group of members of the Applied Economic Modelling Research Group. Standing, from left, are Dr Khorshed Chowdhury, Mr Ed Wilson and Dr Boon Lee. Seated are Associate Professor Amnon Levy and Dr Charles Harvie.

publications by the Petroleum Institute in the UK and the OPEC Review.

Modelling the developing economies

Chowdhuri’s findings reveal a significant nexus between food and hunger as well as the impact of food aid on domestic food production in Bangladesh. The problems of external debt, foreign investment, economic growth and inflation were investigated by Tran Van Hoa for Thailand, and by Levy and Wilson in relation to capital accumulation and production for Latin America, Asia-Pacific and Sub-Saharan Africa. Perera concentrated on the modelling of the Sri Lankan economy, dealing with export price instability and economic growth. Lee investigated the question of whether habit formation has any part in the business of sovereign debts rescheduling.

During August, Tran Van Hoa completed under a research grant from Thailand the construction of the first econometric multi-sectoral multi-equation model of Thailand based on household activities, thus linking for the first time the theory of Nobel Laureate Becker to other mainstream economic concepts in applied macroeconomic modelling in both industrialised and developing economies. Chaudhri continued his work on compiling a database for major Asian countries. Coupled with other international databases such as the World Bank’s STARS and the University of Pennsylvania’s PWT, researchers on international economic issues have at their disposal an impressive array of computerised databanks.

Some preliminary findings by Harvie and Levy on the effects of financial, industrial and macroeconomic conditions on corporate bankruptcy rates in Australia indicate the important causation between these activities.

Econometrics and economic modelling

Tran Van Hoa continued his work on further applications of his world-renowned theory of two-stage hierarchical-information (2SHI) estimation and forecasting, with collaboration from international and Australian economists, mathematicians and statisticians. The consistency of the superiority in terms of the average mean squared errors of the estimated and forecast fluctuations of economic activity based on this new theory in relation to all existing theories of estimation and forecasting has been well established. During 1993, Tran Van Hoa presented his 2SHI-based research findings on macroeconomic and statistical applications at the famous Tinbergen Institute in The Netherlands and the First World Conference of the International Society in Bayesian Analysis (ISBA) in San Francisco, USA. Early in 1993, he was invited to visit CEPII, the Prime Minister’s office in France, for talks on macroeconomic modelling in the European Economic Community.
Meeting society's demands for the most advanced industrial technology and a deep understanding of the complex mechanical and environmental systems around us

Applied Mechanics and Advanced Manufacturing

Co-ordinator: Associate Professor A Kiet Tieu (tel 042 21 3061)

This RESEARCH Program involves 23 researchers and 16 staff from members of Applied Mechanics and Manufacturing in Mechanical Engineering; and several members from other University Departments and local industries. The Program has established a good relationship with industry – as is evident from the collaborative research program with local and national industries such as BHP Steel SPPD and SCPD, BHP Research, BHP Engineering, MM Metals and Pacific Power.

Rolling mill technology and tribology (A K Tieu)

The collaborative research program with BHP Steel SPPD has been focusing in the areas of rolling-mill technology, steel casting, maintenance research, condition monitoring, tribology, expert system, and product quality.

Maintenance research is now extended to cover the entire BHP Steel group.

BHP Melbourne Research Laboratory and the AMAM program are now collaborating research in the areas of condition monitoring of hydraulic systems and tribology. BHP Steel has also donated to the program a comprehensive hydraulic test rig ($63,000) for research in condition monitoring.

Research in rolling-mill technology within the program has been significantly boosted by an experimental rolling mill ($85,000) funded by the Faculty of Engineering for research between this Advanced Materials Research Program and BHP Steel.

A major collaborative research project with BHP Steel, entitled Expert Systems for Quality Control in Hot Strip Rolling, was initiated in 1993, with BHP committing $93,000 in cash and $255,000 in kind and the ARC Collaborative Scheme granting $240,000 for three years.

A research link was also forged in 1993 with the Research and Technology Department of BHP Steel SCPD to collaborate on hot and cold rolling.

The effect of slab forces, roll conditions on slab-quality were studied at the Slab Caster. Studies on rolling-mill technology were carried out on gauge variation of strip, coil shape at the HSM, friction at the strip-work roll interface and vibration in Hot and Cold Mills at BHP Steel SPPD. An ARC APRA (Industry) was awarded to study the dynamics at the strip-roll interface in the roughing mill. Four PhD, one ME and one final-year student were involved in the area of rolling technology.

Tribology (A K Tieu)

In an endeavour to provide a tool for condition monitoring in the power industry, a computer simulation has been carried out to determine the vibration characteristics of steam-turbine bearings in power stations. Two methods of determining the bearing dynamic characteristics were studied – the unbalance method and the impact method. Two PhD students are working on this project.

In another area of tribology research, turbulent flow in bearings was studied.
Fluid velocities are obtained by miniature laser doppler anemometers using laser diodes. Results of experiments on bearings operated in the superlaminar regime correlated very well with our new theory. This three-year project will be supported by an ARC grant of $69,000 in 1994.

**Cavitation and underwater explosion (W K Soh)**

The bubble dynamics Research Group, led by Dr Wee-King Soh, consists of one research fellow, three PhD candidates and two ME students. The aim is to further the understanding of bubble behaviour, focusing especially on its effects on cavitation and underwater explosions.

Under a research agreement with the Materials Research Laboratory of DSTO, an experimental study was carried out to investigate the interaction of an underwater explosion bubble and various forms of target. Computer studies focused on the modelling of bubble interactions with compliant surface, the thermodynamics process in a bubble and the technique for image analysis of photographic data.

The research group in 1993 welcomed international visitors from Singapore, the UK and Canada. Dr. Soh was invited to lecture on underwater explosions at the CFD Research Centre at the National University of Singapore.

**Natural convection in enclosures using scale models (P Cooper)**

This project concerns the modelling of natural convection (ie air movement and temperature distribution) in large spaces as found in commercial office buildings and where hot and dusty air is generated by industrial processes.

**Water-filled scale models**

A natural convection enclosure, now completed, comprises a water-filled model of a room with a cold window surface above a heater on one wall. Novel temperature measurement by 0.005 inch diameter thermocouple wire and fluid flow technique by pH indicator have been implemented. This work is being conducted in close collaboration with the well-known Natural Convection Numerical Simulation group at the University of New South Wales.

**Salt-solution scale models**

Plumes of hot air and dust are being modelled through apparatus using salt solution and water respectively as analogous to hot and cold air. The use of specialised techniques to model large area sources is being pioneered and will have a wide range of applications from industrial pollution control to building heat transfer and bush fires. Then, too, monitoring of real-life situations has been extended to a three-storey atrium in Wollongong and dust plumes arising from tapping operations at No 5 Blast Furnace.

An ARC Grant of $6000 was won in 1993 by Dr Cooper for his research on naturally ventilated spaces.

**Jet ejector development project**

Progress during the year was maintained in the development of the Jet Ejector Refrigeration System. The major thrust of the work has been theoretical, with improvements to the modelling of the supersonic compressible fluid flow field in the ejector itself.

**Intelligent manufacturing system (G Arndt)**

Research activities under the Advanced Manufacturing Technology umbrella into ‘Japanese’ manufacturing and quality techniques continue, with Professor Arndt the national academic representative on the Australian delegation of the Committee for the Global IMS Program. Together with Professor C D Cook he has also been instrumental in the...
Figures show the computer print-outs of two stages of the collapse of a vapour cavity on to a rigid floor, as captured by a video camera (see Cavitation and Underwater Explosion on the previous page). Photographed by Dr Wee-King Soh.
successul application for a third-round CRC in Intelligent Manufacturing Systems and Technologies. This will be the 'Australian flagship' for the international IMS project.

**Fuzzy logic (D Fang)**

During 1992-1993, a major research effort has been made by Dr D Fang to develop a new algorithm for machine-condition monitoring by introducing the concept of Fuzzy Feature-State Matrix for signal synthesis with the support of a knowledge-based expert system. Other research activities include the development of an applied fuzzy-logic control strategy for a drilling machine, design and manufacture of a six-leg robot providing more research facilities for postgraduate research, fuzzy set for optimal assignment of metallurgical grade in BHP steel production, and optimisation of selective assembly process.

An APRA (Industry) scholarship-plus cash and in kind contribution from BHP on a three-year research project — fuzzy set-based optimal assignment of metallurgical grade for steel production — was awarded to a PhD student.

**Robotics (A Basu)**

Dynamic Load-carrying Capacity for a robot manipulator, based on a flexible arm model with high speeds and high tracking precision, is formulated in a project on robotics. A computational procedure for determining the maximum allowable load subject to constraints is applied on the basis of a theoretical model.

An experimental set-up is to be established to confirm theoretical results for verifications of the trajectories and control of the manipulator. Four journal and five conference papers from this project were accepted for publication in 1992 and 1993. As a result of these publications, Dr Basu and his PhD student Mr Korayem have been requested to review papers in ASME and European Robotic System journals.

**Welding and joining of materials (E Siores and A Basu)**

On the Arc Welding (GMAW) project by Dr E Siores, Dr A Basu and Mr Kim, a PhD student, analytical work to establish empirical mathematical relationship using the Phoenixes package is progressing. Experimental work completed includes:

(i) formulating the relationships between input parameters (current, weld speed, wire diameter, gas flow rate) and output parameters (bead width, height, penetration, depth and shape factor, area)

(ii) use of infra-red thermography equipment to determine temperature distribution.

**Microwave joining of plastics (E Siores, P C Cooper and T Marchant)**

This work is concerned with the development of theoretical modelling and practical demonstration of microwave joining of plastics. Activities in 1992 and 1993:

- Theoretical analysis (finite difference) of the temperature distribution in a microwave-heated slab of Nylon 6 was developed and correlated with existing experimental work.
- A rig is under construction to measure dielectric loss of plastics as a function of temperature.

**Advanced diagnosis system for machine-condition monitoring and process control (D Saini)**

The process and machine-condition monitoring by using Acoustic Emission (AE) techniques have been observed to have higher sensitivity towards changes in the cutting process due to flank wear of the tool.

A machine and process condition data acquisition system has been developed. Under Dr D Saini a reference data base in turning operations was completed in June. Currently two ME (Hons) research projects — one based on the machine tool and process condition monitoring and the other based on the application of neural networks for detection of abnormalities in machining process condition — are progressing satisfactorily.

**Effect of microstructure on machinability and surface quality of copper in HSLA steel (T Chandra)**

To gain its maximum potential strength and toughness, the copper bearing steel has to be heat treated by tempering and annealing. These treatments will vary the properties and microstructure of the material, and will also affect its 'machinability' and surface quality. A study was carried out to investigate the effect of heat treatment on these machining properties of copper-bearing High Strength Low Alloy (HSLA) steel.

**Technology transfer/asparagus harvester prototype field trial (R Rudziewjewski and CAMIA)**

This project is in the hands of Dr R Rudziewjewski, Professor G Arndt and Mr W M Perry of CAMIA in conjunction with the asparagus industry. On April 16 a field trial of the asparagus harvester took place on the Powers' Brand Asparagus Ltd field in Jugiong, NSW.

Based on these trials further research focused on cutting below the ground surface, cutting cycle and knife wear, so that an improved reliable harvester prototype can be built for the industry. This has now been done.

**Maintenance management (D Saini and R Dwight)**

Members of the program have also been involved in offering internal and external courses in Maintenance Management to industry, and in particular to CityRail in Sydney. The contact with CityRail has been valuable to the program, and the prospect of collaborative research and consultancy with CityRail is bright in 1994.
Asia and Pacific Development Studies

Co-ordinators: Dr Melanie Beresford (tel 042 21 3669) and Dr Dennis O’Brien (tel 042 21 3654)

The program continued to consolidate and expand research in the area of Asia-Pacific Development Studies. It has done this through the existing work, the introduction of new projects and the extension of collaboration within the university and with scholars in the Asia-Pacific region. Four new staff members will become members in 1994, bringing membership to 13.

Several projects are nearing completion in 1994 and the intention during the next three years is to introduce new areas of research. Nearing completion are Dr Beresford’s project on ‘Economic and Social Development of Indochina since the Nineteenth Century’. A book-length manuscript is in preparation on Vietnam, while the PhD thesis on Cambodia by Ms P Rungswasdisab is expected to be completed during 1994. Dr Beresford has applied for a large ARC grant (with Drs A Fforde and D Marr, both based at the ANU) to carry out research in 1994-96 on ‘Economic Growth and Institutional Change in Contemporary Vietnam’. Ms I Schraner started PhD work on this project, which will involve extensive collaboration with Vietnamese scholars and institutions. Dr Beresford visited Hanoi in December to make initial preparations and to present a paper at a conference organised in conjunction with the Central Institute for Economic Management in Hanoi.

The study of rural income and employment in Indonesia will be formally completed in 1994 with the presentation at a workshop, to be held in Indonesia, of the findings of the research. Eight occasional papers have been published, several conference papers have been presented at meetings in Australia and Indonesia, and one student has completed a MCom (Hons) thesis as part of the project; she will complete her research early in 1994. A series of journal papers will be developed from the work.

Mr A Naughton’s research into Asian capital markets has received substantial external funding, part of which enabled him to bring Dr Huimin Chung from NCTU Taiwan to Wollongong to work on producing a database. From the original focus on Taiwan and Korea, the project has now been extended to Malaysia, Singapore and China; four research postgraduate students are now working on the theme.

An area of research developed in 1993 was Dr Vickers’ work entitled ‘Modernity in Bali’. By October he had almost completed editing a collection of papers to be published by Yale University Southeast Asian Studies Monographs Series. He has been carrying out field work in Bali and collecting research materials on population movements, industrial development and tourism. He has also been expending a joint research proposal with Balinese colleagues to be implemented in 1995. Dr Vickers continues as co-editor of the scholarly journal Review of Indonesian and Malaysian Affairs (RIMA).

Dr G Waitt, a new member from the Geography Department, plans to carry
out a study of Korean tourism to Australia, focusing on the development of Korean overseas tourism and the perceptions Koreans have of Australia. This is a project of undoubted significance for the Australian tourist industry, now one of our major areas of export earnings. The project fits well with the strong focus on the role of regional trade in economic development, something also evident in the continuing work of Associate Professor DP Chaudhri and Dr K Chowdhury on regional integration of the cereal trade; and in the research of Associate Professor M Metwally on the importance of international interdependence in regional economic development. During the 1993-94 summer, Associate Professor Chaudhri will be presenting the results of his research at seminars at the International Rice Research Institute and Asian Development Bank in the Philippines, the University of International Economics and Business, Beijing, Nanjing College of Economics and the Institute of Economic Growth, Delhi University.

Also interested in studying regional economic integration, but from a different point of view, is Dr A Cornish, another new member from the Department of Sociology. His project will focus on local trade and economic development in the predominantly Malay-speaking region of southern Thailand, paying attention to the interaction of culture and economics. This research will form the basis of a wider study of ASEAN's new 'Development Triangle' project, encompassing southern Thailand, northern Malaysia and northern Sumatra, Indonesia.

In the area of political development in the Pacific region, Professor Wolfers is writing his monograph on the political effect of constitutions in the South Pacific. In collaboration with AJ Regan (PNG), he will be starting work in 1994 on electoral administration in developing countries. Dr H Beran's project on 'Mutuaga: a nineteenth century New Guinea wood carver' will be written as a book; it has been accepted for publication by the University of Wollongong Press. He intends to renew his work on the philosophy of political self-determination, which he began two years ago with his study of Fiji.

The Asia-Pacific Database of 12 Asian countries and Australia, started in 1991 as a joint project between the Asia-Pacific Development Studies Program, the Economic Modelling Group and the Department of Economics, was expanded in 1993 to cover major economic variables with material from ESCAP, World Bank, IMF's International Financial Statistics and elsewhere. Some of these series are now available on the network for use by students and staff. With help from the Department of Economics, a hard copy of the entire data set, each country file separately presented, will be placed in the Commerce Faculty Resource Room in early 1994. Organisation of an introductory demonstration of the data retrieval system is planned for February 1994.

Other activities organised during 1993 included the continuing seminar series. The program included a number of local and international speakers.

In November, Dr Beresford was invited to take up a short-term Research Fellowship at the Research School of Pacific Studies, Australian National University, to work with Professor B. Kerkvliet on economic reform in Vietnam and to present a seminar on her research.

In January 1994 a conference organised by Dr Beresford and the other editors of the Journal of Contemporary Asia was planned to take place on campus on Social and Political Impact of Accelerated Industrial Development in Southeast Asia. Participants from Thailand, Philippines, Singapore, Malaysia, Vietnam and Burma would contribute papers.
HE AUSTRALIAN Flora and Fauna Research Program supports a group of seven academic staff, two post-doctoral fellows and 20 associated research students. Research conducted within the program is largely field-based, focusing on the biology of Australian plants and animals: evolution, physiology, ecology, genetics and biogeography. Systems studies include subtidal and intertidal marine, freshwater streams, forest, heathland and arid zone, and industrial lands.

Previous Research Reports have described studies, in this program, of insect behaviour, conservation genetics of plants, endangered orchids, remote sensing of plant nutrient status, natural marine anti-fouling compounds, evolution of warm-bloodedness in mammals, and metabolism in reptiles. This report focuses on some of the developments through 1992-93.

New staff and research directions
Two new staff members joined the Program during 1993. They are Dr Kristine French (BSc Sydney, PhD Monash, Post-doc Macquarie) and Dr Bill Buttemer (BA San Diego State University, PhD Michigan, Post-doc UC Davis, Lecturer Tasmania). Kris is interested in dispersal of seeds by animals and biological diversity of insect species in forests. Bill is a 'physiological ecologist', interested in the physiological strategies animals have for coping with the challenges of the environment.

Kris French has started research into the diversity of invertebrates in native forests of eastern Australia. We know so little about our Australian insects and related groups that such research must begin with making an inventory of the species in an area.

The focus of this research is to determine whether, when we conserve areas for species such as mammals or birds, we are also adequately conserving the diversity of invertebrates. Kris is also starting to research the diversity of Australian animals in woodlands infested with weeds. The aim of this is to determine how well native species can live in areas infested with Bitou Bush and Lantana and what regeneration strategies might be most suitable.

Bill Buttemer’s research will address questions about the biology of frogs and birds. The first examines how changes in ultraviolet radiation, associated with ozone layer depletion, might affect Australian species. The study will evaluate how much various frog species utilise solar-basking to warm up and how well their skin blocks ultraviolet radiation. The bird research, in collaboration with Dr Lee...
Astheimer, examines how environmental factors and stress affect breeding activities of Australian birds. This research will examine the role of seasonal and habitat effects in the secretion of reproductive and stress hormones.

**International connections**

During the year the Program hosted several visitors. Program funds were used to appoint a postdoctoral research fellow, and Dr David Skelly arrived from the University of Michigan in September 1992. Dr David Innes and Dr Luise Hermanutz (Memorial University, Newfoundland, Canada) arrived in September for a one-year sabbatical developing collaborations with David Ayre (ecological genetics of aquatic organisms) and Rob Whelan (pollination ecology).

There was also a stream of shorter-term visitors. Professor James Thomson (State University of New York) spent two months (April-May), working with Rob Whelan and David Ayre on the genetic make-up of Australian strangler figs. Professor Paul Zedler (San Diego State University) visited from August to October, collaborating with Rob Whelan on a study of the pollination of an endangered orchid species. As part of his PhD project, Mikel Becerro, a postgraduate student from the University of Barcelona, spent three months doing a research project with Andy Davis.

The Program was represented abroad, too. David Ayre spent the latter half of 1993 on sabbatical at the University of California at Davis, working with Professor Rick Grosberg to develop molecular biology techniques for addressing questions in evolutionary biology and ecology. Tony Hulbert, David Ayre and Andy Davis all gave papers at international conferences in North America; Tony Hulbert’s was a plenary lecture at the 9th International Hibernation Symposium.

**Successful postgraduates**

The Program has continued to have an active postgraduate research group. Several PhD students finished during 1993 (Kerry Ayre, Kerry Withers, Patrice Couture, Alison Hunt). Kerry Ayre and Alison both moved on to post-doctoral positions in the USA, and Patrice returned to Canada.

Re-establishment of native plants in steelworks wastes – a project being conducted as part of an APRA (Industry) award to Ms Justine Cox, with Professor Rob Whelan and Mr Stuart Thompson (BHP) as supervisors.
RESEARCH PROGRAMS

Two of the frog species being studied by Dr David Skelly: (left) *Litoria citropa* (Blue Mountains Tree-frog) and (right) *Litoria aurea* (the endangered Green-and-Golden Bell Frog)

Industry and community links

A feature of research activities in 1993 was the gaining of two APRA (Industry) awards: one with BHP to study the establishment of plants in artificial soils made from steelworks' waste products (Ms Justine Cox) and one with Wollongong City Council to study the ecology of urban streams (Mr Mick Gregory). Also during 1993, one of the Program's Masters students, Mr Jack Baker, established ‘Ecotalk’, a weekly column in a local newspaper – with the aim of communicating the research activities of the Program to the Illawarra community.

Some research in progress

Marine ecology and genetics

Marine research is supported by two large ARC grants. It includes projects on the Great Barrier Reef and NSW Coast. Terry Hughes (James Cook University) and David Ayre are collaborating on a population genetic study of a number of coral species on the Great Barrier Reef. This project combines over 30 years of field data on the population structure of corals with genetic data obtained by gel electrophoresis. In particular, it focuses on patterns of recruitment and the mating systems of a number of common species. This project has important implications for the conservation and management of species on the Reef.

Closer to home, David Ayre and Andy Davis are examining the ecological and evolutionary consequences of dispersal in a common group of subtidal invertebrates – ascidians (the sea squirts, including the well-known cunjevoi). This group is characterised by a variety of life history strategies, including species which brood larvae and those which broadcast spawn into the water column. Brooded larvae have always been thought to disperse relatively short distances from the parent – in some case little more than a few metres. Andy and David have provided the first genetic confirmation.

Native birds, native plants and introduced weeds – Anita Zubovic, an Honours student working with Dr Kristine French, studies the impact of Bitou Bush on natural communities of coastal forests

Native, native and introduced weeds – Anita Zubovic, an Honours student working with Dr Kristine French, studies the impact of Bitou Bush on natural communities of coastal forests
that brooding species do indeed disperse only short distances. Attention will now focus on the consequences of short-distance dispersal with a series of mating and transplant experiments.

Waratahs, Grevilleas and Banksias
Previous research by Rob Whelan and several research students suggests that many native plant species have to tolerate a lot of ‘inappropriate’ pollination, for example, transfer of pollen within a plant when flowers need to receive pollen from a separate plant; if seeds are to be produced. However, many native plants in the family Proteaceae (Waratahs, Grevilleas, Banksias and their relatives) produce many more flowers that could possibly be matured into fruits. Could this apparent ‘excess’ of flowers provide plants with a mechanism for plants to ‘choose’ the best possible pollinations? How much flexibility is there for mate choice among flowers on an inflorescence, or among inflorescences on a plant? Rob’s current ARC-funded study is examining these questions. Work on two Waratah species and one Grevillea suggests that there may, in fact, be little flexibility. The flowers that are usually successful in Waratahs are the topmost on the spike, and fruits developing there may suppress lower fruits regardless of how the lower ones were pollinated. Grevillea inflorescences given a mixture of self pollination and outcrossed pollination do not appear to favour either one over the other.

Tadpoles, predators and temporary ponds
Dr David Skelly’s research on eastern Australian frogs is aimed at discovering the trade-offs in life-history characteristics. High levels of activity of tadpoles, and hence rapid growth rate, are advantageous in temporary ponds, where a tadpole must be able to develop into a frog before the pond dries up. However, activity will be accompanied by a high risk of predation. David has been examining a range of Australian tree-frog species and has found dramatic variation in larval behaviour. Nearly all of the dozen or so species examined are highly specialised in breeding habitat requirements. In general, species from small temporary habitats are much more active than species from permanent habitats where predators including fish are found. These results suggest that tadpole behaviour and habitat use have co-evolved in Australian tree-frogs and that behavioural trade-offs can provide an effective means of understanding frog distributions.
Drug synthesis, radiopharmaceuticals, and bioactive chemicals from marine organisms, plants and environmental sources

Bioactive Molecules

**Co-ordinators:** Professor Leon Kane-Maguire (tel 042 21 3509) and Associate Professor Stephen Pyne (tel 042 21 3511)

**Members**

Professor John Bremner, Associate Professor John Ellis, Dr Renate Griffith, Associate Professor Ross Lilley, Dr Philip Maynard, Dr Garry Mockler, Dr Will Price, Dr Stephen Ralph, Dr Margaret Sheil, Dr Roger Truscott, Dr Geoff Wickham

In addition to the 12 academic staff members during 1993, the research personnel directly involved in the Program grew to 16 PhD students, two MSc(Hons) students, three Honours students, two Postdoctoral Fellows, two Visiting Fellows and three Research Assistants, making a total of 38 research personnel.

The Program continues to be successful in attracting external research funds - some $538,000 for 1993. This included $192,000 from the ARC and $87,000 from the NHMRC. The Program’s strong commitment to industrially significant research is shown also by the four APRA (Industry) Awards granted to Program members, valued at some $116,000 in 1993. Direct research support from the pharmaceutical industry has also increased significantly with recent grants (for 1994 spending) to Associate Professor Stephen Pyne from Johnson & Johnson and to Professor John Bremner from AMRAD and Glaxo totalling $86,000.

Among the outstanding achievements of individual Program members in the last year was the award to Associate Professor Stephen Pyne of the Young Researcher of the Year Award for 1992 (an ARC/Academy of Science prize), and more recently his award of a Senior ARC Fellowship. Two members of the Program (Associate Professor S Pyne and Dr W Price)
also obtained prestigious von Humboldt Fellowships, while Professor Bremner joined the Chemistry Committee of the ARC in 1993. Members of the Program presented a number of invited plenary and session lectures at international conferences, and presented 22 research colloquia at other universities in Australia and overseas.

There are two major research strands in the Program. The first is concerned with the design, synthesis and evaluation of bioactive compounds, the second with the structural elucidation and analysis of such compounds from natural sources.

The great majority of the projects involve collaboration between several staff, a trend which is encouraged by the regular Program research meetings. Developments in some of the major areas of the Program are summarised below.

**Heterocyclic bioactive compounds**

As part of a search for new medicinal agents having high beneficial activity and minimal adverse effects, Professor John Bremner’s medicinal chemistry group is involved in the design, synthesis and pharmacological evaluation of novel lead compounds as potential anti-depressants, anti-psychotics and anti-hypertensive agents. Significant progress has been made, for example, in the design and preparation of serotonin potentiators based on new heterocyclic derivatives for potential use as anti-depressants.

Structure-activity relationship studies and associated computer-aided molecular modelling have led to a clearer picture of the key structural requirements for activity. New routes to functionalised benz-fused mediumsized heterocycles have been developed and these derivatives are to be used for probing structural needs for \(\alpha_1\)-adrenoceptor interactions. A prototype for a potential new dopamine pro-drug has also been made and routes to new heterocyclic derivatives based on aporphine alkaloid precursors have been developed.

**Asymmetric synthesis of pharmaceuticals**

A high proportion of drugs exist in two mirror image (enantiomeric) forms, which frequently have very different biological effects. Many such drugs, only one of which has the desired physiological function, are currently administered as a mixture of the two forms. This has led in some cases to serious medical problems, the most publicised of which was the case of thalidomide in which one of the mirror forms led to serious birth defects.

These concerns and recent stringent regulations by the Food and Drug Administration have led to intense interest in developing methods for the production of drugs in only the one desired mirror form. The research group of Associate Professor Stephen Pyne and Professor Leon Kane-Maguire in the Department of Chemistry has recently developed several novel and efficient routes to such asymmetric synthesis. These include a new and general asymmetric synthesis of non-proteinogenic amino acids in high optical purity.

The incorporation of these new amino acids into insect neuropeptides is planned in the near future, potentially providing new, potent and speciessel ective insecticides. The asymmetric synthesis of a number of analogues to the anti-immunosuppressive drug THI has also been developed. These compounds are currently being tested on diabetic mice at the Walter and Eliza Medical Research Institute in Melbourne as possible drugs to prevent the onset of diabetes.

Chiral iron organometallic reagents have also during the past year been attached to polymer surfaces and their reactions with various reagents examined, as a prelude to their use in asymmetric synthesis.
RESEARCH PROGRAMS

Members of the Bioactive Molecules Program meet for a discussion on drug synthesis. From left are Assoc Prof Stephen Pyne (co-ordinator), Professor John Bremner, Dr Geoff Wickham, Professor Leon Kane-Maguire (co-ordinator) and Assoc Prof Ross Lilley

New anticancer drugs
Dr Geoff Wickham's medicinal chemistry group has made considerable progress in the synthesis of terephthalamide alkylating compounds as new DNA-minor groove binding agents. The kinetics of binding of some of these compounds to synthetic oligonucleotides have been studied by NMR spectroscopy. This throws light on DNA binding site selectivity in tumour cells. Progress has been similarly made in determining the structure of the complex formed between the antitumour antibiotic hedamycin and a synthetic nuclease. Sequencing studies have also been carried out on minor-groove-directed platinum(II) complexes in collaboration with researchers of the University of NSW. Other metal complexes under study as potential anti-tumour agents are ruthenium amino acid complexes being examined by Dr Stephen Ralph in the Department of Chemistry.

Radiopharmaceuticals
In collaboration with the Biomedicine and Health Program at ANSTO, groups in Chemistry led by Professor John Bremner, Professor Leon Kane-Maguire and Associate Professor Stephen Pyne are developing novel synthetic routes for the preparation of radiolabelled pharmaceuticals. These include model compounds as potential precursors for the incorporation of radioisotopes for PET and SPECT imaging studies of $\alpha$-$\beta$-adrenoceptors.

Electrospray mass spectrometry is also being explored by Dr Margaret Sheil's group as a new and facile method for characterising, at the molecular level, radioimmunospecific pharmaceuticals to be used for the diagnosis and treatment of diseases such as cancer. A major advance has been the observation of intact molecular ions for monoclonal antibodies with masses as large as 150,000 Da. These researchers have also recently achieved the generation of double-stranded DNA molecules in the electrospray source, and are currently extending this to study the interactions of DNA with anti-cancer drugs.

Bioactive metabolites from marine organisms and plants
The salt-resistant marine organism *Dunia tertiolecta* has potential for aquaculture to produce commercial biochemicals. Recent studies by Associate Professor Ross Lilley in Biological Sciences have established that glycerol synthesis is triggered by glycerol loss even though the osmotic pressure of the medium is kept constant. This provides the first evidence that glycerol content is set not by medium osmotic pressure per se but by a parameter tied to cell volume.

The structures of some chromone derivatives from a Thai medicinal plant used in the treatment of malaria have been confirmed by Professor Bremner's group in collaboration with researchers at Silpakorn University. As part of a joint project with Dr Andy Davis of the Department of Biological Sciences, potentially bio-active alkaloids have also been isolated from some local tunicates and work is under way to elucidate their structures.

Kinetic studies by Dr William Price in Chemistry of the aqueous extraction of sugar and organic acid components from citrus fruit have established the mechanism as first order. Most significantly, high temperatures were found to cause major compositional changes of the soluble constituents, leading to degradation of the aqueous extract. This is important, since proponents of counter-current aqueous extraction techniques for citrus fruit currently advocate high extraction temperatures.

In collaboration with Dr Margaret Sheil, the recently developed technique of capillary electrophoresis has been shown to be very effective in separating mixtures of Thearubigins extracted from tea. A capillary electrophoresis/mass spectrometer interface has now been incorporated on to our mass spectrometer, which will facilitate future characterisation of bio-active components from various sources.
RESEARCH PROGRAMS

Structure, function and biotechnology of nucleic acids and proteins: applications in vaccine development, mutation in antibody genes, eye cataract, cancer and inflammation studies

Biological Macromolecules

Co-ordinator: Associate Professor Ross Lilley (tel 042 21 3431)

PROTEINS are a diverse and numerous set of macromolecules that are primarily responsible for the multitude of reactions and complex structures associated with the cells of every living organism. Each protein is specified by a gene; genes in turn are another type of macromolecule of very uniform structure called DNA. All the information necessary to specify each living organism is contained in the base sequence of its DNA.

Many problems in biological science, both fundamental and applied (eg in medicine and agriculture) hinge on the function of particular proteins. A change in one letter of the DNA base sequence may cause a small change in the shape of a protein but this can result in major changes to the function of that protein and have major effects on the living organism.

**Development of new vaccines by genetic engineering**

The group headed by Dr Mark Walker is researching new vaccines against bacterial infection. One aim is to develop acellular and live oral recombinant vaccines against the whooping cough bacterium, *Bordetella pertussis*. Oral immunisation with recombinant, live, avirulent *Salmonella* spp. has been shown also to stimulate an immune response in the lung.

Pertussis toxoid is the most effective vaccine component against the causative agent of whooping cough, *B. pertussis*. Four of the five genes which encode pertussis toxin (PT) have been cloned into plasmid expression vectors. These genes will now be used in an attempt to over-express pertussis toxoid to enhance purification of the recombinant antigen, and in the avirulent *Salmonella* spp. system to try and develop an oral whooping cough vaccine. An overexpression system has been developed to allow overexpression of the PT antigen in avirulent and virulent *B. bronchiseptica*. Investigation of the mechanism of PT secretion in this heterologous expression system is now in progress.

The molecular analysis of both urease and flagella biosynthetic genes of *B. bronchiseptica* have been initiated in 1993. Systems have been developed for the isolation of transposon mutants in this organism. Urease-deficient and non-motile transposon mutants have been isolated and are now undergoing genetic analysis.

In collaboration with NSW Department of Agriculture (EMAI), vaccine antigen genes of several porcine pathogens have been cloned and expressed in avirulent *Salmonella* spp. The COOH-terminal of one such *M. hyopneumoniae* antigen gene has been sequenced, and encodes a protein analogous to the *proU* genes of *E. coli* and *S. typhimurium*. This protein is a porin involved in scavenging of proline from the external environment.

Recombinant overproduction of this antigen will allow vaccine trials to be undertaken in mice and pigs.

**Members**

Dr Mark Baker, Dr John Carver, Dr John Fitter, Ms Julie-Ann Green, Ms Therese Marengo, Dr Marie Ranson, Associate Professor Ted Steele, Associate Professor Roger Truscott, Dr Mark Walker, Dr Salwa Woodroffe
RESEARCH PROGRAMS

A. SOMATIC MUTATION & SELECTION

![Diagram of mutational processes]

B. GENERALIZED REVERSE TRANSCRIPTION

DNA → RNA → PROTEIN

C. GENETIC PERMEABILITY OF WEISMANN’S BARRIER

Differentiation & Growth

GERM CELLS → SOMATIC CELLS

Soma-to-Germline genetic feedback
eg endogenous retroviral vectors

![Diagram of cellular interactions]

Elements of the Somatic Selection theory

Antibodies and the immune system: Immunoglobulin variable genes

Associate Professor Ted Steele, Mr Harry Rothenfluh and their co-workers joined the Program in 1993. Their research concerns how mice and humans develop immunity against infections. DNA, once inherited from parents, is generally thought to be unchanged except by rare mutations. An apparent exception to this rule, associated with the development of the array of genes which specify antibodies for the immune system, is under investigation. In fact evidence has been obtained which contradicts a central tenet of modern evolutionary theory* that the genes in the germline* cannot be directly altered or influenced through invasion by mutated representatives of somatic genes* expressed in the circulating white cells of the immune system.

In the past year, progress has been made on two fronts: (a) in defining the nucleic acid substrate for somatic hypermutation and (b) in a detailed elucidation of the genetic structure of the 5' flanking and 3' putatively transcribed regions of immunoglobulin germline variable genes. With respect to the former, it has been established that >97 per cent of somatic mutations are confined to the VDJ transcription unit and neighbouring J-C intron. The data are therefore compatible with mutator models which target the transcribed region of Ig DNA.

In the study of the evolutionary origin of germline V genes the research has entered a very interesting phase: it can be stated with a high degree of confidence that either the extensive tandemly arranged repertoire of V elements has evolved via 'Darwinian'
tissue culture facility and this facility has begun to produce monoclonal antibodies against novel conformational epitopes on proteins which reflect biological or catalytic functions.

**Mechanism of infection of human cells by cytomegalovirus**

The mechanism of infection by cytomegalovirus (CMV) is being studied by Professor Helen Garnett and her co-workers. The isolation and purification of clinical isolates of human CMV which are not adapted to any cell type and which infect endothelial cells has been achieved. These clinical isolates were found to suppress the production of some cytokines (eg Interleukin-1), which are important in stimulating the immune system. Their suppression may reflect the ability of CMV to establish infection. Infection of endothelial cells by CMV weakens the binding of these cells to the basement matrix. Flow cytometry has been used to show that this is due to reduced expression of integrin receptors. These receptors, on the cell membrane, are involved in the attachment to the extracellular matrix protein. CMV infection also upregulates the expression of other integrin receptors causing increased adhesion of inflammatory cells to infected endothelial cells. Additionally, CMV infection has been shown to induce the production of growth factors by endothelial cells, increasing the division and proliferation of these cells. Work is now in progress to identify these growth factors.

Previously developed radioactive virus binding assays, using a laboratory-adapted strain of human CMV, show that the virus binds strongly to blood monocytes *in vitro* with little penetration compared to permissive fibroblasts. These assays are now being performed with several strains of virus isolated from clinical specimens. Virus stocks are produced after limited passages in cells of different origins to avoid host range restriction and to assess whether they confer differential infectivity in monocytes. Preliminary data obtained so far resemble the initial results. Some characteristics of the growth patterns of the clinical isolates and the human sera used in the assays could provide interesting explanations for *in vivo* observations.

**Mechanism of cataract formation in the eye**

The mechanism of cataract formation in the eye lens of the elderly is under investigation by groups led by Associate Professor Roger Truscott and Dr John Carver. Associate Professor Truscott's group is investigating the metabolism of tryptophan in human eye lenses and have found that the major tryptophan precursor, 3-hydroxykynurenine glucoside, is rapidly synthesised and exchanged with the surrounding ocular humor. Lenses were obtained post-mortem from Sydney Eye Hospital and maintained under organ culture conditions. The precursor of 3-hydroxykynurenine glucoside, 3-hydroxykynurenine, is also found throughout the lens body. This compound was shown to be highly reactive toward lens proteins called crystallins under oxidative conditions *in vitro*. This resulted in protein aggregates resembling those that occur in human cataract.

Further studies are now under way, funded by AMRAD, to ascertain whether adducts of 3-hydroxykynurenine or its oxidation products with protein do, in fact, exist in the lens. Lenses from cataract surgery will be obtained from Third World countries in cooperation with the Fred Hollows Foundation. Studies funded by AMRAD have also begun on indoleamine 2,3-dioxygenase (IDO), the enzyme responsible for the initial cleavage of tryptophan resulting in the eventual formation of 3-hydroxykynurenine and 3-hydroxykynurenine glucoside. It is hoped eventually to synthesise inhibitors of this enzyme, which is found in most mammalian tissues and assess whether they confer differential infectivity in monocytes.
RESEARCH PROGRAMS

has recently been identified in the small intestine of calves. This will provide a convenient source of material for purification of IDO.

Model studies are also being undertaken on the modification of proteins by 3-hydroxykynurenine. Lens crystallin proteins are readily coloured by this compound, and adducts with peptides have been isolated and characterised by NMR and mass spectrometry to determine their structure. Similar studies are being undertaken on crystallin proteins to determine whether these adducts are also present in cataractous and normal lenses.

Dr Carver's group uses the technique of nuclear magnetic resonance (NMR) to study the lens crystallin proteins. Despite the large size of the a- and b-crystallins, short and flexible N- and C-terminal extensions have been identified. We have been able to define the important role that some of these extensions play in crystallin-crystallin interactions and hence in the maintenance of order within the lens. The disruption of this arrangement leads to opacification (ie. cataract formation).

Studies have also been undertaken into the chaperone (protective) function of a-crystallin whereby it stabilises other crystallins against aggregation and precipitation. In many ways, a-crystallin displays properties of a protein surfactant in stabilising unfolded proteins through hydrophobic interactions.

As a result of the successful ARC Mechanism C grant for $700,000 jointly to the School of Biochemistry at the University of NSW and Dr Carver, a state-of-the-art 600 MHz NMR spectrometer will be installed there in early 1994. Access to this spectrometer on a regular basis will enable the rapid advancement of the present and new projects.

Plant Biotechnology

The iso-forms of small proteins from Sicyos australis, a climbing plant native to the Illawarra, have been purified by Dr John Carver's group using high-performance liquid chromatography. These proteins are trypsin inhibitors and their sequences have been determined by a combination of gas-phase sequencing and mass spectrometry. The next stage of investigation will be NMR studies on the proteins to determine their shape.

The mechanism of the plant carbon-fixing enzyme, rubisco, is under investigation by Associate Professor Ross Lilley's group. This enzyme is the most abundant protein in the biosphere and the reaction that it catalyses represents the gateway through which all carbon is fixed from the atmosphere into organic matter. The oxygenase activity of this enzyme is being measured with a recently developed assay based on light emission. This assay provides unprecedented sensitivity and should enable advances in the currently limited understanding of the catalytic mechanism.

The mechanism is being probed by using inhibitors of the enzyme and by comparative studies using rubisco from a range of plant and microbial sources. This research is performed in collaboration with Dr T J Andrews at the Research School for Biological Sciences, Canberra.

Associate Professor Ross Lilley's group is also developing a method for identifying the different species and strains of the salinity-tolerant alga Dunaliella by DNA fingerprinting. The powerful technique of random primer polymerase chain reaction (RAPD) is being applied for this purpose. Procedures for extracting suitable DNA samples from the alga have been established. Differentiation by RAPD between two species of Dunaliella having different salinity tolerance and b-carotene content has now been achieved.
RESEARCH PROGRAMS

Solving industries' bulk solids storage and flow problems
Design, evaluation and modelling of pneumatic conveying systems
Understanding dust and fume generation and movement

Bulk Materials Handling and Physical Processing

Co-ordinator: Dr Arnold McLean (tel 042 21 3053)

The Bulk Materials Handling group of the Department of Mechanical Engineering undertakes research and development in the area of bulk solids storage, properties, flow, conveying and physical processing. Indeed, it has been so engaged for over three decades.

The Group also actively pursues the transfer of the technology developed within the Department to industries which can benefit from that research and it is involved, too, in teaching courses covering a range of bulk solids handling and processing topics; these courses are presented as part of the undergraduate and postgraduate programs at the University as well as to industry through short courses and conferences.

Research activities in progress include the development of a novel device to measure conveniently the air shock-wave-induced compaction of powders. This powder property test rig was developed to help researchers understand and quantify the compaction of powders in lock-hoppers on pressurisation. By observing the extent of compaction for different rates of pressurisation, recommendations can be declared to lock-hopper operators as to the allowable maximum rate of pressurisation to ensure reliable and consistent discharge at the required process flow rate. Observations from this rig, conducted as a ME Hons project, have proved extremely useful in providing recommendations to the State Electricity Commission of Victoria to ensure reliable handling of milled brown coal. In particular, by testing milled brown at various extents of partial drying, it was possible to identify the maximum moisture at which the Commission could safely handle the otherwise extremely difficult-to-handle material. As a result, this work proved extremely valuable in the design and operation of the current demonstration scale integral drying gasification combined cycle power generation (IDGCC) system under evaluation by the Commission. Recommendations were made also toPacific Power in relation to the reliable handling of different fly ashes and to the discernible differences between seemingly similar powders.

Other research in progress is to explain the 'handleability' differences between various pulverised coal fuels (PF) during dense phase pneumatic conveying in direct coal-injection systems (DCI). Conducted as a subcontractor to the Australian Combustion Technology Centre (a Division of ACIRL) and funded by ACARP, to terminate in 1993, this work seeks to explain the generally poor suitability of local soft coals (characterised by high Hardgrove grindability index) for use in Direct Coal Injection (DCI) systems. In contrast, hard coals (low HGI) appear to be extremely good candidates for DCI, can be reliably handled and reveal a greater tolerance over a much wider range of system operation parameters and configurations (including multiple pipelines).

This work seeks also to identify whether the coal can be ground to a suitable size consist by appropriate adjustment or optimisation of mill parameters. This project has so far identified, by use of both bench scale measurements and pilot scale pneumatic conveying testing, that vast differences in characteristics occur between seemingly similar PFs. Obviously, the overall thrust of this work is to enhance coal sales for application in the significant and expanding DCI market.

Members
Professor Peter Arnold, Dr Paul Cooper, Dr Zhihong Gu, Mr Oliver Kennedy, Dr Renhu Pan, Professor Nick Standish, Dr Peter Wypych
One industrial problem-solving investigation, for a major international blast-furnace feed-system manufacturer, seeks to identify, quantify and improve the extent of segregation in the feed hoppers of twin-hopper feed blast furnaces. This work, utilising a scaled model of the blast furnace feed system, has shown that significant segregation of the feed ingredients occurs during charging. More significantly, however, it has revealed that tentative techniques to improve the extent of segregation do exacerbate the segregation. As an outcome of the observed poor system performance, an improved system will be recommended and evaluated. These improvements will include geometric design changes to the feed chute system and hopper internal fitments as well as the use of novel technology. Such changes should attain the desired consistent discharge consist (specified as not exceeding 10 per cent), necessary for effective blast furnace burden control and subsequent overall operation.

Aspects of this work will continue in 1994 as part of an industrially sponsored BE final-year thesis project.

Also in progress is an investigation of grain storage in metallic silos. Here, particular problems such as storage integrity, sealing, rat and mice ingress, moulding, dewing, caking, drying (including the development of a novel grain dryer) and disinfestation of grain during storage in metallic silos are all being examined. Conducted by a Visiting Scholar from the Chinese Academy of Agricultural Engineering Research and Planning, Beijing, this work is being funded by private industry. The outcome will have significant application in Asia, particularly in China, to reduce the current huge grain losses (attributed to mice alone, losses in China are stated to exceed 20 million tonnes, or enough to feed 60 million people). The Australian grain industry is fortunately largely free of these problems.

Throughout the year Dr Peter Wypych continued to make progress in the advancement and understanding of pneumatic conveying systems, both lean and dense phase, stepped-diameter pipeline technology, scale-up procedure, system configuration and material/system selection. This research was further highlighted and reinforced by the provision of successful short courses on pneumatic conveying and dust and fume collection systems.

Investigations also continued into the development of scale-up procedures for low-velocity transport, which have been found for certain materials to produce complex and unexpected flow pattern. An understanding of this behaviour is being reached by an experimental investigation using a variety of pipe lengths and diameters. This work, and the development of a suitable general model, is well advanced and will be fully documented in a PhD thesis now in preparation.

Experimental work as part of a PhD project was also begun to investigate the performance of air jet nozzle prime movers for suction pick up lean phase pneumatic conveying systems. Further progress has also been made on the NERDDP-funded project (funds total in excess of $350,356 over three years up to December 1993) to develop handling techniques for the injection of coal into boilers. This project, which aimed to investigate the accurate feeding, control and dense-phase transportation/injection of pulverised coal and crushed Run of Mine (ROM) coal, also attracted support from Pacific Power in the form of a donation of a full-scale injection test facility and the salaries for additional personnel. Test observations so far indicate that worthwhile improvements can be effected in the...
attainment of uniform flow, transfer and feed-vessel design and operation and feed splitting. Results from this work will benefit the electricity generation industry by facilitating replacement of existing oil-fired main and auxiliary fuel systems by coal-fired systems. The technology developed will also benefit other industries seeking accurate and reliable coal-injection technology. These industries include iron blast furnace operations, medium-size boilers and non-ferrous smelting operations. In the longer term, advanced coal-fired power-generation systems will rely heavily on areas of the technology under development.

Under the supervision of Dr Paul Cooper, novel research was embarked upon to record, analyse and model dust and fume generation and flow mechanisms. Three final-year undergraduate thesis student projects are contributing to this work. One student has built a rig to study dust generated from a falling stream of dusty material. Using video images, qualitative results have been gathered on air-flow patterns and dust-generation mechanisms. This video image analysis is possible through the purchase of a high-resolution video camera and recorder system from a Small ARC Grant and the Applied Mechanics Research Program (Mechanical Engineering). The video equipment will shortly be complemented by the purchase of a ‘frame grabber’ with funds sourced from both the Applied Mechanics Research Program and the Environment Institute (Professor John Morrison). This suite of high-resolution equipment will also be used by the other undergraduate thesis projects which are examining the dust generation and air movement from molten-metal processes and in water-filled scale-model studies of air flow and dust-generation mechanisms. It is hoped, in 1994, by appropriate level of funding from the University Research Program, to enhance these investigations by the purchase of a major video image software package.
RESEARCH PROGRAMS

Security, privacy and confidentiality of information networks
Database and access security
including smart cards intelligent keyboard identification
Design and analysis of cryptographic and hashing algorithms

Computer Security: Technical and Social Issues

Co-ordinator: Professor Jennifer Seberry (tel 042 21 4327)

The rapid growth of information and the desire for its rapid dissemination have led to an explosion in the information services, communications and computer industries. This phenomenal growth has been accompanied by growing concerns about confidentiality, privacy and accuracy of information. And this in turn has led the Computer Security: Technical and Social Issues Program members to the study of a broad range of issues related to computer and communications security, privacy and ethics.

In 1993 Professor Jennifer Seberry was invited to visit Taiwan and China for several weeks. In China she was the guest of Academy Sinica, Wuhan University, Sezuhan University and Shanghai University. She gave 11 invited lectures, including a series of four on security and applications of discrete mathematics. This visit resulted in a number of inquiries for postgraduate study and research publications and has so far resulted in one PhD enrolment from Taiwan.

Professor Seberry, Dr Reihaneh Safavi-Naini and Associate Professor Joan Cooper attended and presented papers at the prestigious EUROCRYPT’93 Conference in Lofthus, Norway, in May and Professor Seberry and Dr Safavi-Naini attended and presented papers at the equally prestigious CRYPTO’93 Conference in Santa Barbara, USA, in August.

Professor Seberry is an elected member of the Board of the International Association for Cryptologic Research.

As issues related to security and ethics are intricately intertwined, researchers are usually studying many facets at the same time. Password security of on-line databases and the provision of key management and shared secret schemes for password distribution are a continuing area of interest. Drs Hardjono, Miller and Zheng, Professor Seberry and Ms Carole Alcock are also studying how more efficient backup procedures can be used to enhance the security and reliability of databases. Drs Hardjono and Zheng are also investigating the security issues in object-oriented databases and the use of parallelism in database-replicated architectures to prevent implicit leaking of data.

The widespread emergence of distributed computing systems as the direction of computing in the future has prompted questions concerning their security. Studies are being conducted by Professor Seberry, Dr Zheng, Associate Professor Josef Pieprzyk and other Program members on how interaction between the entities in a distributed system can reduce its overall security. These include investigations on the use of authentication servers and certification servers within the client-server concept that is becoming the main units of interaction in distributed systems. Such servers are crucial in a distributed system since entities rely on them for the authentication and identification of other valid entities in the system.

Vacation students, Associate Professor Cooper and Ms Robyn Lindley have carried out an extensive study of the penetration of smart card technology into the Australian market.
Dr Xian-Mo Zhang, Professor Jennifer Seberry, Dr Reihaneh Safavi-Naini, Dr Yulian Zheng and Assoc Prof Josef Pieprzyk discuss the Centre's work on smart card technology.

Study indicated that there has been only very small penetration by smart card technology and discovered that untoward commercial secrecy is leading to the Australian market being exposed to excessive provision costs.

The use of smart card technology to enhance the security and privacy of citizens' data in the databases of public institutions is also being studied by Dr Hardjono, Dr Zheng and Professor Seberry.

An important problem in the provision of electronic services is the reliability of the information and certification of authenticity. Professor Seberry, Associate Professor Pieprzyk, Dr Zheng and students have received considerable overseas interest for their message hashing algorithm, HAVAL, for digital signatures which has survived peer scrutiny in the public domain for over a year in an area where the average survival time is two weeks.

A continuing interest to all members of the Program is in the design of secure symmetric and asymmetric encryption algorithms. The Program's family of encryption algorithms, LOKI, has been subjected to world-wide scrutiny and shown to be more resistant to cryptographic and message hashing attacks than has the Australian Data Encryption Standard.

Software versions of the Program's symmetric cryptographic algorithm, LOKI 91, as well as HAVAL have been written and tested. Research is proceeding to obtain hardware versions using VLSI technology.

Research has continued on the generalised testbed for analysing block and stream ciphers by Professor Seberry, Associate Professor Pieprzyk, Dr Safavi-Naini, Dr Lawrie Brown and their students. This is a crucial foundation for ensuring the ability of the Program and Australia to evaluate the security of computer systems.

Dr Safavi-Naini and Mr Leonid Tombak have continued work to find and implement strong, perfect authentication codes and schemes for systems and network security. Progress in this area is both theoretical and practical: new bounds have been found for the reliability of information and codes which meet these bounds have been constructed.

Dr Safavi-Naini, Professor Seberry and students continue research into techniques for evaluating the security of cryptographic protocols, the design
of secure operating systems and the evaluation and certification of secure products, systems and networks. Lately interest has focussed on availability as a security feature of systems and networks, as lack of availability causes other less-secure computer habits. As part of continuing work by Associate Professor Pieprzyk, Dr Zheng and Professor Seberry in the area of provably secure algorithmic design, Drs Zheng and Zhang and Professor Seberry have been studying a class of Boolean functions, called bent functions, for which we have for the first time made astonishing progress showing how to build new longer functions from old while preserving desirable cryptographic properties such as high non-linearity, balancedness, propagation and the strict avalanche criteria. Program members also study the effect of new cryptographic attacks such as differential cryptanalysis and linear cryptanalysis on cryptographic design.

Society is beginning a new era where mobile wireless information networks will provide universal mobile and ubiquitous communications and computing services. Dr Zheng, Professor Seberry, students and other members of the Program are investigating security and privacy issues with the new communications and computing environment. Preliminary measures for protecting mobile and wireless information have been obtained; more study will be carried out into this area.

A continuing, but unsolved, problem is access and control of computer systems and keys efficiently and effectively when there are hierarchies in the trust placed in users and the need to provide differing levels of confidentiality for data. We are continuing to study more efficient solutions to access control problems. Group access to information has emerged as a very interesting theoretical concept which has many practical applications. It allows a subset of authorised participants to recreate a secret information (key) while any subset of unauthorised participants gains no information about the secret.

This information can be used later to access (decrypt) files and log into the computer. As the group access also allows participants to own a secret collectively, it is also called a secret sharing system. Associate Professor Pieprzyk and Dr Chris Charne are studying secret sharing systems whose access structure (the description of subsets of authorised participants) are expressed by an arbitrary monotone Boolean function. In particular, the application of so-called cumulative arrays are being investigated to design optimal or close-to-optimal secret sharing schemes.

Associate Professor Cooper, Dr Diane Donovan and students have been studying minimal critical sets in Latin squares for application as hierarchical secret sharing schemes and have obtained encouraging results which have been implemented in a secure mail system. Dr Zheng, Dr Hardjono and Professor Seberry have had considerable interest in their work on reusable shares for secret sharing schemes.

In December 1992 members of the Program travelled to the Gold Coast to participate in AUSCRYPT'92 for which Professor Seberry was the Program Chair and Associate Professor Pieprzyk and Dr Safavi-Naini were members of the International Program Committee of 12. The conference attracted submissions from 19 countries and participants from 16; one third of the papers came from Japan, Taiwan and Australia.

The International Association for Cryptologic Research has elected Associate Professor Pieprzyk as Program Chair and Professor Seberry as General Chair for ASIACRYPT'94 to be held in Wollongong in December 1994. Dr Safavi-Naini and Dr Zheng are members of the International Program Committee.

Application of combinatorial optimisation algorithms such as simulated annealing and hill climbing for combinatorial searches and cryptanalysis of ciphers has been an innovative and fruitful area of research. Studied by Professor Seberry, Dr Safavi-Naini and students required human effort for such analysis with computation performed by computer. Dr Safavi-Naini and students have been active developing a tool that allows formal analysis of secure protocols. The tool applies probabilistic logic to calculate ‘trust’ that can be put as the goal of protocol.

The Program is pleased with the rapid growth in the number of postgraduate research students and honours undergraduate students associated with it. Every Program member has a number of students working with her or him in areas spanning all aspects of the Program.

A long-term objective is to provide computer systems, networks, programs and encryption algorithms which can be proved to be secure. Members of the Program have made considerable progress in studying provably secure encryption algorithms. A certification facility is planned.
The Education Policy Program continued to grow on all fronts in 1993, confirming and consolidating the trend of its first years of operation. The intake of grants has been substantial (figure 1) and continues to reflect an overall upward trend. The number of publications and other output has also been impressive, with substantial growth in all categories of output (figure 2). The upward trend in research student numbers has also continued in 1993, with a different distribution of enrolments across categories of degrees after the introduction of the new Doctorate of Education (figure 3).

With yet further growth, other features have emerged which characterise the Education Policy Program as a ‘matur ing’ research program. Notably, the research carried out in 1993 appears less fragmented than in previous years, involving a smaller number of projects, with greater funding and larger teams. The research agenda for 1994 indicates that this trend will continue.

Among the major projects carried out in 1993, Professor Russell Linke coordinated one focusing on the performance of the Institute of Advanced Studies at the Australian National University. The project aimed at developing appropriate performance measures which could be used in reviewing the research activities and achievements of the Institute and its individual schools and centres.

Continuing his work on resource allocation in education, Professor Ken Gannicott was invited to be part of a team reviewing the success of the Asian Development Bank lending policies for vocational education in Indonesia. He also gathered field data for his ANU-based research on ‘Women and Development in the South Pacific’. Beside focusing on Asia and the South Pacific, Professor Gannicott turned his attention to Australian educational matters, conducting research on university fees (reviewed very positively by the Australian Financial Review) and on patterns of HSC results across public and private schools in New South Wales.

The Quality Assurance Project of the University has kept some senior EPP researchers busy for most of the year. As Project Coordinator, Professor Carla Fasano has been leading a team of experts from Education, Management and Planning and Marketing, into developing a Quality Management model appropriate to this University, supported by an information system and an innovative interactive multimedia user interface.

**Members**
Professor Ken Gannicott, Dr Barry Harper, Associate Professor Malcolm Harris, Associate Professor John Hedberg, Associate Professor John Patterson, Ms Nita Temmerman
Another contribution has been provided by the 'Policy Space' project, also led by Professor Fasano, and involving a team of six EPP members. In close cooperation with the Library Research Service, an advanced bibliometric capability has been developed by the team. The outcome so far includes a strengthening of the Library research infrastructure with the development of advanced search and down-loading capabilities from a range of research databases, and these are now available to all researchers on campus. Both research projects will continue in 1994, with publications planned. Continuing on the resource allocation theme, Associate Professor Malcolm Harris has developed a user-friendly presentation of a computerised workload allocation model at work in the Faculty. The paper has been accepted for publication, with referees’ commendation, by the Journal of Tertiary Education.

Efforts in the area of Performance Technology in Education and Training have led to a substantial outcome. In addition to the contribution to the Quality Assurance Project above, and under the leadership of Associate Professor John Hedberg and Dr Barry Harper, innovative software has been completed in science education and more is being developed within the Apple-based international project Christopher Columbus, of which this group is the Australian 'leg'. Quality software has also been completed on adult career education and lecture presentation. All the software production has received highly positive reviews in specialised journals. Plans for 1994 involve the continuation of production of innovative multimedia packages in education, training, and educational management, as well as the development of a line of basic research on cognition, navigation and learning style as they can be monitored through the use of interactive multimedia packages.

Specific output from other Program members has also been substantial in 1993. Ms Nita Temmerman has submitted her PhD thesis on the Australia Council's Performing Arts Board and received invitations to serve as guest lecturer at universities in UK and US during her forthcoming study leave. Keeping busy between the completion of a MEd (Hons) and the commencement of a PhD degree, Brian Ferry has managed to present his results on the implementation of the science and technology syllabus in the South Coast region to major national conferences. An article on the same subject has appeared in the Australian Computer Education Journal. Further findings on the use of science and technology kits to support the professional development of primary teachers are part of the 1993 AARE Conference.

Ian Brown has seen his preliminary work on art education policy already accepted for publication by a leading national journal, with commendation by referees. Wing Cheung has presented his prototype for computer-based multiple-choice techniques at a national conference. As part of his involvement in the Introduction to Tertiary Teaching course in this university and his expertise in adult education, Dr Max Gillett, in cooperation with Personnel Services and union representatives, has contributed to the development of University policy on teacher development. Finally, a word on our research students. As their number increases, the need has emerged to rationalise supervision while introducing additional elements of quality. A first program has been developed on the initiative of the Education Policy Program in co-operation with the other two research groupings in Faculty, which will be piloted in 1994. The program has been designed to allow research students with no previous experience of research contexts to fast-track the development of closer links with the working environment of professional researchers.
From left are Mr David Green (research assistant), Professor Carla Fasano, Assoc Prof John Hedberg, Assoc Prof Barry Harper, Mr Ian Brown (associate member), Ms Christine Brown (associate member) and Assoc Prof John Patterson at work on the Policy Space project.
Enabling technologies for industrial automation
High-performance electric motors, drives and servo systems, robotics, flexible manufacturing

Industrial Automation
Co-ordinator: Professor Chris Cook (tel 042 21 3065)

This program now consists of 16 staff members from three different departments (Computer Science, Mechanical Engineering, Electrical and Computer Engineering) and 17 postgraduate research students enrolled in Honours Masters or PhD research degrees. There is also substantial support for the program through project work by undergraduate Honours Thesis students (over 20 in 1993) and course work MEngSc students (over 15 in 1993).

The Program concentrates on three major interdependent areas of industrial automation:
(a) Power Engineering, comprising industrial electric drives and actuators including power electronics and control, electrical machine design, power system stability.
(b) Intelligent Manufacturing, including materials handling, robotics, gripper design, mobile robot navigation, cognitive science and sensor fusion, machine vision, integrated manufacturing.
(c) Fast processing using parallel processors (transputers) and neural networks applied to the control of robotics, industrial drives and integrated manufacturing tasks.

The year was notable for some outstanding landmarks. One was the successful awarding of the CRC in Intelligent Manufacturing Systems and Technologies to Industry and University partners including the University of Wollongong. The activities and track record of the Industrial Automation Research Program (IARP) greatly assisted in this success.

Research in the CRC in intelligent manufacturing systems and technologies is divided into three programs. The first (managed by Laszlo Nemes from CSIRO) is entitled 'Enterprise Integration' and deals with problems arising from the interconnection of systems within the manufacturing enterprise, the human and technical organisation of the workplace and the development and operation of control, computer and communications systems for manufacturing. One example is a project in 'holonic control' being developed with BHP and others for early 1994, and this is expected to interact with some of the work that Dr Fazel Naghdy has carried out within the IARP in Wollongong.

Another CRC Program, named 'System Components and Technologies', managed by Professor Cook, involves the development of what could broadly be called 'enabling technologies', ie the 'real-time' control schemes, actuators, electric motors, sensors, assembly machines, robots and materials-handling machines necessary for manufacturing.

One project in this Program already formally approved by the CRC is in association with ANCA, a Victorian manufacturer of the world's leading cylindrical grinding machines. (These machines produce the tools that other machines use to make parts.) Dr Don Platt from the IARP is the project's leader, and the project involves the development of digital servo drives to control AC machines used in precision machine tools, and the development of two novel electrical machines for use in grinding machines. One of these machines is designed to run at high speed (6000 rpm), and the other to produce high torque at low speed. Both machines are intended to exploit and extend research work carried out previously within the IARP.

Other projects planned to complement IARP work include the development of...
sensors (involving Dr Fang from Mechanical Engineering, and RMIT in Melbourne), implementation of advanced control schemes for more accurate speed and velocity control of actuators (machine-tool builders are seeking accuracies down to microns), and the development of better assembly systems (with Tyree Industries).

Another landmark for the IARP in 1993 has been the extension of a major grant from Pacific Power. This new grant, for $1,250,000 over three years, will enable the continued employment of research staff, PhD students and engineering staff at Wollongong, and will assist in the IARP’s ability to contribute to the CRC in manufacturing. Pacific Power is to be congratulated on making this further major commitment to power engineering research and development.

A further 1993 highlight was the hosting of the annual Australasian Universities Power Engineering Conference at this University from 29 September to 1 October. The Conference attracted over 120 registrants from Australia and abroad, over 70 percent more than attended the Conference last year in Brisbane. Response was so great that the Conference was extended to run over three days, with parallel sessions scheduled for most of that time.

Over $7000 of industrial sponsorship, from both Pacific Power and Illawarra Electricity, was obtained by the IARP to support the event. This enabled the organisation of eminent keynote speakers and the awarding of three substantial prizes to presenters of ‘best’ papers, two of which were specifically for student presenters.

All the program’s major projects proceeded well during 1993. These include the successful programmable array manipulator (PAM) project, funded by a Government-Industry research grant of $500,000, and completed in August. Two postgradu-
ate students were awarded their Honours Masters degrees based on research carried out for the PAM project, and a further thesis is also now being prepared. Another grant of $150,000 from the State Energy Research and Development fund (SERDF) has led to the development this year of a general high-speed digital processing system which now provides access to much faster processing power for all IARP researchers.

Since electric drives and motors are central to most industrial automation systems, research in drives and motors will continue to be consider­ably extended in 1994, especially as the grant from Pacific Power has been renewed, and because additional support will be provided from the CRC to complement IARP programs.

Work on the control and dynamics of fixed robots continued during the year in order experimentally to verify the new mathematically proved adaptive control theory developed so far. An analysis of the way in which 'fixed gain' controllers are inadequate for robotics has been completed. New gripper designs, using tactile sensing and three finger grippers combined with force and torque sensors mounted in the gripper's 'wrist', are also being investigated to attempt to improve robotic assembly operations.

Dr Zelinsky (associated with a University Research Group as well as the IARP) was awarded external funding to spend time at one of the world's leading mobile robot research laboratories in Japan as the result of his research work in mobile robotics. Investigation of a possible 'Targeted Institutional Links' proposal with this laboratory is continuing.

Collaborative work with Loughborough University in the UK continued, with an IARP researcher, funded by a DITAC grant, visiting Loughborough to study the details of the software platform for manufacturing integration that has been developed there after several years' research. This has now been provided to the IARP for incor­poration into the IARP's own research in this field.

Most of the Program's research areas would benefit if faster processing techniques could be devised. Conse­quent­ly, the program continued during 1993 to apply parallel processing techniques (using transputers) and neural networks to a number of problem areas.

All the foregoing research areas will be continued in 1994. Additional interesting new work on applying machine vision and digital signal processing techniques to the output of ultrasound machines to provide better quality information to medical practitioners has started recently and will be continued in 1994.

The 1993 IARP budget has been invested in providing long-term equipment and staff infrastructure to furnish support to all areas of the Program's research. Notable budget items for 1993 include the employ­ment of a research engineer to facilitate the program's often experi­mentally intensive research, the purchase of high-performance SUN workstations to support all research­ers and thesis students, and the purchase of PCs and software to support specialised software pack­ages and experimental verification work (eg, to control robot grippers, machines and other systems).

The IARP was successful in employing (from July) a well-qualified engineer to support projects in the IARP (an experimental and engineering based program). This appointment has already been of great help in all aspects of the Program's operations.

Research Associate Philip Ciufo working on the Programmable Array Manipulator, which is funded by the Government Industry Research and Develop­ment scheme (GIRD). The principal investigators are Professor Chris Cook, Dr Paul Wong and Dr Fazel Naghdy
‘This is simply a communications problem, though not a simple communication problem because it occurs at the molecular level’

Intelligent Polymeric Materials

Co-ordinator: Professor Gordon Wallace (tel 042 21 3127)

Communicating with the building blocks of life – water, ions, amino acids, proteins, biological cells...

If we could only sneak a look at how biological molecules and surfaces interact, we might unravel some of the remaining mysteries of life. We might then, for example, be able to engineer systems capable of nerve or tissue repair... understand the complex biochemical processes that determine medical complications or understand what makes materials biocompatible. The ability to control such interactions in situ could then have far-reaching consequences for all of us.

This is simply a communications problem, albeit not a simple communication problem because it occurs at the molecular level.

Mankind in the past two decades has developed the materials (silicon, fiberoptics and others) and techniques necessary to transmit almost instantaneously vast amounts of information around the globe and through space. A challenge remaining, however, involves our ability to communicate with systems at a molecular level. The first challenge is to monitor molecular interactions in situ (in aqueous environments) in real time without irreversibly changing or disturbing the systems behaviour. To achieve this requires materials capable of acting as a molecular interface. They must be capable of obtaining molecular information and transducing it into a signal that we can understand. The second challenge is to manipulate and control the behaviour of these systems at the molecular level.

Materials and techniques developed at IPRL will now assist in this venture. During 1993 IPRL developed a technique that allows changes in a number of polymer properties (eg mass, resistance, oxidation state) to be monitored simultaneously as an electrical stimulus is applied to it.

This information is critical to the development of new polymer materials so that they can be fine-tuned to respond in an appropriate fashion to external stimuli. We can for example use such experiments to show how electrical stimuli can be used to control the flow of simple ions in and out of the polymer in real time – such ion fluxes are the basis of many important biological processes.

We have also continued to develop

**Members**

Dr Norm Barisci, Dr Fang Chen, Dr Antony Hodgson, Dr Mark Imisides, Professor Leon Kane-Maguire, Dr Will Price, Dr Stephen Ralph, Dr Geoff Spinks, Dr Chee On Too, Dr Lin Yuping

- Stimulus
- Output
  - Δ Mass
  - Δ Resistance
  - Δ Current

Multidimensional Analyser
RESEARCH PROGRAMS

The Processing and Mechanical Properties Group, led by Dr Geoff Spinks, Materials Engineering, utilises sophisticated characterisation methods to study materials produced. From left in the picture are Trevor Lewis, Manish Ghandi, Geoff Spinks, Hossein Eisazadeh and Professor Gordon Wallace

other analytical tools that enable us to study interactions of polymers with water and other molecules/ions dissolved in water. Two techniques that have proven particularly useful in this regard are dynamic contact angle analysis and inverse chromatography. The former allows quantitative data to be obtained on the strength of polymer-water interactions to be obtained while the latter allows quantitative data on the strength of interactions between molecules or ions and polymers. For example, the interaction of our new polymers with amino acids or proteins (the building blocks of life itself) has been studied.

We have also used these characterisation tools to study how interactions are influenced by external stimuli and then used this information in 1993 to produce several exciting technological breakthroughs.

A new ion sensing technology
An extremely sensitive sensing technology that allows simple ions and molecules to be detected at the part per billion level (or less) has been developed. Using extremely small sensors (less than the diameter of a human hair) high performance can be achieved.

A new biosensing technology
The Program has developed methods that allow protein (antibodies or antigens) to be incorporated into conducting polymers. When a polymer containing antibody is exposed to the antigen an electrical signal arises. What is even more fascinating is that this communication channel is two-way. Imposition of small electrical signals can be used to control the Ab-Ag interaction. This has now been used in the develop-

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ment of a new rapid immunosensing technology (Anal. Chim. Acta. 15 July 1993). The technology described enables low levels of antigen, eg, human serum albumin, thaumatin (an artificial sweetener like Nutrasweet) or crescol to be determined in seconds rather than hours.

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Developing new sensing technologies is one of the tasks undertaken within IPRL. Afshad Talaie (a PhD student), is working on development of a revolutionary electrical sensing method that can identify as well as quantify analytes of interest.

Cell culturing on smart materials
It was also shown (in a collaborative project with the US Army Research Office, Sophia University, Japan, and Illawarra Regional Health Service, Wollongong Campus) that mammalian cells can be grown on top of conducting polymer surfaces. Using techniques at our disposal we will now study the reactions occurring as these cells are stimulated electrically or chemically. Since the bioactivity of the polymer surfaces can be controlled externally this presents an exciting opportunity for managing cell growth characteristics.

New membranes for chemical and biochemical processing
A novel processing method that allows chiral membranes to be produced readily and simply has been developed. These materials will now be investigated for their ability to discriminate between two hands of the same molecule, eg, amino acids or common drugs.

The foregoing advances in characterisation and the application areas emerging clearly indicate that the communication channels with the building blocks of life are becoming clearer.

These activities are underpinned by continued efforts in monomer synthesis, polymerisation and polymer processing. Significant advances were made in these areas in 1993. In particular, the development of a continuous method for colloid production. These colloids may then be used to produce paints and other formulations.

Collaborations
Work in this area is supported by an array of collaborative arrangements. Currently input is from the University of Western Sydney (Professor S Adeloju) on development of enzyme based biosensors, CSIRO-Food Technology (Dr D Barnett) on production of 'synthetic antibodies' for immunosensors, CSIRO-Mineral Products (Dr S Fletcher) on resistometric measurements, the US Army Research Office (Dr I Ahmed, Dr D Kaplan) on cell culturing and other membrane studies, Sophia University, Japan (Professor N Ogata) on new polymers for cell culturing, University of Utah, Centre of Controlled Chemical Delivery (Professor S Kim) on development of conducting polymer composites for drug release and Illawarra Regional Health Service, Wollongong Campus (Dr I McKenzie) on cell culturing projects.
Economic and social development  
in the Australian and international labour markets  
The place of women in society — an analysis

Labour Market Analysis

Co-ordinator: Dr Chris Nyland (tel 042 21 4027)

The Labour Market Analysis Program involves a number of researchers across the disciplines of economics, history and sociology. The program seeks primarily to meet the growing demand for information about specific labour markets at national and regional levels. Research over the past year has focused on a number of key issues, including Aboriginal labour market policy, labour market regulation, protective labour law, women in the workforce, education and unemployment.

Progress and achievements

Members of the Labour Market Analysis Program continued work on individual and cooperative research projects into various aspects of the labour market and the employment relationship during the 1992-93 year.

Ms Kelly, Ms Verucci and Ms Hodgkinson edited Responding to Unemployment, a book published by the Program, based on the papers presented to the successful conference on unemployment organised by the Labour Market Analysis Program and held at the University in 1992.

Together with Associate Professor Robert Castle, Ms Verucci also contributed a paper to this publication as did Dr Michael Donaldson, Professor Lewis and Mr Bret Shorten.

Associate Professor Castle continued work on the Focus on Economics series for Oxford University Press, editing three volumes and writing one on Labour Economics. He also continued work with Professor Jim Hagan on the History of Aboriginal Labour in the Australian Economy.

As part of his wider study into the history of the economic analysis of the status of women, Program Co-ordinator Dr Chris Nyland completed a detailed examination of the contribution made by Francis Poullain de la Barre, John Locke and Adam Smith respectively to the economic analysis of women's labour and the place of women in society. Two of the resulting papers have been accepted for publication in The History of Political Economy, the leading international journal in the history of economics; a third paper has been published in the History of Economics Review, the journal of the history of economic thought society of Australia. In addition to this work on the 18th century, Dr Nyland organised the Seventh Bi-annual Conference of the History of Economic Thought at Wollongong University in 1993. He has also continued to take an active interest in contemporary issues, and has been involved in examining the case of the two local union leaders charged with 'watching and besetting' in New South Wales, a development which endangers the legal right to picket in this state.

Several members of the program presented papers to the 7th AIRAANZ Conference held at Auckland in January. In conjunction with Kyle Bruce, Dr Nyland presented a paper on the influence of members of the scientific management movement on the labour market policies of the Hoover and Roosevelt administrations. Together with Dr Charles Harvie and the Program's research assistant Mr Stuart Svensen, Dr Nyland also delivered a paper on the impact of protective legislation on the labour market opportunities of women. The latter paper reviewed American studies examining the impact of these laws, and reports the findings of an empirical study of the effect of the now-abolished weight-lifting laws for female employees on employment opportunities for women. A revised version of this paper has been accepted for publication by the Journal of Industrial Relations.

Ms Di Kelly presented a paper to the conference on women's occupational health and safety in Sweden. She was invited to present this paper, 'Making the Workplace Safe for All Women Workers: Lessons from Sweden', to
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the International and Comparative Industrial Relations Seminar at Cornell University in December. The elimination of ‘traditional’, full-time jobs was the focus of a study by Di Kelly and Elsa Underhill, ‘Eliminating Traditional Employment’, published in the Journal of Industrial Relations in September. Ms Kelly attended the 1993 ACTU Congress to observe the latest developments in the trade union movement, and was invited to write the annual feature article on trade unions for the Journal of Industrial Relations.

While in New Zealand, Stuart Svensen completed the research for his book on the 1890 Maritime Strike; the manuscript has been completed and accepted for publication by the University of Queensland Press. He also wrote a chapter entitled ‘Motives and the Maritime Strike’, for the book edited by Professor James Hagan and Dr Andrew Wells, entitled The Maritime Strike, a Centennial Retrospective: Essays in Honour of Eric Fry.

Professor Don Lewis has been investigating issues regarding admission to university, the transfer of credit from TAFE to university and the performance of university students. His research has resulted in a book, A Review of Credit Transfer Arrangements Between TAFE and Universities in New South Wales, which he co-authored, and two book chapters, ‘Analysis of University Admissions Data’ and ‘Credit Transfers Between TAFE and Higher Education’. He was the keynote speaker at the national conference organised by the National Board of Employment, Education and Training and received a research grant from DEET to evaluate the performance of university students admitted through alternative entry modes. He has also been analysing the Australian longitudinal survey data and has published articles on ‘Youth Unemployment’ and ‘The Effects of Career Interruptions on Young Men and Women’.

Dr Ray Markey received a large Australian Research Council Grant to undertake a history of the political economy of wage determination in Australia for the period 1850 to 1993. Dr Markey expects to complete the study by the end of 1994. Dr Mike Donaldson met with leading American labour market analysts while visiting the University of California at Santa Cruz. He also completed the manuscript of his book on the utilisation of time, Taking Our Time.

Ann Hodgkinson continued her active involvement in the Australian and New Zealand Regional Science Association continuing as a member of the editorial board of their publication Papers in Regional Policy. She published a number of papers relating to local employment initiatives during the year. She was also appointed an inaugural Board member of the Environment Research Institute.

Dr Chris Nyland, Program co-ordinator

Long-term Unemployment (Persons)


August 1978 - 1991
The year saw two of the Program's major projects coming to completion. James Wieland's critical bibliography of Australian Literary Criticism and his book on literary responses to war in Australia, *Shaking Hands with Shadows*, were completed before the end of the year.

With the completion of these projects, the Program will aim to have Paul Sharrad's South Asian Bibliography the next major project completed. The bibliography will be widely used by scholars in the field, and will provide an invaluable research tool to anyone working in the area of the new literatures in English. Paul Sharrad is also drafting a book on Pacific literature and, towards the middle of 1994, he expected to release a collection of some seminal essays on Pacific literature. It is hoped that making this material more readily available will act as a spur to teaching in the field.

The Program continues to promote publication and research in the area of the New Literatures in English, through its editorship of the journals *New Literatures Review* (Paul Sharrad, editor) and *Australian/Canadian Studies* (Gerry Turcotte, editor). Both journals have worldwide circulation.

Under the auspices of the Program, the New Literatures Research Centre continues to host its seminar series, which has proved a valuable forum for exchange of ideas and a place for researchers in the field to meet. This year speakers included the distinguished Australian academic and film-maker Ross Gibson, Brenda Austin-Smith, lecturer in film and women's studies, University of Manitoba, Mark Williams, a leading critic on New Zealand literature, Bruce Woodcock, lecturer in post-colonial literature at Hull University, English Department lecturer Richard Harland, and Program members Jane Freebury and Joseph Pugliese.

During the year, the Program hosted two conferences. Jointly with the Department of English, the Program hosted the week-long annual conference of the Australasian Drama Studies Association, in October 1992. Kate Newey and Maurie Scott were co-convenors, together with John Sanczuk (Creative Arts). In March, the Program hosted its second Children's Literature Conference, *Australian Children's Literature: Finding a Voice*. Michael Stone was convenor; he was assisted by Anne Lear.

In September, Program members combined to host a one-day seminar on HSC English texts, which attracted more than 300 students from all over the state. The day was organised by the Program's project officer, Kerry Lyon, and chaired by Anne Lear.

Program members were also indirectly involved in design of the post-colonial section of the new comparative literature option for NSW Education Department Distinction Courses for advanced final-year high-school students.

**Individuals' research, conferences, consultancies**

Graham Barwell took part in the 'Australia and the Electronic Library' Conference, Canberra, in April. He was appointed in February as specialist consultant to the sub-committee on electronic texts, Academy Editions of Australian Literature series, a project sponsored by the Australian Academy of the Humanities. As part of the work for this committee he has produced a number of reports on electronic texts, on conferences and on published conference proceedings, besides...
engaging in daily contact by e-mail with scholars and bulletin boards in Australia and around the world.

Anne Cranny-Francis spent three months of her study leave on a research trip to Canada and the United States, then as Visiting Specialist in the School of Communications and Cultural Studies at Curtin University of Technology, Perth. In Canada, she attended the Systemic Linguistics Summer School in Vancouver, and presented a paper at the international Systemics Conference at Victoria University, BC. She also presented papers at Harvard University and at Clark University, Worcester (Mass). Her major publication project is her forthcoming book, *Popular Culture*, to be published by Deakin University Press.

Dorothy Jones has just completed a substantial entry on Elizabeth Jolley for the forthcoming *Dictionary of Literary Biography*, and she is currently working on an a paper entitled 'Empire, Feminisms and the Semiotics of Cloth'. She has a major involvement with the autobiography project, which involves all members, see *New initiatives...* specialising in women's writing. She continued to officiate as a member of the AVCC review committee which visited and reviewed the teaching practices in every university English Department in Australia.

Anne Lear is working on a book based on her successful first-year subject, *Understanding Literary Techniques*. While there are American books performing this function, there is no comparable text for Australian students.

Paul Sharrad took part in LaTrobe University's conference celebrating the quincentenary of Columbus's landfall in the Americas with a paper exploring the uses of the 'voyager' motif in E K Brathwaite's *X/Self* and Mudrooroo Narogin's *Dalwura*. He was a judge of the Phillip Larkin Prize for poetry in 1992 and 1993, and Consultant to the NSW Board of Studies in the Comparative Literature component of the Distinction Course.

Anne Cranny-Francis

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James Wieland received a grant from the Canadian Government to make a study tour of Canada at the end of the year and also attended the Graz Commonwealth Literature conference while on leave, in First Session. He also began working as joint editor of a book on Australian War writing. He has been appointed to the editorial board of *Terra Australis*, a journal of Australian studies published from the University of Lecce, Italy.

James Wieland's critical bibliography has generated another project – undertaken jointly with Joseph Pugliese – to compile a Reader in Australian Literary Criticism. Not only will this be a useful text, but, because it will be a first, it will have a wide market as a University student text in English and Communications departments. A small ARC grant has been applied for to fund this research.

At the end of 1992, Gerry Turcotte spent two months in the US and Canada on a grant from the Canadian government working on native American writing as part of his research on a new Honours and postgraduate course on indigenous literatures. He organised a weekend seminar on Australian Gothic in Literature and Culture for the Library Society of the State Library of NSW in February. This was a resounding success and led to a radio program on the same subject.

Kate Newey's book on Mary Shelley's *Frankenstein* has been published, and her next major project, the edition of *East Lynne*, is now in press.

Louise Raveli was consultant at the Queensland Department of Education Intensive Linguistics Summer School in December 1992, and is part of a team of researchers evaluating the Department of School Education and NSW Training and Education Foundation Disadvantaged Schools Program, Metropolitan East Region, *Write it Right* Project 1992-1994. She was also involved in developing the Australian Museum's 'Materials Analysis and Workshop Development for Text-production guidelines', 1993.

Maurie Scott presented a paper at the Graz conference of EACLALS (the European Association for Commonwealth Literature and Language Study) while on study leave, during which he also visited centres of post-colonial studies in Britain, and presented papers on post-colonial issues in London and Kuala Lumpur.

New initiatives: the year ahead

The principal 'new Direction' is in the area of autobiography – one which involves all Program members. The Program has scheduled a conference on autobiography to take place in 1994, and will publish the proceedings. The interest generated by this work has already encouraged two Honours students to undertake research in the area (one involving a visit to the UK).

Assoc Prof James Wieland, co-ordinator of the Program
RESEARCH PROGRAMS

Quaternary studies - understanding the basis for present and possible future environmental change through analysis of past records

Quaternary Environmental Change
Co-ordinator: Associate Professor Gerald Nanson (tel 042 21 3631)

THE QUATERNARY Period represents the most recent interval of earth history and spans essentially the last two million years. It is an interval that has repeatedly witnessed pronounced changes in climate. In Australia this long-term environmental change is evidenced by dramatic shifts in sea level, enhanced aridity, significant changes in vegetation patterns and the extinction of taxa including the mega-fauna.

Interest in the Quaternary Period centres on its relevance to environmental investigations in general. The Quaternary provides an essential backdrop to assess present and ongoing environmental change (eg. Greenhouse Effect). Similarly, the records from sediments deposited during this interval permit the identification of environmental change that occurred significantly before the advent of human instrumental records. The Quaternary thus presents answers to vexing questions such as whether aspects of present environmental change are natural or humanly-induced, as well as insights into the recurrence intervals of natural hazards such as floods, earthquakes and volcanic eruptions.

Members of the Quaternary Environmental Change groups maintained a vigorous program of research during the year on a diverse range of topics in Australasia.

Quaternary Projects

Lord Howe Island
Situated at the world's southernmost limit of coral reef formation, Lord Howe Island consists of eroded remnants of Tertiary basalt, fringed by a reef and lagoon. Because the island is so close to the limit of reef growth, the sediments produced from the reef which have been blown up into the limestone deposits (known as calcarenites), provide a relatively short but sensitive record of environmental change.

The project's research aims include: to examine changing conditions in the Tasman Sea reflected in the differing make up of fossil dunes; to place the Australian record of environmental change within a wider context; and to establish a framework for the island's biogeographic history from its sedimentary and geomorphologic records.

During the year, a series of nine vibrocores was collected from the back reef lagoon. The cores indicate that the reef complex is a highly productive carbonate environment. The sediments recovered in the cores are presently being studied in detail and are also being dated using radiocarbon and amino acid racemisation methods.

Central Australia
Research continued on the response of dune building episodes and river flow regimes to climate change in central and northern Australia during the past 300,000 years. Several graduate students are involved in this project, which will ultimately provide one of the most comprehensive overviews of fluvial stratigraphy and chronology, encompassing a full glacial cycle in the world.

Recent work examining flooding of Cooper Creek in SW Queensland shows these events to be widespread (tens of km in extent) but not to be very erosive. Velocities are low and they transport surprisingly little sediment - mostly mud and some sand. In contrast, floods in the high energy channels of the Kimberley region, affected by the northwest monsoon, are catastrophic in nature, ripping huge slabs of rock from the channel floor and stacking them like dominos downstream of waterholes. The frequency with which these events occur is not known but is being evaluated. Three PhD students are examining sites in central and northern Australia in order to assess the
role of flooding and changes in flow regime in these contrasting environments, and to evaluate the impact of past and possible future climate change on different parts of the Australian continent.

Archaeological studies
Excavation of archaeological sites in the northwest of Northern Territory has been undertaken during the past three years, as part of a long-term project studying Aboriginal land use and resource management in the far east Kimberley. An excavation at Jinmium is of particular significance for it contains rock art and stone artefacts of considerable antiquity. This study provides an opportunity to compare contemporary Aboriginal environmental perception with a significantly longer record. Thermoluminescence in conjunction with radiocarbon dating from younger horizons is being used to establish a chronology for this deposit.

Palaeoecology of Stick-nest rats
Traditional sources of evidence for reconstructing vegetation changes, such as pollen preserved in lake and swamp deposits, are both rare and poorly preserved in arid regions,
RESEARCH PROGRAMS

The rarely sighted arboreal geomorphologist, believed to be still evolving in trees along Cooper Creek, in south-west Queensland

Ground-penetrating Radar (GPR) used in a PhD study (Jerry Maroulis) to investigate unique deposited environments of the Cooper Creek floodplain. GPR is a relatively new technique which provides continuous sub-surface profiles of sedimentary structures.

leaving large parts of Australia for which there is presently no palaeo-ecological record. However, the stick-nest rats, Leporillus conditor and L. apicalis, now extinct on the Australian mainland but once widespread through the southern part of the arid zone, left a palaeoecological legacy in the form of nests of plant and animal remains. Some of these nests became cemented by viscous urine known as amberat, which acts as a preservative for a range of materials.

Work on macrofossils and pollen from nests in the northern Flinders Ranges provides a discontinuous vegetation record for the last 10,000 years. In the early Holocene (c. 10,000 to 6000 years ago) vegetation was dominated by woodland communities with grassy understoreys. By contrast, in the past two thousand years, open saltbush shrublands have become dominant. This suggests wetter conditions than present in the arid zone in the early-mid Holocene. The 10,000 year record is the oldest in Australia, and serves to reinforce the potential of the techniques, which in America provide a 40,000 year record of ecological change.

Human environmental impacts deduced from lake records
Examination of trace element, ash and heavy metal distributions and sedimentation rates have been conducted in the coastal lakes of central New South Wales including Lake Illawarra and Lake Macquarie. Results indicate that in some areas, sedimentation rates have increased in order of magnitude in response to recent human impact.

This research is now being extended to compare and contrast the longer record of environmental change along the Illawarra coastal plain with recent environmental change.

Coorong coastal plain
Coastal research was initiated in the far south-east of South Australia examining the relationship between Late Quaternary volcanism and uplift of ancient shorelines. Samples were
collected from numerous stranded coastal barriers for radiocarbon, amino acid racemisation and thermoluminescence studies. Preliminary results indicate that the Coorong coastal plain has undergone varying rates of uplift during the last 125,000 years, with by far the highest rates recorded near the volcanic edifices of Mt Gambier and Mt Schank.

**Quaternary dating methods: thermoluminescence and amino acid racemisation**

During the year, the thermoluminescence (TL) dating laboratory undertook the analysis of its 1000th sample since the laboratory was established within the Department of Geography in 1986. Recent laboratory-based research has centred on attempts to distinguish the origin of different quartz types. This research will significantly enhance sedimentary studies concerned with determining the source areas of sediments.

An amino acid racemisation dating laboratory was established this year within the Department of Geology and its research activities will complement the TL laboratory, as well as collaborative arrangements with other Quaternary Dating centres within Australia and overseas.

**Remote sensing and geographic information systems**

During 1993 remote sensing and geographic information systems were applied to a number of biogeographical questions. Several statistical models were established using the ERMS geographic information system to predict the distribution of the rare species *Grevillea barkleyana* in the Jervis Bay area. Fire monitoring in the Kimberley region of northern Australia was also undertaken, using Landsat Thematic Mapping Imagery and the SPANS geographic information system. The results of this research will provide baseline information to compare with the archaeological record. Future research directions involve the use of high-resolution airborne scanner data.

The Quaternary Environmental Change Program is developing into one of the strongest research groups in the southern hemisphere, concerned with the manifold forms of environmental change that have occurred during the past two million years. The program's research findings are directly relevant to understanding present environmental change as well as providing a sound basis for developing strategies for environmental management.
Science, technology and society
Analysing the history of science and technology, scientific controversies
Environmental strategies and socio-technical change

Science and Technology Analysis

Co-ordinator: Dr Brian Martin (tel 042 21 3763)

How should science and technology be evaluated, managed and controlled? Who should be involved in doing these things? These are complex and difficult questions. But their importance cannot be overstated in today’s world where the need for answers is increasingly urgent. Modern science and technology underpin almost every feature of society. They impinge daily upon our lives and shape our futures. Their economic and social significance is immense.

Science and technology are sources of knowledge and authority to which people increasingly look for guidance in political decision-making. In theory, they are strictly rational, impersonal and precise. In practice, they are deeply social undertakings, shaped by personalities, politics and cultural assumptions. For these reasons, science and technology are being studied in considerable depth and from many points of view at the University of Wollongong — from points of view including history, philosophy, sociology, anthropology, archaeology, political science and economics.

The picture of science and technology that is emerging is a fascinating one that challenges many commonsense and popular conceptions. This picture has profound implications for scientists and technologists, for policy makers and for the public.

The Science and Technology Analysis (STA) Research Program brings together researchers and postgraduate students who have the collective aim of promoting and integrating research into the nature, dynamics, impact and management of science and technology in their social and cultural contexts. The largest number of STA members are from the Department of Science and Technology Studies; there are in addition others from a range of departments and faculties. Many members of STA maintain regular contact with the Centre for Research Policy, where other researchers do related work.

Members of STA are involved in projects and collaborations, in several cases with overseas scholars. STA working papers have been distributed to dozens of centres around the world. Some of, but not all, the activities of STA members over the past year are described below.

Rebecca Albury has used STA support to pursue the project Abortion Politics: medical science and practice, law and public policy in the social construction of women as reproductive beings. She has completed several papers in this area and given conference and seminar papers. Her research assistant, Nicole Rankin, is completing an analysis of a part of the data collected during the project as a BA Honours thesis.

Ms Albury is in the early stages of a lengthy study of the Australian Government responses to the demand that in vitro fertilisation (IVF) and related technologies be regulated. This will include three case studies: the rise of ‘bioethics’, embryo experimentation and arguments about human personhood, and public policy about surrogacy.

For a number of years, Stan Aungles has been interested in the changes brought about in organisations when information and communication technologies are introduced. Currently he is concerned with particular changes in publicly funded universities. He asks, what happens to academic, administrative, secretarial and library work in educational...
Program co-ordinator
Dr Brian Martin
(right) and Professor
Jim Falk discuss
with amiable
satisfaction the
scholarly production
of the research
program

Institutions when word processing, compact discs, computer-assisted learning, electronic mail and networks are introduced? As an example, he notes that most academics have found that word processing can produce an increase in 'writing' output. However, few realise that sentences become longer and more difficult to follow, the volume of writing may increase to the point of excess and the ease of editing produces an increase in careless writing. Moreover, when blocks of text are moved around, writers shift towards a modular style of text production. The frequent reshaping of text can cause them to lose the thread of their argument.

Richard Badham leads a team which received $780,000 from the Federal Department of Industry, Technology and Commerce (DITAC) to fund, from 1993 to 1995, Australian-German collaboration in research and development on a project on smart manufacturing techniques. The project is industry-focused, with its core part being the successful implementation of team-based production islands in a number of Australian companies. This involves researchers and consultants being funded to assist the firms in the implementation process and develop software and organisational methods suitable for production island operation in Australia.

Sharon Beder won a Michael Daley award for excellence in Science, Technology and Engineering journalism for a New Scientist article entitled 'The Fallible Engineer'. She has also been awarded a National Teaching Development Grant for 1994 of $49,700, one of five awarded to the University.

At the end of 1992, Dr Beder completed The Nature of Sustainable Development, a book which was published in November by Scribe Publications. Some of her research was presented at the Ecopolitics VI Conference in Brisbane in July. During 1993 she also researched and wrote on engineering ethics. This work was published in a New Scientist article in September and was presented at a National Conference on Social Responsibility of Science in Canberra in March.

Professor Jim Falk has carried out research combining the analysis of technological change with the need to develop strategies for dealing with accompanying environmental problems. The central focus is on the urban setting where the bulk of environmental degradation, technological development and economic activity take place. This strategy involved building a research team and associated sources of data, now referred to as the Technological Change and Environmental Strategies (TCES) group, which is capable of intervening in real world environmental problems. In addition to Professor Falk, members of the group include Greg Hampton, Ann Hodgkinson, Kevin Parker and Stewart Russell. In its second year TCES attracted some $240,000 in grants and fees external to the STA program.

Current projects include a commissioned review of national, state and
local greenhouse information strategies (for the Australian and New Zealand Environment and Conservation Council), a study of environmental attitudes and values in the Illawarra region (NSW Environmental Protection Authority), and the development and implementation of methodologies for public participation in major infrastructural projects (NSW Public Works, NSW Water Board).

Dr Richard Joseph completed a major study, 'The politics of telecommunications reform: a comparative study of Australia and New Zealand'. He spent the last half of 1993 on study leave, visiting key centres in Europe.

Dr Brian Martin, in collaboration with research assistant Mary Cawte, began work on the project 'Science and technology for non-violent struggle', funded for three years by the Australian Research Council. Governments provide massive funding of science and technology for war, but nothing at all for science and technology aimed at improving the effectiveness of non-violent struggle. The project involves surveying the literature on non-violent resistance to aggression and repression, determining key elements of non-violent struggle (such as survival, communications, and morale), and interviewing scientists and engineers to find and test ideas for using their skills for a system of non-violent resistance to aggression. It turns out that many of the technologies that could improve the capacity for non-violent struggle—such as using decentralised systems for energy and water, and using resilient network communications—are currently available.

During study leave in the first half of 1993, Dr Martin visited researchers and activists in the nonviolent defence area in Netherlands and Belgium. His book, *Social Defence, Social Change* appeared during the year.

Also in 1993, Evelleen Richards and Catherine Berglund began work on a three-year project on AIDS, AZT and the role of consumer participation in drug evaluation, funded by the Australian Research Council. The project is using both professional and community sources of information to investigate the problem. To date, the drug evaluation systems in the United States and Australia, and changes to those systems, have been investigated. A comprehensive literature search on AZT trials has been completed. All articles on AZT appearing in the *New York Times* and the *Sydney Morning Herald* have been analysed. Interviewing leading AIDS researchers, drug evaluators, drug company representatives and AIDS activists is now under way in the United States. The project will continue over the next two years to build up a comprehensive picture of the development of AZT as a drug used in AIDS treatment.
THE WATER Engineering and Geomechanics Research Program (WEGRP) encompasses a spectrum of interdisciplinary subject areas in Civil, Mining and Environmental Engineering. Considering the current economic trends and community concerns, special emphasis is placed on environmental issues, planning for and mitigation of natural hazards, extension of the current state-of-the-art in water resources, water quality and earth structures, as well as resource development and management towards the year 2000.

Research activities of the WEGRP have expanded significantly. In particular, with the addition of two members in Environmental Engineering, the scope of potential research projects has grown. The program today benefits from 12 members plus ten external associates from industry, government agencies and universities. Moreover, 42 postgraduate students are associated with the WEGRP. Highlights of 1993 include organisation of an international conference in February and a national conference in October. Major projects are described below.

Water-quality modelling and real-time monitoring (Dr M Sivakumar, Dr H B Dharmappa)

Water quality has become a primary concern in the Australian community. Modelling the physio-chemical and biological processes occurring in water bodies should provide a better understanding for both design and management. Process-orientated catchment water-quality models are being developed for the prediction of nutrient loads in Australian and overseas catchments.

A one-dimensional model has been developed, and will be applied to the Nepean-Hawkesbury river system. The University in collaboration with the Wollongong City Council, Public Works Department (NSW), Environmental Protection Authority (NSW) and Catchment and Land Management (NSW) will be monitoring water-quality parameters and meteorological data in two creeks on a real-time basis.

Risk and reliability analysis in geomechanics (Associate Professor R N Chowdhury)

In the field of civil engineering, practitioners are rarely faced with a more complex array of operating parameters than those caused under variable loading and material conditions.

In risk and reliability analysis, among other geotechnical projects, further research is being carried out with particular reference to earth dams, excavations, management of landslides, earthquake-induced failures and land reclamation.

The research conducted by the WEGRP has been recognised internationally by the appointment of Dr Chowdhury to an expert panel of the United Nations Commission on Human Settlements, as well as by the invitation received by him to deliver a keynote address in London, at a major risk and reliability conference hosted by the Institution of Civil Engineers, UK.

Research concerning risk of landsliding is being supported by ARC, Wollongong City Council, and the State Rail Authority.

Members:
Dr Richard Arenicz, Dr Yasmin Ashaari, Dr Ernest Baafi, Associate Professor Michael Boyd, Dr Bruce Cathers, Dr Hagare Dharmappa, Dr Buddhima Indraratna, Associate Professor Denis Montgomery, Dr Ian Porter, Professor Raghu Singh, Dr Muttucumaru Sivakumar
Flood hydrograph modelling
(Associate Professor M J Boyd)

The hydrograph model WBNM was developed as a combined effort by Universities of Wollongong and NSW, and CSIRO Division of Water Resources. For the purpose of extending this model to include a more realistic representation of urban catchments and design storms, another collaborative effort has been launched by the Program, Wollongong City Council, Forbes Rigby Consultants and GHD Engineering.

Constitutive modelling of dams and foundations
(Dr B Indraratna, Dr R Arenicz)

This research includes the predicted behaviour of dams and foundations based on computer-aided modelling. The extent of settlements and lateral movements, development of failure modes and the effect of drains and filters are investigated using the finite element technique. The research developments achieved by WEGRP are reflected by the invitation received by Dr Indraratna from the United Nations Centre for Human Settlements (HABITAT) and the Department of Irrigation, Sri Lanka, to deliver a series of professional development seminars in Colombo, in January 1994.

Utilisation of by-products, marginal or waste materials
(Associate Professor D G Montgomery, Dr M Sivakumar, Dr B Indraratna, Associate Professor RN Chowdhury, Professor R N Singh)

Use of slag and mill tailings in engineering applications

Investigations into the properties and uses of various types of ferrous slag have continued. Particular attention has been paid to the expansive properties of BOS slag and its potential use in applications such as blended cement and concrete. Further investigations into the chemical activation of blast-furnace slag have also been carried out. The effect of mill tailings on the erodible nature of soils is also studied.

Biofly bricks

This project is concerned with the efficient utilisation of industrial by-products such as flyash and sewage sludge to produce lightweight bricks. The project has been financially supported by Pacific Power, Sydney Water Board and Borai research. Current developments have already attracted interest from Australian and overseas engineering communities.

Reinforced earth and stabilisation of mine tailings
(Dr R Arenicz, Dr Indraratna, Associate Professor R N Chowdhury)

Research is being carried out to investigate the effect of woven, non-woven, strip and grid reinforcements on the behaviour of compacted backfill. Apart from fundamental research, Dr Arenicz and Dr Palmeira (University of Brasilia) have continued their joint research project on ‘pull-out testing of strip reinforcement’, including some applications in marine environments. The concepts of reinforced earth have been extended to investigate the effect of geofabrics on the behaviour of wet mine tailings. The strength and consolidation characteristics of reinforced tailings would provide valuable data for the design of mine access roads and tailings dams.

Geotechnical earthquake engineering
(Associate Professor R N Chowdhury)

This project is concerned with the analysis of embankments and dams under earthquake loading conditions. Following the Newcastle earthquake, the design codes and construction practices need to address the potential earthquake hazards. The research at Wollongong is aimed at developing models for simulating the change in reliability of earth structures during earthquakes. The effect of earthquake dynamics on the strength of earth materials is considered to be an important analytical phase of such research. The methodology developed so far has already been applied successfully to the Lower San Fernando Dam, USA, which failed during an earthquake in 1971.

Sediment transport modelling
(Dr M Sivakumar, Associate Professor M J Boyd, Dr B Cathers, Associate Professor R N Chowdhury)

Several research projects are being conducted in the area of sediment transport in river systems, sediment deposition in reservoirs, river-bank erosion and sediment control basins for urban development. A notable feature is the development of the computer program SEDLOAD to estimate sediment loads carried by rivers. This program incorporates a new theory of sediment transport developed at the University of Wollongong.

Urban flood reduction
(Associate Professor M J Boyd)

This project is conducted in collaboration with the Wollongong City Council and Hydrotech Research. With urban consolidation becoming government policy, the higher-density residential development courses increased runoff. The effectiveness of on-site stormwater detention policies will be evaluated and recommendations will be prepared to formulate guidelines for the design of on-site stormwater detention facilities.
RESEARCH PROGRAMS

Mining geomechanics, mine-site rehabilitation and geostatistics (Professor R N Singh, Dr E Baafi, Dr I Porter, Dr B Indraratna)

Several projects are concerned with the analysis and design of support systems, pillar design, strata control, groundwater modelling and mine inundation, geological modelling of ore deposits and the application of geostatistics in underground mine planning and design. Most of these projects involve demanding experimental and field work, in addition to computer-based numerical analysis.

Professor Singh presented an invited lecture to AusIMM, Collie (WA), on mine readamation in April, as well as an invited lecture to the Key Centre for Mines in Sydney in August. Dr Baafi was invited by AIDAB to conduct a two-week workshop on geostatistics to mining students at University of Technology, Lae, PNG. He also conducted a geostatistical study in Queensland for Collide Coalfields Pty Ltd.

Hydromechanics of jointed rock (Dr B Indraratna, Professor R N Singh)

In-situ stress conditions and stress changes introduced by underground mining activities influence the geological and hydraulic properties of rock masses. The project involves the study of two important aspects related to rock mass behaviour (i) the effect of strata movement and bed separation on roof stability and (ii) the effect of stress changes and associated joint displacements on hydraulic properties of rock mass.

Emphasis will be placed on the development of mathematical models to predict groundwater flow under mining situations.
Environmental control in transportation engineering (Dr Y Ashaari)

Traffic noise depends upon traffic volume, speed, composition, road gradient and surface texture. A project evaluating the traffic noise in the Wollongong area has been completed and another investigation is being conducted on the assessment of lead content in the air near a highway. The possible use of vegetation to control lead pollution is also being studied.

Optimal design and operation of water treatment plants (Dr H B Dharmappa, Dr B Cathers, Dr M Sivakumar)

The increasing deterioration in the quality of natural water together with stringent water-quality requirements warrant better and more efficient treatment facilities for the provision of drinking water. This research program is focused on the optimisation of the individual processes as well as the system as a whole. In addition, the inclusion of the particle removal concept in the model makes this approach more realistic. When developed, a similar approach could be applied also to wastewater-treatment systems, with further emphasis on the application of artificial neural networks to water-treatment systems.

International collaboration

A collaborative exchange program was initiated by Dr M Sivakumar and Professor L Kane-Maguire in the field of Environmental Control Engineering with Shenyang University, China. Six academic staff (Engineering and Chemistry) and three research fellows from Shenyang University have received training in Wollongong. Professor Singh, Dr Sivakumar, Associate Professor Chowdhury and Dr Boyd of the WEGRP visited Shenyang University to give a short course in Environmental Control Engineering.

A strong collaborative research link has been established between the Program and the Division of Geotechnical Engineering, Asian Institute of Technology, Thailand. Already several projects have been conducted jointly between Dr Indraratna and Professor AS Balasubramaniam (AIT).

A research link related to landslide studies is being developed by Associate Professor Chowdhury with the Public Works Research Institute, Japan, under the Australia-Japan Bilateral Collaboration Program.

An academic and research link program has also been initiated by Associate Professor Chowdhury with City University, London (UK), with particular reference to soil mechanics and environmental risk.
The campus nestles between a tree-clad escarpment and attractive beaches, the surf and the sea.
THE MAJOR accomplishment during the year was the writing and submission for publication of the research monograph, 'Difference Spaces and Multiplication Spaces on Locally Compact Groups' by Associate Professor Rodney Nillsen. This work is seen as one of the best pieces of research to come out of the Department of Mathematics in several years. The ideas in it have had a long period of gestation, although their fuller development and expression have occurred over a relatively short, intense period. Dominant ideas emerged in an attempt to answer the question: how can the behaviour of the Fourier transform near the origin of a well-behaved function be described and characterised? Powerful answers presented in the monograph have implications for the understanding of the ranges of partial differential operators and of the behaviour of singular integral operators. Completion of the monograph has been assisted greatly by the financial support provided by the Analysis Research Group which included bringing distinguished mathematicians to Wollongong.

In 1993 Analysis at the University of Wollongong was put on the map. The list of distinguished mathematicians who visited and stayed for significant periods is impressive. It included Professor Norman Dancer (University of New England); Professor Sachio Hirokawa (Hirokawa Kyushu University, Fukuoka, Japan); Professor P. Kannappan (Waterloo University, Canada); Dr Mohammad Saeed Khan (Sultan Quaboos University, Muscat, Sultanate of Oman); Professor Yuichi Komori (Shizuoka University, Japan); Professor Michel Lapidus (University of California at Riverside); Professor Ely Merzbach (Bar Ilan University, Israel) Professor Mike Mislove (Tulane University, New Orleans); Dr Vladimir Pestov (Victoria University of Wellington); Dr Ivan Reilly (University of Auckland); Dr Douglas Rogers (ANU); Dr Bert Schreiber (Wayne State University, Detroit); Dr Sergey Svetlichny (University of Melbourne); and Dr Bevan Thompson (University of Queensland).

The importance of mathematical contacts to mathematicians cannot be overstated. Most of these distinguished visitors took part in the Analysis Miniconference organised by the Analysis Research Group at the University in July. Thirty-five were present. Most of the visitors participated also in the first annual meeting of the Australian Mathematical Society held at the University of Wollongong.

When the Analysis Research Group was established in 1992, it declared that finding and clarifying limit laws in varieties of topological groups was one of the major problems we would attack. The visits in 1992 of Professor Ralph Kopperman (New York) and in 1993 of Mike Mislove, Vladimir Pestov and Sergey Svetlichny have resulted in this problem being solved. A major paper by these authors, Dr Peter Nickolas and Professor Sid Morris is being prepared for publication.

Professor Morris, Dr Sheila Oates-Williams (Queensland) and Dr Bevan Thompson (Queensland) previously characterized compact groups with every closed subgroup open. The extension to locally compact groups was posed as an open question. This has now been proved false by Professors Morris, Karl Hofmann (Darmstadt), Dr Oates-Williams and Dr Vladimir Obraztsov (Moscow) in a paper submitted for publication. The Research Group has funded visits by Morris to Germany to work with Hofmann and Queensland to work with Oates-Williams. The University of Queensland and the Analysis Research Group will fund a visit by Obraztsov to Australia in 1994. The work in the submitted paper is based on the notoriously difficult Ivanov-Ol'shanskii monster group – a simple
group in which all proper, non-degenerate subgroups have order $p$. The group constructed in the submitted paper is a highly non-trivial central extension of a $p$-adic group by the monster group.

The Minimal Surface Equation is a partial differential equation which can be used to model surfaces which have the smallest area within a given class of surfaces. Information about solutions to this equation is of some interest from a practical as well as a theoretical point of view. The equation has been studied extensively over bounded domains.

During the year Dr Graham Williams has made progress in the less-well-studied case of unbounded domains. His results are largely concerned with questions of whether or not solutions actually exist. Collaboration has occurred with Associate Professor Nillsen and Mr Wai-Lok Lo particularly in some of the aspects involving Sobolev Spaces.

Papers by Williams and Sternberg and Zeimer have recently been published. A long paper entitled 'The constrained Least Gradient problem in $\mathbb{R}^m$' has also been accepted for publication in the Transactions of the American Mathematical Society.

Associate Professor Bunder has continued to publish in type theory, illative combinatory logic, and lambda calculus. He has four papers on these and related topics accepted for publication by major international journals. He won an ARC grant for $40,000 for 'Type theory and Illative Combinatory Logic'.

During the year Wai-Lok Lo began his PhD under the supervision of Nillsen and Williams. He is the first PhD student in Pure Mathematics at Wollongong for many years.

Professor Sid Morris has been elected Vice-President of the Australian Mathematical Society. This reflects very well on the Analysis Research Group and the University of Wollongong.
THE APPLIED Cognitive Studies Group has continued to focus on the study of perception and cognition within an experimental framework and to extend this basic research to a range of applied problems. Its research has been broadened and strengthened by a number of new appointments.

The appointment of Professor Barry and Ms Fox extends the research of the Group into the increasingly important domain of Psychophysiology. This addition is of major significance, since it provides a means of relating psychological measures to their physiological substrates. Professor Barry is developing a theory relating somatic and EEG responses to early stages of information processing of stimuli such as stimulus registration and the appraisal of stimulus magnitude. Another component of his research is concerned with the effects of stress.

Several Group members have continued researching various aspects of the reading process in children and adults. Professor Lovegrove (with Karen Pepper) has begun work on his new ARC project concerning the remedial implications of his previous findings that many dyslexics have a deficit in the visual subsystem known as the transient system.

Dr Avons and Professor Lovegrove have completed data collection on their ARC-funded project on cognitive factors indicating children at risk for reading disability.

Stephen Dawson has extended this research to children with attention deficits and children with hyperactivity and attention deficits (ADD). This work indicates that ADD have oversensitive transient visual systems suggesting that they might have difficulty filtering out irrelevant stimulation.

Dr Kruk has continued his research into the effects of colour on reading-like situations in adults, normal reading children and dyslexics. It had been reported that the use of coloured filters improves reading comprehension in dyslexics but the mechanism by which this may work has not been identified. Dr Kruk’s data on adults indicates that blue increases temporal resolution of the visual system, thus making reading easier. He is currently completing data collection with children.

Kristen Pammer has been investigating a related issue concerning the effect of colour on the relative timing of the transient and sustained systems.

Dr Conlon has completed a series of studies which have led to the development of a model of visual discomfort. She has further extended this work to the effect of a range of variables on visual discomfort and tasks such as reading.

Professor Lovegrove and Dr Avons have won a new three-year ARC grant to investigate temporal resolution of information processing in dyslexia. This continues the work completed this year by Agnes Au which showed that when single words are being...
read, the sustained visual system only is involved whereas when reading continuous text, both sustained and transient systems are involved.

Research on short-term memory loss has concentrated on visual spatial STM. This year concentration has focused on the effects of indirect visual stimuli on visual STM, and the comparison of these effects with indirect auditory stimuli on verbal STM. This work has achieved international recognition, with the invitation of Dr Avons to the First International Conference on Working Memory in Cambridge, England, in 1994.

PhD students Mohammad Vaez Mousavi and Kerrie Wilde with Alison Fox and Professor Robert Barry. Mohammad is studying brain activity related to a complex perceptual/cognitive task in the Cognitive Neuroscience laboratory.

Chul-Woo Lee has completed several studies investigating the effect of depressed mood on verbal and visual STM. The results show that depressed mood does not affect STM capacity directly, but leads to reduced performance in more complex STM tasks which require updating of strategies.

Bernadette Bibb has completed her research on memory bias in depression, showing that depressed, self-focused individuals experience more negative recall and interpretation of interpersonal memories. This work has clear clinical implications.

In visual perception Dr Chekaluk has developed an innovative basic research technique for the study of a wide variety of perceptual phenomena associated with eye movements. The main aim is to determine why our visual world remains stable and continuous despite discrete inputs separated by rapid eye movements.

Amirkhiabani has almost completed data collection investigating the effects of size and retinal eccentricity on speed of visual processing. He has shown that these factors account for a large amount of the global precedence effect.

Dr Wragg has focused his research in two areas. The first concerns the area of adolescent risk taking and drug and alcohol rehabilitation treatment. The second has been the further development of an earlier reading recovery program concerned with phonemic retraining utilising a tape or computer-assisted approach. This has reached the stage where a joint research funding proposal with the Department of School Education is currently being explored.
RESEARCH GROUPS

If you want to be fed only dried biscuits/
Or to be treated in manner sadistic/ Or to drink hemlock wine/ Then bring forth that false line/ Concerning lies, and damned lies, and statistics

Applied Statistics
Co-ordinator: John Rayner (tel 042 21 4308)

THE APPLIED Statistics Research group is organised into three projects.

**Project 1: Statistical modelling**
Researchers: Chan, Davy, Ellem, Griffiths, Gulati, Lin, Rayner
Professor Eli Merzbach from the University of Barr-llan and Professor Gail Ivanoff from the University of Ottawa each visited the department for three weeks in June to work with Yan-Xia Lin. She reports that research about spatial data has created much interest among statisticians and probabilists, and was her main research interest in 1993. The first focus has been to establish a reasonable stochastic integral for processes that are subset-indexed. The theoretical research on that problem is almost completed. Further research will centre on applications and other properties of the stochastic integral.

**Members**
Mr Wai Kong Chan, Mr Francis Crumplin, Dr Pam Davy, Mr Bernard Ellem, Prof David Griffiths, Dr Chandra Gulati, Dr Yan-Xia Lin, Mr Kamel Micheal, Ms Anne Porter, Dr Ken Russell, Dr David Steel

The second focus relates to limit theory of subset-indexed processes. Work in progress concerns the limit process of a sequence of subset-indexed simple processes.

Meanwhile Yan-Xia continues her research in the area of the quasi-likelihood method. Some results have been published, submitted or preprinted in the Department.

John Rayner continues to work with John Best of the CSIRO IAPP Biometrics Unit on a variety of topics. Smooth models for testing goodness of fit have been extended to analysing contingency tables. This has enabled the construction of new moment-orientated tests. Papers on S-Sample Smooth Goodness of fit Testing and Smooth Tests for the Bivariate Poisson Distribution have been submitted to journals. A paper on Estimating Correlation from Categorised Bivariate Normal Data has been accepted for publication.

Chandra Gulati's research into optimal stopping problems is continuing. Results obtained so far show that under certain conditions individuals do better than teams. A joint paper in the area of queueing theory has been accepted for publication.

Wai Kong Chan began his PhD, working with John Rayner in the goodness of fit area. A grant has been obtained to work on Semi Parametric Tests with particular reference to tests important in taste-testing. Bernard Ellem continues to work with David Griffiths on Curved Exponential Families.

**Project 2: Statistical design and analysis**
Researchers: Crumplin, Griffiths, Gulati, Russell, Steel

Ken Russell took his first-ever study leave from December 1992 to June 1993. From December to February he visited Professor J A John of the Waikato Centre of Applied Statistics at the University of Waikato, Hamilton, NZ. There he worked on various aspects of the study of row-column designs, and finally began simulation work to compare four methods of analysing row-column designs with inter-block information. A preliminary draft of a paper has been written. An invited talk on this work was given to Statistics'93.

During March and April, Ken Russell visited Professor A M Dean of the Department of Statistics at Ohio State University. They worked on the design
of change-over experiments with fewer subjects than treatments, where the treatments have a factorial structure. This work is continuing.

In May and June Ken visited Dr S M Lewis of the Department of Mathematics at the University of Southampton. They worked initially on a problem of designing pairs of change-over designs and then began an investigation of good change-over designs when there is interaction between the direct and carry-over effects of treatments. Some good initial results have been obtained, and a paper on the first topic has been submitted for publication.

David Steel's main active research interests are in the areas of:

• survey methodology
• sample survey design and analysis
• analysis methods for complex social and economic data.

Survey methodology
This area is concerned with methods used to collect data. The main activity in 1993 was a project undertaken with Pass Masters student Joe Vella and Peter Harrington of the Illawarra Regional Information Service. The project examined quality aspects associated with telephone surveys and the conduct of a telephone survey on attitudes towards republican issues.

A paper on this research was presented at Statistics'93 and will be submitted to the Australian Journal of Statistics.

Sample Design and Analysis
This covers several projects.

• Sample Design and Analysis for Time Series
An application, supported by the Australian Bureau of Statistics, has been submitted for an APRA (industry) award. If successful this will enable the recruitment of a full-time PhD student to work on this project.

• Analysis of Survey Data
Honours student Rodney Venn completed a project in late 1992 looking at binary segmentation techniques applied to sample surveys.

• Inference for Sample surveys
Dr David Street presented a Departmental seminar on the use of generalised variance functions. Virginia Wheway began an Honours project looking at the application of the Bootstrap method to sample survey, particularly when the estimates have high relative sampling error.

Analysis methods for complex social data

• Ecological inference and Aggregation Effects
David Steel was invited to Southampton as a Visiting Research Fellow in January and October 1993. He wrote a detailed report setting out the analysis of UK census data that should be studied. Extensive analysis has been undertaken of group level data. Unfortunately the person level data required has only recently been made available so the analysis is not yet complete. A paper describing the main theory underlying the analysis has been drafted and will be submitted shortly to the Journal of the American Statistical Association.

The results of this research will be discussed in two papers to be presented at the annual meeting of the American Association of Geographers in March 1995, and a further paper at the US Bureau of the Census Annual Research Conference in March 1994.

Data have been obtained for the 1986 Australian census which can be used to investigate aggregation issues, as well as other sampling issues and analysis is proceeding.

David Griffiths co-authored an invited paper on Prescribed Medication Use in People with Asthma. Chandra Gulati carried out the statistical analysis to identify regions of food poverty in India. These regions were compared with previous data and the results appear in the GeoJournal article.

Project 3: Statistical Education Research
Researchers: Crumplin, Davy, Griffiths, Micheal, Porter, Rayner, Russell, Steel

• David Griffiths has submitted to publishers a manuscript entitled 'Statistics by Practice and Experiment', co-authored with Doug Stirling.

• A companion book 'Statistical Exercises with Models' n' Data' by Doug Stirling has also been submitted. Many of the exercises are based on jointly developed material or material developed at, and first used at, Wollongong.

• Six teaching modules for laboratory classes, developed in association with the books, have been adopted by UTS, Sydney, and by Sydney Institute of Technology.

• Four papers were presented at the Statistics'93 conference held on campus in late September. Where there are multiple authors, the * indicates the presenter.

Anne Porter*, David Griffiths and John Hedberg

Repacking the Expert’s Knowledge in Teaching Statistics
This paper reported some of the very substantial progress on Anne's PhD.

John Rayner

Two Vignettes : Estimating Saddam's Arsenal and Unifying Expectations
The first vignette involves a startlingly effective demonstration of the power of statistics.

Kamel Micheal*, David Griffiths*, Anne Porter and Doug Stirling

The Powers of Two : How and Why Should We Teach Probability in Introductory Statistics Courses?
A radical approach to teaching probability has been trialled at Wollongong; this paper reports on developments.
It's 'back to basics' for some of the Applied Statistics Research Group. From left in this picture are Dr Chandra Gulati, Dr Pam Davey, Dr Yan-Xia Lin, Dr Ken Russell, Mr John Rayner, Mr Kamel Micheal, Dr David Steel and Ms Anne Porter.

Ken Stevenson*, Francis Crumplin and David Griffiths

Computer-aided Learning in Statistics: the Models 'n' Data Experience

CAL has had a substantial impact in many areas. The paper reported on experience in using a CAL package in four institutions. The experience puts Wollongong at the leading edge internationally in this field.

In addition, Anne Porter ran a conference workshop.

Anne Porter

The Beginnings of Statistical Learning: Structuring Basic Concepts

David Griffiths, Doug Stirling, Anne Porter and Kamel Micheal have written a Department teaching module on Teaching Conditional Probability.

Statistical consulting services

Principal consultants: Russell and Steel

The Department of Applied Statistics has once again assisted the research output of the University by providing statistical consulting services to members of other Departments. The list of clients includes members of most Faculties.

Services provided include initial discussions on running an investigation, the content of a questionnaire, appropriate way to enter the data into a computer, methods of analysing the data, and the most suitable means of presenting the results and conclusions. We need to devote more effort to persuading researchers that they should consult the service at the beginning of their investigation.

Many topics for which assistance was given are noted elsewhere in this report.

Several highlights are mentioned briefly here. Advice was given on the analysis of data from an experiment to design an effective wheelchair for paraplegic and quadriplegic users. Advice on a recent method of data analysis was provided for a researcher in the Faculty of Education considering what factors in a high school might be associated with outstanding student performances in the Higher School Certificate. A continuing association exists with a researcher interested in various psychological aspects of sports performance. A student is being helped with an investigation considering stress situations in various sports, and what strategies are used to cope with these stressors. A student with the Department of Nursing has been advised on methods of assessing the attitudes and needs of users and potential users of a neighbourhood support service.
Throughout the year the Group continued to provide high-level mathematical and computational expertise over a wide range of problems encountered in engineering and industry. Particular examples of the work include the flow of granular materials, applications of microwave heating, mathematical modelling of the BHP annealing furnace and a large number of fluid/water related problems, such as wave loads on vertical structures in the ocean and the seepage of water through soils. The Group has also been involved in other projects, too numerous to deal with in detail, but including the development of Computer-aided Learning modules to be used by our own first-year Mathematics students.

Successful mathematical modelling ultimately involves solving partial differential equations either analytically or a numerical solution using the computer. Our group is well known, both in Australia and overseas, for the development of theoretical techniques for the analytical solution of non-linear partial differential equations. Indeed, one of our PhD students (Maureen Edwards) won the B H Neumann prize for the best student talk at the annual Mathematical Society Conference held at this University for her talk in the area. The talk was entitled ‘Symmetries and nonlinear diffusion-convection equations’.

The photograph on page 69 shows the principal members of the Group involved in this specialist area (Professor J M Hill, Dr D Arrigo, Ms M Edwards, Mr T Katoanga and Professor P Broadbridge).

Through the Group’s participation at national meetings, we were successful during the year in promoting the research group to the extent that it is now recognised as one of the principal groups in Australia in its field. Dr Zhu travelled to the UK and US to promote the Group’s activities and monitor overseas developments. He visited Cambridge, Birmingham, Newcastle and Edinburgh and later went to a major international conference in the US.

In addition to the mathematical modelling work of the Group, Dr Annette Worthy has been active in the development of Computer-aided Learning modules for which she has received funding from both DEET and the Apple Development Fund. Modules have been developed with the intention of not being an electronic book, which would be no more advantageous than a textbook. With this in mind, the presentation of material on the screen is of the utmost importance and it is crucial that the material is displayed in such a way that students learn from it. The development of learning modules may take many hours to prepare but the time thus spent is far outweighed by the enormous educational benefits. Students can learn at their own pace without fear of embarrassment – something that is commonplace in mathematics class rooms. Moreover, it allows teachers/lecturers to spend more time with their students. The modules developed use the approach of learning by discovery and exploration, with guidance when necessary.

Professor Hill has continued to work in the areas of differential equations and the mechanics of granular media. Post-doctoral appointees Dr Danny Arrigo and Dr Xiao-Ming Zheng have been particularly active collaborators in these areas and their work has resulted in several publications.

During the year, Professor Broadbridge’s research has concent-
trated on two main areas: symmetries of nonlinear partial differential equations and the evolution of metal surfaces. He and Maureen Edwards constructed new solutions to multi-dimensional nonlinear diffusion-convection equations with special forms of nonlinear diffusivity. These equations describe practical transport phenomena such as fluid flow in porous media. With PhD student Peter Tritscher, Broadbridge has been investigating the nonlinear equations for the transport of matter at the surface of a solidified metal near a grain boundary. There are two possible mechanisms for this process. The first (dominant in magnesium, for example) is transport by evaporation and recondensation. The second (dominant in gold) involves diffusion of atoms along the surface.

Dr Marchant continues to investigate the mathematical modelling of microwave heating. The use of microwave radiation to heat and process materials is becoming widespread, attributable to the speed of heating and its efficiency. Industrial uses include smelting metals, sintering ceramics and the joining (welding) of various materials such as polymers and ceramics. The absorption and diffusion of heat in the material is governed by the forced-heat equation, with the absorption term dependent on the temperature. As the material heats up, the absorption increases, which can lead to thermal runaway (a hot-spot) which can damage or destroy the sample being processed. Links have been made with the Departments of Mechanical and Materials Engineering regarding their development of the process of welding or joining materials using microwave energy. This cooperation has resulted in joint publications and the joint supervision of a PhD student, P Groombridge.

The Korteweg-de Vries equation describes weakly nonlinear waves in shallow water and it is well known to have soliton solutions. These are solitary waves which interact without
change of shape. Research is focused on whether solitary wave solutions to higher-order equations, which describe steeper waves in deeper water, are solitons. This work is proceeding on theoretical and numerical fronts with Dr N Smyth of the University of Edinburgh.

Wave interactions with solid structures have been studied by Dr S Zhu, Mr P Satavaha and Mr G Moule, concentrating on the interaction of linear and nonlinear short-crested waves. Preliminary results show that short-crested waves can sometimes generate larger wave forces on solid structures; their influence should be considered in the design and operation of offshore structures.

Numerical modelling of water waves in coastal areas is of great significance to ocean and coastal engineers. The dual reciprocity boundary element method has been found to be very efficient in modelling waves diffracted by islands or offshore structures. In addition to carrying out research on wave interactions with solid structures, Dr Zhu has been working on the application of this method to wave modelling.

Associate Professor Des Clarke revised and extended the numerical data sets for oceanographic and climatic variations around Australia. The long-term trends for sea-level-pressure along 40 degrees latitude below Australia have been evaluated. Comparisons with previously computed storm intensities for the east and west coasts of Australia have also been made.
Experimental and Analytical Stress Analyses of Structures

Co-ordinator: Dr Richard Kohoutek (tel 942 21 3385)

INFRASTRUCTURE testing which involves investigation of methods for inspection and monitoring of road bridges, in conjunction with Road and Traffic Authority, APRA (Industry), is completed. Extensive investigation requested by the Road Traffic Authority (RTA), NSW, into the effect of static and dynamic loads on a bridge in Dubbo has been completed and reported to the RTA as well as at the International Model Analysis Conference (IMAC11). The Group was also involved in the planning of the tests. The accuracy of predicted and measured results is excellent, making predictions for new designs and possible modifications to the existing structures a viable proposition. New bridges on the Mittagong bypass were also investigated before being opened to the public. The RTA also requested advice and measurements for two bridges in Sydney. This testing has been completed and reports have been submitted to the RTA.

Dynamic and static stress analyses of railway track involves the investigation of stress levels in all components. This project will soon be extended to a third site of investigation. After Taree and Unanderra field tests, there is a plan to investigate, in co-operation with City Rail, stress distribution and the dynamic coefficient of the rail track at a site near Wollongong. Several rails have also been tested in the laboratory, using strain gauges and the photoelasticity method.

Space truss development of erection technology for large space structures (ARC funded) aims at a significant reduction of site erection work. Work on shape formation of reticulated space structures is progressing well, with two papers published. A related project, on the stability of curved mild steel struts, is also making headway. One paper has been published; the experimental work is complete, and theoretical work is under way.

Strength of curved monorail beams and strength of bottom flanges are two projects in which several members are working. A curved beam has been made and tested using loads produced by a hydraulic jack, with measurements using strain gauges, load cells and photoelastic coating. The first round of tests has been carried out, with a BE thesis completed. The aim of the project is to establish guidelines for designers of such beams in Australia, information which is not at present available. Monorail beams are frequently used in materials bulk handling.

Damping of concrete, needed for vibration control of structures, is progressing. Two specialised companies from Sweden and Denmark are supplying free samples of their products for testing at the Department.

A project on base isolation of buildings against earthquakes was embarked upon. An extensive literature review was needed, so the project is in an early stage of development. Some experience is being acquired in the use of a mathematical programming language in the solution of vibration problems.

A new project was started on the development of computer-based training modules on the subject of stress analysis. Four members of the group are to design a module to provide senior undergraduates and postgraduates with a basic under-
From left, standing, are Professors Sid Morris, Michael West, Tibor Rosgonyi and Lewis Schmidt. Below, adjusting the charge amplifier gain, is Dr Richard Kohoutek while positioning the Accelerometer is Dr Arnold McLean. In the right foreground Dr Javad Sadeghi operates the spectrum analyser.

standing of stress analysis and its latest developments.

Dr Kohoutek, during his Sabbatical Leave in the Czech Republic, was an honorary consultant to the United Nations under the program TOKTEN. The result is a co-operative project with the Czech Technical University. He also received the Felber Medal (Grade I, Gold) for his contribution to the field of mechanics and the establishment of co-operation with the University of Wollongong.
Fossil fuels remain the focus of our energy needs. With its vigorous research base, Wollongong University continues at the forefront.

Fossil Fuels

Co-ordinator: Dr Adrian Hutton (tel 042 21 3832)

The Fossil Fuels Group continued to build upon the strong and vigorous research base on which it was founded. It supervised a large contingent of postgraduate students and was successful in attracting significant research funds from outside the University. During the year, four PhD and 12 Masters students, some from overseas, were successful and are to be warmly congratulated.

The Group continued its association with the Key Centre for Mines—a joint University of Wollongong and University of New South Wales initiative, linking industry with education and research. Several members of the Group received funding from the Key Centre.

University researchers within the Group have formed a strong alliance with colleagues in industry and academics in overseas institutions; collaborative research conducted with associate members from external organisations continues to be a feature of the research activity.

During the year, Dr Baafi successfully convened the Australian Conference on Applications of Computers in the Mineral Industry. Dr Baafi, Dr Porter and Associate Professor Aziz organised short courses and workshops. Dr Indraratna was an invited panellist at the 6th Australia-New Zealand Geomechanics Conference and Dr Hutton was invited to present two lectures at the NATO-sponsored Advanced Institute Course on oil shales held in Ackay, Turkey, in July. Associate Professor Jones was prominently involved with the International Fluvial Congress held in Brisbane in July.

Research activities focus on four projects.

- **Gas and dust control in coal mines**
  Under the leadership of Associate Professor Aziz and Dr Baafi, this project has continued to attract a significant external grant from the Joint Coal Board and the Australian Coal Association research projects. Because of the industry-oriented, practical nature of the project, this work has important implications for the coal-mining industry in Australia and the Wollongong area in particular. Research interests include longwall dust extraction, geological modelling of orebodies using the Octree technique and computer-aided feasibility studies of Indonesian coal deposits. The in-seam gas studies are interdisciplinary, involving gas drainage, gas sorption and environmental aspects of gas and water in coal-bearing sequences. A recent PhD thesis on geological aspects of gas produced significant landmark findings—linking structure of the southern Sydney Basin with gas distribution and composition—that have significant practical implications for the mining industry.

  Several conference and journal papers were presented.

- **Characterisation of oil shale**
  This project continued to be funded by an ARC grant which will continue in 1994. Major emphasis of the project has been the adaptation of a CSIRO-developed Siroquant X-ray diffraction program for accurately quantifying the mineralogy of rocks. In the past, X-ray diffraction studies of rocks have been semi-quantitative at best and the development of this standardless computer program is a major breakthrough.

  A poster paper, presented at a Clay Mineralogy Symposium in Brisbane, attracted much attention and indicated that success with the technique is urgently needed in the study of fine-grained rocks. Not only has the technique tremendous potential for oil shale sequences but it has unlimited possibilities in environmental areas. A small ARC grant is being sought to initiate a study of the inter-seam clastic rocks of the Leigh Creek coal field. Success of this application will place the Group in an excellent position to attract an APRA scholarship.
Indonesian student Chairul Nas using, under the watchful eye of Group co-ordinator Dr Adrian Hutton, one of the four research microscopes which provide detailed information on the composition of coal, oil-shale and petroleum-source rocks.

Other studies relating to oil shales during the year covered oil shale characterisation, retorting behaviour and organic petrography of spent shales.

- **Petroleum basins**

  After the graduation of five students the number of postgraduate students dropped in 1992. The project now has one postgraduate student; several applications have been received from overseas.

- **Sedimentology and stratigraphy of coal sequences**

  This project is one of the two major Group strategies; it involves ten overseas postgraduate students; and applications have been received from other potential candidates.

  Research was conducted into the sedimentology and stratigraphy of coal-bearing sequences in the southern Sydney Basin (New South Wales), Galilee Basin (Queensland) and Indonesian Tertiary basins.

  It is expected that three PhD theses will be completed in 1994.

  **Future directions**

  The Siroquant program has tremendous potential in a number of areas, with significant applications in the study of coal and oil shale waste dumps, the more so because it has the potential to quantify organic as well as inorganic constituents.

  Dr Buddhima Indraratna is welcomed as a member of the Group.

Carbon dioxide in coal seams in the Southern Sydney Basin can be formed during igneous activity or from transformation of buried organic matter. The model here shows migration paths for carbon dioxide.
**RESEARCH GROUPS**

**Fundamental experimental and theoretical research relevant to the electro-optic and electronics industries**

## Fundamental Properties of Semiconductors

**Co-ordinator: Professor Peter Fisher** (tel 042 21 3556)

The principal interest of the Group is to investigate and understand the fundamental properties of semiconductors. The semiconducting materials being studied include the recently developed layered nanostructures. The physics of impurity elements, called dopants, deliberately introduced into the elemental semiconductors, germanium and silicon, is also being studied. It is only when the physics of such materials is known that practical electronic and electro-optic devices can be designed and constructed. The study of layered materials, a field still in its infancy, is relevant to ultrafast and optoelectronic devices while elemental semiconductors form the basis of the well established semiconducting industry.

The experimental methods employed at Wollongong usually involve the interaction of electromagnetic radiation, or light, with the semiconductor. This can provide a very sensitive probe into the various processes involved. Additional information can often be obtained by applying mechanical stress and/or a magnetic field to the sample. Absorption spectroscopy in the infrared and far infrared is one technique used. Here, the solid to be studied is probed with infrared light and the beam transmitted through the solid is observed with a highly sensitive, low-noise detector and compared with the unobstructed beam. The spectral region (or wavelengths) of any light that has been absorbed by the solid is determined and a spectral analysis can reveal many of the physical interactions between the impurity and its host. This technique is used for the study of dopants in germanium and silicon. For example, for group III elements of the periodic table (shallow acceptors) in germanium and silicon the absorptions are very narrow in wavelength range and thus sharp spectral features are observed. A spectrum measured for gallium doped germanium in a high magnetic field is shown in Figure 1.

For the nanostructure quantum well devices, the techniques of photoluminescence and electron tunnelling spectroscopy are employed. Photoluminescence or emission spectroscopy is carried out in the visible and near infrared region of the electromagnetic spectrum. The semiconductor is stimulated by radiation, from either a high-powered argon ion laser, or a tuneable titanium sapphire laser or ring dye laser. Emitted radiation from the sample is collected and analysed. In the second technique, a voltage is applied across one of these structures and electrons move through the layers by means of a quantum mechanical process called tunnelling. An electronic technique has been developed here for probing regions of the current vs. voltage curve of resonant tunnelling diodes that is not accessible to conventional techniques. Figure 2 shows such a curve. The detailed shape of the curve provides new information on the physics of the tunnelling process.

Spectroscopic techniques used in the study of semiconductors at Wollongong provide valuable and relevant training to the research students working in the group. This will increasingly be the case as the opto-electronic industry evolves.

Theoretical research in this area involves investigation of dissipation effects in electron resonant tunnelling, field dependent level widths of the quasibound states and short-range correlation effects in nanostructures. Magneto-impurity resonance in bulk semiconductors and cyclotron resonance under extreme quantum limits are also being studied. The main

### Members

Dr Carey Freeth, Dr Roger Lewis, Dr A David Martin, Dr Phil Simmonds, Dr Rodney Vickers and Dr Chao Zhang
RESEARCH GROUPS

Research physicists gather round to observe one of the world’s most powerful argon ion lasers pump a titanium-sapphire laser.

Techniques are the many body theory, path integral method and band structure analysis.

During 1992 and 1993 the Solid State Spectroscopy Laboratory (SSSL) has further developed its reputation both nationally and internationally with collaborations with the Departments of Physics at the University of NSW and the University of Nottingham, UK. The work of the program was presented at major conferences in Japan, China, UK and Germany. The PhD thesis of Dr Piao, a former PhD student of the group and now employed by SSSL, has been submitted to the National Committee of the Australian Institute of Physics (AIP) by the NSW Branch of the AIP in nomination for the Bragg Medal of the AIP. (It was selected as one of the two best theses in NSW for

Figure 1: Spectra showing G transition of Ge (Ga) with a magnetic field of 7.0T
the period July 1992 to June 1993.) It was also recommended by the Postgraduate Committee of the Graduate Faculty to be considered, along with others, for the outstanding Doctoral thesis award in 1993 at the University of Wollongong.

The major projects of the Group involving various members are:

(i) Luminescence spectroscopy of semiconductor quantum well structures.
(ii) High field Zeeman effect of acceptors in bulk germanium.
(iii) Double barrier tunnelling structures.

(iv) Piezo- and piezo-Zeeman spectroscopy of bound acceptors in group IV semiconductors.
(v) Spectroscopy and piezo-spectroscopy of Coulomb-related Landau states of shallow acceptors in germanium.
(vi) Theory of magneto-impurity resonances and quantum transport in semiconductors and nanostructures.

A number of major advancements have been recently achieved in these projects and some of these have been published and also reported at international conferences. Highlights of the progress made are as follows:

1. Observations of a number of fundamental effects in quantum well (QW) structures (see Figure 2).
2. The first comprehensive Zeeman study of group III impurities in Ge at fields high enough to observe all allowed components of the simplest transitions, permitting comparison with recent theory (see Figure 1).
3. Development of a novel technique for accessing the region of multistability in double-barrier tunnelling structures.
4. The first observation of bound-hole related Fano resonances in Ge and their experimental and theoretical behaviour under external stress.
5. The experimental and theoretical development of the technique of piezo-Zeeman optical spectroscopy of acceptors in Ge.
6. Theory in electron correlations and electron-phonon coupling in nanostructures have been developed. A new mechanism involving electron-plasmon coupling in resonant tunnelling has been proposed.

With a new grant from ARC for funding for the next three years and the possibility of two new research students joining the Group, 1994 promises to be another very productive year.
RESEARCH GROUPS

Evaluation, development, support
and application of information systems
in business organisations

Information Systems in Organisations

Co-ordinator: Professor Graham Winley (tel 042 21 3760)

Established in 1993, this Group aims to research issues related to the application, development, support and evaluation of information systems in business organisations. The Group’s research interests are organised around three interacting projects which address specific areas relevant to this general aim.

Project 1 is concerned with the investigation, development and implementation of knowledge-based information systems and associated development methodologies for the purpose of managerial decision support. The work focuses on three related topics:

- the development of an intelligent heuristic search algorithm and its application to project scheduling problems with multiple-resource constraints
- the application of knowledge-based techniques to the problems associated with the retrieval of statistical data
- the production of a practical framework which forms the basis for a methodology that addresses the analysis, planning, knowledge-base design, prototyping, implementation and maintenance phases of expert systems development.

Work on these topics has been supported by industry partners and four doctoral candidates are involved in the research.

Project 2 addresses aspects of support important to the efficient and effective operation of information systems in organisations: these include education and training needs of information-systems professionals and users, the interface and interaction between personnel and computer-based systems and the management of information systems resources.

Specific activities in 1993 included:

- Publication of results of a survey of the education and training needs of information-systems professionals working in a variety of industrial sectors in Malaysia. This work has been extended to include the views of information-systems academics in the People’s Republic of China; a similar investigation is taking place with business organisations in Indonesia.
- Studies of the perceived usefulness of information technology in the medical and veterinary professions. This research is now being extended to examine software performance measures and aspects of vendor negotiation and support with a much larger group of small-business professionals
- Preliminary work on an investigation of the tools, techniques and methodologies for the design and implementation of intelligent tutoring systems
- The start of an extensive longitudinal study of the impact of Open Systems approaches and architectures on information-technology management policy in Australian organisations.

Support for these activities has been obtained from the Australian Medical Association and DMR Group (Australia) who are providing significant financial and other resources for the Open Systems investigation. Discussions are under way with the Malaysian Ministry for Science and Technology to provide services to that ministry, as a development of the topic on the education/training needs of information-systems professionals.

An Honours Masters thesis was successfully completed on this project in 1993 and currently one doctoral candidate is associated with the Open Systems investigation.

Project 3 examines methodologies for
the development and evaluation of information systems supporting managerial decision making with a focus on the use of qualitative analysis.

Problem areas include:

- Consideration of spatial aspects of information technology and the implications for emerging forms of social and commercial organisations
- Investigation of the role of information systems in the transfer of advanced manufacturing practice in Australia. This work has been conducted in collaboration with the MITOC research centre at this University.
- Semiotic approaches to information systems research. This work has been closely linked with researchers at the University of Twente, The Netherlands, and Aarhus University, Denmark. An international working paper series on semiotics in organisations has been established through this international collaboration with a focus on semiotic approaches to the provision of systems development methodologies.
- An investigation of the factors affecting the successful utilisation of information systems by senior executives in Australian organisations. Five such, representing different industry sectors, are involved; the study samples the views of senior executives, information-systems professionals and general users of systems.

Four doctoral candidates are associated with the topics in Project 3.

Other achievements of the Research Group included:
- Forty-five publications from the 15 Group members.
- The appointment of Dr S Little to the membership of IFIP Working Group 8.2: Information Systems and the Organisation.
- Distinguished visitors from Germany, United States, Sweden and Denmark contributed to the Group's activities.
- A series of seminars, given by the nine doctoral candidates associated with the Group, was conducted as part of the seminar series.
- The first *Australian Journal of Information Systems* was successfully launched with strong support nationally and internationally. Group members are predominant on the editorial board, Mr R MacGregor is Editor.
Labour History and Industrial Relations

Co-ordinator: Professor James Hagan (tel 042 21 3369)

Members of the Group divided their effort between continuation of their own research, and organisation of an international conference on the history of industrial relations in Australia and Japan.

Funding for the conference was partly underwritten by the Commonwealth Department of Industrial Relations, which joined the University in sponsorship. Six distinguished Japanese scholars presented papers; and they were mirrored by papers given by Australian scholars on the history of industrial relations in the same period. Members of the Group—Associate Professor Ray Markey, Dr Andrew Frazer, and Dr Andrew Wells — gave papers, and members of the Group chaired discussion sessions.

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Members
Ms Josie Castle, Associate Professor Rob Castle, Dr Andrew Frazer, Associate Professor Ken Hale, Ms Di Kelly, Dr Henry Lee, Associate Professor Ray Markey, Dr John McQuilton, Dr Glenn Mitchell, Dr Andrew Wells, Mr Rob Hood

The Group’s convener, Professor Jim Hagan, summed up on the first day, and the Vice-Chancellor, Professor Ken McKinnon, on the second. Allen and Unwin offered to publish the book which will be based on the conference papers, and the Group is negotiating with the Australian Society for the Study of Labour History for distribution.

This venture may provide a further source of income for the Group. Readers of last year’s Research Report will recall that the Group made an arrangement with the Society to distribute The Maritime Strike: A Centennial Retrospective, a book which it produced and printed. This has proved profitable, both to the Society and the Group, and both are looking at other ways in which the profit may fund or top up a scholarship.

Individual members of the Group in their own right won additional funding in 1993. Di Kelly won a research grant from Broken Hill Proprietary Limited (BHP) in recognition of the papers she has presented at the MIT-OECD Australian Group Workshop on the Australian steel industry. Associate Professor Ray Markey received $22,700 to write a report for the Australia Council on the industrial and Professional Representation for Visual Artists and Craftworkers. Others were busy implementing schemes on projects for which they received substantial funding. Josie Castle, John McQuilton and Jim Hagan constructed and taught on a course for the retraining of Australian history teachers, funded by DEET; McQuilton and Hagan also continued their DEET-funded work on the adaptation of Australian history topics for computer-aided learning.


John McQuilton continued his research into regional history, and published 'Comparative Frontiers: Australia and the United States' in American States, Vol 12, No 1, 1993.

Andrew Wells, funded by an ARGC grant, continued writing The History of Australian Communism (with Profes-
Co-ordinator of the Labour History and Industrial Relations Research Group is Professor Jim Hagan

Professor Stuart Macintyre, of the University of Melbourne), and gave a seminar in the Department of History and Politics' postgraduate series, entitled 'The Origins of Australian Stalinism: the CPA 1920-1935'.

Rob Castle and Jim Hagan also gave a seminar in the same series on 'Aboriginal Trust Accounts in North Queensland, 1903-1941'. Rob Castle also continued to edit (with Professor John Mangan, of the University of Queensland) the Focus on Economics Series for Oxford University Press, and since our previous report, OUP has published four new volumes in the series.
Management Strategy and Organisational Change

Co-ordinator: Dr A B Sim (tel 042 21 3611)

The aim of the Group - reconstituted in 1993 - was to develop and integrate new research-based knowledge of organisational strategy, innovation and change in the areas of operations, finance, technology, marketing and human-resource management. This reconfiguration was to focus on the clusters of core research strengths within the Management Department and to develop new linkages and interdisciplinary approaches to management strategy and organisational change.

Dr A B Sim was appointed co-ordinator of the group. A conference (of existing and potential members) was held to review the status of research projects and to explore further research areas and collaboration, particularly with Management of Integrated Technical and Organisational Change (MITOC), recently established within the Department of Management and with new academic staff members to be appointed during the recruitment exercise. Three sub-groups were formed to work out collaborative research arrangements for adoption in 1994.

Significant progress has been made with the Group members producing 41 publications (13 refereed journal articles, 13 published conference proceedings, three books/book chapters and 12 unpublished conference papers and other publications). This compares favourably with the 55 publications of the previously much larger Group. It must be stressed that the majority of the publications are of high quality, with more than two-thirds of them in top international refereed journals and conference proceedings and by publishers renowned worldwide.

In addition, recognition of Group members continued to grow with papers presented at important conferences/seminars and with three members being invited to give keynote and invited papers in Paris and Great Britain (Professor Palmer), Japan (Dr Sim) and Australia (Professor Hough). Dr Jabri won the best-paper award in management education at the American Academy of Management Meeting at Atlanta.

The Group had an active role in postgraduate training and research, with ten PhD and four MCom (Hons) students associated with it. To facilitate postgraduate research, a series of seminars on research methodology, thesis writing and research linkages was held. The Group was well represented on Postgraduate Open Day.

Further development of collaborative research linkages was stimulated by the Group September conference and the inclusion of Associate Professor R Badham of MITOC in the working group on collaborative research. The seminar services in the Department continued to be a major mechanism for research sharing and co-operative developments. The Group's external reputation and linkages have been enhanced by the active participation of members in international groups and research networks - by Professor...
Palmer in Europe and Dr Sim and Anthony Naughton in Asia-Pacific.

Distinguished visitors to the Group included Professor Leonard Berry of Texas A & M University, Professor Joseph Sirgy of Virginia Polytechnic Institute and State University, Virginia, and Dr Mark Dodgson of University of Sussex.

**Future direction**

The Group will be strengthened and expanded in 1994 and beyond by the addition of new members and the development of collaborative research with MITOC and others. In addition the Department will emphasise research strengths and potential linkage with the research group in its rounds of academic recruitment. Through the seminar, workshop and the reactivated working paper series, co-operative research and publication will continue to expand.

Application for external funding for 1994 totals $146,739. Attention will be focused on developing linkages and fundings from industry and other sources.

Postgraduate research student acceptances and activities are to be tied in as closely as possible to the activities of the Group. Research seminars and feedback will continue to assist these students. This will expand further the postgraduate support.

The momentum in terms of quality research and publication will continue. New research extensions and initiatives in specific areas (eg, gender issues and stereotyping in management, strategic innovations of Australian firms in Asia-Pacific, and technology buying for new product development) and strengthening of collaborative research will strengthen this growth. National and international exposure for the research will further enhance the reputation of the Group and the University.
Can regular physical activity modify functional changes in inactive, aged Australians, thus improving their health status and quality of life?

Physical Activity and Ageing

Co-ordinator: Dr Nigel Taylor (tel 042 21 4094 or 21 3881)

Like most Western countries, the average age of the Australian population is increasing. This Group was formed in 1992 to initiate multidisciplinary research aimed at investigating the physiological concomitants of ageing, the health implications of such changes and the possible role of habitual physical activity in minimising age-related dysfunction.

The project was designed to allow Group members and students from different disciplines to address three basic questions: (i) What are the functional differences between habitually active and inactive aged Australians? (ii) Are these functional differences markers for changes in the health status of the aged? and (iii) Can we modify the functional changes that occur in the aged, to improve their quality of life?

During 1993, Group members targeted research towards the first two questions, and are focusing upon gaining information on the affects of ageing using cross-sectional designs, across both the age and physical activity spectra. Specific emphases have included: (i) cardiovascular function; (ii) changes in the mechanics of daily living skills; (iii) neuromotor control of movement; (iv) respiratory function; and (v) thermoregulatory control.

The Group will be strengthened during 1994 by the addition of Professors Len Storlien and Dennis Calvert, Dr Barbara Meyer and Ms Linda Tapsell. Professors Storlien and Calvert will bring into the Group the discipline of endocrinology. This research will focus on the role of lifestyle (diet and exercise) and genetic factors in the aetiology of the 'Syndrome X' cluster of insulin resistance-related diseases including non-insulin-dependent diabetes mellitus, dyslipidemias, obesity, hypertension and cardiovascular disease.

Dr Meyer is working in the area of lipoprotein changes in diabetics. Ms Tapsell is a dietitian whose major interest is the counselling/educational process in diabetes, and monitoring compliance – a very important component of diet and exercise intervention studies.

Using the background developed from this research, the Group plans to undertake a collaborative longitudinal study, where the physiological status of chronically sedentary, elderly subjects will be studied over a 12-month period during exposure to a variety of exercise intervention programs.

Members
Dr Stephen Boutcher, Dr Mark Brown, Dr Peter Milburn, Ms Julie Steele

Applied Physiology Research Laboratory (Taylor)
Eight postgraduate students are involved in research within this laboratory. The work centres on investigating the control of breathing and thermoregulation, with attention to the aged. Completed projects have investigated: the affects of ageing on respiratory control in three age-groups of women, during exercise, hypoxic and hypercapnic stressors; and the control of skin blood flow during thermal stressors in resting males. Collaborative research, with colleagues from New Zealand and Perth, has investigated changes in muscle function in post-menopausal women with and without osteoporosis.

Biomechanics Research Laboratory (Milburn and Steele)
Ageing research studies in 1993 were implemented in conjunction with staff from the Institute of Rehabilitation and Allied Health, Illawarra Regional Hospital. The first study examined gait patterns of elderly below-knee amputee patients, whose amputation has resulted from peripheral vascular disease. The second study examined the influence of ejector chairs on the mechanics of rising to stand, in elderly disabled patients. A third project, in collaboration with Mechanical Engineering, is leading towards the development of a dynamic model of the human hip joint during locomotion.

Cardiovascular Research Laboratory (Boutcher)

The focus of this laboratory is to examine central and peripheral haemodynamic responses to various exercise stimuli. Four research projects are in progress: (i) epidemiology of cardiac neuropathy, as a function of age, in diabetics in the Illawarra; (ii) assessment of cardiac response of trained and untrained aged during exercise; (iii) assessment of the effect of regular exercise on respiratory sinus arrhythmia during rest and during exposure to myocaridal challenges; and (iv) assessment of the effect of regular exercise on cardiovascular response to stress.

Neuromotor Control Research Laboratory (Brown)

Research in this laboratory is concerned with the effect of ageing on the control of skilled movement. Investigated has been the role of muscle activation rate on the time it takes the elderly to react to external stimuli. The results have shown that slow muscle activation rates are indicative of elderly populations. Current research is investigating: (i) whether the age-related deterioration in motor function can be characterised by changes in brain function, as shown by electroencephalographic techniques; and (ii) neuromuscular control of the stoop-lift in the elderly.
PUBLIC HEALTH Research in the University is undertaken by 12 staff members of the Department of Public Health and Nutrition together with four staff in other departments and faculties in association with members of the Illawarra Area Health Service. It is the close relationship between University and Area Health Service which provides the unusual variety and service relevance of this research program.

Overall the Public Health Research Group has sustained and extended its research effort in the past year. New collaborations have been forged with researchers in the Illawarra Area Health Service through the activities of the Medical Research Unit. The

Members
Professor Dennis Calvert, Ms Deanne Condon-Paoloni, Professor Christine Ewan, Ms Rhonda Griffiths, Professor David Griffiths, Mrs Mary Harris, Dr Lindsey Harrison, Professor Don Hindle, Dr Rohan Jayasuriya, Ms Jennifer McArthur, Mr Paul O'Halloran, Mr Brian O'Neill, Ms Linda Tapsell, Dr Barbara Tooth, Professor Murray Wilson, Ms Heather Yeatman

Research Group has been named a Collaborating Centre of the Australian Institute of Health and Welfare. Planning is at an advanced stage for the efforts of the Research Group to be consolidated within an Institute of Health Services Development.

The other significant external event which will have important implications for this Group is the award of a Division of General Practice to the Illawarra (Chairperson, Dr M O'Halloran). General Practice research has always been an interest of the Group and should be facilitated by the Division, which requested that members of the Group serve on its executive advisory committee and research committee.

The sub-groups within the Public Health Research Group are Social Health and Nutrition; Health Services Development and Evaluation; Epidemiology and Environmental Health; and Mental Health.

Social health and nutrition
The year represented an important development period for this Group, which was successful in attracting grants totalling $171,835 – an increase of $95,835 over the previous year – and was marked by close and productive collaboration with the Medical Research Unit and the completion of a pilot program aimed at improving access to healthy foods at takeaway outlets in the Illawarra. Two members of the Group are well advanced in doctoral research. One of them (H Yeatman), will undertake a research exchange at University of California, Berkeley. The other (L Tapsell) has been successful in gaining a CAUT grant to support her research into client-provider interactions in dietary counselling.

Health services development and evaluation
This Group continued to work productively and with marked external grant success. In 1992-93 it attracted $744,517 in external funding in two research areas – Casemix and service utility studies (D Hindle) and GP/Specialist health care networks (M Harris). Of note has been the securing of funding to pay a number of research degree candidates while they undertake projects in Casemix.

Mental health
This sub-group has widened its linkage with mental health researchers in the Area Health Service and in areas of NSW to which the teaching program of the University extends. Of importance is the progress being made in a three-centre service evaluation study embracing the rehabilitation units of Shellharbour, Goulburn and Orange.

A PC-based information system of value to service and research has been agreed in the three units and the Research Group will assist the project with methodology and data analysis expertise. National attention has recently been focused on the need for
improvement in mental health services. It is hoped that this will provide further opportunities for research by the Group.

**Epidemiology and environmental health**

Researchers in these areas again link University and Area Health Service personnel. In the 1992-93 year the Epidemiology and Environmental Health group secured $907,095 in external grants. Environmental health is an area of growing importance nationally, a factor reflected by steady growth in research activity (C Ewan, M Wilson, D Calvert). The linkage between this group and the Public Health Unit of the Area Health Service (D Jeffs) provided real strength in public health issues, including injury prevention and asthma management (R Jayasuriya). General Practice research (J Fardy) was also well supported.

It is anticipated that in 1994 new staff appointments will sharpen the focus and increase the activity in Environmental Health and that the formation of the Division of General Practice will widen opportunities for research in general practice.

The Public Health Research Group is making strong progress on a number of fronts. The diversity of research and the growing number of research students in the Department provide a rich opportunity for continuing progress.
Human communication as a social resource in institutions: how people develop control over resources for meaning in a range of social contexts

Social Literacy
Co-ordinator: Mr Bill Winser (tel 042 21 3963)

This Research Group, formerly the Language Learning and Equity research group, has consolidated its focus on the study of human communication in the social system. Interests of the Group are geared to the study of social semiotics, including discourse systems and practices in institutions and the ways in which meaning is made in the language system, as well as in related areas, such as mathematical symbolisation. Literacy is thus interpreted as including speaking, numbering, writing and reading, in the broadest possible sense.

The Group has been successful in gaining research grants from the Australian Research Council (ARC) to support three of its projects, with a total of $67,000 received by Cranny-Francis, Winser and Wright, by Harris and by Ravelli. Funding from the Department of Employment, Education and Training (DEET) has been secured for two other studies by teams headed respectively by Cambourne and Winser, totalling $55,000. The research component of a major developmental project by Turbill and Cambourne, originating in the US, consists of a grant of $264,000.

Results of this research have been presented at conferences throughout Australia by members of the Group, and overseas – in Britain (Winser), the United States (Cambourne, Cranny-Francis, Turbill, Winser, Wright), Canada (Cambourne, Cranny-Francis, Ravelli, Turbill, Winser, Wright) and in Holland (Winser).

Five members of the Group were invited to deliver a total of 15 keynote, national and/or international conference addresses. The Group has produced a total of 18 major publications and has made 54 conference or seminar presentations.

Members
Associate Professor Brian Cambourne, Ms Beverley Derewianka, Dr Christine Fox, Mr Neil Hall, Ms Jenny Hammond, Dr Pauline Harris, Dr Jenny Jones, Professor Ron King, Dr Louise Ravelli, Ms Jillian Trezise, Ms Jan Turbill, Dr Wilma Vialle, Dr Jan Wright, Dr Felix Yuen

Specifically on written language, a focus which reflects the importance of this mode of language in schooling and in the culture generally. Studies range from interests in younger children to primary, secondary and adult learners, at University and in the workplace.

The last area represents the newest part of the Group's work, demonstrating the effectiveness of using linguistically motivated systems to increase workplace efficiency. In many of the studies there is a critical social orientation towards issues concerning values and ideology that are seen to be essential aspects of semiotic processes in their social setting. This approach provides a theoretical grounding for those equity concerns that have been long-term interests of members of the Group.

• Frameworks (Commercial venture): A staff development package for literacy teachers. Ms Turbill and Associate Professor Cambourne have completed the development of a package for teachers of the language arts in the US and are now extending its use in school systems in Australia.

• Intertextuality and reading: The role of texts, text interpretation and types of readers in reading instruction. Dr Harris has carried out analyses of children's texts to clarify any intertextual features of reading instruction. She has examined the verbal and visual texts in children's
picture books, and the intertextual interplay between the two, and has found that different kinds of interplay between these appear to have important implications for the kinds of readerships which are constructed. The more complex the interplay between visual and verbal texts, the more highly interpretive the reader's role becomes. Of particular interest have been the intertextual relationships between original literary texts and their re-worked versions as classroom-based reader texts.

• Language development and curriculum: Extending and applying language development theory to national language curricula and profiles. Dr Winser has collaborated with a colleague at Macquarie University in this project which has developed the conceptual bases for an understanding of how language develops in school-age children, by modelling the context of language in use at home and at school for the period immediately before and during the early stages of schooling.

• Literacy at tertiary level among native speakers: A linguistic approach to the literacy demands of university study. Dr Ravelli is continuing her pilot study of variation in academic writing according to university disciplines. The results highlight interesting similarities in adult writing requirements as well as differences between them. Some of the key features of successful writing that she has isolated have already been drawn on in writing workshops designed by Ravelli for the Australian Museum, in a project which explored difficulties the Museum has in the production and editing of texts for public exhibitions.

• Student achievement and gender in secondary school Mathematics and Science: Girls' and boys' attitudes to achievement in senior years. Dr Jones has completed the first analysis of data from secondary students in Year 10. The findings thus far show that factors such as socio-economic status of parents, school attended and organisation of school (co-ed or single sex) have little impact on student attitudes towards mathematics and science. These findings are congruent with the analysis of data from Years 7 to 9, although in Year 10 the most significant factors are gender and teachers. That is to say, girls believe more than boys that teachers more than any other factor impinge on their enjoyment and performance of mathematics and science.

• Language of Maths teaching in secondary school: The discourse of secondary school Mathematics teaching and learning. Cambourne, Hall, Turbill and Wright's preliminary analysis of data from mathematics classrooms has identified ways in which teachers build up patterns of mathematical understanding through language used in classrooms and has enabled them to explore the relation between these and the discourses of mathematics as a discipline.

• Mathematics learning in primary school: Studies in the semiosis of mathematics and of the role of the computer in learning. Neil Hall's data analysis in his study of the role of concrete embodiments in mathematics learning has shown that certain methods of teaching using these embodiments are more effective than others. The results of his study of computers in preschool mathematics learning are now being incorporated into a program of teacher development.

• Success and failure in secondary school English: Factors in teachers, students and classrooms affecting English teaching and learning (Drs Cranney-Francis, Winser and Wright). In the first full year of this project teachers and students have been studied and a picture of their backgrounds and assumptions about English has emerged, showing how expectations of both groups about what is important in English may vary and create problems for teaching and learning.

• Evaluation of the Write it Right Project: An evaluation of the effectiveness of a language and learning program across the secondary school curriculum. Drs Winser, Ravelli and Wright have completed evaluations of three key learning areas of the curriculum, showing how essential it is for teachers to use an understanding of the role of language in learning as a means of improving students' writing skills.

It can be seen that the Social Literacy Group's goals are being successfully achieved, in terms of external support for research, its output of published work and its impact on the educational profession. The outlook for further development is one of continuing attention to the work in semiotic systems and is likely to involve a stronger relationship with issues concerning social justice. There are new collaborations emerging with researchers in Information Systems and Telecommunications Software development studies; and the study of information technology as a semiosis is an area that is also likely to develop in the near future.
RESEARCH GROUPS

Critical analysis and policy issues in the understanding of people's changing social and political conditions

Sociological Analysis of Political and Cultural Change

Co-ordinator: Professor John Bern (tel 042 21 3745)

The Group's first year was one of establishing ground work and defining focuses. Eight members and five PhD students are associated with the Group.

The overall approach of the Group centres on the analysis and understanding of the social and political consequences of people's changing conditions of life. The three principal research areas are Urban and Regional studies, Intercultural studies (the areas of multiculturalism, migration, Asian societies and indigenous peoples) and Women's studies. The Group brings together researchers and postgraduate students concerned with the analysis of fundamental factors of advantage and disadvantage in social change and integrates research within sociology in this core area of the discipline.

The Group provided funding support for several projects. This facilitated

Members
Ms Rebecca Albury, Dr Ann Aungles, Professor Stephen Castles, Dr Mike Donaldson, Dr Tom Jagtenberg, Dr Jennifer Jones, Dr Ellie Vasta, Mr Paul Walton

Ellie Vasta's preparatory work for her study entitled Communities in Transition: Political and Cultural Transformations in the Western Suburbs of Sydney, for which she has recently been awarded a two-year large ARC grant.

In February 1993, Ann Aungles co-ordinated a research project investigating the family relationships of the responsible co-householders of Australian offenders being controlled under Home Detention programs.

John Bern began work on a case study of the public debate over the High Court decision in the 'Mabo case', examining issues of sovereignty and self-determination.

Stephen Castles was able to use support from the Group to carry out research on migration and citizenship, particularly through a one-month visit to Germany in June.

Mike Donaldson continued his work on issues of masculinity and published an article on the concept of Hegemonic Masculinity.

Tom Jagtenberg continued his research on media treatment of environmental issues. He is continuing his work on environmental issues and he presented a theoretical paper on Four Dimensional Social Space to the Group seminar.

Jennifer Jones undertook a pilot study in 1992 on her project, Mathematics and Science in the Secondary School Curriculum – Influence of Peers and Gender, and data from that study formed the basis of a conference paper and a research paper. Work was carried out in two local high schools – one a Catholic girls' school and the other a selective co-educational public school.

Research projects supported by external funds included:
Rebecca Albury, together with Susan Dodds (Philosophy) and Colin Thomson (Law), received a grant of $28,750 from the Commonwealth Department of Health, Housing, Local Government and Community Services to provide operational guidelines for the ethics of social/behavioural research for the Department ethics committee.

Ann Aungles’ ARC-funded project, Crime Victimisation Among Illawarra Commuters, focuses on the vulnerability of a specific population of Wollongong residents – those who commute to Sydney. Preparation for the project has involved co-operation with the local Wollongong Council group, the Wollongong Safe Community Action Team and the research branch of the State Rail Security and Protective Services Branch.

John Bern's three-year ARC-funded Hunter in Transition project is ap-
with papers presented by Rebecca Albury, Ann Aungles, Stephen Castles, Jennifer Jones and Trish Vezgoff.

During the year Ann Aungles and Mike Donaldson completed book manuscripts. Mike Donaldson’s manuscript is on the sociology of time, with particular reference to Australia and entitled Taking our Time. Ann Aungles’ manuscript is entitled The Home and the Prison and has been accepted for publication in the Institute of Criminology Monograph Series. Rebecca Albury has signed a contract with Allen and Unwin for a book on feminist struggles for fertility control; its working title is Beyond the Slogans.

In 1994 the Group will focus on two of the key areas drawn from the Department of Sociology’s priority areas.

Urban and regional studies
In this area the Group is building on achievements in the analysis of urban social and political issues and aims for at least two large ARC grants in the next two years. Each of the research students is undertaking regional research. Topics being researched by Aungles, Bern, Donaldson, Jones and Vasta fall within this area; they have obtained two large ARC and two small ARC grants.

Intercultural studies
The proposed focus in 1994 is on the development of research into linked themes: nationalisms, ethnicities, citizenship, sovereignty and self determination. Current work by Bern, Castles, and Vasta is directly concerned with these projects, which have no external funding. One small ARC application is pending and others are planned.

The Group considers that its main task is to raise the profile of its activities and attract both outside support and research students. The SBS initiative forms a part of this, as does the establishment of the area as a central theme of the Department of Sociology.
MEMBERS were again successful in obtaining grants from the Apple University Development Fund. These provide a Macintosh Workstation for research with the intent that one of the spinoffs from the research would be a software package for education. The projects funded in 1993 were: Optical Chemical Recognition (Associate Professor Neil Gray) - the recognition of chemical compounds from diagrams of their atomic structure, Fuzzy Logic Simulator (Dr Phillip McKerrow) - developing the control architecture for a mobile robot using fuzzy logic.

In addition, the group received an ARC infrastructure grant to purchase a precision positioner. This will be used to locate precisely and move sensors relative to objects in range sensing and mapping research with ultrasonic and vision sensors.

Dr Zelinsky received a two-year scholarship from the Japanese Ministry of International Trade and Industry (MITI) to work in the Electrotechnical Laboratory (ETL) in Tsukuba. ETL is the largest and most prestigious National Research Laboratory in Japan. ETL has an international reputation for excellence in robotics research.

To capitalise on Dr Zelinsky’s stay in Japan, Dr McKerrow and Dr Zelinsky obtained a grant from the Department of Industry, Technology and Regional Development to initiate collaborative research with Professor Yuta in the Intelligent Robotics Laboratory at the University of Tsukuba. This link was formalised with the signing of a collaborative research agreement during a subsequent visit by Dr McKerrow to Japan. The first project under this agreement is to rewrite a robot simulator developed at Tsukuba to simulate multiple robots. Jim Naumovski, a Master of Computer Science student, is working on this project.

Dr McKerrow’s work in ultrasonic mapping for mobile robots was recognised internationally with his appointment as the Australian member of the Board of Governors of Intelligent Autonomous Systems (IAS), an international society which organises conferences and workshops in intelligent robotics. His research has moreover attracted quality graduate students, with five PhD students, all supported by scholarships, working in his research team.

John Fulcher’s work in face recognition with neural networks received international recognition with his appointment as guest editor of a special issue of the North-Holland journal Computer Standards & Interfaces on neural network standards. He has begun a project to classify volcanic rock samples with neural networks.

Dr Nickolas continued his collaboration with the Department of Computer Science at the University of Queensland. He is working on three projects: implicit data structures in logic programming, formalising meta-level notations, and formalisation and correctness of Qu-Prolog unification. The goal of these projects is to develop a theoretical basis for improving logic programming.

Dr Stafford spent a sabbatical year as a visiting researcher at the Hayes...
Microsystems Research Facility in Toronto, Canada, working in the area of high-performance file systems. The work is commercial in confidence, so details may not be reported.

Dr Pirie successfully headed the Faculty's Computer-Aided Learning (CAL) project with funding from the Department of Employment, Education and Training (DEET). The Department's contribution to the group was to write seven CAL modules in a form suitable for in-house use. Formal trials begin in 1994. Apple Australia was so impressed with one module, ‘Inside the LC', that they purchased the rights to it and began distributing it to current and potential customers in the education area.

Dr Jonathan Gray organised two workshops on Parallel Software Engineering, one national and one international. In September Dr Gray and his international colleagues ran a workshop in Aachen, Germany, with 60 participants. They are currently negotiating with publishers for publication of the workshop proceedings as a book and also editing a special issue of a journal on this theme. With members of this research group he ran a second workshop in Wollongong in October, with 30 participants.

Professor O'Brien and his team in the Telecommunications Software Research Centre (TSRC) achieved international recognition with their involvement in International Federation of Information Processing (IFIP) working parties and the establishment of collaborative relations with the Telecommunications Information Network Architecture Consortium (TINA-C).

The focus so far has been on one application, Universal Personal Telecommunications (UPT), one platform and one set of tools. In line with the TINA-C program, TSRC sees benefits in the generalisation and extension of the UPT application to provide total communication support within the work organisation across a range of media, in the extension of the modelling of services to implementation and the development of software libraries as part of the implementation, in the extension of the modelling of services to the enterprise and information levels and in the extension to other services such as video on demand, virtual private networks and virtual reality.

With the development of the Distributed Programming Environment, Hermes-ST, TSRC is now contributing actively to TINA-C's proposed Distributed Processing Environment (DPE). Finally, TSRC's work in repair and object-oriented database technology vis-a-vis relational has the potential to make a significant contribution to the translation between network services systems and existing systems which provide operational support such as provisioning, billing and fault management.
The main activity of the Structural Engineering and Construction Research Group may be grouped collectively by the acronyms CCC, i.e., concrete structures, construction materials and computer applications. Selected projects from these areas are summarised together with information concerning a fourth C — conferences.

Concrete structures

In this category are two projects which are making a significant impact.

(a) Punching shear strength of post-tensioned concrete flat plates with spandrel beams

To investigate the punching shear strength behaviour of concrete flat plates, a six-year project conducted by Associate Professor Yew-Chaye Loo and supported by the Australian Research Council (ARC) and industry began in 1989. The first three years were devoted to the study of reinforced concrete flat plates. This was completed in 1991. From the ultimate load tests of nine half-scale models, it was found that the Australian Standard recommendation frequently, and at times grossly, overestimates the punching shear strength of reinforced concrete flat plates with spandrel beams. By incorporating the model test results, a new prediction procedure was developed which has been shown to be superior to the Australian Standard method as well as those recommended in the British Standard and the American Concrete Institute design code.

This is the second year of the second three-year project supported by the ARC. By October 1993 three half-scale post-tensioned concrete flat plates with spandrel beams had been tested to failure. Punching shear strength data on nine edge-and corner-columns have been obtained. An initial comparative study has indicated that the design code methods are again inadequate in predicting the punching shear strength of post-tensioned concrete flat plates. It is hoped that a reliable semi-empirical prediction method will result from this research.

Parallel to the laboratory and semi-empirical studies, a rigorous analytical procedure is being developed. It is based on the non-linear finite element method which incorporates the layered-element procedure. When completed, the punching shear ‘tests’ of flat-plate structures of any size and complexity may be ‘conducted’ in a computer.

(b) Reinforced concrete beam and column connections for precast multi-storey buildings

The behaviour of beam and column connections is one of the most important considerations in the design and construction of precast concrete building systems (Figure 1). The connection details (Figure 2) and the load-transfer mechanism affect the strength, stability, ductility and ‘constructability’, as well as load redistribution, of the building under load.

Directed by Associate Professors Loo and Montgomery, a project was begun in 1992. The aim is to investigate in the laboratory, using half-scale models, the structural behaviour of precast connections under static and cyclic loads. Included in the first year of the study are connection types recommended for use in this country, in the UK and in the US. Twelve models (each weighing a quarter of a tonne) have been tested to failure under static loads (Figure 3). The tests of further six models under cyclic loads are in progress.

Members

Dr Animesh Basu, Associate Professor Max Lowrey, Associate Professor Denis Montgomery, Dr Yen Wen Wong
Construction materials

Various projects concerned with the behaviour and applications of engineering construction materials have been continued, or instigated, during 1993, by Associate Professor Montgomery. Investigations into the use of marginal or byproduct materials, such as blast furnace slag, BOS slag and fly ash as supplementary cementitious materials, have resulted in the development of theoretical relationships and empirically based criteria to assess the degree of acceptability for various applications. This work has resulted in the publication of several research papers in engineering journals and has been presented at Australian and international conferences. A research project associated with determining quantitative values of plastic shrinkage of conventional and blended cements has produced initial results which will be beneficial in determining the behaviour of these materials in practice. Other work which began this year concerns the corrosion characteristics of steel fibres in concrete, cathodic protection of concrete and encapsulation of hazardous wastes in cementitious matrices.

Computer applications

Associate Professor Lowrey continues his work on the development of personal computer (PC) software for structural mechanics. Further extension to the popular educational package, 'Animated Vibrations', has been carried out. The improvements are published in the proceedings of an international conference held in Europe. His other work on the closed-form analysis of orthotropic plates, folded-plates and box structures has been successful. PC programs are now available for use by structural engineering academics and designers.

Dr Wong's development work on PC software to aid structural design is making good progress. The package will create a database for a structural system widely used in Australia's rural industry. The system utilises cold-formed light-gauge steel and it is often subjected to high wind loads. The difficulties currently encountered in the design are the lengthy process of estimating the wind loads, and the complicated procedure for designing cold-formed steel sections. In this effort, Dr Wong is assisted by some local consultants and steel fabricators. When completed, the package will enable the designer to make a rapid but accurate prediction of the dimensional limits of a given structure of this type. Dr Wong is also developing a
CAL (Computer-aided Learning) program in the structures field.

To add to the strength in computer applications, Dr Basu has joined the Group from the Mechanical Engineering Department. With his expertise in the areas of finite element method and computational mechanics, the quality and quantity of the work will be increased.

Conferences

Associate Professors Loo, Lowrey and Montgomery and Dr Wong served on the organising committee of the 13th Australasian Conference on Mechanics of Structures and Materials (ACMSM-13).

Held at the University of Wollongong from July 5 to 7, the conference attracted some 125 participants. Written and verbal comments received indicate that it was one of the best in the ACMSM series.

Associate Professor Loo was elected member of the International Steering Committee and the Executive Committee of the East Asia-Pacific Conference on Structural Engineering and Construction; Associate Professor Montgomery was elected member of the Executive Committee.

In recognition of its standing and contributions, the Group has been awarded the right to hold the next Conference (EASEC-5) in 1995 in Wollongong. The theme of the Conference will be Building for the 21st Century. Associate Professor Loo will serve as the chairman and Associate Professor Montgomery the vice-chairman, of the organising committee. If attendance at EASEC-4 (September 1993, Seoul, Korea) is any guide, EASEC-5 can expect to be an important event in the international calendar of structural engineering and construction activities.
RESEARCH GROUPS

Visual art/craft theory and curation
Theatre traditions and technology in Australia
Australian music documentation

Studies in Contemporary Arts Practice and Performance in Australia

Co-ordinator: Dr Andrew Schultz (tel 042 21 3302)

RESEARCH FOCUS is related to the creative arts in Australia with special emphasis on interdisciplinary research and methodologies; questions of national identity including those which emerge within an international context; and providing documentation resources in 'under-researched' areas.

The types of research include collaborative projects between Group members and researchers outside the University and a smaller number of projects by individual Group members that relate to the main research focus.

In 1993 the Group's research activities were consolidated into three key areas with a number of subsidiary projects.

Some highlights of the year include the publication of Andrew Ford's book Composer to Composer, invited lectures to key international conferences in Canada and the United Kingdom by Diana Wood Conroy and Sue Rowley, and the strong external funding support for Peter Shepherd's 'Identities' project.

Various Group members have also been active artistically. The film version of Andrew Schultz's Black River was awarded the Grand-Prix Opera Screen at the Opera Bastille, Paris, and his Dead Songs (a song cycle for soprano, clarinet, cello and piano with texts based on gravestone inscriptions from NSW seaside cemeteries) was successfully premiered in Brisbane and Sydney. Dead Songs was described by one critic as 'a vital, spellbinding experience' and a 'work of art of a high order with an ending of universal resonance' (Roger Covell, Sydney Morning Herald).

Continuing Projects

1. Visual art theory projects: Diana Wood Conroy, Sue Rowley, Peter Shepherd, Nan Chien Tsou, Janis Jefferies (Goldsmiths College, University of London)
   a) Craft/art theory and curation involving an anthology of scholarly writing in relation to tapestry and textiles dealing with developing theoretical frameworks for interpreting craft.
   b) 'Identities'. Directed by Peter Shepherd, the Australian/Taiwanese Art Exchange Project is the first time that artists and the public of each of these two countries have had the opportunity to see a major exhibition of contemporary art from the other. The first exhibition from Australia, curated by PhD student Deborah Hart, was shown at the Taipei Fine Arts Museum from December 1993 until the end of February 1994. The exhibition brings together the work of 30 of Australia's leading contemporary artists and has been carefully researched to represent some of the major issues in current art practice.
   c) Studies of artistic process - an examination of the relationship between artistic practice, critical and theoretical writing about the arts and curatorial practice. The project investigates the autobiographical sources and content of selected contemporary Australian artworks, and the relationship between personal experience and the broader cultural milieu in which artworks become meaningful.

2. Studies in theatre traditions and technology in Australia: Clem Gorman, Ian McGrath
   a) 'Caretaker of the vision'. A draft text by Ian McGrath on directing

Members
Ms Diana Wood Conroy,
Mr Andrew Ford, Mr Ian McGrath, Dr Sue Rowley,
Dr Peter Shepherd
Excerpt from Dead Songs. Movement 8, 'Peace Perfect Peace'. Andrew Schultz, Sydney: Sounds Australia, 1992, 51pp
Gorman’s new project on Australian epic theatre will research an area which has been little studied and seek to ask questions such as: is an Australian epic theatre tradition already in existence? If it exists, what are its characteristics? Is it necessarily historical? Does it involve, or depend upon, monologue?

3. Australian music documentation projects: Andrew Schultz, Nan Chien Tsou, Brenton Broadstock (University of Melbourne)
   a) Annotated anthology of 19th century Australian music; an ongoing survey.
   b) Directory of Australian composers. In collaboration with the Australian Music Centre, the group is providing research services and editorial oversight for the research and publication of Volume 2 of this standard reference text.
   c) Dictionary of Australian composers: Brenton Broadstock, University of Melbourne and Andrew Schultz.

Completed Projects
1. Constraints which impinge on the collaborative process in music-theatre production: Peter Shepherd, Andrew Schultz, Andrew Ford.
2. Relationship between artistic practice in the visual arts and scholarly writing: Sue Rowley.
3. Critical studies of music and postmodernism with regard to parody, meaning and text aesthetics: Sue Rowley, Andrew Schultz.
5. Interviews with contemporary composers: Andrew Ford.
6. Processes of lighting for the stage: Ian McGrath.
7. Directions of contemporary tapestry weaving in Australia in relation to national and international movements: Diana Wood Conroy.
Studies of ancient basement rocks of the Tasman Fold Belt continue to produce important conclusions on various aspects of the geological evolution of the region.

Tasmanides
Co-ordinator: Dr Chris Fergusson (Tel 042 21 3860)

T HE TASMANIDES Research Group includes six academic staff of the Department of Geology, together with associate investigators from Australian organisations including James Cook University, University of Technology (Sydney), Geological Survey of Queensland, Geological Survey of Victoria, and the NZ Crown Institute of Geological and Nuclear Sciences. Group members are actively publishing research jointly with these associates and many overseas colleagues. This high level of activity has continued - despite the fact that all finances provided by the University to the Research Group have been committed to support part of a PhD scholarship.

The Group’s research focuses on the ancient basement rocks occurring in the Tasman Fold Belt of Eastern Australia and spanning the interval from approximately 500 to 100 Ma. These rocks contain important mineral deposits, located in continental edge environments dominated by island arc settings. From the Group’s studies it is hoped to generate data significant in the understanding of aspects of mineral deposits in the Tasmanides. This has led, for instance, to a close working relationship with CRA Exploration, who provide continuing field and logistical support for honours students. Significant research emphasis is also placed on the tectonic environment of the Indonesian region, which provides a modern analogue for the ancient arc-related setting of the Tasmanides: *the present is the key to the past.* Staff and student research projects have been established in Iran and New Zealand, where rocks of similar age and style to the Tasmanides occur.

The very active postgraduate research cohort in the Department of Geology includes many research students studying aspects of the Indonesian region. Currently there are 13 PhD, two Masters and three honours students pursuing topics directly pertaining to the Tasmanides.

**Anakie Inlier**

A second year of ARC funding for Tasmanides research has been enjoyed by Chris Fergusson and Paul Carr for research on the Anakie Inlier in Queensland. This funding is supporting a PhD student, and also involves Bryan Chenhall. Following 1992 field work, a further three months of detailed structural mapping was undertaken by Tim Green (PhD student) in two further areas of the Anakie Inlier. A third new area in the southern part of the Anakie Inlier was investigated by Chris Fergusson, in order to assess the relationship between the Anakie Metamorphics and the lower grade Ordovician Fork Lagoon Beds.

With more emphasis being placed on the determination of the metamorphic history of the Anakie Inlier, field work was also carried out by Bryan Chenhall (and Tim Green), and a detailed laboratory analysis, including microprobe analysis, of selected samples is currently under way.

The age of the Anakie Metamorphics has proved more difficult to establish, with several methods being investigated by Paul Carr. Initial age data were obtained using Rb/Sr isotope ratios of biotite extracted from the Retreat Batholith and the Anakie Metamorphics. This method proved to be unsuitable for determining the age of the metamorphics; dating of monazite and garnet, and studies of Pb isotopes at the CIS at CSIRO, North Ryde may provide age determinations for these rocks. Two papers concerned with the structure of the Anakie Inlier, along with a third on the metamorphic history, are currently in preparation.

**New England Fold Belt**

Chris Fergusson and co-workers continue his ongoing and very productive collaboration with Professor E C...
RESEARCH GROUPS

Figure 1. Geologists on the job at Warden Head, Ulladulla, examining structures in the Permian Wandrawandian Siltstone. Left to right, Dr Chris Fielding (University of Queensland), Associate Professor Brian Jones and Stuart Leitch (UTS) and Associate Professor R A Henderson (JCUNQ) on the tectonics of the northern New England Orogen. In addition, collaborative work with members of the Geological Survey of Queensland on the geology of the Anakie Inlier in Central Queensland was commenced in 1992 and is continuing. This NEFB project is supported by a large grant from the ARC.

Permian of southern Sydney Basin

The major project funded by the Tasmanides Research Group this year is a PhD study by Stuart Tye (see photograph) which aims to provide better understanding of the Early to Middle Permian sedimentary rocks of the southern Sydney Basin. The study area encompasses a relatively inaccessible area extending from approximately Marulan in the north to Batemans Bay in the south. Previous studies are generally outdated and far from comprehensive; recent developments in sedimentary facies analysis have thus not been incorporated into any interpretations of this area.

At this stage, sedimentary sections and drill cores covering much of the northern half of the study area have been logged in detail. Petrographic data are providing information on the source and diagenetic history of the sedimentary sequence. Organic petrography data will be used to model the thermal history of the basin, and to shed light on the amount of erosion since deposition of the Sydney Basin sequence ceased, no earlier than the Jurassic.

Research by Brian Jones, Kobus Le Roux (sabbatical visitor to the Group) and former students has yielded one paper in press on the Nowra Sandstone. Three papers in preparation provide discussion and interpretation of sedimentary facies within two basal units of the coastal exposures of the Permian (the Wasp Head and the Snapper Point formations), while the third paper discusses implications from some of the organic petrographical work.

Joint studies in the southern part of the study area, with Dr Chris Fielding from the University of Queensland, will provide data fundamental to the understanding of the earliest development of the Sydney Basin.

Studies of the age, geochemistry and isotopic character of igneous rocks of the southern Sydney Basin and their significance for the tectonic development of the basin are continuing. Paul Carr presented a talk on this topic at an international symposium held in Johannesburg in September and has submitted a paper for publication.

Graptolites and other Tasmanides fossils

Studies on Lachlan Fold Belt graptolites have been undertaken in collaboration with Dr Barrie Rickards, Reader in Palaeobiology, University of Cambridge, by Tony Wright while on leave in early 1993 at Cambridge. A large fauna of Silurian graptolites from the Quarry Creek area west of Orange, NSW, has been described, and a large manuscript (Rickards and Wright, jointly with Gordon Packham and Penny Williamson) is in press in the Memoirs of the Association of Australasian Palaeontologists. Several other NSW Silurian graptolite faunas are under study with Dr Rickards.

Tony Wright, Dr Des Strusz (Australian Geological Survey Organisation) and Dr John Pickett (New South Wales Geological Survey) are collaborating in studies of unique Silurian shelly faunas, on which a manuscript is in preparation. A major paper on the
Cambrian-Ordovician trilobites of the Mount Patriarch area, South Island, New Zealand, prepared jointly with Dr Roger Cooper (NZ Crown Institute of Geological and Nuclear Sciences) has been submitted for publication.

Studies of Iranian fossils collected by Ali Hamedi are being carried out by Tony Wright in collaboration with Professor Art Boucot (Oregon), Professor David Bruton (Oslo), Professor Brian Chatterton (Edmonton), Dr Peter Jones and Dr Bob Nicoll (Australian Geological Survey Organisation) and Dr Barrie Rickards (Cambridge). This Iranian project is, in part, supported under the aegis of an agreement with the Geological Survey of Iran; one paper is in press.

**Capertee High and Windellama Tract**

Studies of the Capertee High by John Pemberton, Gary Colquhoun (PhD student) and Tony Wright are yielding important results concerning the evolution of the northern part of the High. Excellent age control is being provided by conodonts extracted by Gary Colquhoun and Tony Wright from limestones in the region.

The illustrated coral is a new genus under study by Tony Wright and Julie Bauer from Silurian limestone at Bungonia. Julie’s honours studies have revised the stratigraphy of this area and it is hoped that the results will be published in the near future.

**Editorial activities**

These have, until recently, occupied a considerable amount of time for several Tasmanides members.

Brian Jones was Editor of the Australian Journal of Earth Sciences, ably assisted by Paul Carr and Chris Fergusson.

Chris Fergusson (along with Dr Dick Glen, Geological Survey of NSW) edited a special volume of the Elsevier journal *Tectonophysics* on the Lachlan Fold Belt.

Paul Carr has again edited the *Research Report for the Centre for Isotope Studies*. The CIS is a most important analytical facility (providing essential equipment for researchers in our department), being a co-operative ARC-funded venture between CSIRO and several universities.

**Summary**

The Group continues to carry out a vigorous program of research on a number of aspects of Tasmanides geology. Good relationships have been established with CRA Exploration in particular.

Postgraduate student numbers are at a reasonable level. Members continue to apply for funding from, mostly, the ARC.

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**Figure 2.** Thin section of a new genus of Silurian coral from Bungonia

**Figure 3.** A reconstruction of the mid-Silurian coastal sedimentary environment in the vicinity of Cudgegong, NSW, as deduced by Pemberton *et al* (in press) from studies of the Willow Glen Formation
SEVERAL MEMBERS of this Development Group travelled to many different parts of the globe to present papers at conferences and other research gatherings such as doctoral consortia. Consequently the group is developing an international reputation for the high quality of the work it is generating.

The Group is essentially departmentally based and as there have been changes in the personnel of the Department there have also been changes in the membership of the Group. This has necessitated restructuring the Group and refocusing some of its activities.

Some earlier projects have been refined and narrowed in their scope, other new projects have been added. There are now eight different projects within the Group. These are:

**Major projects:**
- Public Sector Accountability Issues
- Management Accounting and Information Systems
- Small Business Financial Management
- Accounting History
- Critical Accounting Issues
- Finance
- Financial Reporting of Australian Companies
- International Accounting

Whereas the first project originally concentrated on efficiency audits of the Government Audit Office it has been expanded to include research into public-sector accountability. The project has been greatly strengthened by the admission of Associate Professor Michael McCrae who has had substantial experience and is well-published in the area and has attracted significant research funding in the past. Mary Kaidonis is undertaking an investigation into the structure and management of the South Australian Housing Trust, especially the effects of the changing emphasis of the Trust away from the traditional 'welfare-service' philosophy to a more corporatist, profit-driven body. In fact, this is the major thrust of the work by members of this project because of the changing emphasis in almost all public-sector bodies with the change to the concentration on public-service economy and efficiency and the change in accounting methods.

The management accounting and information systems project has also changed because of changes in key personnel. There is now a greater emphasis on more traditional methods of assessment of new developments in management accounting systems, especially those in manufacturing concerns. Associate Professor Linnegar is undertaking studies on activity based costing and on accounting techniques and economic performance within Australian companies. His work extends to cover the implications of just-in-time (JIT) processing and total quality management (TQM).

Larry Blackett has been developing an understanding of notions of controllership with Australian entities and has been a presenter at major workshops for the ASCPAs. Bob Williams has been examining the historical development of some major management-accounting concepts.

The largest number of business entities in Australia are classified as small business and it is vitally important to the economy that these be...
Published financial accounting is important for accountability. Seen here scrutinising company Annual Reports are, from left, Anne Mitchell, Garry Tibbitts, Michael Gaffikin, Mary Kaidonis and Anne Abraham.

Managed successfully. Yet many small businesses cease to exist because of faulty financial management. The members of this project are currently researching financial planning and funding, growth factors, family companies, strategic planning and management, success prediction, the role of advisers and franchises. The objectives are to examine factors influencing success and or growth in the small-business sector including organisational form, the use of accounting information, access to funds, planning strategies and the role of advisers.

Most of the members of the history project are employing 'new history' in examining the development of concepts and institutions in accounting. For example, a Foucauldian study of the growth of the accounting professional bodies is useful when examining the role and extent of accounting regulation imposed in the business community. Similarly, the development of taxation—the economic and non-economic uses of it. Also the development of accounting in Indonesia and the influence it has on contemporary business practice (ie, the development).

The critical accounting issues project is seeking to add a new dimension to accounting thought. It is concerned with employing non-mainstream research to accounting problems. This has involved studies of the impact of feminism on accounting and the socio-political forces influencing the development of accounting education. It also involves examining power relations within the profession (discipline). Additionally, it is being extended to incorporate postmodern views of accounting.

The finance project, as its name implies, is concerned with researching the role of finance in contemporary business. This is potentially a very broad area of study but members are concentrating on specific areas within the generic. For example, there is a major study of implications of superannuation funds management. Another area is the use and availability of venture capital.

The financial-reporting project has as its major aim the publication of empirical studies of company reporting practices in Australia. Results are included in a major monograph published by the Australian Accounting Research Foundation and provide an important database in the area for researchers and business analysts. Members all contribute at least one chapter to the monograph, two having being published in the last four years (the next is due to be published in 1994). This is a major project and consumes time and resources as the source data are not easily available.

The international accounting project is concerned with accounting issues across national boundaries and therefore involves examining different regulatory environments as well as cultural factors. It also examines attempts at regulatory and other forms of accounting globalisation (and international harmonisation). One member has been on study leave (Spring Semester) with a view to collecting data to develop his research.
This group of busy and productive researchers is engaged in a number of projects central to the provision of psychological services in health centres, counselling centres and hospitals of both local and international importance. In 1993 these projects included:

A. Palliative care: the quality of life of dying patients and their carers (Dr Viney, Dr Walker and Dr Tooth);

B. The transition from HIV to AIDS (this research is being carried out with Professor Beverly Raphael at the National Centre for Social HIV Research, at which Associate Professor Viney spent three months as a Research Fellow);

C. Academic’s construing of organisational change (Dr Viney, Dr Walker and Dr Hampton);

D. Construct change, confirmation and emotion (Dr Viney and Dr Tooth);

E. Editing Personal construct theory: A psychology for the future (Dr Walker and Associate Professor Viney);

F. Extended indexing of Kelly’s psychology of personal constructs (Dr Walker);

G. Dependency dispersion and interpersonal intimacy (Dr Walker);

H. The role of cognitive and motivational concepts in clinical psychological explanation (Dr Mackay);

I. Service delivery to people with developmental disability (Dr Tooth, Ms Gerry and Bowen);

J. Clinical psychological assessment (Mr Freestone);

K. Assessing psychodynamic and constructivist processes (Dr Henry);

L. Psychotherapy with adolescents (Dr Henry);

M. Psychiatric rehabilitation (Dr J de Wet).

These projects we see as contributing to our six mutually agreed goals:

To explore the often-ignored intellectual underpinnings of clinical, counselling and health psychology (achieved by projects D, E, F and H);

To devise new methods of assessment for them (achieved by projects A, I, J and K);

To develop and evaluate better treatments in these areas (achieved by projects A, B, C, D, G, I, L and M);

To liaise with local clinical, counselling and health services to conduct research relevant to their needs (achieved by projects A, C, I, J, K and M);

To provide channels of communication about research in these areas (achieved, in part, by the convening of the 10th International Personal Construct Psychology Congress in Australia for the first time (Viney and Walker); and

To develop the skills of researchers in these areas, by ongoing research meetings and supervision. It should be noted that one of our associate members, Dr Barbara Tooth, has completed her PhD (Clinical Psychology). Combining excellence in both research and professional practice, this degree was first introduced at the University of Wollongong.
EDUCATIONAL policy and planning in curriculum has taken significant new turns both nationally and internationally over the past few years. On the one hand there is greater emphasis on teacher accountability and on precision in determining indicators of learning outcomes. On the other hand an academic debate rages over the wisdom of using the language of economic rationalism in that endeavour.

These debates spark further discussion in research circles and in the national media over what is important about culture and learning in a multicultural environment. They provide fertile ground for broadening educational research in particular learning areas, such as in science, music, mathematics, health and art. And they have a wide impact on perceptions of professional and curriculum development.

In such an environment, the Curriculum Research Group (CRG) is well placed to combine theoretical concerns with research in practice. The CRG is now completing a second year of operation.

Members
Dr Ted Booth, Mr Ray Crawford, Ms Tonia Gray, Dr Grace Masselos, Dr J Michael Wilson

Professional development and the curriculum
Perceptions of beginning teachers
Wilson and Booth completed the next stage of their research into enhancing perceptions of professional development.

The year was spent in analysis of the data from the second phase of the project which had been collected from 1990 to 1992. Data were from semi-structured interviews with graduating students in both the BEd and GDE programs and from a small number of teachers in their first year in the field. Issues raised relate to a number of recent developments in national policy on teacher education. It is anticipated that this work will be extended into the South Pacific in relation to changes arising from aid projects and other sources.

Early childhood
Dr Masselos has initiated a program on early childhood, where parents/guardians learn to study the development of their own child in a preschool setting using a literature-based curriculum with a metacognitive approach to learning.

In addition to this major project, Masselos is working on a longitudinal study on the perceptions and expectations of primary school teachers during their first five years of teaching, and on another study relating to undergraduates’ concepts of multicultural education.

Health education
The main thrust of Tonia Gray’s research involves two significant educational areas: the investigation of the effects of outdoor education in extended school settings and the AIDS related behaviours of pre-service health educators. Her work in the Outdoor Education field is widely recognised and has generated a high degree of professional interest Australia wide. The evaluation of the impact of a 12-month outdoor education program (Timbertop-Geelong Grammar) forms the basis of her doctoral studies which are nearing completion.

Gray’s research in AIDS Education involves studying the ‘instructional paradox’ or gap between what is taught and what is practised by health educators. This is a major issue for health educators, because it is strongly associated with aspects of role modelling.

Another of Gray’s interests is in asthma research. She is working collaboratively with the Public Health Unit (Illawarra Area Health Service) and a research team associated with the Australian Sports Commission.

Science and technology
Bryan Ferry’s work on professional development in Science and Technology includes two programs. The first aims to support classroom teachers and pre-service teachers to implement hands-on science. The pilot study is
In 1994, the program will be conducted across 15 schools and will involve 120 pre-service teachers, 60 classroom teachers and 1200 students. The second project aims to study the effects of the explainer program at the science centre.

Music Education
Nita Temmerman's research has been related to following up some findings specific to the Australian community's perceived role and the influence schools have in the development of adult preferences for certain music forms. It is anticipated that in 1994 a joint project with Temmerman and a colleague from the University of Western Sydney will be started. The project will involve an analysis of music education offerings available in Universities around Australia.

Intercultural and international contexts
Best of both worlds: cross-cultural art education
Children represent or reproduce their world in many ways, one of which is through art. Ian Brown is continuing his study of similarities and differences in art method and teaching cross-culturally. This study has enabled major pedagogical issues in art education to be highlighted between Australia and Thailand. Schools and educational institutions have been visited in Thailand resulting in interviews with exemplary teachers, curriculum developers and Ministry of Education officials. Thai educational practices and theory have been examined and investigated. Numerous differences and similarities in curricula materials, teaching methods and assessment procedures have been examined which has resulted in some interesting and worth-while findings. The results of this continuing research will help Australian art educators to share some positive aspects of cross-cultural education. The study is beneficial to curriculum developers in art education as well as forging strong international links between both educational institutions and systems.

Pacific island research
Research by Dr Booth and Dr Fox is progressing and Booth undertook a further qualitative investigation into the professional development of teachers through an overseas practicum in Fiji in June. As part of the second ongoing project on a comparative analysis across three countries in the Pacific of curriculum innovation and changes in classroom teaching practices, extensive inter-

Impact of immigration on NSW education
Research by Dr Fox as a chief investigator with project coordinator Dr Robyn Iredale (Centre for Multicultural Studies) and Dr Graham Harrison (Census Applications) has been funded by the Bureau of Immigration and Population Research and the NSW Ministry of Education. The project is investigating the impact of immigration on NSW education, in relation to demographic changes; provision of language and literacy for second-language learners in schools, TAFE, higher education and the community; curriculum implications; impacts for students; and implications for professional development. The results of this work will be published by the BIPR in 1994.

Aboriginal perspectives
A project in the area of Aboriginal perspectives teaching and learning in the Foundations Strand of pre-service teacher education courses is being explored by Dr Arthur Smith and Dr Booth. Smith is engaged in a project with UNSW outside the Faculty on Aboriginal Studies and Torres Strait Islander Studies for Teacher Education Courses Steering Committee (Chair until recently: Oodgeroo, Dr Kath Walker).

Content analysis for cultural inclusiveness
The CRG plans to work as a team in 1994 to investigate the extent to which specific curriculum program documents and support materials developed for schools since 1983 reflect and support the NSW Multicultural Education Strategy. This is a pilot study aimed at examining a key area of concern in education.
THE INTERNATIONAL Business Research Group was established in 1993 to consolidate and enhance research activities in the general field of international business with emphasis on its implications for Australia. Interdisciplinary, the Group concentrates on theoretical and applied research areas in accounting, business systems, economics and management. Major research topics of Group members were export-import relationships, international investment, capital markets and the internationalization process, with emphasis on strategic alliances between firms in different countries, exchange rates, transfer pricing policies and Islamic banking.

A major research topic initiated was entitled 'Export Australia'. Its aims are to study trends in Australian exports and market shares and identify market opportunities and needs through analysis of industry and consumer requirements. It would assess customers' attitudes and motivations towards Australian products, analyse the impact of changes in international money and capital markets on investment in particular lines of production. And it would evaluate the effectiveness of the industry's promotional activities and marketing strategies on the dynamics of international marketing.

The Group approached the business community for financial support. A number of applications for ARC grants would also be lodged to obtain the finance needed to achieve the objects of the major topic – 'Export Australia'.

During the year, the Group succeeded in building up a record of 26 publications, most of which were articles published in international refereed journals. Given that the Group set itself a target of 30 publications over the three years 1992-1993 to 1995-1996, the progress is certainly praiseworthy. Some members of the International Business Research Group are also members of other research groups/programs. Those authors listed some of their publications under the research output of the other University groups (eg Metwally listed three in the Asia Pacific Program, Perera listed two in the Modelling Group, Ed Wilson listed two in the Modelling Group and Ann Hodgkinson listed three in the Labour Group).

Many publications are in the pipeline. These will basically reflect the findings of 'Export Australia'. And, of course, members are jointly or individually engaged on research in related fields.

Members during the year attended a number of international and local conferences. Associate Professor Metwally was appointed the Academic Co-ordinator of the Third International Conference on Business and Economic Development in Middle Eastern and Mediterranean Countries, which was held in Istanbul during the period July 5 to 7. He gave a keynote address and presented a paper. Also present at that conference was Dr Nelson Perera, who gave a paper to the Conference of Economists held in Perth in September. Mr Anwar Chowdhury, Associate Professor Metwally and Mr Anthony Naughton presented papers at the International Conference on Islamic Banking held in Sydney on November 9 and 10.

The conference on Islamic Banking was the first of its kind to be held in Australia. Islamic banking is a new concept, with important implications for international business. In an Islamic system, where interest is prohibited, banks are expected to operate solely on the basis of profit and risk sharing. The conference was held in the University Centre in Sydney.

Twenty papers were submitted by scholars from many parts of the world. Among them were the Dean of Faculty of Administrative Sciences, King Saud University; the Head of the...
The International Business Development Group was established in 1993 to consolidate and enhance research activities in the general field of international business and its implications for Australia. The Group is interdisciplinary and covers theoretical and applied aspects of accounting, business systems economics and management. Members of the Group seen here are, from left, Mr Ed Wilson, Mr Anwar Chowdhury, Mr Anthony Naughton, Ms Liliana Vlachos, Ms Ann Hodgkinson and Dr Nelson Perera. Seated is the Group co-ordinator, Associate Professor Mokhtar Metwally.

Department of Economics, University of Kuwait; the Dean of the School of Management, University Utara, Malaysia; the Head of the Department of Economics, Delhi School of Economics; the Dean Hailey School of Commerce, University of Punjab; the Deputy Governor, Central Bank of Iran; and the Dean, Research Centre, International Islamic University, Iran.

Interest was also expressed by a number of Vice-Chancellors to attend the Conference as participants. These include the Vice-Chancellor of the Islamic University of Malaysia, the Vice-Chancellor of Dhaka University, the Vice-Chancellor and Chancellor of the University of Isfahan.

In its first year in action, the Group attracted $19,746. This was in addition to the ARC $45,000 grant Metwally received in 1992. Application has been made for grants of $100,000 to finance 'Export Australia'. And individual members applied for external grants to finance specific projects.
THE CENTRE for Court Policy and Administration was established in 1991 to foster research and teaching on the policy and practice of the management of courts and tribunals in Australia.

Increasing costs of litigation and competition for allocation of resources in the public sector have led to a growing appreciation, among judges and administrators, of the need for more effective management of courts and of the process of litigation. This reflects experience overseas, particularly in the United States of America and Canada. There is considerable literature in North America and an emergent body of Australian literature on court policy and administration.

The Centre conducts postgraduate courses for those employed in the management of courts, in both judicial and administrative positions. It also offers short courses and workshops. In 1993 workshops were presented on behalf of the Judicial Commission of NSW to the senior magistrates of New South Wales and their clerks and, at the University of Wollongong, to members of courts, tribunals and the private legal profession. Topics covered concerned judicial leadership and management, the conduct of complex litigation, evaluation of court management programs and court design.

Future research planned by the Centre includes:

- costs of justice,
- case management and delay,
- judicial independence and the appointment of judges,
- accountability of courts,
- the proliferation of tribunals and their rationale.

The Centre was responsible for the following research projects in 1993.

**Caseflow Management for Australian Courts**
Grant: ARC Small $5,000
Professor Helen Gamble, tel (042) 21 3638, with Dr Richard Mohr and Mr Lindsay Curtis.
Support from the ARC grant has allowed members of the Centre to travel to all capital cities in Australia, except Perth, to discuss the practice of caseflow management in the different States and jurisdictions. An article assessing the implementation of caseflow management in this country is being prepared.

**Decision Making for Courts**
Professor Helen Gamble
This study examines the ways in which policies are made and practices developed for the administration of courts and tribunals. Interviews were conducted with people in New South Wales who were thought to have influenced court policy during the past 20 years, to discover the ways in which they considered they had contributed to policymaking for the courts and to try to assess the impact of their contributions. The aim of the study is to understand how policy might best be developed for courts and tribunals. A report of the study is being prepared for publication.

**The Appointed Place**
Grant: University Project (initial), $2,000
Dr Richard Mohr, tel (042) 21 3638
The concept of 'place' has wide popular currency, as well as being a concept common to the disciplines of geography. Many previous studies of this issue have been applied to religious architecture, sacred sites, and places contested by different religions.

The courts provide a useful subject of study in applying this topic to questions of the significance of place to a new and secular society like Australia. They are among the most significant sites for ritual in secular white Australia, and they have greater continuity than the legislative or executive branches of government, being essentially uninterrupted in their authority in the transition from the colonial to the Federal era.

This study is addressing issues of the siting, design and changing use of court buildings in relation to issues of cultural meaning. Three case studies, of conversion of Mark Foys department store to a court complex, of abolished courthouses and of rebuilding of a historic courthouse are casting light on the meaning of courts as places in colonial and contemporary Australia.

**Administrative Tribunals Research Project**
Grant: ARC Small $5,000 (1992)
Grant: ARC Small $2,000 (1993)
Mr Robin Handley, tel (042) 21 3726, with Professor John Goldring and Dr Richard Mohr
A research methodology has been developed with a view to establishing a database on tribunals. This methodology is currently being tested by its application to two New South Wales tribunals, the Guardianship Board and the Residential Tenancies Tribunal.
THE CENTRE for Multicultural Studies (CMS) carries out research and teaching on international migration, ethnic relations and social policy in a multicultural society. The Centre has been in operation since 1978, and is funded partly by the University of Wollongong, as a service to the community, and partly through consultancy work for the Federal Government and other bodies. The projects listed below give some idea of the wide-ranging policy research carried out by the Centre. In addition, CMS staff played an active role in policy-formation as members of Government advisory committees and as consultants to international agencies such as the International Labour Organisation and the United Nations Population Fund.

However, independent academic research is also a central part of the objectives. CMS staff are involved in a range of projects, often in cooperation with colleagues at other universities both in Australia and overseas. Participation in local and international conferences is also an important part of our role. In 1992-93 CMS staff were responsible for many publications, in the form of books, monographs and articles, as listed in the research publications section later in this report.

Research Projects

The concept of equity
Funding: $19,910 from the Office of Multicultural Affairs
Research Team: Stephen Castles, Colleen Mitchell and Michael Morrissey.

Access to Excellence - Review of Issues Affecting Artists and Arts from Non-English-Speaking Backgrounds
Funding: $103,720 from the Office of Multicultural Affairs
Research Team: Stephen Castles and Mary Kalantzis (Coordination) Annette Blonski, Chandrabhanu, Sneja Gunew, Eugenia Hill, Anna Messariti, Nicos Papastergiadis and Nicholas Tsoulas.

Content Analysis of Australian Non-English-Language Newspapers
Funding: Stage 1: $40,924; Stage 2: $47,062, from Office of Government Information and Advertising
Research Team: Rogelia Pe-Pua, Michael Morrissey
Editor: Colleen Mitchell

Older Migrant Workers
Funding $1,500 from the Human Rights and Equal Opportunity Commission
Researcher: Michael Morrissey

Social Justice Strategies in the Department of Health, Housing, Local Government and Community Services (DHHLGCS)
Funding: $45,000 from the DHHLGCS
Research Team: Michael Morrissey, Colleen Mitchell, Birgitt Baader, Rogelia Pe-Pua

Impact of Immigration Policies on Education in New South Wales
Funding: $49,848 from the Bureau of Immigration and Population Research and the NSW Ministry of Education and Youth Affairs
Research Team: Robyn Iredale, Graham Harrison and Christine Fox (Faculty of Education)

Settlement Experiences of Recent Immigrants: Education and Overseas Qualifications and Labour Force Experience, Analysis of Bureau of Immigration Research's Pilot Longitudinal data
Funding: $45,880 from the Bureau of Immigration and Population Research
Research Team: Robyn Iredale and Ian Nivison-Smith (Census Applications)

Community Relations and Local Government
Funding: $30,000 from the Commonwealth Office of Local Government
Research Team: Michael Morrissey, Colleen Mitchell

Evaluation of the Community Relations Strategy
Funding: $65,000 from the Office of Multicultural Affairs
Research Team: Michael Morrissey, Colleen Mitchell
Centre for Natural Resources Law and Policy

Directors: Professor David Farrier (tel 042 21 3456) and Professor Martin Tsamenyi (tel 042 21 4120)

The Natural Resources Law and Policy Research group operates within the Centre for Natural Resources Law and Policy. One of the aims of the Centre is to conduct research into the law relating to the development and conservation of natural resources from a policy and management perspective. The Centre integrates research in what until now has been a segmented approach to laws which bear on the availability and use of natural resources.

The Centre’s approach to the concept of natural resources includes not only the traditional resources of significance to Australia’s economy (such as minerals and petroleum, fisheries and forests) but also national parks, which are both tourist destinations and gene pools; the soil itself; native vegetation palatable to stock, and water, availability of which is crucial to other resource development.

Even natural things which have no obvious immediate, commercial uses may still be regarded as natural resources. They may have potential commercial uses, as yet undiscovered. They may play a vital part in sustaining life on earth. Or they may have values which are held dear despite the fact that they cannot easily be reduced to dollar and cent equivalents at the present time. The research projects undertaken attempt to bring all these different perspectives together within the framework of sustainable development.

Members of the Centre for Natural Resources Law and Policy have published extensively in the area of natural resources law. A brief summary of the major projects currently undertaken by members of the Centre is provided below.

Biodiversity conservation
Professor David Farrier, tel (042) 21 3456
This project seeks to design appropriate policy instruments, particularly legal and fiscal instruments, to induce private landholders to retain and manage native vegetation. Increased focus is now being placed by the international community on the conservation of biodiversity as a resource for human beings, resulting in the signing of the Biodiversity Convention in Rio de Janeiro in 1992.

It is abundantly clear that Australia cannot meet its international obligations in this area through the reservation of conservation areas, such as national parks. In the past, these have been selected on a largely opportunistic basis, with the result that they are not representative of the species, communities and ecosystems found in Australia. Increasing attention is now being placed on the responsibilities of private landholders and a range of legal and fiscal instruments have been employed by the various States. The objective is not simply to induce landholders to retain native vegetation, but to ensure that it is adequately managed. This includes pest and fire management.

On the other hand, conservation agreements with landholders have also proved largely ineffective. Professor Farrier is now exploring the possibility of using a strategy based on command and control combined with the provision of management payments.

Local government and resources
Andrew Kelly, tel (042) 21 4424
This project involves the examination of the powers of local government to regulate natural resources development and conservation. The following issues are of immediate concern: attitudinal change by local government towards the natural environment; the historical role and functions of local government in relation to natural resources extraction; the integration of local government in environmental legislation; the reach of the planning legislation to attain environmental objectives; and local government initiatives in conserving the natural environment and the policy behind such initiatives.

Biotechnology and the law
Natalie Stoianoff, tel (042) 21 4050
This project examines the impact of biotechnology on the law and the extent to which the law has been able to cope with developments in biotechnology. Ms Stoianoff has written an issues paper on the law and genetic engineering which has been published in the Australasian Biotechnology Journal. The project is funded partially by the Law Foundation of New South Wales.

Fisheries law and policy
Professor Martin Tsamenyi, tel (042) 21 4120
This project involves research in the law relating to fisheries exploitation, conservation and management within Australia’s 200 nautical mile fisheries zone. A number of publications and conference papers have resulted from this project.
THE CENTRE for Research Policy (CRP) is a Special Research Centre or 'centre of excellence' of the Australian Research Council. CRP conducts an active research, consultancy and education program, nationally and internationally - with a particular focus on Asia. The Centre operates as a tight, high-quality, multi-skilled team of approximately 15 people.

Research culture, organisation and management
A major objective is to provide insights that will lead to creative and more effective management of research within and between different research environments.

- 'Research Cultures within the University System'. The major findings from this work emphasised the growing significance of collaborative and multi-disciplinary research and the varying organisational strategies that have evolved to support such work.

- 'Research Centres in the University System'. The focus of this project was on the identification, organisation, focus and funding of research centres within the Australian higher education system.

- 'Collaborative Project with CSIRO on Cultural Change within a Major Research Institution'. The emphasis on this project was to gain a better understanding of the strains that emerge during the process of moving from one research culture to another.

- 'Research Links between Industry and Higher Education': The main focus was on the nature, location and depth of research linkages between industry and higher education across Australia.

Policy-research linkages
This program broadly addresses research policy steering media and specifically research-funding mechanisms and distinguishes three main kinds of policy focus reflected in the range of types of research finding: institutional, governmental (primarily commonwealth) and other.

- 'Performance Indicators for Research'.
- 'Commonwealth Competitive Research Funding'.
- 'Research Infrastructure Needs within the Tertiary Education Sector'.

Research-application linkages
This program has been designed to focus on the study of the Cooperative Research Centres (CRC) program and examines factors influencing the Australian technological innovation climate and the problems of managing linkages between producers and users of research and the various determinants of successful university-industry research collaboration.

- 'Case Studies of Cooperative Research Centres': Findings during 1992 have been drawn from detailed monitoring of the management, work program and strategies of CRCs with particular reference to inter-institutional linkages.

- 'Management of Cooperative Research Centres': The main focus of results in this project has been on management strategies for multi-institutional research groupings.

- 'Research Concentration in the University System': Findings have demonstrated concentrations of research strengths within the Australian research system.

International research and technology policy
The Centre plays a key role in regional science and technology policy activities throughout Asia with CRP being the regional centre for STEPAN, the UNESCO-linked Science and Technology Policy Asian Network and international coordinating institution of the Asian Pacific Economic Cooperation forum Human Resource Program on Industrial Technology (APEC-HURDIT).

STEPAN (Science and Technology Policy Asian Network)
Present member countries of STEPAN are Australia, Bangladesh, People’s Republic of China, India, Indonesia, Republic of Korea, Lao People’s Democratic Republic, Malaysia, Maldives, Nepal, New Zealand, Pakistan, Philippines, Sri Lanka, Thailand and Vietnam. Japan currently has observer status.

STEPAN is an official Asia-wide network involved in research and training support for national science and technology (S&T) policy and management. STEPAN operates under the auspices of UNESCO through ‘National Focal Points’.

APEC-HURDIT (Asia Pacific Economic Cooperation – Human Resource Development in Industrial Technology)
Present member countries of APEC are: Australia, Brunei, Canada, Chinese Taipei, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, People’s Republic of China, Philippines, Singapore, Thailand, and the United States of America.

CRP was commissioned by DEET to found APEC’s Human Resource Development Network in Industrial Technology (HURDIT) as international co-ordinator on behalf of Australia.
THE CENTRE for Advanced Manufacturing and Industrial Automation (CAMIA) at the University is one of the Federally funded Key Centres for Teaching and Research established in 1988. Its overall mission is to serve industrial and academic customers in solving problems, specialising in manufacturing management, automation, technology, quality and maintenance techniques by striving for excellence in research, education and application in these fields. Various staff members from academic and industry-linked units are contributing to the Centre as consultants, involved in offering both professional and postgraduate courses, as well as in a range of applied research and development.

Facilities

Together with the Departments of Mechanical Engineering and Electrical and Computer Engineering, as well as the Automation Engineering Applications Centre (AEAC), CAMIA has built up a computer-integrated Flexible Manufacturing System (FMS) comprising CNC machines, industrial robots, automated guided vehicles (AGV) and on-line metrology equipment, which is capable of welding, machining, assembly and quality-control monitoring. This demonstration – as well as R & D facility – is acknowledged as one of the most comprehensive demonstration manufacturing systems in Australasia. It is complemented by a Manufacturing Systems Laboratory containing smaller equipment, including a computer-controlled 'Fischertechnik' FMS and warehouse model.

Teaching

CAMIA is an integral part of the Department of Mechanical Engineering and with it has developed an undergraduate manufacturing stream in the BE (Mech) Course, as well as joint postgraduate programs (Graduate Diploma and Honours Masters) in Total Quality Management (MSc:TQM, 1991) and Maintenance Management (ME:MtceMgt, 1992). Some subjects in these programs have also been given to companies on an in-house basis.

However, the main teaching activity of CAMIA is in its one-day professional short courses to industry, offered both in-house and as-advertised public courses. The range of courses offered covers Quality Management, Maintenance Management, Operations Management and several specialty manufacturing courses.

Research


The major research activity for 1993 was the development of a prototype selective asparagus harvester by Dr Richard Rudziejewski. First field trials conducted at Jugiong, NSW, show considerable promise for this harvester technology. Asparagus is a fast-growing vegetable with individual spears growing more than 75mm per day; it is however also fragile and very easily damaged. With no commercial harvesters available, the crop is currently harvested manually. Selective harvesters must be able to cut and collect spears which are longer than 250mm without damaging shorter spears not fully grown.
Key Centre for Mines
University of Wollongong Division

Director: Dr Naj Aziz (tel 042 21 3449)

The Key Centre for Mines is a joint initiative between the University of New South Wales School of Mines and the University of Wollongong Department of Geology and the Department of Civil and Mining Engineering. It serves the mining industry through training and research in the areas of applied geology, mining engineering, mineral processing, mineral extraction and computer applications for the minerals industry in response to the needs of professionals who are often located in remote areas.

Research

Dust control
Research on dust control in mines is progressing satisfactorily, and a compressed-air-operated dust scrubber has been successfully developed by a team headed by Associate Professor Naj Aziz and comprising Dr Ernest Baafi and Mr Srinivasa Rao Balusu. The equipment is funded jointly by the Australian Coal Association Research Projects, the Joint Coal Board, Tower Colliery and the Key Centre for Mines.

Research on dust control is now entering the next phase, with the application of ultrasonic technology to capture respirable airborne dust in a mine environment. Ultrasonic waves in the air medium produces strong agitation in the particles, causing them to impact, agglomerate and coagulate, and to precipitate quickly. High-powered ultrasonic transducers, operating at frequencies of between 20 and 30 kHz, will be required to induce dust agglomeration.

Mine ventilation and safety
In the area of mine ventilation and safety, research is in progress on the effectiveness of various stopping materials for sealing off worked-out areas in underground coal mines. Undertaken by Associate Professor Aziz, this project is partly funded by Fosroc Chemfix of Nowra.

Stress-induced deformations and ground water flow in jointed rocks
In-situ stress conditions and stress changes introduced by underground mining influence the mechanical and hydraulic behaviour of rock masses. The project involves study of the effect of stress changes and associated joint displacements on hydraulic properties of rock masses.

Resource estimation
An evaluation of Lehyson Gold deposits is being supervised by Dr Ernest Baafi. This study compares various linear and non-linear estimators commonly used to assess gold resources. The project is funded by Lehyson Gold Mine.

Key Centre for Mines-funded research
The Key Centre for Mines awarded two new scholarships in 1993 to support two postgraduate students in their research on ground stabilisation and gas drainage and gas/coal outbursts. Mr A K Herath was awarded $45,000 for three years' research on the stability of multi-layered or jointed rock-mass structures in mining engineering. The work is supervised by Dr B Indraratna of the Department of Civil and Mining Engineering.

Mr N Ridha obtained funding from the Key Centre for Mines to conduct research on the influence of coal geology on the gas composition and gas outbursts in Australian coal. The Key Centre for Mines has also set aside $20,000 to provide the necessary equipment and computing facilities for all the research undertaken by the Key Centre members.

Training
Technical training programs are offered by the Key Centre and through its international arm the Centre has provided technical training to engineers and geologists from Pakistan, Korea, India, CIS, Indonesia and China. Today 41 postgraduate students are enrolled in the Key Centre for Mines postgraduate degree programs in both institutions (Universities of NSW and Wollongong). In 1993, 24 short courses were offered, of which five were run by Wollongong.

Members of the Key Centre for Mines include Associate Professor Najdat I Aziz, Associate Professor in Mining Engineering and Deputy Director, Key Centre for Mines; Dr Ernest Baafi, Senior lecturer in Mining Engineering; Dr Buddhima Indraratna, Lecturer in Mineral Processing; Dr Ian Porter, Lecturer in Mining Engineering; Professor Tibor Rozgonyi, Professor of Mining Engineering and Dean, Faculty of Engineering; Professor Raghu N Singh, Professor of Mining Engineering and Head, Department of Civil & Mining Engineering.

Members from the Department of Geology are Dr Brian Chenhall, Senior Lecturer, Dr Paul Carr, Senior Lecturer, Dr Adrian Hutton, Senior Lecturer, Dr Chris Fergusson, Senior Lecturer, Associate Professor Brian Jones and Associate Professor Anthony Wright, Head, Department of Geology.
at this stage, a section on Whitman styles and periods will be considered; Dickinson and Hopkins are in progress. A wide variety of different ordinary language is 'stretched' in exploring the different ways in which structuralism: the Syntagmatic Side of being) on general syntagmatic theory, opening up a range of novel foundation of recent language options for literary criticism, linguistics and philosophy. Harland challenges the very narrowness of this period. Dr lanziti's new book aims to reconstruct the premises of history-writing as they were being re-defined during the period. Dr lanziti's new book aims to develop a framework for history-writing, together with innovation and experimentation involving major figures such as Leonardo Bruni and Biondo Flavio in the fifteenth century, and Niccolo Machiavelli and Francesco Guicciardini in the sixteenth. Such figures have of course been the subject of specialised investigation of a monographical kind. What is missing is a broader-based study which would reconstruct the premises of history-writing as they were being re-defined during the period. Dr lanziti's new book aims to do just this. It will thus help to clarify a key moment in the Western tradition of history-writing; one which currently constitutes something of a blind spot within the configuration of international work in this area.

HENRI JEANJEAN continues to develop his interest in the indigenous minorities of Europe. His research aims to develop a framework for
comparing and evaluating the political, economic and cultural strategies and practices of three of the European Community’s Nation-States (France, Spain, Italy) when dealing with their indigenous minorities in a rapidly changing environment, as well as the strategies and practices put in place or advocated by those minorities depending on their level of recognition.

He will examine and compare the policy approaches of the different layers of power (local, regional, national and European) in a chosen geographical area (Catalunya, Occitania, Aragon) towards the question of minorities in the new Europe. He will also examine and compare the demands of the minority groups in this region. Particular attention will be paid to the question of how existing differences and conflicts could be resolved and to the implications for political, economic and cultural policies in the new, emerging European system.

The debates taking place in several European countries around the ratification of the Maastricht Treaty have shown that, although the dominant tendency is towards economic and political ‘integration’, a corresponding process of ‘fragmentation’ also exists. The European political reality is increasingly incompatible with existing frontiers. Languages, cultures and nationalities do not neatly correspond to the arbitrary state borders of today.

Ms Noriko Dethlefs
(tel 042 21 4083)

NORIKO DETHLEFS is also working in the area of Linguistics, in the field of Applied Japanese for Business Purposes.

Associate Professor Brian McCarthy
(tel 042 21 3670)

BRIAN MCCARTHY and Ray Stace have established the Department as a leading centre for the production of CALL Software. A 1992 National Priority Reserve Fund Grant enabled work to proceed on the production of further software units in French and Japanese. In addition to writing additional software units, Professor McCarthy’s research activities in applied linguistics have been closely linked to CALL software development. The main focuses have been:

- integration of CALL software into university teaching programs
- the transferability to other languages of templates designed for a specific foreign language
- the effect on software design of competing influences: language system, teaching methodology and computer logic
- the adaptation of the linguistics of real-life communication to linguistic realism in computer-assisted language learning activities
- the sequencing of micro activities within CALL modules designed to provide a comprehensive review of a given language feature.

Professor Brian Moloney
(tel 042 21 3676)

BRIAN MOLONEY continues to collect material for his history of the novel in Italy. Work is concentrated on the production of a Repertorio Bibliograﬁco della Narrativa Italiana dell’Ottocento by a team which also includes Professor Carlo Maria Simonetti of the University of Florence and Professor Neil Harris of the University of Udine. He has also written two more chapters of his book, *Italian Novels of Peasant Crisis*, and further papers on Italo Svevo. In connection with this latter author, he has been invited to contribute a volume of the series *Piccola Biblioteca di Letteratura Italiana Inediti e Rari*, and also to join the editorial board of a new journal of Svevo studies, *Aghios*, which is to be published in Rome and will open with his study, ‘La coscienza di Zeno come romanzo di Guerra’.

Associate Professor Gaetano Rando
(tel 042 21 3644)

GAETANO RANDO’S research has included work on Italian Australian Literature, on which he is a recognised authority, through the collection and updating of newly produced works and the comparison of Italian Australian with Italian Canadian writers. This involved the presentation of a paper on Italian Australian Cinema at the Fourth Conference of Italian Canadian writers, Montreal, 18-21 November 1993.

He is also active in the field of translation and has completed his translation into English of Stanislao Nievo’s novel *La ballena azzurra*. He is now preparing an Italian version of Raffaele Carboni’s *The Eureka Stockade* for the Istituto per la Storia del Risorgimento Italiano.

Dr Madeleine Strong Cincotta
(tel 042 29 9068)

DR CINCOTTA is engaged in translating the complete short stories of Luigi Pirandello as well as works by Giovanni Finzi-Contini.

Ms Elizabeth Thomson
(tel 042 21 4002)

ALSO USING a McCarthy template to develop Japanese software to teach ‘time’ is Elizabeth Thomson. The transfer to Japanese, however, requires major modifications, including dialogue exchange between the user and the computer. Ms Thomson is also working on the notion of ‘theme as first position in Japanese’ in the field of Systemic Linguistics.
SUCCESSFULLY completing her Oxford DPhil thesis on humour in the Japanese theatre Dr Wells has been awarded a Seizan Fukami post-doctoral scholarship at Curtin University of Technology and Kyoto University. She will be working on rewriting a part of her doctoral thesis as a book on the theory of humour. It will be a study of how societies go about making rules to control humour.

SUSAN YATES'S most recent project entitled 'The New Confessor: The Role of the Doctor in Nineteenth Century French Society as Represented in Selected Novels by Balzac', was awarded a Small ARC Grant in 1992. Continuing the sociohistorical-literary approach used in her study Maid and Mistress (Peter Lang,1992), the project will involve an investigation of medical imagery, of bourgeois male discourse about female biology in nineteenth century France and of the influence of the doctor within the bourgeois couple as shown in the realist and naturalist writers such as Flaubert, Maupassant and Zola. The focus will then be narrowed to an in-depth study of the relations between the doctor and the bourgeois wife in selected novels by Balzac. Dr Yates is particularly interested in the notion of an alliance which develops at this stage in French history between, on the one hand, the doctor and the bourgeois husband – who work together, with the male intelligence and rationality they hold in common, to keep the woman, the fragile and unpredictable presence, in check – and, on the other hand, the doctor and the bourgeois wife, whose help is enlisted by the doctor in his project of the medicalisation of the family and of the society at large.

CURRENT RESEARCH involves completing a book giving a conceptual and normative analysis of economic rents. In particular, the book concentrates on providing an analysis of economic rents in the form of income to labour. He tries to show that certain fundamental confusions have led people in the past to believe that there is a much greater conflict between the dual objectives of efficiency and justice in income payments than in fact there really is. The conclusion is that there are quite a number of policies which would make the economic system both more just and more efficient. His intention in writing the book is that it will contribute to debates over distributive justice, progressivity of income taxes, the regulation of the professions, and so on.

His other research projects include an investigation into free-rider problems as a way of understanding obligations to protect the environment; an exploration of conceptual problems involved in claims about harming and benefiting future and past individuals; and various investigations into moral arguments over economic justice.

THE CHIEF areas of research being pursued by David Simpson are the philosophy of language (with special focus on theories of communication and interpretation), epistemology, and Ancient Greek philosophy. He is continuing his work on the presuppositional background of communicative interaction, and on the implications and consistency of interpretive holism.
Faculty of Commerce

Department of Management

**Associate Professor Richard Badham**  
(tel 042 21 3634)

The management of Integrated Technical and Organisational Change (MITOC) research unit was established in 1993 as an interdisciplinary unit for research and postgraduate education located in the Department of Management at the University. MITOC is a member of the CAPIRN and European Commission FAST Man-Technology networks, and the recently established Cooperative Research Centre on Intelligent Manufacturing Technology and Systems.

Aims of the unit are to conduct action research and consultancy projects in the design and implementation of new production systems; to organise and develop methods for promoting user involvement in system design and implementation; to further Australian research and industry participation in national and international research and consultancy networks promoting intelligent socio-technical systems, skill-based system design, human centred systems, anthropocentric systems, symbiotic approaches to technology management, and appropriate innovation strategies for different industrial cultures; and to carry out and promote professional training and postgraduate education in critical management perspectives and broader interdisciplinary curricula in the management of technological change.

Full-time staff are Associate Professor Richard Badham, Administrative Assistant June Aspley, Senior Research Fellow Dr Paul Couchman, and Research Assistant Rosemary Klein.

Grants attracted in 1993 were:

- Team-based Cellular Manufacturing ($780,000) Grants for Industrial Research and Development, Department of Industry, Technology and Regional Development, April 1993 to April 1995; Integrated Manufacturing: Training Modules ($113,000) New South Wales Science and Technology Council/Education and Training Foundation, October 1993-October 1995; Beyond Lean Production: International Best Practice Diffusion Workshops ($38,000) Australian Manufacturing Council/Department of Industrial Relations: Best Practice Program, 1 November to 12 November 1993; Australian-German SMART Project: International Travel Grants ($24,000) International Branch, DITRD, May 1993 and August 1993; APEC-HURDIT: Skill Based Automation and Cellular Manufacturing ($5,000 + $24,000) APEC/HURDIT, Network Manager CRP, October 1993 to October 1994.

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Faculty of Education

**Associate Professor Philip deLacey**  
(tel 042 21 3728)

Research includes:

1. The development of early-childhood enrichment programs for rural and disadvantaged children. This project is largely based on the Project Enrichment of Childhood Preschool at Bourke, NSW, where data have been gathered over some 25 years and are periodically being analysed. The research has shown that structured programs, based on Direct-Instruction Methodology, can be beneficial to such children, in a broad-based context that includes medical and community support.

2. Inquiries into the contemporary role and function of universities, in the context of the decline of many humanities areas and acknowledged responsibilities to link teaching with research and critical evaluations of current issues, and of the ascendancy of technological and 'skills-based' activities.

3. Investigations of personal and social antecedent variables in relation to achievement in reading and mathematics.

4. Studies of the relationship of some cognitive and personality variables in regard to education, with colleagues in Canada.
ROBYN HOLDEN and Dr P Mooney (University of Tasmania) have been conducting theoretical research into the biochemical substrates underlying serious mental disorders. To this end they have developed a multi-causal hypothesis that outlines the interplay between environmental stress, neurotoxic damage and genetic abnormalities which, together, represent the jointly necessary and sufficient conditions for mental illness to occur. This includes the effect of stress on blood-brain barrier permeability (BBBP) which exposes the brain to increased risk of sustaining neurotoxic damage from heterocyclic amines. Heterocyclic amines are potent carcinogenic mutagens, found in cigarette smoke, broiled and fried meat, azo dyes and petroleum and diesel fumes, that easily pass through the blood brain barrier where they lock into the dopamine receptors and block dopamine reuptake.

The genetic contribution involves the p21 product of the Harvey ras oncogene, which is one of the nine genes situated on the short arm of chromosome 11 that are collectively responsible for the activation of certain neurotransmitters and glycometabolism. Low levels of p21 indirectly compromises the activity of tetrahydrobiopterin (BH4) which, in turn, down regulates the activity of the serotonergic and catecholamine pathways and, hence, glucose utilisation.

This hypothesis is in keeping with objective data in which Positron Emission Tomography (PET) scans indicate a gross impairment of glucose metabolism in all serious mental disorders. For this reason, mental illness is redefined as 'cerebral diabetes' — a term which was chosen to convey the absence of glucose being transported into the cells — both astrocytes and neurons. This analysis is also intended to serve as an alternative explanation to the 'geographical drift' hypothesis and various viral hypotheses currently favoured by biological psychiatry. In respect of this research two papers have been accepted for publication by 'Medical Hypotheses': one concerning unipolar depression and the other on schizophrenia.

Ms Lynne Newman (tel 042 21 3338)

THIS PROJECT describes and examines the responses from first-year students on professional disorientation suffered through the persistence of a stereotypical image of the nurse’s role.

Relevant literature supports the fact that while nursing is continually evolving and is now far from the traditional image, society has chosen to maintain that image and failed to keep up with the radical changes made in recent decades. This presents problems for the student of nursing who enters the profession with the accepted societal view in mind. This mismatch between expectation and reality has, naturally, many attendant problems.

The objectives of the study are to illustrate and clarify this dilemma. An empirical study has been conducted on first-year students who withdrew from various institutions in NSW in 1992 and with a control group of students who did not withdraw. Data from the study are currently being analysed. It is believed that conclusions will be drawn from this study that will present a clearer view of the problem of stereotyping and how it contributes to student withdrawal and student dissatisfaction. A deeper insight into this problem will, presumably, illuminate problems which can then be taken into account remedially in future.
A MAJOR two-year study into energy use in Australian land freight was completed in 1993 with the support of the Energy Research and Development Corporation (ERDC), who also published an end-of-Project report.

The ERDC project found that while many Australian rail and road freight operations demonstrated ‘world best practice’ in energy efficiency, others showed considerable room for improvement in energy efficiency. In road freight, there is the scope for some truck operators to reduce use of diesel fuel with the aid of on-board vehicle monitors.

In rail freight, the project found that most scope for improvement would result from upgrading the existing Sydney - Melbourne mainline railway by a series of deviations and minor track upgrading to ease ruling grades and tight radius curves. Such rail upgrading, and an increase of rail’s modal share of line haul freight to 50 per cent on this major corridor, was found to have a benefit-cost ratio greater than one with significant energy savings.

For the Sydney-Brisbane railway, the project recommended grade and curve easing at two locations north of Grafton. This work is now proceeding as part of the current ‘One Nation’ program.

The ERDC project also showed that the transportation of coal to Port Kembla had an overall energy efficiency of about one third of that of Central Queensland coal train operations. The project found that completion of an electrified Maldon - Domarton rail link would have a positive net present value, and appreciable energy savings.

Work has continued with the support of the Faculty of Informatics and the Environment Research Institute.

Future work includes examination of the mathematical models underlying computer simulation of freight-train movements.

I AM NOW, to use the ARC expression, negotiating a ‘shift of interest’ into the field of ALife (Artificial Life) which is a multi-faceted approach to the modelling of computer-simulated life systems in which the main concern is the evolutionary development of patterns. In its simplest form it can be regarded as a generalisation of the modelling approach typified in John Conway's well-known Game of Life. The modelling with ALife that I am carrying out, in contrast to the global and top down approach which characterises much of artificial intelligence, is a bottom-up approach based on the emergence of complex patterns from simple local rules.

My research has established relationships between integer part sequences, characteristics, chaos, self matching in strings of symbols as well as telegraph codes and games, so this gives me a very good basis to enter this field.

The main aim is to set up computer pilot systems incorporating the genotype-phenotype concepts and to describe and characterise the patterns emerging from these systems.

The significance of this work is twofold: biological insights can be used to help in setting up ‘lifelike’ models on the computer and the behaviour of these models can be fed back to biologists so as to sharpen our insights into the processes of natural selection. This work will at least extend the computer modelling of biological evolutionary processes as well as the modelling of evolutionary computer processes allied to genetic programming. The work also has ramifications in the area of computer viruses (very dangerous ones that evolve) and also computer security.
One of the most important results is the identification of evolving patterns of string codes which mimic the stretching and folding characteristic of chaos. This has bearing on the very important area of information structures associated with protein folding.

Faculty of Science

Department of Chemistry

Dr David Griffith
(tel 042 21 3515)

RESEARCH PROJECTS:
1. Atmospheric trace gas emissions from bushfires

Measurements of the emissions of a range of trace gases from fires in tropical Australian savannas have been completed. The fieldwork was performed at the Kapalga Research Station in Kakadu National Park together with the CSIRO Tropical Ecosystems Research Centre. The measurements have resulted in much-improved estimates of the contributions of the Australian continent to global budgets of greenhouse and other important atmospheric trace gases, as well as improved understanding of the cycling of nutrient nitrogen by fire.

We have constructed and begun using an instrumented laboratory combustion facility for investigation of smoke composition under controlled conditions.

2. Trace gas exchange between atmosphere and soils

In collaboration with Swedish colleagues during study leave, a long-path Fourier transform infrared (FTIR) technique for measurements of the exchange of trace gases between the atmosphere and soils was developed. This technique was then used for measurements of nitrous oxide emissions and methane consumption in agricultural and forest soils in Sweden and Denmark. Both gases are greenhouse gases with significant sources and sinks in soils. A similar instrument will now be built for Australian studies.

As part of this work, a complete software package MALT (Multiple Atmospheric Layer Transmission) has been developed to obtain atmospheric trace gas concentrations from the analysis of long-path FTIR spectra.

3. Solar FTIR spectroscopy

In solar FTIR spectroscopy, the sun is used as the light source, an FTIR spectrometer is based on the ground, and the entire atmosphere acts as the 'sample'. Analysis of solar FTIR spectra yields a wealth of information on the composition of both the troposphere and the stratosphere. Using the MALT software we took part in an international intercomparison of algorithms for the analysis of solar FTIR spectra. The results were very satisfactory and validated the use of the package. The software is now used routinely for the analysis of spectra collected from the Jungfraujoch at 3580m in the Swiss Alps and from Lauder in southern New Zealand. The emphasis to date has been on greenhouse gases (eg N₂O, CH₄) and species involved in stratospheric ozone chemistry (eg O₃, HNO₃, HCl, HF, OC₅).

Dr Stephen Wilson
(tel 042 21 3505)

Research Progress – UV-B Measurements

RESEARCH has focused on developing reliable methods for measurement of solar UV-B (295 - 320 nm). Reliability is defined in terms of needing to detect trends in solar UV of the order of one per cent a year, and the less-stringent requirement for the estimation of photolysis rates to within ten per cent. This requires the accurate determination of wavelength and the sensitivity of the instrument at each wavelength.

The wavelength scale of the instrument used varies by an order of magnitude greater than the required stability. However, correction methods now in place reduce this to well within the required limits.

Techniques are continuing to be developed that allow the in situ
irradiance calibration of a UV-B spectral radiometer. Very promising results have been obtained for wavelengths above 310nm, with a standard deviation in the calibration of less than two per cent.

This work has been paralleled by the development of computer models to test for biases in the calibration method and has identified a systematic underestimate of the determined sensitivity below 310 nm. This is due to the finite resolution of the spectrometer.

In conjunction, a broad-band UV-B radiometer has been purchased and stationed next to the scanning instrument, with several experiments about to begin. The work is being carried out in collaboration with Dr Bruce Forgan (Bureau of Meteorology) and has financial support from the Cape Grim Baseline Air Pollution Station and the University of Wollongong.

Other highlights

Co-editor, for 'Baseline 91', the scientific annual report of the Cape Grim Baseline Air Pollution Station, Tasmania, published June 1993.

Adviser to the Cape Grim Baseline Air Pollution Station on the design and implementation of a new data collection system, 1992-1993.

Dr Audrey Wilson
(tel 042 21 3155)

RESEARCH in the general area of chemical education has two major foci — (a) study processes, and (b) assessment instruments.

(a) Study processes
An approach to study comprises two parts: motives and strategies. The two parts may be related in different ways to form specific approaches to study known as surface, deep, achieving or some combinations of these. Study approaches of tertiary students have been shown to influence academic achievement and gender has been suggested as a significant factor in the approach used. Detailed investigations have been carried out with first-year Chemistry students into the study processes they employ and data are being examined for possible relationships between the processes, gender and achievement.

(b) Assessment instruments
Investigations are also continuing into the effects of different presentation modes on successful problem-solving and achievement by students at both pre-tertiary and tertiary levels and relating these to gender.

CAUT multimedia project
Dr Wilson was the initiator and is the co-ordinator of a committee for the Advancement of University (CAUT) grant for $39,000, the purpose of which is to produce multi-media pre-laboratory materials for use in first-year chemistry classes. A major concern in first-year chemistry has been ensuring consistently good-quality, pre-laboratory preparation for all students. Although all demonstrators give some instruction before laboratory activities begin they don’t all have the same experience or expertise. To ensure that all students receive the same high-quality preparation, multi-media interactive materials are being produced. These materials, under production, will replace the demonstrator-given pre-activity talk. They include video material of techniques, glossaries of terms, calculations and interactive simulations of procedures. Four of these productions should be in use during session 1 of 1994.

Department of Geography
Dr Rochelle Ball
(tel 042 21 3189)

DR BALL’S research interests include the relationship of international migration to issues of economic restructuring, particularly to labour-market changes; human resource development and regional integration in the Asia-Pacific region; the feminisation of international migration in the Asia-Pacific region; and the theorising of the role of the state in the context of internationalising labour markets.

Dr Laurie Brown
(tel 042 21 4441)

A VISITING lecturer from Christchurch, New Zealand, Dr Brown has continued to enjoy a successful and productive research year. Dr Brown, a medical geographer, arrived in the Department in July, having attended the Annual Scientific Meeting of the American Diabetes Association in Las Vegas in June. During Spring session, she maintained her research activities with the Lipid and Diabetes Research Group at Christchurch Hospital.
In 1993 she had six articles published in international refereed journals and has one currently in press. Three further papers have been submitted for publication. She was also successful in obtaining a $50,000 research grant from the New Zealand Health Research Council for investigating rates and causes of mortality in insulin-dependent diabetic people.

In addition to her diabetes-related research Dr Brown, in collaboration with Dr Ross Barnett, Department of Geography, Canterbury University, was active in undertaking contract and consultancy work to the New Zealand Department of Health. This area of research has resulted in three refereed reports during the year. These deal with the development and implementation of geographical methodologies for measuring access to personal frontline health-care providers in rural and urban areas, and geographical implications of the growth and changing composition of the general practitioner workforce.

Dr Brown serves as a referee for a number of research-granting bodies in New Zealand as well as several international social science and medical journals.

**Dr John Formby**  
(tel 042 21 4165)

Since joining the Department in July, Dr Formby has continued his research into Australian forest policy, in particular, the politics, economics and decision-making processes of the South-east NSW forests. He also continues his work on the determinants of Australian environmental policies. He has in press publications in all those areas. He is, moreover, with Associate Professor Bob Fagan and the Geography of Economic Restructuring Group at Macquarie University and Dr Rochelle Ball at Wollongong, expanding his research interests into global restructuring and its consequences for the Australian environment.

**Dr Gordon Waitt**  
(tel 042 21 3684)

Dr WaITt's research concerns the economic relationship between Australia and the Republic of Korea (ROK). While trade between Australia and Korea has significantly increased since 1985, the flow of capital has remained small. Less than 0.1 per cent of Australia's foreign direct investment (FDI) is located from the ROK.

The project examines the process of the ROK's FDI in Australia. The aim of the project is to explain the lack of motivation behind Australia as a location for ROK's capital. The hypothesis is tested that newly industrialising countries' transnational corporations are motivated by different reasons from those of their advanced country counterparts.

**Dr Ann Young**  
(tel 042 21 3633)

Dr Young is researching and writing a book on the environmental impact of European settlement in Australia. The book is due for publication by Oxford University Press in 1995 and deals with impacts due to such major land uses as agriculture, forestry, mining, conservation and urbanisation. Many books on similar topics are emotive and historically based; this one will come from a geographical perspective.

With a Masters student, Mark Pease, Dr Young has been working on acid sulphate soils near Berry, NSW. These soils develop extreme acidity due to oxidation of natural sulphides when they are drained for agriculture. Much of the lower Shoalhaven floodplain was drained earlier this century and has been productive pasture. The effects of acid leachate into the river is now, however, being recognised. 'Acid events' after heavy rain can cause severe fish kills. The research is aimed at management strategies to preserve pasture but to minimise ecological damage from acidic runoff.

**Dr Jagdish Narain Mathur**  
(tel 042 21 3507)

**Mr Martin Carolan and Mr Steven Wallace**

In 1990 a Neutron Capture Therapy research group came into being within the Physics Department. Today it consists of two postgraduate students.
(Martin Carolan and Steven Wallace) and Dr Mathur. It was formed in collaboration with the Biomedicine and Health Program at Ansto. In 1993 collaboration with the Commission of the European Communities, Joint Research Centre, at Petten in the Netherlands, and the Paul Scherrer Institute in Villigen, Switzerland, was established. During his study leave this year Dr Mathur visited both research centres each for three weeks. A direct result of this collaboration is that Martin Carolan and Steven Wallace will travel to Petten in 1994 to take vital measurements connected with Boron Neutron Capture Therapy (BNCT) using three phantoms.

Boron Neutron Capture Therapy (BNCT) is an experimental tool for the treatment of cancer. BNCT offers significant promise for the treatment of previously intractable cancers. Activation foil measurements on existing filtered and unfiltered neutron beams have been made in preparation for the development of a beam suitable for normal tissue dose tolerance studies.

Further measurement techniques for the characterisation of neutron beams are under development. These include MRI gel dosimetry, track etch as well as semiconductor and other macro and micro dosimetry techniques.

Also under development is a treatment planning code utilizing Monte Carlo neutron transport techniques on the Fujitsu super computer facility at Australian Numerical Simulation and Modelling Services (ANSAMS). This code when complete will enable clinicians to plan therapeutic neutron irradiations and determine dose distributions. Monte Carlo microdosimetric simulations of radiation damage to microvasculature also make use of the ANSAMS supercomputer.

From February to October Dr Mathur was on study leave for eight months. He visited the Commission of the European Communities’ Joint Research Centre in Petten, which is the European Research Centre for BNCT and Paul Scherrer Institute in Switzerland, each for three weeks. In Petten he took part in the setting up of the BNCT instrumentation for patients.

The ultimate goal is to develop filtered epithelial neutron beams and eventually design a patient treatment facility using the High Flux Australian Reactor at Lucas Heights or its replacement.

**Dr Paul Nulsen**
(tel 042 21 3523)

**THE MAIN areas of research are astrophysical dynamics and gas dynamics, with particular application to clusters of galaxies and the formation of jets. Rich clusters consist of thousands of galaxies bound into dense clumps by gravity. Because of their great size they represent significant samples of the universe. A large quantity of gas hot enough to emit X-rays is trapped in clusters by their enormous gravity. Dr Nulsen has devised a method for using X-ray observations of the hot gas to determine the mass of a spherical cluster. H Boehringer (MPE Munich) and Dr Nulsen have applied this method to X-ray observations of the Virgo cluster to obtain physically interesting constraints on its mass.

Gas near to the centres of many clusters cools significantly by emitting X-rays. This causes an inflow of the surrounding gas known as a cooling flow. The fate of the cooled gas is a major unsolved problem. Dr Nulsen has continued two theoretical projects bearing on this: one to determine the condition for non-linear growth of thermal instability in a cooling flow; and the other to determine the importance of acoustic heating in cooling flows.

It is predicted that the gas in cooling flows is nonuniform, causing them to appear slightly patchy. Dr Nulsen has been using new techniques to look for this effect in ROSAT X-ray data for the Virgo cluster.

Jets of plasma are emitted by a wide variety of astronomical objects. Of the many models for jet formation, almost all rely on a disk of matter accreting onto something ranging from a protostar to a massive black hole. Work is continuing on a new model where the jet is driven by frictional heating of gas above an accretion disk, in contrast to the majority of models which rely on a magnetic field to propel the jet.

**Dr Anatoly Rozenfeld**
(tel 042 21 3507)

**DR ROZENFELD carries out research in the field of semiconductor sensors for dosimetry of nuclear radiation for Radiation Oncology. The semiconductor sensors are based on p-i-n and MOS silicon structures and in contrast to TLD dosimeters can be used for on-line absorbed dose measurements for high energy x-rays, electrons and neutrons. Because of their small size, these dosimeters are very convenient for in vivo application.**

The investigation of dosimetric characteristics of these sensors has been carried out at St Vincent’s Hospital in Sydney on a Siemens medical accelerator for 6-MeV x-ray and 5 and 14-MeV electrons as well as at ANSTO on a Cs137 neutron source and a Co57 gamma source. Experiments were done in free air geometry and in a phantom. The influence of charge build-up in the phantom under electron irradiation on the MOS semiconductor dosimeters was studied.

As a result of these and previous experiments p-i-n and MOS dosimeters will be applied for future trials of BNCT (Boron Neutron Capture Therapy) in the Petten (Holland) reactor.

This research is in collaboration with Professor Barry Allen and the Bio-
YOUNG STARS form out of massive rotating disks of gas and dust. During their early years these stars drive supersonic winds which blast out of the disk. The interaction of this outflowing material with the surrounding interstellar cloud heats molecules and atoms – producing emission in the visible, infrared and radio bands.

Research is closely co-ordinated with that of other international groups which are probing young stars in an attempt to understand the physics of the earliest phases of evolution.

Bill Zealey, Mark Suters and Phil Randall are making a major contribution to the study of southern outflows through infrared observations of the outflows. Early in 1993 they used the Anglo Australian Observatory’s infrared camera, IRIS, to image several young star complexes. Infrared emission was observed for the first time, from molecules at the edges of the giant cavities blown by the outflowing material. This work places the University at the forefront of this kind of research and addresses these unresolved questions:

- what is the cause of the emission from the jet?
- does the jet pick up material from its surroundings?
- what makes the jet narrow?

From 1994 onward it is hoped to extend the maps into millimetre wavelengths using the 20m Mopra antenna and later on the ATNF Compact Array. This will allow the researchers to image sources in CO emission at a resolution comparable with those obtained by visible and infrared mapping.

Studies of the surface of Venus

In 1990, using radar, NASA’s Magellan spacecraft began to image Venus. The availability of radar images on CD ROM and access to PC-based image analysis systems have allowed University researchers to engage in planetary physics projects at an early stage of the Magellan mission. Bill Zealey and Graeme Melville are concentrating on identifying classes of structure which are directly comparable to terrestrial structures and include lava tubes and impact craters. Graeme Melville, as part of studies toward his Masters thesis, travelled to Mount Surprise to study the terrestrial counterparts of Venusian lava tubes.
RESEARCH PUBLICATIONS

ADVANCED MATERIALS AND SURFACE ENGINEERING
Co-ordinator: Professor Druce Dunne, tel (042) 21 3012

BOOKS
Chandra, T, and Dhandra, A K (eds), Advanced Composites '93 - Proc Int. Conf. on Composite Materials, August 1993, TMS-USA, 220 pages, 1530 pages.

JOURNAL ARTICLES


CONFERENCE PAPERS


ADVANCED TELECOMMUNICATIONS

Co-ordinator: Professor Gary Anido, tel (042) 21 3065

JOURNAL ARTICLES


PUBLISHED CONFERENCE/SEMINAR PAPERS


PUBLICATIONS

APPLIED ECONOMIC MODELLING
Co-ordinator: Associate Professor Tran Van Hoa, tel (042) 21 3659

BOOKS

BOOKS EDITED

BOOK CHAPTERS

JOURNAL ARTICLES

Chowdhury, K, ‘Food and Hunger Nexus: Food Availability and Entitlement’


Levy, A, ‘An Efficient Rule for Allocating Remunerations to Academic Staff’,

Economic Papers, 12, No 2, June 1993, pp 42-47.


CONFERENCE/SEMINAR PAPERS

REPORTS


"Towards a Competitive Edge", Wollongong, September 1993, pp 242-245.


Siores, E, 'Real-Time Expert Systems and Artificial Neural Networks for Ultrasonic
ASIA AND PACIFIC DEVELOPMENT STUDIES

Co-ordinators: Dr Melanie Beresford and Dr Dennis O’Brien, tel (042) 21 3654

BOOK CHAPTERS


JOURNAL ARTICLES

Beran, H, ‘Boundary Disputes and the Right of National Self-Determination’, History of European Ideas, 89, 4-6, 1993, pp 479-86.

Beresford, M, (with D Kelly), ‘Industrial Relations in ASEAN and other Capitalist Countries’, Economic and Industrial Democracy, 41, 1, Stockholm, pp 89-107.


PUBLISHED CONFERENCE PAPERS


PUBLISHED MONOGRAPHS/ REPORTS


challenge in an Arctic-nesting passerine', Amer Zool, 32, 1992, p 13A.


Edwards, W, 'Size, distribution and selected dynamic processes in the seed bank of Grevillea barklyana (Proteaceae)', Ecological Society of Australia, Roseworthy, South Australia, p 16.


Hoskin, M G, 'The evolutionary consequences of philopatry in the murid gastropod Bedeva hanleyi (Angas)', Ecological Society of Australia, Roseworthy, South Australia, p 21.


Hulbert, A J, Couture, P, and Brand, M D, 'Liposomes from mammalian liver mitochondria are more leaky to protons than those from a reptile', Proc 8th Comp Physiol Meeting, Sydney, 1992, p 17.


Skelly, D K, 'An experimental analysis of competition, predation and pond drying as factors in the distribution of treefrog larvae', Ecological Society of Australia, p 27.


Standish, R J, 'The population genetics, reproductive biology and morphology of the serpent's head cowry Cypraea caupenerins (kerneyae), Ecological Society of Australia, Roseworthy, South Australia, p 36.


Styan, C A, 'Cryptic species and host specificity of peacrabs (Pinnotheridae: Donax deltoides)', Ecological Society of Australia, Roseworthy, South Australia, p 38.

Tait, L, 'Some response to season of fire of three bradydnapus Proteaceae', Ecological Society of Australia, Roseworthy, South Australia, p 39.
February 1993, pp 249-268.


REPORTS


Pyne, S G, Dikic, B, Skelton, B W, and White, A H, ‘Diastereoselective Additions of Lithiated N-tert-Butyldiphenylsilyl-S-


CONFERENCE PAPERS


Grugan, A, Kanitz, R, Mockler, G M, Shalders, R, and Sheil, M, 'Electrospray Mass spectrometry of Model Compounds of Type 2, Type 3 and Type 2/3 Sites in Copper Proteins', Sixth International Conference on Bioinorganic Chemistry, La Jolla, California, USA, August 1993, Go27.

Kane-Maguire, L A P, and Manthey, M, 'Mechanisms of Attack of Cyclohexylamine on the Clusters [M,(CO)3(m-Si)3] (M=Fe, Ru, Os); Invited Lecture, RACI 9th National Convention, Melbourne, December 1992.


Pavlopoulos, S, Wickham, G, and Craik, D, 'NMR studies of the interaction of terephthalalimides with the deacyloxybenzocarbamoyl dipeptide d(GGTTAAATCCG),'

RACI 9th National Convention, Melbourne, Australia, 1992, Medicinal Chemistry, p 36.


BIOLOGICAL MACROMOLECULES

Co-ordinator: Associate Professor Ross Lilley, tel (042) 21 3431

BOOK CHAPTERS


JOURNAL ARTICLES


Pietersen, G, and Garnett, H M, 'Some


PUBLISHED CONFERENCE PAPERS


BULK MATERIALS HANDLING AND PHYSICAL PROCESSING

Co-ordinator: Dr Arnold McLean, tel (042) 21 3063

JOURNAL ARTICLES


CONFERENCE PAPERS


BOOK

BOO K S EDITED


PUBLISHED CONFERENCE PAPERS


EDUCATION POLICY

Co-ordinator: Professor Carla Fasano, tel (042) 21 3957

BOOK


BOOKS EDITED


Patterson, J, Parker, R, and Davy J (eds), Personal and Community Health - Book 1, Heinemann, Melbourne, 1992.

BOOK CHAPTERS


Hedberg, J G, 'Review of Media and Technology in European Distance Education' by A W Bates (ed), British journal of Educational Technology, 23, 1, 1992, pp 73-74.

PUBLISHED CONFERENCE/SEMINAR PAPERS


Brown, I, 'Not Possible in Other Forms: Visual Arts and Outdoor Education', 3rd Visual Arts and Outdoor Education Conf, 1993, pp 168-173.


Temmerman, N, 'Music Soundscapes and Outdoor Education', Proc of the 3rd Annual NSW Outdoor Education Conf, September 1993, pp 64-65.

COMPUTER SOFTWARE


INDUSTRIAL AUTOMATION

Co-ordinator: Professor Chris Cook, tel (042) 21 3065

BOOK EDITED


BOOK CHAPTERS


JOURNAL ARTICLES


PUBLISHED CONFERENCE PAPERS


INTELLIGENT POLYMERIC MATERIALS

JOURNAL ARTICLES


PUBLISHED CONFERENCE PAPERS


Woodroffe, C D, 'Late Quaternary evolution of coastal and lowland riverine plains of South-east Asia and northern Australia: an overview', Sedimentary Geology, 83, 1993, pp 163-175.


JOURNAL ARTICLES


Head, L, 'Stick-nest rat (Leporillus spp.) nests as sources of arid and semi-arid zone palaeoclimatic data: review and prospects', Quaternary Australasia, 11(1), 1993, pp 38-42.


SCIENCE AND TECHNOLOGY ANALYSIS

BOOKS


JOURNAL ARTICLES


Beder, S, 'Making Engineering Design Sustainable', Transactions of Multi-Disciplinary Engineering Australia, GE17, 1, June 1993, pp 31-35.


Martin, B, and Beder, S, 'The Arrogance of Scientists', Chain Reaction, 68, February 1993, pp 16-17.


REPORT

PUBLISHED CONFERENCE/SEMINAR PAPERS
BOOKS EDITED

JOURNAL ARTICLES

PUBLISHED CONFERENCE / SEMINAR PAPERS
RESEARCH GROUPS

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JOURNAL ARTICLES


APPLIED COGNITIVE STUDIES

Co-ordinators: Professor William Lovegrove, tel (042) 21 3915 and Dr Steve Avons, tel (042) 21 2156.

BOOKS


BOOK CHAPTERS


JOURNAL ARTICLES


Solorijw, N, Michie, P T, and Fox, A M, 'Frequency and Duration of Cannabis Use Differentially Affect Brain Function in a Selective Attention Task', Int J of Neuroscience, 71, 1993, pp 107-133.


Wrisberg, C A, and Anshel, M H, 'A Field Test of the Activity-Set Hypothesis for Warm-up Decrement in an Open Skill', Research Quarterly For Exercise and Sport, 64, 1993, pp 39-45.

PUBLISHED CONFERENCE PAPERS


PUBLISHED MONOGRAPHS


CONFERENCE PAPERS


FOSSIL FUELS
Co-ordinator: Dr Adrian Hutton, tel (042) 21 3832

BOOKS EDITED

BOOK CHAPTERS

JOURNAL ARTICLES

PUBLISHED CONFERENCE PAPERS
Faiz, M M, and Hutton, A C, 'Structural and Stratigraphic Controls on the Variations of Seam Gas Composition in the Illawarra Coal Measures, Southern Coalfield, NSW', 26th Newcastle Symm on Advances in the Study of the Sydney Basin, University of Newcastle, pp 87-94.

FUNDAMENTAL PROPERTIES OF SEMICONDUCTORS
Co-ordinator: Professor Peter Fisher, tel (042) 21 3556

JOURNAL ARTICLES


GUARDIAN

150


PUBLISHED CONFERENCE PAPERS


INFORMATION SYSTEMS IN ORGANISATIONS

Co-ordinator: Professor Graham Winley, tel (042) 21 3760

BOOK CHAPTERS


MacGregor, R C, 'Towards a User Language for Music Composition for the Young Learner' in R Glanville and G de Zeeuw (eds), Interactive Interfaces and Human Networks, Thesis Publishers, 1993, pp 75-84.


JOURNAL ARTICLES


MacGregor, R C, 'Are We Recognising the Organisational Impact on Educational Software?', Australian J of Education Technology, 9, 1, 1993, pp 59-68.

PUBLISHED CONFERENCE/SEMINAR PAPERS


Hasan, H, 'Executive-Computer Interfaces – a Case Study', OZCHI '92, Bond University, 1992, pp 195-197.


LABOUR HISTORY AND INDUSTRIAL RELATIONS
Co-ordinator: Professor Jim Hagan, tel (042) 21 3369

BOOKS

PUBLISHED CONFERENCE PAPER

REPORT

JOURNAL ARTICLES

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PUBLISHED CONFERENCE PAPER

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JOURNAL ARTICLES

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PUBLISHED CONFERENCE PAPER

REPORT

JOURNAL ARTICLES

BOOKS

BOOKS

PUBLISHED CONFERENCE PAPER

REPORT

JOURNAL ARTICLES


BOOK CHAPTERS


JOURNAL ARTICLES


Bouchter, S H, and Nugent, F W, 'Cardiac Response of Trained and Untrained Males to a Repeated Psychological Stressor', Behaviorial Medicine, 19, 1993, pp 21-27.


Pan, D A, and Storlien, L H, 'Dietary Lipid Profile is a Determinant of Tissue Phospholipid Fatty Acid Composition and Rate of Weight Gain in Rats', J of Nutrition, 123, 1993, pp 512-519.


Stanley, S N, Marshall, R N, Tilyard, M W,


BOUTCHER


PUBLIC HEALTH

Co-ordinator: Associate Professor Ross Harris, tel (042) 21 3463

BOOKS


BOOK APPENDED

Ewan, C E, Bryant, E, Calvert, D, and Garrick, J A (eds), Health in the Greenhouse: The Medical and Environmental Health Effects of Global Climate Change, AGPS Press, Canberra, 1993.

BOOK EDITED

Ewan, C E, Bryant, E, Calvert, D, and Garrick, J A (eds), Health in the Greenhouse: The Medical and Environmental Health Effects of Global Climate Change, AGPS Press, Canberra, 1993.

BOOK CHAPTERS

Calvert, Ewan, Garrick, and Parson, Public Health and Ecologically Sustainable Development (Ch 1); Ewan, Garrick and Calvert, Climate Change and Human Ecology (Ch 2); Ewan, Garrick and Marthick, Impact of Climate Change on Human Health (Ch 3).


BOOK APPENDED


JOURNAL ARTICLES


PUBLISHED CONFERENCE/SEMINAR PAPERS


SOCIAL LITERACY

Co-ordinator: Dr Bill Winser, tel (042) 21 3963

BOOK


BOOK CHAPTERS


PUBLISHED MONOGRAPHS/REPORTS


Harris, R D, Australian Rural Health: A National Survey of Educational Needs, University of Wollongong Press, Wollongong, 1992, pp 1-351.


Harris, P, 'Young Children's Perceptions of Reading Encounters in the Early Childhood Classroom', in P de Lacey, A...
Barlow and S Walker (eds), Young Children Learning: Perspectives on Early Childhood Education in Australia. UWS Reprographic Services, Sydney, 1992, pp 59-75.

JOURNAL ARTICLES
Harris, P, ‘The Social Construction of Reading in the Initial School Years’, The South Coast Researcher, 1, 1, 1992, pp 34-36.

PUBLISHED CONFERENCE/SEMINAR PAPERS

PUBLISHED MONOGRAPHS/REPORTS

SOCIOLOGICAL ANALYSIS OF POLITICAL AND CULTURAL CHANGE
Co-ordinator: Professor John Bern, tel (042) 21 3745

BOOK CHAPTERS

JOURNAL ARTICLES

PUBLISHED CONFERENCE PAPER
Aungstes, A, and Cook, D, ‘Information Technology and The Family: Electronic Surveillance and Home Imprisonment’ in Proc International Conf on Information Technology and People (ITAP), sponsored by International Centre for Scientific and Technical Information (Moscow) and The Open University (UK), Moscow, May 1993, 2, pp 155-161.
BOOK

BOOK CHAPTER

JOURNAL ARTICLES

PUBLISHED CONFERENCE/ SEMINAR PAPERS

SOFTWARE
Gray, J, PARSE-EDIT: a graphical program design tool.
STRUCTURAL ENGINEERING AND CONSTRUCTION

Co-ordinator: Associate Professor Yew-Chaye Loo, tel (042) 21 3039

BOOK


JOURNAL ARTICLES


PUBLISHED CONFERENCE PAPERS


REPORTS


STUDIES IN CONTEMPORARY ARTS PRACTICE AND PERFORMANCE IN AUSTRALIA
Co-ordinator: Dr Andrew Schultz, tel (042) 213302

BOOK

BOOKS EDITED
Rowley, S, S Magarey and S Sheridan (eds), Debutante Nation: Feminism Rewrites the 1890s, Allen and Unwin, Sydney, 1993.

BOOK CHAPTERS

JOURNAL ARTICLES
Rowley, S, 'Do We Have a Healthy Crafts Culture?', Craftlink, 7, 4, May 1993, pp 4-6.

PUBLISHED MONOGRAPHS/REPORTS
Schultz, A, Chair's Report, Sounds Australian Update, No 63, June 1993, pp 2-3.

PUBLISHED MUSIC COMPOSITIONS

OTHER
Wood Conroy, D, 'Eyeing Love and Death: Dreaming with the Phantom', Tass Mavrogordato (catalogue essay), Christine Abrahams Gallery, Melbourne, April 1993.

PERFORMANCES OF CREATIVE WORK/CURATORSHIPS
BOOK EDITED

EDITED JOURNAL

BOOK CHAPTERS


JOURNAL ARTICLES


Organ, M, 'W B Clarke as scientific journalist', Historical Records of Australian Science, 9, 1992, pp 1-16.

PUBLISHED CONFERENCE PAPERS


Memarian, H, 'Fracture history of the Coal Cliff Sandstone at Coal Cliff, NSW', 27th Newcastle Symposium on Advances in the Study of the Sydney Basin, Department of Geology, University of Newcastle, 1993, pp 113-120.

DEVELOPMENT GROUPS

ACCOUNTABILITY AND FINANCIAL REPORTING
Co-ordinator: Professor Michael Gaffikin, tel (042) 213718

BOOKS

BOOK EDITED

BOOK CHAPTERS

JOURNAL ARTICLES
Coomb, V, and Moore, J, 'Avoiding Students by the Application of Technology', Account, 5, 1, Spring 1993, pp 24-27.
McCrae, M and Aiken, M, 'Full Cost Pricing and Public Sector Reporting: Alleviating Undisclosed Measurement


PUBLISHED CONFERENCE PAPERS
PUBLICATIONS

CLINICAL COUNSELLING AND HEALTH PSYCHOLOGY

Co-ordinator: Associate Professor Linda Viney, tel (042) 21 3693

BOOK


BOOK CHAPTERS


JOURNAL ARTICLE


PUBLISHED CONFERENCE PAPER


CURRICULUM RESEARCH

Co-ordinator: Ms Christine Fox, tel (042) 21 3882

BOOK CHAPTERS


JOURNAL ARTICLES


CONFERENCE/SEMINAR PAPERS


Gray, T and Webb, P, 'Teachers' Perceptions of Their Ability to Teach Dance' 19th ACHPER National/International Biennial Conference, July 4-10 1993, pp 132-146.


INTERNATIONAL BUSINESS

Co-ordinator: Dr Moktar Metwally, tel (042) 21 4017

BOOKS
Metwally, M M, Quantitative Analysis for Decision Making, Parts 1 and 2, Department of Economics, University of Wollongong, 1993, 600 pp.

BOOK CHAPTERS

JOURNAL ARTICLES
FACULTIES

FACULTY OF ARTS

SCHOOL OF CREATIVE ARTS

See also 'Studies in Contemporary Arts Practice and Performance in Australia', page 159.

BOOKS
Pretty, R, with Kaye Bowden, Nicole: Another Chance at Life. Five Islands Press, September, 1993

BOOKS EDITED

JOURNAL ARTICLES

PUBLISHED MUSIC COMPOSITIONS

RECORDINGS
Conyngham, B, CD Recording, Silent Night, Tall Poppies, 1992, TP016.

OTHER CREATIVE WORKS
Dixon J W, conducted concert by City of Illawong Symphony Orchestra; Beethoven Symphony No 9 Choral, IMB Theatre, Illawara Performing Arts Centre, November 1992.
Dixon J W, conducted concert by City of Illawong Symphony Orchestra; Beethoven Gala (Egmont Overture, Piano Concerto No 3, Symphony No 6 Pastoral) IMB Theatre, Illawara Performing Arts Centre, April 1993.
Dixon J W, conducted concert by City of Illawong Symphony Orchestra; Nights at the Opera, IMB Theatre, Illawara Performing Arts Centre, August 1993.
Dixon J W, revised version of String Quartet No 2 Op 11 for performance in Adelaide.
Kevin, J, Director, Prophesying Backwards, Wollongong/Sydney, October 1993.
Senczuk, J, Designer, Diving For Pearls, Wollongong, August 1992.
Senczuk, J, Designer, A Whimsical Fellow, Sydney, April 1993.
Senczuk, J, Designer, A Song to Sing, O! Sydney, June 1993.
Senczuk, J, Director, Twelfth Night, Wollongong, July 1993.

DEPARTMENT OF ENGLISH

See also 'Literature and the Colonial Legacy', page 142.

BOOKS

DEPARTMENT OF HISTORY AND POLITICS

See also 'Asia and Pacific Development Studies', page 132; and 'Labour History and Industrial Relations', page 152.

BOOK CHAPTER
Melleuish, G, 'Republicanism before Nationalism' in Wayne Hudson and David Carter (eds), The Republicanism Debate, New South Wales, 1993, pp 77-87.

BOOK EDITED
Melleuish, G, Guest Editor, Political Theory Newsletter, Australian Political Thought Issue, 5, 1, April 1993.

JOURNAL ARTICLE
Melleuish, G, ‘Conceptions of the Sacred in Australian Political Thought’, Political Theory Newsletter, 5, 1, April 1993, pp 39-52.


Rando, G, ‘Journey, Quest and (Self) discovery in the Narrative of Stanislao Nico’ in Christine Arkininstall (ed), Literature and Quest, Amsterdam – Atlanta, Editions Rodopi B V, 1993, pp 29-43.


JOURNAL ARTICLES


JOURNAL ARTICLES


BOOK CHAPTERS


DEPARTMENT OF PHILOSOPHY

BOOK CHAPTER


DEPARTMENT OF MODERN LANGUAGES

BOOKS EDITED


Rando, G, and Arrighi, M, Italians in Australia: Historical and Social Perspectives, Department of Modern Languages, University of Wollongong/Dante Alighieri Society, Wollongong Chapter, 1993, 3, 239 pp.

DEPARTMENT OF MODERN LANGUAGES

BOOKS EDITED


Rando, G, and Arrighi, M, Italians in Australia: Historical and Social Perspectives, Department of Modern Languages, University of Wollongong/Dante Alighieri Society, Wollongong Chapter, 1993, 3, 239 pp.

BOOK CHAPITERS

Moloney, B, ‘Riduzioni drammatiche’: Two dramatizations of Svevo’s La coscienza di
DEPARTMENT OF
ACCOUNTANCY


DEPARTMENT OF
BUSINESS SYSTEMS

See 'Information Systems in Organisations', page 151.

DEPARTMENT OF
ECONOMICS

See 'Applied Economic Modelling', page 130; 'Asia and Pacific Development Studies', page 132; 'Labour Market Analysis', page 141; 'Labour History and Industrial Relations', page 152; and 'International Business', page 163.

DEPARTMENT OF
MANAGEMENT

See also 'Asia and Pacific Development Studies', page 132; 'Science and Technology Analysis', page 144; and 'Management Strategy and Organisational Change', page 152.

REFEREED INTERNATIONAL JOURNAL ARTICLE


PUBLISHED CONFERENCE PAPERS


Badham, R, 'Production Islands and Utopian Design', *IFAC World Congress Proc, Sydney, June 1993*, pp 105-315.
See also 'Education Policy', page 138; Social Literacy, page 155; and 'Curriculum Research', page 162.

BOOKS EDITED

de Lacey, P R, Barlow, A, and Walker, S L (eds), Young Children Learning, Kingswood, University of Western Sydney, 1992.

BOOK CHAPTERS


MONOGRAPH


REFEREED JOURNAL ARTICLE


PUBLISHED CONFERENCE PAPERS

DEPARTMENT OF CIVIL AND MINING ENGINEERING

See 'Water Engineering and Geomechanics', page 145; 'Experimental and Analytical Stress Analyses of Structures', page 149; 'Fossil Fuels', page 150; and 'Structural Engineering and Construction', page 158.

JOURNAL ARTICLE


PUBLISHED CONFERENCE PAPERS


DEPARTMENT OF MATERIALS ENGINEERING

See 'Advanced Materials and Surface Engineering', page 128.

DEPARTMENT OF MECHANICAL ENGINEERING

See also 'Applied Mechanics and Advanced Manufacturing', page 131; 'Bulk Materials Handling and Physical Process-ing', page 136; and 'Structural Engineering and Construction', page 158.

REPORTS


FACULTY OF HEALTH AND BEHAVIOURAL SCIENCES

DEPARTMENT OF BIOMEDICAL SCIENCE

See 'Physical Activity and Ageing', page 153.

DEPARTMENT OF NURSING

BOOK CHAPTERS


JOURNAL ARTICLES


PUBLISHED CONFERENCE/SEMINAR PAPERS


Holden, R J, 'Psychiatric Nursing Post Radical Reconstruction Surgery', 19th National Convention of the Australian College of Mental Health Nurses. 'Mental Health Nurses Setting the Agenda', Hyatt Kingsgate Sydney, September, 1993, pp 137-144.

Holden, R J, 'Does the Nurse's Heaven Represent the Patient's Hell?', Mental Health Nursing Seminar, 'Voyage from Here to Utopia', Universities of Sydney and Western Sydney, Cumberland Hospital, November 1992, pp 1-7.


Yuen, F, and Blair, M, 'Assessment in Mental Health Settings', Conf Proc, Int Psychiatric Nursing Conf, Royal Melbourne Inst of Technology, Bundoora Campus, April 1993, pp 132-137.

Yuen, F, and Blair, M, 'Transcultural Nursing Assessments — Some Practical Issues', Conf Proc, National Transcultural Nursing Conf, University of Sydney, Cumberland Campus, May 1993, pp 82-86.
DEPARTMENT OF PSYCHOLOGY

See 'Applied Cognitive Studies', page 147; and 'Clinical Counselling and Health Psychology', page 162.

DEPARTMENT OF APPLIED STATISTICS


DEPARTMENT OF INFORMATION AND COMMUNICATION TECHNOLOGY

See also 'Computer Security: Technical and Social Issues', page 137, and 'Science and Technology Analysis', page 144.

JOURNAL ARTICLE

Dean, A F, and Mahony, M J, 'Pro Bono Publico (For the Public Good), Strategic Thinking in Distance Education', ICDE, Open Praxis 2, 1993 pp 16-18.

PUBLISHED CONFERENCE PAPERS


DEPARTMENT OF COMPUTER SCIENCE


DEPARTMENT OF MATHEMATICS

See also 'Advanced Telecommunications', page 129, and 'Industrial Automation', page 139.

PUBLISHED CONFERENCE PAPERS


BOOK CHAPTER


DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

See also 'Advanced Telecommunications', page 129, and 'Industrial Automation', page 139.

PUBLISHED CONFERENCE PAPERS


BOOK CHAPTER


DEPARTMENT OF PUBLIC HEALTH AND NUTRITION

See 'Public Health', page 154.

DEPARTMENT OF ELECTRICAL ENGINEERING

See also 'Advanced Telecommunications', page 129, and 'Industrial Automation', page 139.

PUBLISHED CONFERENCE PAPERS


BOOK CHAPTER

FACULTY OF LAW

BOOKS

BOOK CHAPTERS

JOURNAL ARTICLES

PUBLISHED CONFERENCE / SEMINAR PAPERS
Kelly, A, ‘An Introduction to the NSW Planning System’, Environmental Planning


PUBLISHED MONOGRAPHS/REPORTS


Goldring, J, 'Why Aren't Consumer Remedies Used?', LEXPO Symposium, Sydney, October 1993, pp 1-5.


McNamara, L, Aboriginal Peoples, the Administration of Justice and the Autonomy Agenda: An Assessment of the Status of Criminal Justice Reform in Canada with Reference to the Prairie Region, Research Report 4, Winnipeg, Legal Research Institute, University of Manitoba, 1993, pp 1-222.

DEPARTMENT OF BIOLOGICAL SCIENCES


DEPARTMENT OF CHEMISTRY

See also 'Bioactive Molecules', page 134; 'Biological Macromolecules', page 135; and 'Intelligent Polymeric Materials', page 140.

BOOK CHAPTERS


JOURNAL ARTICLES


CONFERENCE PAPERS


ENVIRONMENTAL SCIENCE

BOOK CHAPTER


JOURNAL ARTICLES


PUBLISHED CONFERENCE PAPERS


PUBLISHED MONOGRAPHS/REPORTS


DEPARTMENT OF GEOGRAPHY

See also 'Australian Flora and Fauna', page 132, and 'Quaternary Environmental Change', page 143.

BOOK


BOOK EDITED


BOOK CHAPTERS

Ball, R E, 'The Middle East' in Stahl et al Global Population Movements and Their Implications for Australia, AGPS, Canberra, 1993, pp 50-61.


Ball, R E, 'Latin America' in Stahl et al...
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See also ‘Fundamental Properties of Semiconductors’, page 150

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