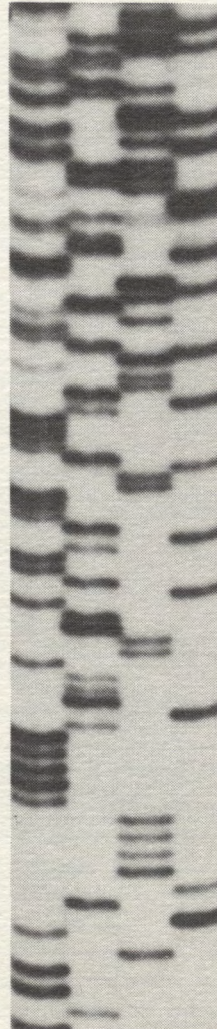
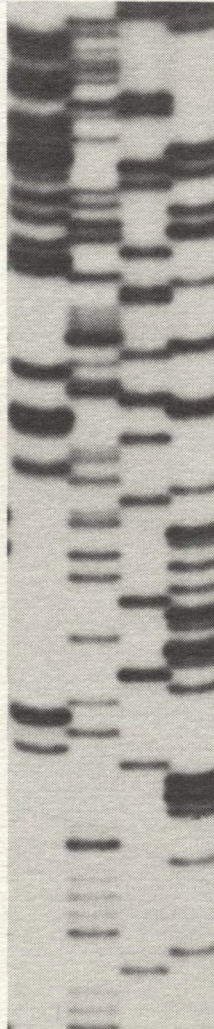


The Australian National University

Research School of Biological Sciences

Annual Report 1982

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Cover Illustration

The isolation of genes by molecular cloning is a necessary prerequisite for determining their molecular structure. The photograph represents part of the nucleotide sequence pattern obtained from a radioactively labelled clone of a mouse kallikrein gene. From this sequence ladder it is possible to identify the precise nucleotide arrangement of the gene segment and this is shown alongside the ladder. In a final step the nucleotide arrangement can be used to predict the amino acid sequence of the encoded protein. (courtesy Dr John Shine, Research Director, CRDR).

The Australian National University
Research School of Biological Sciences

Annual Report 1982

Activities of the Research School Departments, Staff, Courses and Centres	3
Publications	21
Conferences and presentations	33
Staff, Visitors and Students	63

Director

Professor B. John, MSc, PhD (Wales), DSc (Birm), FIBiol

School Secretary

Mr A.C. Dodd, BEc (Syd)

Business and Technical Manager

Dr D. Hardman, BA (Admin) (CCA), FIMLS

Assistant Business Manager

Mr A. McDonald

Faculty Board

Chairman

Professor B. John

Members

Dr M.R. Badger (to July)	Professor G.A. Horridge
Dr A.D. Blest (to July)	Professor R.F. Mark
Dr N.J. Deacon	Dr J.G. Oakeshott
Dr A.J. Gibbs	Professor C.B. Osmond
Dr J.B. Gibson	Professor J.A. Pateman
Professor B.E.S. Gunning	Dr J. Shine (from July)
	Dr S.M. Wick (from July)

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REPORT OF THE DIRECTOR

Professor Robert John

There are three rather distinctive approaches to the study of living systems. The first is the Descartian strategy of dealing with living organisms as machines with a view to analysing the basic mechanisms by which they maintain and reproduce themselves. There are two areas of enquiry in the School which rely heavily on this approach. The mechanistic approach is concerned with the mechanisms by which animals receive information via their sense organs, process it within the central nervous system and then convert it into an overt response. Current studies of concentration deal with the processes of vision and audition in both vertebrates and invertebrates as well as with the visual and auditory systems of invertebrates. The other area of enquiry is concerned with the physiological and the molecular biology of plants. The physiological approach is concerned with the way in which plants convert light energy into chemical energy and the molecular approach is concerned with the way in which plants convert carbon dioxide into organic compounds.

A second approach to living systems is concerned with analysing how an adult organism develops from its earliest microscopic starting point and how this process is regulated and integrated. On the one hand we use two rather different techniques. On the one hand we use the technique of the manner in which genes of known structure control both defined morphological sequences and developmental events. On the other hand we also use the technique of the role which two plant genes, ribonuclease and phytochrome, play in controlling the growth and form of plants.

The third approach to living organisms is concerned with the way in which they change and evolve. This theme in fact encompasses both the mechanistic and the developmental approaches in the sense that organisms' evolution depends on alterations in both developmental programmes and the mechanisms which such programmes bring into being. The emphasis on evolutionary studies within the School is to examine the sources of variation within the genome and the extent to which such variation finds expression in modified patterns of development. The dramatic effect which molecular approaches have had in re-examining much of classical biology inevitably means that members of any one Department within the School may now work comfortably in mechanistic, developmental or evolutionary disciplines as the boundaries which traditionally have separated these disciplines begin to erode.

The results of our activities in these three areas of enquiry over the past year are summarised in the individual reports that follow and the 164 research publications which arise from these reports. In addition to direct support from the Australian Government our work has been facilitated by financial assistance from the following outside sources:

- Agrigenetics Research Corporation
- Australia-China Council
- Australian Associated Brewers
- Australian Marine Sciences and Technology Grants Scheme
- Commonwealth Department of Health
- Commonwealth Department of Home Affairs and Environment
- Commonwealth Department of Science and Technology
- Central Council of N.S.W.
- Smey Research Committee

CONTENTS	Page
Report of the Director	1
Activities of the School's Departments, Units, Group and Centre	3
Publications	25
Conference presentations	53
Staff, Visitors and Students	65

REPORT OF THE DIRECTOR

Professor Bernard John

There are three rather distinctive approaches to the study of living systems. The first is the Cartesian strategy of dealing with living organisms as machines with a view to analysing the basic mechanisms by which they maintain and reproduce themselves. There are two areas of enquiry within the School which rely heavily on this approach. The neurosciences deal with the mechanisms by which animals perceive information via their sense organs, process it within the central nervous system and then convert it into an overt response. Current areas of concentration deal with the processes of vision and audition in both vertebrate and invertebrate animals as well as with the structure and mode of operation of the mammalian brain cortex. Paralleling this approach in plants is the integral study of the biochemical, the physiological and the ecological mechanisms which govern plant performance with particular reference to the key process of photosynthesis.

A second approach to biosystems is concerned with analysing how an adult organism develops from its modest microscopic starting point and how this process of development is regulated and integrated. Here we use two rather distinctive approaches. On the one hand we focus attention on the manner in which genes of known structure control both defined metabolic sequences and individual developmental events. On the other hand we also have an active interest in the role which two important gene products, microtubules and phytohormones, play in controlling the growth and form of plants.

The third approach to living organisms is concerned with the way in which they change and evolve. This theme in fact encompasses both the mechanistic and the developmental approaches in the sense that organismic evolution depends on alterations in both developmental programmes and the mechanisms which such programmes bring into being. The emphasis on evolutionary studies within the School is to examine the sources of variation within the genome and the extent to which such variation finds expression in modified patterns of development. The dramatic effect which molecular approaches have had in recasting much of classical biology inevitably means that members of any one Department within the School may now work comfortably in mechanistic, developmental or evolutionary disciplines as the boundaries which traditionally have separated these disciplines begin to crumble.

The results of our activities in these three areas of enquiry over the past year are summarised in the individual reports that follow and the 244 research publications which arise from these reports. In addition to direct support from the Australian Government our work has been facilitated by financial assistance from the following outside sources:

Agrigenetics Research Corporation
 Australia-China Council
 Australian Associated Brewers
 Australian Marine Sciences and Technologies Grants Scheme
 Commonwealth Department of Health
 Commonwealth Department of Home Affairs and Environment
 Commonwealth Department of Science and Technology
 Coastal Council of N.S.W.
 Honey Research Committee

National Geographic Society
 National Institutes of Health, U.S.A.
 NH & MRC (with the University of Melbourne)
 N.S.W. State Pollution Control Commission
 Reserve Bank of Australia Rural
 Credits Development Fund
 University of California, San Francisco
 Wheat Industry Research Council

To all of these we express our appreciation.

Finally, our research students continue to play an active and important role in the work of the School and during the past year 13 of them successfully completed their doctorates. The students concerned and their doctoral topics are listed below:

BALL, M.C. (Environmental Biology). Physiology of photosynthesis in two mangrove species: responses to salinity and other environmental factors.

BOAG, T.S. (Environmental Biology). Characterization of C₄ photosynthesis in sodium deficient plants.

CONSTABLE, G.A. (Environmental Biology). Carbon fixation and distribution in cotton: implications of single leaf measurements to plant performance.

DUBS, A. (Neurobiology). Processing of spatial information in the fly's eye.

EHRlich, D. (Behavioural Biology). Topography of the origin, course and termination patterns of optic nerve axons in the chick (*Gallus gallus*).

FISHER, P.R. (Genetics). Orientation behaviour by *Dictyostelium discoideum* slugs.

GALEOTTI, C.L. (Genetics). Studies on interspecific cell fusion in yeast.

GUY, P.L. (Virus Ecology Research Group). Viruses, host range and the Australian flora.

HUGHES, J.E. (Genetics). Molecular cloning and characterization of 'symbiotic' genes from *Rhizobium trifolii*.

IINO, M. (Developmental Biology). Control of maize seedling growth: light and auxin.

PAYNE, R. (Neurobiology). Chemical modifications to transduction in an insect eye.

WELLINGTON, A.B. (Environmental Biology). A study of the population dynamics of the Mallee *Eucalyptus incrassata* Labill.

WILLIAMS, D.S. (Neurobiology). Photoreceptor membrane turnover in insects.

ACTIVITIES OF THE SCHOOL'S DEPARTMENTS, UNITS, GROUP AND CENTRE

DEPARTMENT OF BEHAVIOURAL BIOLOGY

The Department studies the development and function of brain mechanisms underlying animal behaviour. In the past year, we have made some important discoveries on the mechanisms of sensory perception, in vision and hearing.

Some years ago we began an investigation of drugs, particularly kainic acid, that had toxic effects on the bird retina, with a view to determining which chemical neurotransmitters were involved in the functioning of the various classes of nerve cells in the eye. Electrophysiological studies of affected eyes have revealed that the pathways through the retina responsible for signalling an increase in light survive the toxic effects of kainic acid, but those signalling darkening are totally destroyed. In addition to suggesting that an endogenous kainic acid-like substance is a photoreceptor transmitter, this system provides a new way of analysing and assigning function to different retinal nerve cells and determining the visually guided behaviour that they subserve.

The behavioural study of bird vision has revealed that pigeons have stereoscopic depth perception, and has led to a search for the nervous pathways in the brain responsible for this. Visual acuity at high light intensities for the Australian wedge-tailed eagle is twice that of man, which correlates with the optical and nervous structure of the eye. This performance is being compared with other birds of prey such as the owl which have evolved to hunt at low light intensities. The timetable of development of visual centres has been determined in the pouch young of the tammar wallaby in much greater detail than has been possible with placental mammals and has initiated a new approach for the experimental study of the formation of visual pathways.

The comparative anatomy of visual centres in a series of marsupials has demonstrated that there is an evolutionary trend to segregation of visual input from the two eyes.

In addition, the mechanisms of directional hearing have been studied in the owl and the wallaby. The wallaby external ear turns out to be an extraordinarily effective directional antenna. Since the ears are mobile, this has led to the study of ear position in directional hearing. The same biophysical techniques applied to the owl have shown that the facial ruff of feathers has acoustical properties similar to that of the mammalian external ear. In addition the owl's two ear drums are connected by a large air-filled bony canal allowing the motion of one ear drum to be affected by sound reaching the opposite one. The intensity differences between the ears generated by these two peripheral mechanisms substantially account for the behaviourally observed directional hearing abilities, a matter that has been overlooked by other investigators of directional hearing. These studies have a wider significance than illuminating natural history. Both the eye and ear are of very similar design across the vertebrates. Understanding their special features in one animal broadens understanding of them all.

In the bird brain, the entire neuronal circuit concerned with feeding, from the sensory endings in the beak through hitherto unknown pathways in the forebrain and back to the motoneurons controlling the beak muscles has been mapped. This feat parallels the recent similar achievement of identifying the pathways for

vocalization in song birds, and is the essential basis for any understanding of the brain mechanisms involved in various behaviours. Progress has also been made in understanding the organization of sensory and motor pathways in the wallaby and other mammalian brains by both anatomical and electrophysiological techniques.

Hormonal control of seasonal breeding in the tamarin wallaby and the sexual differentiation of the brain are being studied in collaboration with the CSIRO Division of Wildlife Research. Studies of the growth of the retina and optic centres of fish have revealed a seasonal, presumably hormonal, control of brain development and differentiation. Quantitative morphometric studies of regenerating retino-tectal projections in the goldfish have shown that young animals can regulate the number of synapses made by retinal neurons more flexibly than can older animals.

Further work is proceeding on the development of spinal motor neurones in animals from frogs to the wallaby. Cell death is a common feature of development in all these animals and appears to be related to the formation of the correct pattern of connections to muscles by way of the peripheral nerves. This project is being carried out in collaboration with the John Curtin School of Medical Research.

Other Activities

A new departure for the Department has been the acceptance by the Faculty of Science of an Honours/Diploma course in Neuroscience for 1983 taught by members of the Institute, coordinated by the Department of Behavioural Biology, together with the Faculty. The course is the first of its kind in Australia and the first to be run as a formal coordinated effort between the Faculties and the Institute.

Dr. Morgan attended the annual meeting of the Association for Research on Vision and Ophthalmology in Florida in May. Ms. McFadden gave an invited seminar at the Université Pierre et Marie Curie in Paris. Professor Mark is regional editor of Physiology and Behaviour and Behavioural Brain Research. Dr. Morgan is on the editorial board of Neuroscience. Ms. McFadden is Secretary and Mr. Faulks Treasurer of the Australian Society for the Study of Animal Behaviour. Dr. Sanberg was awarded the Crawford Prize for his PhD thesis.

CENTRE FOR RECOMBINANT DNA RESEARCH

During 1982 a new laboratory was constructed in the School for the Centre, and became available in July. The CRDR was officially opened on August 6th by Emeritus Professor A.J. Birch, President of the Australian Academy of Science, who gave an address to an audience of some 300 invited guests and members of RSBS. This was followed by an afternoon scientific session in which John Shine, ANU; Peter Starlinger, Universität zu Köln; Robert Goldberg, UCLA; and Dean Hamer, NCI, Bethesda, gave invited lectures. The Opening and the Scientific session was attended by about 100 invited representatives of appropriate industrial companies and CRDR members from outside Canberra, together with local members.

The majority of the research carried out in the CRDR laboratory is supported by outside funds, and some RSBS staff also work at least part-time, in the laboratory. In many projects and activities work

is done both in the CRDR laboratory and in the Department of Genetics, and consequently the project and researchers may be included under both headings.

A major research project involved the cloning and characterisation of genes encoding the establishment of an effective nitrogen fixing symbiosis between legumes and bacteria of the genus Rhizobium. A 14 kb DNA fragment containing the host specific nodulation genes of the clover bacterium R. trifolii has been isolated and is being sequenced. Similar studies are also being carried out on the non-legume symbiont Parasponium Rhizobium. Already it has been shown that the structural genes of the nif operon are unlinked in this Rhizobium, in contrast to our finding of contiguous nif genes in R. trifolii. Differences in the organization of the nif genes between these two Rhizobium suggest a fundamental difference in the regulation of nitrogen fixation between these two types of symbiotic bacteria.

An analysis of the plant genes involved in symbiotic nitrogen fixation has also been initiated using mRNA extracted from nodules induced on the tropical legume Siratro and the non-legume Parasponia. Such studies should help elucidate the host requirements for the establishment of the symbiotic state.

Another major project has been the examination of the kallikrein gene family. The kallikrein gene family consists of 25-30 highly homologous genes which encode specific proteases involved in the processing of different biologically active peptides. Molecular cloning and DNA sequencing has been used to isolate and initially characterise the members of this large gene family. In the mouse all the members of this family are closely linked on chromosome 7. The isolation and characterisation of mouse genomic kallikrein clones has demonstrated that the kallikrein genes are frequently tightly linked and exhibit a remarkable degree of conservation in their DNA sequence and structural organization. A project has started to determine the structure of the human renin gene and to examine its expression in various tissues and pathological states. Renin, through its ability to cleave its plasma substrate angiotensinogen, plays a physiological role in the control of blood pressure and electrolyte homeostasis. Already several clones have been isolated which carry human renin gene sequences, although it is not yet clear whether there are multiple genes or that these clones represent overlapping fragments of the same gene.

A facility for the chemical synthesis for defined sequence DNA fragments has been set up. Such specific oligonucleotides have become crucial to the success of any project involving in vitro mutagenesis, use of specific probes or the planned manipulation of gene sequences. The first oligonucleotide synthesised using the phosphoamidite method of synthesis was the specific 17-mer used for sequencing in the bacteriophage M 13-dideoxy system.

The CRDR has also purchased both the Protein Sequence and the Nucleic Acid Sequence Database from the National Biomedical Research Foundation. These databases will be continually updated. Already the Nucleic Acid Database contains almost 900 entries making a total of 10^6 bases.

Other Activities

Dr. J. Shine presented invited papers at the Second International Congress of Recombinant DNA Research in Los Angeles, the INSERM meeting on Processing and Secretion of Peptide Hormones in Siellac, France, the ANZAAS meeting in Sydney, the International Union of Biochemistry meeting in Perth, the meeting on Manipulation and Expression of Eukaryotic Genes at Monash University, the 1st International Symposium on Molecular Genetics of the Bacteria-Plant Interaction in Bielefeld, Germany as well as presenting a Plenary Lecture at the Annual meeting of the Australian Society for Microbiology in Hobart, and invited seminars at the Garven Institute for Medical Research, St. Vincent's Hospital, Sydney and the Department of History and Philosophy and Science, University of Wollongong, he also participated in the workshop on Genetic Engineering run by the Department of Science and was a member of the Scientific Sub-committee of the Recombinant DNA Monitoring Committee and a member of the NHMRC Regional Grants Interviewing Committee.

Dr. J. Watson was an invited speaker at the Seoul International Symposium on Genetic Engineering in Seoul, South Korea. He also presented papers at the Fourth International Symposium on the Genetics of Industrial Micro-organisms, Kyoto, Japan, the Botany Department, ANU, and the National Institute of Genetics, Misima, Japan.

A number of other researchers in the CRDR presented papers or posters at local and international conferences.

DEPARTMENT OF DEVELOPMENTAL BIOLOGY

Much of the work of the Department is long-term in nature, and the record is one of continued progress combined with new developments. Overall, we still use plants as our main source of experimental material, but many of our studies are relevant to all living organisms.

Plant hormones:- Of the several types of plant growth regulator, two, auxins and cytokinins, are under intensive investigation. A Finnigan 4500 gas chromatograph/quadripole mass spectrometer is now in extensive use for identification and quantitative analysis of these hormones, which are present as trace components, varying in nature and amount according to the growth status of the tissue. The complexity of some situations is apparent from the fact that no less than 16 cytokinins have unequivocally been identified in crown-gall tumor tissue, which turns out to contain unusually high levels of cytokinin activity, and is therefore valuable as material for examining pathways of biosynthesis of these regulators. Biosynthetic pathways are relevant to questions of hormonal control of development, and in other experiments a highly active cytokinin metabolite that retards leaf senescence has been identified. In another system it seems that formation and persistence of nitrogen-fixing leguminous root nodules is controlled more by auxins than by cytokinins. Metabolism of cytokinins is very similar in both "effective" and "ineffective" nodules, and similar also to that in the normal root tissue. However auxins and cytokinins do interact in certain growth responses, and it is therefore of note that auxin (indole-3-acetic acid) has been found to be a potent inhibitor of an enzyme that converts the cytokinin zeatin to an alanine conjugate. This is the first link between the two types of regulator to be specified in detail.

Tissue culture, regeneration, and cell division:- It is of great importance to learn how cell division in plant tissues is regulated. That auxins and cytokinins interact in the process is especially evident in work on induction of cell division in explants taken from growing or mature plants. Cells in slices of Jerusalem artichoke tissue do not normally divide even if cytokinin is supplied, but auxin induces division and cytokinin augments this effect. A Leitz MPV-3 microscope photometer was commissioned during 1982, and is being used to correlate DNA levels per cell with structural changes that precede induced cell division. It is apparent that wholesale alterations in cell organisation occur in a definite sequence, long before the actual division. Division of cells in normal meristems is also being examined by light and electron microscopy.

Hormone treatments are needed to promote division in portions of tissue taken from leaves of cereals. Surveys of many species and cultivars of wheat have specified the conditions that must be met for obtaining growth of these tissue cultures. However, before the methods can be used in crop improvement and propagation programs, it is necessary to modify the hormone regimes in such a way as to promote regeneration of new plants from the cultures. This has been achieved for some cultivars of wheat but the procedure is not yet consistent.

Cell ultrastructure:- One stage that is crucial in the development of any organism occurs when products of gene action combine with one another to create microscopically visible 3-dimensional structures which are essential for the formation of cells with particular sizes, shapes, and polarities. Much of our research effort is being devoted to this level of analysis - study of the "cytoskeleton", or in general, the molecular scaffolding that governs subcellular organisation and thereby functional properties of cells and tissues. Types of cells that are being studied include giant cells in the alga Chara, infective zoospores of the pathogenic fungus Phytophthora cinnamomi (which now poses problems of enormous magnitude in the Australian environment), reproductive cells in orchids and mosses, and various categories of dividing and differentiating cells in flowering plants.

Antibodies are increasingly valuable in this part of our work. As in previous years, conventional, or polyclonal, antibodies labelled with fluorescent dyes have been used to map the distribution of microtubules in a range of cell types and under varying experimental conditions. Microtubules are also under study by electron microscopy. They are involved in cell division and they control deposition of cell wall material, thus indirectly controlling cell shape. In this case the antigen is a known protein, tubulin. Most of the other components of the plant cytoskeleton are as yet undescribed, and the task of penetrating into this unknown field has been taken up by raising a library of monoclonal antibodies from crude preparations of cytoskeleton. Through the agency of these very highly specific reagents it has been confirmed that a form of the muscle protein, actin, occurs in plant cells, where it participates in generating movement of cytoplasm. Monoclonal antibodies to other cytoskeletal components, some of them structural, others probably involved in cytoplasmic streaming, have also been obtained, opening the way to entirely new analyses of cell structure.

Cell physiology and biochemistry:- Our footing in these fields will be strengthened in 1983 by the arrival of a biochemist who will study

cytoskeletal proteins. Meanwhile new projects on regulation of cytoskeletal properties by free calcium ions and the calcium-dependent regulator protein calmodulin have been started using giant cells of the alga Chara. These cells are also in use for related work on cytoplasmic streaming, pH regulation, compartmentation within the cell, and intercellular communication - the latter being another topic of long-standing interest in the Department.

Other Activities:-

The major conference for members of the Department was the 11th International Conference on Plant Growth Substances, held in Aberystwyth, Wales. Drs Letham, Palni and Palmer attended, along with C. Hocart and Visiting Fellows Dr Warren Wilson and Tao Guo-qing. All of these presented their work at the meeting. Two other projects were presented at an overseas meeting, by Dr R. Overall (electrophysiology and ultrastructure of plasmodesmata, see Annual Report, 1981) and Dr S. Wick (immunocytology of microtubules in meristematic cells) - both at the annual conference of the American Society for Cell Biology in Baltimore, USA. Dr Hardham described her work on Phytophthora cinnamomi at the 12th International Biochemistry Congress in Perth, also attended by Dr Wick.

In local conferences, Professor Gunning gave an invited lecture at the Australian Society of Plant Physiologists meeting in Perth. Four presentations were given at the inaugural meeting of the Australian and New Zealand Society for Cell Biology.

Research seminars were given by Dr Wernicke (Division of Plant Industry, CSIRO), Dr Williamson (La Trobe University), Dr Wick (La Trobe University; University of Saskatchewan, Canada; University of Massachusetts; University of Connecticut; Worcester Foundation for Experimental Biology; University of Toronto), Dr Palni (University of Pant Nagar; Kumaon University), Professor Gunning (ANU Botany Department).

Drs Palni and Palmer visited research centres while overseas, including the Phytotron, Gif-sur-Yvette; University of Hohenheim; Institute for Plant Protection, Budapest; Rubber Research Institute, Kuala Lumpur; Hewlett Packard Laboratories, Singapore; Thai-German Plant Protection project, Bangkok. S. Wick undertook preliminary work on collaborative projects during visits to the Universities of Georgia, Colorado, Toronto, and Massachusetts.

Drs Palni, Wick and Gunning continued their contribution to the ANU Botany Department course in Advanced Botanical Concepts, this year joined by Dr Hardham, who also lectured to students in the School of Botany, University of Melbourne. R. Bray participated in the Administrative Development Program run by the Community Affairs section of the University.

Three members of staff are editors of major journals - Dr Williamson, for Cell Biology International Reports; Dr Letham, for the Journal of Plant Growth Regulation; and Professor Gunning, for Protoplasma.

In committee work Professor Gunning represented the School on the Life Sciences Library Users Committee, the Science Periodicals Advisory Committee and the ANU EM Committee, and was a member of the RSBS Finance Advisory Group. He also served on the program committee

for the 7th Australian Conference on Electron Microscopy, the Australian and New Zealand Society for Cell Biology Committee, the Australian Academy of Science National Committee for Electron Microscopy, and the Advisory Committee for the Australian Journal of Plant Physiology. Dr Letham served on the RSBS GC-MS Committee. Dr Palni, who with Dr Wick continued to organise the Departmental Seminar program, became convenor of the School Lectures and Seminars Committee, and was also Deputy Head of Garran Hall, ANU.

DEPARTMENT OF ENVIRONMENTAL BIOLOGY

The Department's research emphasis and objectives centre upon the ways plants acquire energy, water and carbon. It seeks to understand the events involved, in terms of basic mechanisms, and to discover the ways these are integrated, and regulated so as to determine the response of plants to the physical, chemical and biological environment. These objectives are achieved by interactive research projects between the broad areas of plant biochemistry, physiology and ecology.

Conversion of solar energy to biomass by means of photosynthesis, which is fundamental to the functioning of all plants, is a major theme of the Department's research. This year, work in conjunction with the Department of Applied Mathematics, RSPHYS and the Biochemistry Section, Division of Plant Industry, CSIRO, has advanced our understanding of the molecular organisation of chlorophyll/protein complexes in chloroplast membranes. The distribution of light energy between these complexes helps explain regulation of the energy requirements for carbon fixation in the chloroplast, the basic unit of the photosynthesis apparatus. Novel approaches to the origins of light dependent oxygen uptake which accompanies oxygen evolution in photosynthesis, using stable isotopes and a mass spectrometer, have helped distinguish the contributions of cyclic and noncyclic electron transport to chloroplast bioenergetics. These events are particularly complex in the specialised bundle sheath cells in leaves of C_4 plants such as maize and saltbush. They are central to further understanding of the process of photorespiration in which carbon and nitrogen assimilated in photosynthesis is subsequently released from the cell. Recovery of photorespiratory nitrogen seems vitally important and progress has been made in the characterisation of a dicarboxylic acid transport process in the chloroplast envelope which facilitates this recovery.

Consumption of photosynthetic products by respiratory processes in different plant parts has also been studied. Analysis of leaf respiration suggests that it often continues as rapidly in the light as in the dark, and that it increases as sugars accumulate within the leaf after prolonged photosynthesis. A significant finding has been that much of this extra respiration is insensitive to the metabolic poison, cyanide. Studies of leaf mitochondria, the basic units of respiratory metabolism, show that they, like root mitochondria have a cyanide insensitive alternate pathway for electron transport which is engaged when sugars accumulate and the conventional energy transducing (cytochrome) pathway is blocked. These observations raise new and fundamental questions about the energetic basis of plant growth.

The accumulated knowledge of the biochemistry of photosynthesis and photorespiration proves increasingly adequate to explain the

characteristics of photosynthesis in whole leaves in "normal" physiological conditions. One exception is the rapid and reversible inhibition of photosynthesis at high concentration of CO₂. It will receive further study. It may have important ecological implications, for under some conditions it occurs with ambient CO₂ concentration expected to obtain in the global atmosphere in the foreseeable future. In the longer term also, the influence of enhanced CO₂ concentration raises interesting problems. An increase in rate of growth in cucumber plants exposed to high CO₂ proved to be a transient phenomenon. Initially rate of photosynthesis per unit area of leaf and production of dry matter was doubled at double normal ambient CO₂ concentration. After seven weeks, however, rate of production of dry matter per plant was no greater than at normal ambient CO₂ concentration. Our exploration of these trends has been greatly facilitated by installation of on-line control and data analysis of experiments carried out in our two high precision controlled environment cabinets.

The effects of other growth conditions, particularly light, nitrogen and phosphorous nutrition, and water availability have been widely studied. Adequate nitrogen nutrition proves to be essential for photosynthetic acclimation from low to high light, especially if accompanied by water stress. Interactions between phosphorous nutrition and the regulation of photosynthesis by means of phosphate supply to the chloroplast have been explored. There have been two schools of thought on the influence of water availability on photosynthetic carbon metabolism. One points to the decrease in potential rate of regeneration of the substrate for CO₂ fixation as being fundamental, and suggests that the concomitant closure of stomata is an adaptation that limits the rate of water use in a way tuned to the reduction in photosynthetic capacity. The other finds more fundamental reasons for the closure of the stomata, and argues that the reduction of photosynthetic capacity, which is not manifest while the stomata are partially closed, and is reversible when water is again available and the stomata are open, is of ancillary importance. The controversy is expected to continue to stimulate experimental and theoretical activity. This year saw also the beginning of an active Departmental interest in hormonal control of carbon fixation and water use, with experimental work on particular aspects of the function of abscisic acid and cytokinin.

Our ecological work is concerned with long term vegetation change, and is focussed on ecological succession and stand dynamics in communities subject to disturbance by grazing or fire. Questions of particular interest include the factors underlying the stability of ecotones such as valley bottom and alpine tree-lines; the phenomenon of invasion of an ecosystem by exogenous species and the role of fire in ecological systems.

This year, a study of competition between the shrubby, exotic weed Chrysanthemoides and a native Acacia in coastal dunes has been completed. Significant differences in rates of photosynthesis, water use and carbon allocation in the two species have been identified, the exotic appearing to be more aggressive in its competition for light and water but less resilient in the vegetative phase to conditions of drought. But equally important in determining the competitive balance between the two species is a marked difference, favouring the exotic, in seed loss due to predation. The difference is the reverse of that which occurs in S. Africa where Chrysanthemoides is the native, and

the Acacia the exotic. The impact of animals on vegetation is the theme of several other current projects: on insect herbivory in eucalypts, sheep grazing in a chenopod shrubland, and the effect of rabbits on the regeneration of ephemeral and perennial vegetation.

The role of fire in the dynamics of high altitude eucalypt forests has been of long-standing interest. Some ten years of data describing the regeneration of a stand of Eucalyptus pauciflora burnt in 1972-3 is currently being analysed and is underpinned by studies of the physiological ecology underlying germination of seeds and seedling establishment, and the characteristics of renewed growth from stem and base of fire-damaged adults and seedlings. A study of the performance of species transplanted along altitudinal gradients is providing additional information on the key physiological and ecological factors underlying the comparative success of different species.

Theoretical studies this year have centred on the way in which the optimal balance between plant survival in the vegetative phase and reproduction is influenced by the characteristics of seed dispersion in time and space. They have demonstrated previously unsuspected mechanisms of coexistence between species, and between phenotypes within a species.

Other Activities:

The Department was especially peripatetic this year. Barry Osmond spent a brief period in Professor Walker's laboratory in April where he showed that placement of spinach leaves in an antipodean attitude relaxed limitations on their fluorescence yield. In August he commenced part-time appointment as Director of the Bioresources Center, Desert Research Institute, Reno, Nevada. Tom Sharkey was the first appointee to the physiological group at the Institute and it is anticipated there will be further exchanges between this Department and the Institute. Graham Farquhar spent six weeks in January and February as Senior Visiting Scientist at the Riken Institute of Physical and Chemical Research, Wako-shi, Japan where he studied aspects of photosynthetic quantum yield as a function of irradiance. In August he commenced six months as Visiting Fellow at the Carnegie Institution of Washington, Department of Plant Biology, Stanford, to take part in a cooperative program on the influence of high CO₂ concentration on plant productivity and water use. Murray Badger was in the same Department in July to November, working on properties of RuBP carboxylase related to selection under high CO₂ concentration. Graham Farquhar, Barry Osmond, and Chin Wong took part in the discussions at the AAAS-sponsored conference on Plant Responses to Rising CO₂ Concentration, Athens, Georgia, in May. Ian Noble visited several laboratories in the United States and Canada during February and March to assist in the preparation of a review of fire ecology for SCOPE, the environmental programme sponsored by the International Council of Scientific Unions. Ralph Slatyer also spent brief periods abroad in connection with his commitments to SCOPE, of which he was elected President at the SCOPE General Assembly in Ottawa in June, and to the World Heritage Committee of which he was President through 1982. He was also appointed Chairman of the Australian Science and Technology Advisory Council in December. He continues to serve also, as Past President on the International Coordinating Council of the UNESCO Intergovernmental Committee on "Man and the Biosphere", and as a member of the UNESCO International Advisory Committee on Science, Technology and Society, was appointed to the Board

of Management and the Policy Advisory Council of the Australian Centre for International Research. Woo Kam Chau left in November to spend a year as Humboldt Fellow in the Pflanzenphysiologisches Institut, University of Göttingen, to work on the kinetics of dicarboxylate transport across the chloroplast envelope. Zarko Rokсандic attended the 9th International Mass Spectrometry Conference in Vienna, and visited a number of stable isotope laboratories in England and Japan in August to September.

Despite this global activity, the Department remained visible on the domestic front. Five members of staff attended the Annual Conference of the Australian Society of Plant Physiologists in Perth in August, and contributed six papers and posters. Ralph Slatyer retains the Chairmanship of the Australian Biological Resources Study Advisory Committee, and is a member of the Commonwealth Committee on Communications and the Media. Barry Osmond is a member of Council, Australian Academy of Science, and continues as a member of the Editorial Board of 'Australian Journal of Plant Physiology', 'Plant Physiology', 'Planta' and 'Oecologia'. Ian Noble is Editor of the 'Australian Journal of Ecology'.

During the course of the year, three members of the Department received honours or awards for their contributions to science. Ralph Slatyer was appointed Officer of the Order of Australia in the Queen's Birthday Honours list. Murray Badger received the P.L. Goldacre Award from the Australian Society of Plant Physiologists for merit of original research in plant physiology, and Graham Farquhar was awarded the 1982 Gottschalk Medal by the Australian Academy of Science for distinguished research in medical or biological sciences.

DEPARTMENT OF GENETICS

The research of the Department is concentrated in the area of molecular genetics and largely on the structure and expression of procaryotic and eucaryotic genes. There are four main research groups with a considerable diversity of projects and interests within each group.

Molecular genetics of simple eucaryotes

The main work of the group is on the structure, expression and regulation of the alcohol and aldehyde dehydrogenase genes and gene products in Aspergillus nidulans.

The most significant findings during the year were:

- (1) The demonstration of multiple mRNA species derived from the single alcohol dehydrogenase structural gene.
- (2) A clone which probably contains the alcohol dehydrogenase gene together with the adjoining regulatory regions, was obtained from an Aspergillus genomic library in the Charon 30 λ vector. This clone is being analysed.
- (3) The demonstration of two forms of alcohol dehydrogenase which differ by about r_{mw} 3,000. The relative amount of the two forms of the enzyme in the cells is apparently dependent on the carbon source available during growth.

Biological nitrogen fixation

a. Symbiotic genes of clover bacterium (Rhizobium trifolii).

A restriction map of the nodulation (Nod) and nitrogen fixation (Nif) region of R. trifolii strain ANU843 has been completed by the cloning of overlapping restriction fragments into both plasmid and phage vectors. A 14Kb fragment of the Nod region has been shown to carry sufficient genetic information for infection, nodule initiation and bacteroid development in different clover species. The nifH gene has been completely sequenced, together with the coding region for the first 141 amino acids of the nifD gene.

b. Symbiotic genes of broad host range bacteria

The nifH and nifD genes have been isolated and sequenced from the slow-growing Rhizobium strain ANU289, which nodulates different tribes of legumes and the non-legume Parasponia. Strain ANU240 is a fast-growing Rhizobium which can nodulate a broad group of legumes and the non-legume Parasponia. The genes involved in legume and non-legume nodulation reside on a large plasmid. A mobilizing system has been developed so that this Sym-plasmid carrying the capacity for broad host range has now been transferred into many different bacteria.

Molecular genetics and mitochondrial biogenesis in yeasts

The discovery of common gene order in the mtDNA of Torulopsis glabrata raised the possibility that co-transcription of genes occurred analogous to that found in mammalian mtDNA. However, we have found, using the guanylyl capping reaction and S1-mapping techniques, that there is a separate transcript for each large gene sequence. The characterization of mtDNA from high frequency petite forming strains of Saccharomyces cerevisiae has shown that this trait is associated with structural alterations comprising duplications and novel junctions.

Analysis of mtDNA size in members of the Dekkera/Brettanomyces yeasts has revealed a four-fold diversity within this related group, suggesting that size variation may be a relatively rapid process. Products derived from fusing yeast species have been examined by DNA hybridization using cloned gene sequences. In one case it appears that a mutant phenotype may be the result of a novel event involving insertion and subsequent asymmetric excision of a foreign sequence into one of the parental genomes.

Mammalian hormone gene structure and expression

Relaxin: Clones of human DNA containing at least two relaxin genes have been obtained. Sequence analysis of one relaxin gene allowed the prediction of the sequence of a human relaxin protein which was subsequently synthesised by collaborators in the Howard Florey Institute. This is the first synthesis of a biologically active hormone based solely on the analysis of a genomic clone.

Kallikreins: A total of 29 clones containing kallikrein genes have been obtained from mouse genomic libraries. Genomic blots and restriction mapping indicate that there are 25-30 kallikrein genes

with some linked in pairs and a cluster of four linked genes. One complete gene has been completely sequenced and has been shown to consist of 5 exons and 4 introns spanning 4.5 kb.

ACTH and β -endorphin: The gene coding for the pituitary hormones ACTH and β -endorphin in the chicken has been cloned and more than 90% of the coding region sequenced for comparison with the previously sequenced human gene. The arrangement of exons and introns in the chicken gene is identical to that in mammalian genes and the nucleotide sequence of the coding region is highly conserved. Experiments have continued on increasing the expression of the human gene in *E. coli* and it is now possible to obtain up to 20% of the *E. coli* cellular protein as the hybrid β -galactosidase- β -endorphin fusion product.

Metallothioneins: The complete nucleotide sequences of two human metallothionein genes have been compared. One is a functional metallothionein-II gene, the other is a pseudogene, lacking introns, terminating in a poly(A) tail and flanked by two direct repeats. There is a region of secondary structure homology between a 5' flanking region of the functional human metallothionein-II gene and that of a mouse metallothionein-I gene.

Other activities

Professor J.A. Pateman gave an invited lecture, Genetics Departments of La Trobe and Melbourne Universities.

Dr. B. Rolfe gave invited lectures in Madison (USA), Bielefeld (W. Germany), Microbiology Departments of Sydney University, and Melbourne University. He was an invited consultant in policy discussions of the new Australian Centre for International Agricultural Research.

Dr. K.S. Sriprakash presented seminars at the Indian Institute of Science, Bangalore, India and Ruhr Universitat, Bochum, W. Germany.

Dr. J. Shine was awarded the Gottschalk Medal by the Australian Academy of Science in April. In November he presented the 1982 Goldsworthy Oration for the Australian Society for Microbiology and was the invited lecturer for the 1982 Boehringer Christmas Forum.

MOLECULAR BIOLOGY UNIT

During the year, the Molecular Biology Unit has embarked on studies of carcinogenesis by viral, chemical and physical agents, in addition to continuing its work on the molecular mechanisms of post-transcriptional regulation and gene structure of higher eukaryotes.

Different carcinogenic agents, such as adenoviruses, 3-methylcholanthrene, and metallic oxides, interact with cell constituents in quite different ways. The ultimate aim of cancer research in the Unit is to discover how such diverse agents transform cell functions to a "cancerous" state.

The following five cancer projects have been initiated during 1982.

A number of metallic oxides are implicated as simple forms of primary carcinogens. Uranium is a particularly interesting example of this.

Bioassay for uranium in industrially exposed workers is not a routine procedure for measuring toxic burdens in the Australian uranium industry. However, following a pilot study (Mary Kathleen Uranium Ltd., 1980) which examined the relationship between uranium excretion in hair, blood, and urine using neutron induced autoradiographic methods of analysis, a project has been initiated to examine the early events which occur after exposure and the practical applicability of the techniques in determining residual 'body burdens' of uranium.

One of the early molecular events induced in rat liver cells by the hepatocarcinogen, 3'-methyl-4-dimethylaminoazobenzene is the release into the cytoplasm of a specific nucleus-restricted RNA. This RNA and the DNA sequences homologous to it were isolated and characterized. Some of these sequences are dispersed in DNA and others are present on one EcoRI restriction fragment. These sequences are conserved in vertebrates. It was postulated that the RNA originates during the formation and/or processing of higher molecular weight transcripts.

Recently we have highlighted the territorial effects of genes by which the transcriptional activities of neighbouring genes are seriously suppressed. Some pseudogenes have been shown to arise as a direct result of territorial confrontations among genes and the occurrence of these pseudogenes is proportional to the size of the multigene family cluster concerned. This investigation was further extended to develop a theory according to which the spatial distribution of cellular oncogenes, responsible for normal cellular functions, is relevant to oncogenic transformation of cells. This theory can account for both the restricted low levels of cellular oncogenes required for maintaining cellular functions in normal cells and the enhancement of oncogene activity in cancer cells induced by viral and non-viral carcinogenic agents.

Notable progress has been made in the characterization of cDNA clones derived from a human cancer cell (β -cell lymphoblastoid) line. As well as determining the nucleotide sequence of the cDNAs. We are using them to probe the distribution of the genes, including the use of a human genomic library to determine tissue specificity of transcription and an analysis of the relationship between transcriptional activity and gene methylation on human and mouse DNA. Transcripts show greatest abundance in tissues with a high rate of cell division and in immune response tissues. The use of a ts mutant cell line shows no strict association with the S or G₂+M phases of the cell cycle. More interesting is the finding of altered gene structure and perhaps number in association with certain cancers. These findings are similar to those of recently published retrovirus-cancer associations.

Very little clear evidence exists that adenoviruses can integrate during normal productive or semi-productive infections. The evidence to date suggests that group C adenovirus DNA sequences are present as integrated DNA within the cell genome and that integration occurs in a site-specific manner. Furthermore, viral DNA is present in high copy number and certain regions of the genome are over-represented.

The Unit's work on post-transcriptional regulation, gene organization and other studies has continued. We have prepared a cDNA library to anaemic chicken reticulocyte nuclear poly(A)⁺ RNA to further investigate the precursor/product relationship of globin and other messages. Three types of nuclear message containing sequence have been observed. One of them, i.e. non-globin coding sequences not represented in polysomal RNA,

will offer the possibility of analysing specific transcripts that, while appearing to be normal mRNA/pre-mRNA molecules, never leave the nucleus. A unique feature of the eukaryote gene is the commonly occurring mosaic arrangement of exons and introns. We have demonstrated a complex correlation between the genetic information contained in the exons and the surrounding intron sequences with regard to their spatial arrangement. Analysis of the genes that violate this correlation suggested that conservation of sequence, which is required by the family members, internal repeats, or the entire gene, would motivate the removal of introns.

Studies were done using quiescent (G_1 arrested) cells in tissue culture to test the hypothesis that the rate of cell cycle progression is determined solely by labile initiator proteins synthesised in the G_1 phase of the cell cycle. Results showed that in normal (uninfected) cells, cycloheximide, an inhibitor of protein synthesis, delayed progression through all phases of the cell cycle. It was concluded that specific labile initiators are not solely required as regulators of cell cycle progression in either normal or virus infected cells.

Collaborative work was carried out with the Department of Genetics, to obtain nucleotide sequence information of yeast mitochondrial RNAs in order to study the mode of transcription of mRNAs from the mitochondrial genome.

Other activities

Invited lectures and seminars were given by Dr. Braithwaite at the University of Auckland, at the Department of Microbiology, JCSMR and other departments in RSBS, and by Dr. Deacon at the Molecular and Cellular Biology Unit, CSIRO and the Department of Pathology, University of Melbourne. Dr. Braithwaite presented an invited paper at the Symposium organized by the Australian Society for Medical Research in December.

DEPARTMENT OF NEUROBIOLOGY

Those interested in the significant advances should note the four principal areas of study with which members of the department have been concerned during the past year. The one of broadest scope is on the lateral inhibition between neurons which code the visual image. The lamina ganglion cells of flies (like some retinal ganglion cells of vertebrates) have receptive fields with a central excitatory region flanked by an inhibitory surround. Lateral inhibition of this type makes possible the coding of spatial detail in a way which increases the information captured by the retina, by incorporating a built-in prediction of the spatial correlations that exist in natural scenes. The spatial extent of the lateral inhibition corresponds exactly to that predicted by a simple statistical theory (used in computer picture transmission) from the measured spatial correlations in the typical visual scene. Lateral inhibition is reduced at low light levels exactly as predicted by the information available at various intensities. In addition, the time relations of the visual neurons of the lamina turn out to be matched to the movement across the eye of an image that is blurred by the receptors.

The most easily understood advance was undoubtedly the elegant demonstration that each of the 40 or so auditory sensory neurons of the ear of the tettigonid is tuned to a different pitch, irrespective of

any mechanical properties of the tympanum or trachea. The largest sensory cell at the proximal end of the row of sensory cells is tuned to 1 kHz and the smallest at the distal end to about 40 kHz, with an approximately 1 kHz interval in the tuning of adjacent receptors. This was demonstrated by microelectrode recording with dye marking, while the auditory sensitivity is measured over the full range of sound pitch. This finding has fundamental repercussions for the study of hearing in general because it is now possible that the corresponding row of sensory cells in man and all the vertebrates are similarly pitch-sensitive in their own right and the discrimination of pitch need not depend solely on the mechanics of the basilar membrane of the cochlear.

Another finding that will change the text books is the demonstration of ultraviolet vision and of conducting light-guides in the eye of the male mayfly. These are insects that dry-fly fishermen copy in appearance and movements on the surface of streams. The dorsal eye of the male does not see visible light at all, and uses ultraviolet apparently to increase resolution, so that it can catch the female in flight. The description of this new type of eye, which has drawn upon a wide range of techniques in optics, electrophysiology and microanatomy, is a culmination of a project conducted in the mayfly season for a month every year over more than 12 years. For the study of the eye, one of the new conclusions is that the male dorsal eye is an anatomically separate fovea and, like any other fovea, it reveals that there must be a behavioural pattern (in this case sex) where visual resolution is at a premium.

Finally, a filament structure down the centre of the microvilli which stabilize the photoreceptor membranes of the rhabdom has been discovered and described. There are also stabilizing attachments between microvilli. In some species, where a part of the rhabdom sloughs off each day the filaments in the microvilli disappear as a first step in the process. In species where there is a turnover of the whole rhabdom, the process is described. Also where the rhabdom changes size between day and night, there is no change in the density of the rhodopsin molecules on it, and the visual pigment must therefore be drawn from store each evening. A new chapter has been added on the cytoplasmic skeletal fibres that form a part of the basis of these changes.

A very satisfactory feature of this year's report is the number of invitations overseas, particularly to our Ph.D. scholars. Three of them have had invitations to speak at conferences and visit laboratories in Europe with financial support based on the merit of their work. Also seven members of staff have been abroad, two for long periods, and have visited international conferences. The list of these visits in this report is a readily understood indication of the respect that this department enjoys internationally.

Other Activities

Professor G.A. Horridge delivered the Swammerdam Lecture to the Royal Society of Holland, Amsterdam. Apr. 1982. He also taught a course for selected South American post-doctoral students at Caracas, Venezuela, supported by UNESCO, and took the opportunity to visit Cambridge, Mass. and Cambridge, England.

Professor Horridge and Mr R. Jahnke won the prize for the best poster exhibit at the 1st Australia and New Zealand Cell Biology Congress.

Dr. E.E. Ball spent most of the year on outside studies in the laboratory of Dr C. Goodman at Stanford University, California, learning new immunological techniques to study the development of muscle and nerve.

Ms K. Bryceson was invited to speak on optical and electrophysiological studies of the 24 hour periodicity in the yabbie eye by the University of Lund, Sweden. Nov. 1982.

Dr K.G. Hill visited Max-Planck Institut für Verhaltenstudien, Seewiesen; Max-Planck-Institut für Biologische Kybernetik, Tübingen; Ruhr Universität, Bochum; University of Münster, West Germany.

Dr J. Israelachvili was elected a Fellow of the Australian Academy of Science. His activities and publications are listed in the report of RSPHYS. He will give up his joint appointment in Neurobiology at the end of 1982 and will then be entirely in the Research School of Physical Sciences.

Dr S. Laughlin spent a period of outside studies as a Visiting Research Scientist, Department of Ophthalmology and Visual Science, Yale Medical School, USA from December 1981 to August 1982. He presented seminars at the Universities of Cambridge, Yale, Montreal, Purdue, U.C. Berkeley, Columbia and Rockefeller, and Woods Hole Marine Biological Laboratory.

Mr B. Oldfield was invited by the Ruhr Universität, Bochum, FRG, to speak on single cell studies of the auditory organ of a tettigonidae.

Dr. S. Stowe presented a seminar to the Department of Physiology, University of Otago, New Zealand.

DEPARTMENT OF POPULATION BIOLOGY

The research achievements of the Department during 1982 are conveniently outlined in terms of the four major lines of endeavour to which our resources have been committed.

Population cytogenetics: Work continued studying the mechanisms underlying chromosomal variation in natural populations of Australian grasshoppers and their relevance to the key evolutionary questions concerning modes of speciation and the nature of the chromosome polymorphisms operating in natural populations. For example, investigations into the significance of chromosomal rearrangements as genetic isolating mechanisms have conclusively shown that their major role relates to the disruption of patterns of recombination in heterozygotes. Empirical evidence has revealed that these major disruptions to the distribution of recombination events results in a breakdown of intra-chromosomal organisation leading to the generation of a high frequency of unbalanced gametes which, in turn, fail to function during early embryonic development.

This breakdown in embryogenesis arises entirely from "within-chromosome" effects due to the unusual recombination patterns induced by chromosomal heterozygosity. Moreover, after analysing a unique series of hybridisation experiments, the chromosomal component of embryonic breakdown is expressed quite independently of the genic divergence which exists between the hybridising taxa. These

experiments have permitted the partitioning of embryonic mortality into two components; (i) that due to genic differences between hybridising taxa which have no chromosomal differences and (ii) that due to chromosomal differences between taxa which are not genically differentiated.

The results reveal that, even when genic equivalence exists between homologous chromosomes, chromosomal rearrangement heterozygosity is capable of generating up to 46% embryonic mortality via recombinational repatterning. This clearly emphasises the importance of both the pattern of recombination within the genetic system and also some form of internal organisation within the chromosome which must be maintained for the expression of normal developmental processes. The existence of such cis-acting chromosomal organisation has been endorsed by assessing the fitness values of individual chromosomes - both as recombinant and non-recombinant forms - during embryogenesis. This experimental analysis of the effects of chromosomal rearrangements has provided an ideal analytical method for assessing the intensity of natural selection in maintaining coadapted chromosomes in natural populations.

Alterations in the pattern of genetic recombination have also been shown to be implicated in a number of chromosome polymorphisms involving the presence of added heterochromatin. Here the precise effect varies in different species and depends both on the normal pattern on recombination operative and on the precise type and location of the heterochromatin involved.

Population genetics of enzyme variation: The experimental advantages of Drosophila melanogaster have been used to detect natural selection operating on variants of gene loci in wild populations. This research has revealed a remarkable worldwide pattern of latitudinal clines in four genetic enzyme variants. Indications of similar clines in human populations have also been reported. This discovery, which by itself is of the utmost importance to population genetics, was supported by studies attempting to elucidate the mechanisms maintaining this pattern of genetic variation in natural populations.

In particular, research on the alcohol dehydrogenase polymorphism has shown that the enzyme encoded by this locus varies in amount in natural populations. It has been shown that the variation does not track levels of ethanol but responds to other environmental factors. The three detected alleles at the alcohol dehydrogenase locus respond differently to environmental variation. A start was made to investigate the mechanisms underlying this gene/enzyme variation by preparing DNA clones from genes extracted from natural populations.

Genome organisation and molecular developmental genetics: It is axiomatic that knowledge of the genetic control of development is crucial to our understanding of how biological variation arises in natural populations of animals and plants. In the 1981 Annual Report a new development, using recombinant DNA techniques to investigate the mechanisms controlling gene action in higher organisms, was mentioned. The question that can be asked using these new techniques is how do cells become progressively committed to the expression of a set of processes which limit their function in the organism. Why, for example, do some cells produce a particular enzyme while others, with the same genetic machinery, do not?

Drosophila melanogaster is an ideal organism to use in attempts to answer developmental questions at the molecular level. One particular chromosomal region, the base of the X chromosome, has been so well characterised genetically that a molecular analysis of it is now feasible. The molecular cloning techniques can be brought to focus on specific genes in this area. Some of these genes produce phenotypes such as uncoordinated, extra organs and legless. These genes can give rise to duplicated appendages as well as to tumors. Legless, in particular, probably involves defects in one of the most fundamental of all embryonic processes, that of specifying or responding to positional information.

Clones have been isolated which fall into this interesting genomic region. One clone is close to the locus of uncoordinated and it has not only been pinpointed in the molecular landscape but its expression is being studied. Another codes for collagen, one of the most fundamental proteins utilised in the development of both vertebrates and invertebrates. These clones have provided entry points from which it will be possible to reach other genes of interest, and thus fulfill the major aim of determining the molecular architecture and expression of genes involved in important developmental decisions.

Genetic variation in human populations: Human twins have been used to investigate genetic variation in a number of traits of medical and/or social significance. For example, using the NH & MRC Australian Twin Registry, which is maintained in the Department, it has been found that there is no evidence for the idea that extra doses of vitamin C protect people from succumbing to the common cold. This work made full use of identical twins in a control study and underlined the advantages of such material in any test of the efficacy of medical treatments. Of particular importance were the results of analyses investigating genetic variants of alpha-1-antitrypsin in relation to susceptibility to lung disease. This work revealed a set of physiological advantages and disadvantages associated with the level of activity produced by a particular variant sufficient to explain the genetic polymorphism.

In 1982 the Department's research continued to benefit from external grants. The ARGC supported studies of the evolutionary origins of the parthenogenetic grasshopper, Warramaba virgo. The Australian Associated Brewers financed a collaborative study with the Department of Medicine Melbourne, into the alcohol drinking patterns of twins. The State Pollution Control Commission NSW financed a study of the relationships between atmospheric pollution and lung function in Sydney and a 96 page report on this work was submitted in March. The NH & MRC continued to fund the NH & MRC Australian Twin Registry in the Department, which is used by scientists in many Universities and research institutions in Australia.

Other Activities

Mr J. Benzie presented a poster on Zooplankton of Lake Cootapatamba to the Ecological Society of Australia, Mountain Symposium in May.

Dr D. Coates gave a seminar in the Department of Botany, ANU on Patterns of recombination in F_1 hybrids and embryonic inviability in the grasshopper Caledia captiva. In April he gave invited seminars in the Department of Agricultural Botany, University College of Wales, Aberystwyth, and Institute of Botany, University of Vienna.

Dr J. Gibson gave seminars at the Davis and Los Angeles campuses of the University of California and at the University of Hawaii at Manoa on Genetics of the Adh locus in D. melanogaster in January.

Prof B. John and Dr M. King presented a poster on meiotic effect of supernumerary heterochromatin in Heteropternis obscurella to the Genetics Society of Australia 29th General Meeting.

Mr G. Mengden gave an invited seminar in Cell Biology at the M.D. Anderson Hospital and Tumor Research Institution, University of Texas Medical Center, Houston Texas on variation in elapid snakes - its implications to chromosome structural rearrangement and sex chromosome evolution in September. He gave an invited seminar at Texas Tech University, Lubbock, Texas on Chromosome banding analysis in elapid snakes in October.

Dr G. Miklos gave evidence on aspects of Biotechnology to the Senate Standing Committee on Science and the Environment in May.

Dr D. Shaw gave a seminar in the Department of Botany, ANU on Increased chromosome mutation rate following hybridisation between two subspecies of grasshoppers: evolutionary significance.

Dr M. White gave seminars at University College London, University of Vienna and Institutes of General Biology and Genetics, University of Rome in October.

Members of the Department served on the Editorial Boards of five international journals, Can. J. Genet. Cytol. (B. John), Caryologia (B. John, M.J.D. White), Chromosoma (B. John), Genetique, Selection, Evolution (M.J.D. White) and Ann. Hum. Biol. (J.B. Gibson).

TAXONOMY UNIT

The Unit is involved in experimenting with the methodology of biological classification and identification; acquisition, organisation, and presentation of taxonomic data on large plant groups (currently grasses and legumes); comparative anatomical studies, with special reference to grasses and to features of physiological and ecological interest; formal taxonomic revisions of selected groups of plants important in the Australian region; and applying taxonomic sampling expertise to formulating and answering questions of agronomic, ecological and general biological interest. Our research projects often encompass active collaboration and joint publications with members of other Departments of RSBS and other institutions in Australia and overseas: in 1982, these included Environmental Biology, Virus Ecology, CSIRO Divisions of Entomology (Canberra) and Tropical Pastures (Brisbane), the British Museum (Natural History) and Agriculture Canada (Ottawa).

In a project commenced in 1970 and principally in collaboration with CSIRO, we have developed a computerised data bank of morphological, anatomical and physiological information, which by December 1981 comprised 214 attributes recorded for 421 genera. The observations are encoded in a format facilitating their use for a variety of purposes, ranging from information retrieval and correlation finding to classificatory analyses and automated generation of printed descriptions and identificatory keys. The system is directly linked to automatic typesetting and microfiche-generating facilities, and since the generic descriptions are prepared at world level, these can be used to prepare complete taxonomic accounts tailored to different world regions and to the specified requirements of different kinds of user. In 1982 the number of genera included has been increased to 470; an experimental punch-card key (the most comprehensive ever attempted for any large group) has been generated and successfully tested; and in connection with a collaborative project involving Agriculture Canada, we have generated a variety of keys to the Canadian grasses, and sample descriptions in English and French.

A parallel data bank for the 175 genera of Leguminosae-Caesalpinioideae is also maintained. This has been extensively improved and updated during 1982, in readiness for production of a book to appear in 1983.

An exciting development this year, directly attributable to the Unit's calculated exercises in applied systematics, has been the discovery that very closely related grasses in the exclusively Australian grass genus Neurachne include species differing greatly in leaf physiology. This was predicted from our systematic anatomical descriptions (which include criteria developed in the Unit for predicting photosynthetic pathways), and confirmed by carbon isotope ratio determinations. Anatomical evidence further suggests the likely occurrence here of C_3 - C_4 intermediate forms, and Neurachne offers unique opportunities for studying in detail the evolution and ecological significance of the C_4 pathway.

Geographical distribution studies of C_3 and C_4 grasses in Australia reveal seasonal rainfall, in addition to temperature, to be highly correlated with C_3 and C_4 species numbers (spring and summer rainfall, respectively). The significance of seasonal rainfall has not been recognised in studies for other parts of the world. This work is being extended to relate the distribution of the three different C_4 types to climate. Comparative ultrastructural studies on C_4 types in grasses have been extended to the examination of herbarium material prepared for

electron microscopy. This enables C_4 type to be predicted from dead leaf material, with the potential for typing grasses from anywhere in the world using small pieces of dried leaves.

A revision of the grass genus Digitaria in Australia has been completed, with full taxonomic descriptions and keys, in which 38 species are recognised. This work (supported by the Bureau of Flora and Fauna, in connection with preparing the new 'Flora of Australia') represents the first application, anywhere, of a fully automated system to a formal taxonomic revision at the species level.

Visitors to the Unit are working on the comparative grass leaf development of different C_4 types, and on immunocytochemical localisation of the photosynthetic enzyme RuP_2 carboxylase in C_3 and C_4 grass leaves using gold-labelled and fluorescent-labelled antibodies. Other visitors worked on co-ordination of complementary taxonomic computer facilities available at the British Museum and in Canberra, discussed an ongoing collaborative project concerning leaf protein amino acid profiles, and determined $Km(CO_2)$ values of ribulose-1,5-bisphosphate carboxylases from grasses of different C_4 types.

Other activities

Dr. Webster visited the USA in August, giving seminars and demonstrations of automated key generation at Texas A&M, Louisiana State and Florida State Universities.

VIRUS ECOLOGY RESEARCH GROUP

The Virus Ecology Research Group studies the ecology of viruses and their vectors, seeks clues to their evolution by studying various aspects of their comparative taxonomy, and isolates and describes viruses of the Australian biota.

During 1982 work has concentrated on a study of the inter-relationships of the tymovirus group with particular emphasis on different isolates of two Australian tymoviruses, Kennedyya yellow mosaic virus and Cardamine yellow mosaic virus (CdYMV). cDNA/RNA hybridization tests involving 13 tymoviruses further confirmed the possibility that evolution of this group has involved genetic recombination as well as mutational divergence. Partial sequences of the coat protein mRNAs from CdYMs from the Mount Kosciusko region show that they are closely related to, but distinct from, one of the two groups of turnip yellow mosaic viruses of N.W. Europe; CdYMV probably spread to Australia with the ancestors of its present host many millenia ago, and the observed genome sequence differences provide an estimate of the rate of evolution of these viruses.

Work on viruses of honey bees has continued but with great difficulty because local stocks of bees, though apparently healthy, are infected with sacbrood and Kashmir bee viruses. These latent infections are activated by handling or experimental inoculation of the pupae, thus interfering with attempts to propagate these viruses. The site of these latent infections in the pupae is being investigated.

In collaboration with staff of the Department of Primary Industries, Brisbane, a virus isolated from Cassia pleurocarpa from western Queensland was shown to be a member of the bromovirus group characterised by a multipartite RNA genome and isometric virions. This is the first time a member of this small group of viruses has been found in Australia.

The first major objective of the Virus Identification Data Exchange project has been achieved; data on about 100 viruses, mostly viruses of legumes, has been stored in a computer data-base using the DELTA system. A microfiche edition of this data, together with derived keys, has been produced for assessment and distributed to the more than 100 virologists who have participated in this project.

Other activities

D. Anderson attended the annual meeting of the Australian Entomological Society. He lectured in one course in the Department of Zoology at Hawkesbury Agricultural College, and addressed the local Amateur Beekeepers Association. J. Blok and A. Gibbs attended the conference on 'Manipulation and expression of genes in eukaryotes' held at Monash University in August, and Gibbs contributed to a symposium of the Australian Institute of Agricultural Science at Macquarie University. Gibbs has also been involved in widespread discussions on the role of the Australian National Animal Health Laboratory and the proposal to import foot-and-mouth disease virus; he contributed to the National Farmers Federation Forum at Geelong in August, and to a similar forum of farming industry groups at the University of New England in September. He has continued to provide the virology component of two courses for undergraduates in the Faculties, and to serve as plant virus editor of Intervirology.

Generous support from the Rural Credit Development Fund for the VIDE data-base project, and from the Honey Research Advisory Committee for the honey bee virus work, is very gratefully acknowledged.

PUBLICATIONS

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CRONK, M., HUDSON, P.⁺ HALEY, H.⁺ NIALL, H.⁺ and SHINE, J. Molecular Anatomy and Expression of the Relaxin Gene. 12th International Congress of Biochemistry, Perth. Aug.

MASON, A.J., SHINE, J. and RICHARDS, R.I. The Mouse Glandular Kallikrein Gene Family. International Congress of Biochemistry, Perth. Aug.

SCHOFIELD, P.R., DJORDJEVIC, M.A., ROLFE, B.G., SHINE, J. and WATSON, J.M. Genetic and Molecular Studies of a Region of Rhizobium trifolii DNA encoding nodulation functions. 12th International Congress of Biochemistry, Perth. Aug.

SCOTT, K.F., ROLFE, B.G., FELLOWS, F.[#] and SHINE, J. Structure and Regulation of Rhizobium Nitrogenase Genes. 12th International Congress of Biochemistry, Perth. Aug.

SHINE, J. The Future of Genetic Manipulation in Man. Genetic Biotechnology and In Vitro Fertilization Scientific, Clinical, Legal and Ethical Implications in 1982 and the Future. Annual Forum of the Australian Postgraduate Federation in Medicine, Sydney. Apr.

SHINE, J. Gene Cloning and its Implications. ANZAAS Conference, Macquarie University, N.S.W.

SHINE, J. The Bacterial Production of Mammalian Polypeptides. Australian Society of Microbiology, Annual Meeting, Hobart. May.

SHINE, J. Effective Expression of Eukaryotic Genes in Prokaryotic Systems. 12th International Congress of Biochemistry, Perth. Aug.

SHINE, J. MASON, A.J. EVANS, B.A. and RICHARDS, R.I. The Kallikrein Multi-Gene Family: A General Role in Prohormone Processing. 'Manipulation and Expression of Genes in Eukaryotes', IUB Satellite, Monash University, Melbourne. Aug.

WHITFIELD, P.L., and SHINE, J. A Structural and Evolutionary Analysis of Pro-opiomelanocortin Genes. 12th International Congress of Biochemistry, Perth. Aug.

Overseas

EVANS, B.A., MASON, A.J., RICHARDS, R.I., and SHINE, J. Cloning and Nucleotide Sequence of the Kallikrein Genes. 7th Asia and Oceania Congress of Endocrinology, Tokyo, Japan. Aug.

MASON, A.J., RICHARDS, R.I., EVANS, B.A., and SHINE, J. Glandular Kallikrein Gene Family. Gordon Conference on Introduction of Macromolecules into Eukaryotic Cells, New Hampshire, USA. Jul.

SHINE, J. Structure of the Kallikreine Genes. Molecular and Cellular Mechanism of Secretion of Peptide Hormones. Seillac, France. Aug.

SHINE, J. SCOTT, K.F. FELLOWS, F.⁺ DJORDJEVIC, M.A., SCHOFIELD, P.R., WATSON, J.M., and ROLFE, B.G. Molecular Anatomy of the Symbiotic Region in R. trifolii and R. parasponia. Molecular Genetics of the Bacteria-Plant Interaction. Bielefeld, Germany. Aug.

WATSON, J. Genetic and molecular analysis of clover nodulation by Rhizobium trifolii. Seoul International Symposium on Genetic Engineering, Seoul, South Korea. Jun.

WATSON, J.M., DJORDJEVIC, M.A., SCOTT, K.F., SCHOFIELD, P.R., ROLFE, B.G., and SHINE, J. Plasmid-encoded Nodulation and Nitrogen Fixation Function in Rhizobium trifolii. Fourth International Symposium on the Genetics of Industrial Microorganisms, Kyoto, Japan. Jun.

DEPARTMENT OF DEVELOPMENTAL BIOLOGY

Local

BUSBY, C.H., GUNNING, B.E.S. Microtubules and cell expansion in transverse walls of Azolla pinnata roots. Australian and New Zealand Society for Cell Biology Conference, Canberra. Feb.

GUNNING, B.E.S. The structure-function equation in the plant sciences. Invited lecture, Australian Society for Plant Physiology, Perth. Aug.

HARDHAM, A.R., RALTON, J.E.⁺, HINCH, J.M.⁺, CLARKE, A.E.⁺ Zoospores of Phytophthora cinnamomi: microtubules, flagella, and the cell surface. Australian and New Zealand Society for Cell Biology Conference, Canberra. Feb.

OVERALL, R.*⁺, WOLFE, J.⁺, GUNNING, B.E.S. Ultrastructure of plasmodesmata in Azolla roots. Australian and New Zealand Society for Cell Biology Conference, Canberra. Feb.

RALTON, J.E.⁺, HARDHAM, A.R., CLARKE, A.E.⁺ Adhesion of Phytophthora cinnamomi zoospores to Xanthorhoea australis roots: The nature of the surfaces in contact. 12th International Congress of Biochemistry, Perth, WA. Aug.

WICK, S.M. Tubulin immunofluorescence studies of the plant cell cytoskeleton. Australian and New Zealand Society for Cell Biology Conference, Canberra. Feb.

Overseas

BADENOCH-JONES, J.*⁺, SUMMONS, R.E.[†], ENTSCH, B.*⁺, ROLFE, B.G.[†], PARKER, C.W., LETHAM D.S. Mass spectrometric identification and quantitation of indole compounds produced by Rhizobium strains. Eleventh International Conference on Plant Growth Substances, Aberystwyth, Wales. Jul.

BADENOCH-JONES, J.*⁺, SUMMONS, R.E.[†], LETHAM, D.S., SHINE, J.[†], ROLFE, B.G.[†] Phytohormone metabolism in nodulated leguminous plants. Genetic Engineering of Plants, University of California, Davis, U.S.A. Aug.

LETHAM, D.S., TAO, G.Q.[#] and PARKER, C.W. An overview of cytokinin metabolism. Eleventh International Conference on Plant Growth Substances, Aberystwyth, Wales. Jul.

OVERALL, R.*⁺, GUNNING, B.E.S. Ultrastructural and electrophysiological observations in plasmodesmata. American Society for Cell Biology 22nd Annual Meeting, Baltimore, MD. 30 Nov - 4 Dec.

PALMER, M.V. Cytokinin metabolism in seeded and induced parthenocarpic

fruits of tomato (*Lycopersicon esculentum* Mill.). Eleventh International Conference on Plant Growth Substances, Aberystwyth, Wales. Jul.

PALMER, M.V. Cytokinin metabolism in seeded and induced parthenocarpic fruits of tomato (*Lycopersicon esculentum* Mill.). International Congress on Horticulture, Hamburg. Aug.

PALNI, L.M.S., TAO, G.Q.[#], LETHAM, D.S. Cytokinin metabolism in excised oat leaves. Eleventh International Conference on Plant Growth Substances, Aberystwyth, Wales. Jul.

TAO, G.Q.[#], PALNI, L.M.S., LETHAM, D.S. The cytokinin activities of metabolites of zeatin and BAP. Eleventh International Conference on Plant Growth Substances, Aberystwyth, Wales. Jul.

WARREN WILSON, P.M.[#], WARREN WILSON, J.^φ Hormonal influences on structure and function of grafted petioles. Eleventh International Conference on Plant Growth Substances, Aberystwyth, Wales. Jul.

WARREN WILSON, J.^φ, WARREN WILSON, P.M.[#] Hormonal control of histogenetic patterns. Eleventh International Conference on Plant Growth Substances, Aberystwyth, Wales. Jul.

WICK, S.M. Transitional stages between successive microtubule arrays in plant cells: Pre-prophase band to mitotic spindle and phragmoplast to interphase array transitions. American Society for Cell Biology 22nd Annual Meeting, Baltimore, MD. 30 Nov - 4 Dec.

DEPARTMENT OF ENVIRONMENTAL BIOLOGY

Local

COWAN, I.R. The regulation of carbon gain in relation to water use. Invited lecture. Australian Society of Plant Physiologists Annual Conference, Perth. Aug.

EVANS, J.R. The relationship between photosynthesis and leaf nitrogen content in wheat. Australian Society of Plant Physiologists Annual Conference, Perth. Aug.

FURBANK, R.T., BADGER, M.R. Oxygen exchange associated with electron transport and photophosphorylation in spinach thylakoids. Australian Society of Plant Physiologists Annual Conference, Perth. Aug.

NOBLE, I.R. Maintenance of essential ecological processes and life support systems. Invited lecture. National Conservation Strategy Conference - Balance is beneficial, Adelaide. Aug.

NOBLE, I.R., COMINS, H.N. Eucalyptus as honorary animals - a comparison of life history strategies. Invited lecture. Australian and New Zealand Association for the Advancement of Science, Sydney. May.

RYRIE, I.J. Freeze-fracture analysis of reconstituted membranes containing chlorophyll protein complexes of Photosystems 1 and 2. 12th International Congress of Biochemistry, Perth. Aug.

WEISS, P. The ecology of boneseed in bushland in relation to control. Invited lecture. Australian and New Zealand Association for the Advancement of Science, Sydney. May.

Overseas

FARQUHAR, G.D. Interactions between vegetations, water budget and atmospheric CO₂. Invited lecture. 4th Maurice Ewing Symposia - Climatic Processes: Sensitivity to solar insolation and CO₂, New York. Oct.

OSMOND, C.B. Refixation of ammonia ¹⁵N during photorespiratory metabolism. Society for Experimental Biology Symposium on Photosynthetic C, N, and S. Metabolism, Leicester. Jan.

OSMOND, C.B. Interactions of O₂ and CO₂ during photosynthesis. Agricultural Research Council Conference, What Limits Photosynthesis, Sheffield. Apr.

ROKSANDIC, Z. Environmental and biological determination of isotope fractionation in components of coral symbioses. 9th International Mass Spectrometry Conference, Vienna. Aug.

DEPARTMENT OF GENETICS

Local

CREASER E.H. and PORTER, R. Purification of Alcohol and Aldehyde Dehydrogenase from Aspergillus nidulans. 12th International Biochemistry Congress, Perth, Aug.

DJORDJEVIC, M.A., SCOTT, K.F., SCHOFIELD, P.R., and WATSON J.M. Analysis of the nodulation region in Rhizobium trifolii. Australian Society for Microbiology, Annual Meeting, Hobart, May.

DOY, C.H., PATEMAN, J.A., OLSEN, J.E. and NORRIS, U. The expression of alcohol dehydrogenase and aldehyde dehydrogenase in Aspergillus nidulans. Organisation and Expression of the Eucaryotic Genome, Lorne, Victoria, Feb.

PATEMAN, J.A., DOY, C.H., OLSEN, J.E. and KANE, H. Regulation of alcohol dehydrogenase and aldehyde dehydrogenase in Aspergillus nidulans. Annual Meeting, Genetics Society, University of Melbourne, May.

PATEMAN, J.A., DOY, C.H., OLSEN J.E., and KANE, H. Genes for alcohol utilization in the lower eucaryote Aspergillus nidulans. "Manipulation and Expression of Genes in Eukaryotes". IUB Satellite Conference, Monash University, Aug.

RICHARDS, R.I. Mouse glandular kallikrein gene family - a general role in prohormone processing. Endocrine Society Symposium Meeting, Leura, N.S.W., Mar.

RICHARDS, R.I. Serine proteases - a tissue specific multigene family. Eukaryote Genome Meeting, Lorne, Vic., Feb.

SHINE, J.ROLFE, B.G., GRESSHOFF, P.M.[♂] Rhizobium and the Genetics of a Controlled Disease. and Australian Society for Microbiology, Annual Meeting, Hobart, May.

ROLFE, B.G. Problems of Genetic Engineering in Plants: An Alternative Approach. Genetic Engineering for Agriculture: The Substance Behind the Promise. A Symposium organised by the

Australian Institute of Agricultural Science, Macquarie University,
Nov.

SCHOFIELD, P.R., DJORDJEVIC, M.A., ROLFE, B.G., SHINE, J., and
WATSON, J.M. Genetic and Molecular Studies of a Region of
Rhizobium trifolii DNA Encoding Nodulation Functions. 12th
International Congress of Biochemistry, Perth. Aug

Overseas

CLARK-WALKER, G.D., and SRIPRAKASH, K.S. Mitochondrial genome
structure and Transcription Products in Torulopsis glabrata I.
EMBO Workshop on Regulatory Mechanisms in Mitochondrial Gene
Expression, June, 1982, Castro (Lecce), Italy. Jun.

SRIPRAKASH, G.D., and CLARK-WALKER, K.S. Mitochondrial genome
structure and Transcription Products in Torulopsis glabrata II.
EMBO Workshop on Regulatory Mechanisms in Mitochondrial Gene
Expression, June, 1982, Castro (Lecce), Italy. Jun.

DJORDJEVIC, M.A., SCOTT, K.F., SCHOFIELD, P.R., WATSON, J.M., SHINE
J. and ROLFE, B.G. Characterization of DNA Regions Encoding
Nodulation and Nitrogen Fixation Functions in Rhizobium trifolii.
Thirteenth International Meeting, American Society for Microbiology,
Boston, U.S.A. Aug.

DOY, C.H., OLSEN, J.E., PATEMAN, J.A., and NORRIS, U. Molecular
biology of expression and cloning of ADH and AldDH genes of
Aspergillus nidulans. 11th Neurospora Information Conference,
Georgia, USA. May.

PATEMAN, J.H., DOY, C.H., OLSEN, J.E., and NORRIS, U. The genetics
of ADH and AldDh in Aspergillus nidulans. 11th Neurospora
Information Conference, Georgia, USA. May

SHINE, J., SCOTT, K.F., FELLOWS, F.,[#] DJORDJEVIC, M.A., SCHOFIELD,
P.R., WATSON, J.M., and ROLFE, B.G. Molecular Anatomy of the
Symbiotic Region in R. trifolii and R. parasponia. First
International Symposium on Molecular Genetics of the Bacterium-plant
Interaction, Bielefeld, West Germany. Aug.

WATSON, J.M., DJORDJEVIC, M.A., SCOTT, K.F., SCHOFIELD, P.R., ROLFE,
B.G. and SHINE J. Plasmid-encoded Nodulation and Nitrogen Fixation
Functions in Rhizobium trifolii. Fourth International Symposium on
the Genetics of Industrial Micro-organisms, Kyoto, Japan. Jun.

MOLECULAR BIOLOGY UNIT

Local

BRAITHWAITE, A.W., CHEETHAM, B.F.^Ø and BELLETT, A.J.D.^Ø. Adenovirus
alters the controls of normal cellular proliferation. 12th Internatl.
Congr. Biochem., Perth. Aug. (abst POS 001.)

DEACON, N.J. and NAORA, H. Spatial requirement of clustered genes.
12th Internatl. Congr. Biochem., Perth. Aug. (abst POS 299.)

NAORA, H. and DEACON, N.J. An exon-size dependency of introns of
eukaryote protein-coding genes. 12th Internatl. Congr. Biochem., Perth.
Aug. (abst POS 224.)

DEPARTMENT OF NEUROBIOLOGY

Local

BLEST, A.D. Cytoskeletal organisation of arthropod photoreceptors in relation to membrane turnover. Australian and New Zealand Society for Cell Biology Conference, Canberra, Feb.

DE COUET, H G. Actin in the photoreceptor membrane of the compound eye of the crayfish. Actin Satellite Symposium, 23rd International Biochemistry Congress, Sydney, Aug.

HILL, K.G. Mechanically independent tuning of locust auditory receptors. Australian Pharmacology and Physiology Society, Melbourne University, Melbourne, Aug.

HOWARD, J. Weber's law and compound eye design. Australian Physiological and Pharmacological Society, Newcastle, May.

HOWARD, J. A transduction mutant of the sheep blowfly. Australian Physiological and Pharmacological Society, Melbourne, Aug.

MATIC, T. Electrical coupling of photoreceptors in butterfly Papilio Aegeus. Australian Pharmacology and Physiology Society, Newcastle, May.

VAN DE KERCKHOVE, J.⁺, DE COUET, H.G. AND WEBER, K.⁺ Actin is a focus in different eulacyofic systems: a protective chemical analysis. Actin Satellite Symposium, the 23rd International Biochemistry Congress, Sydney, Aug.

Overseas

HORRIDGE, G.A. Neuron function and behaviour: which explains which?. Multimodal Interneurons Conference at Würzburg, Germany, Apr.

BLEST, A.D. Plasma membrane turnover in arthropods. Neuroscience Centre, University College, London, Jan.

BLEST, A.D. Labile cytoskeletal elements in arthropod photoreceptors. Centre Nationale de la Recherche Scientifique, Marseilles, Jan.

LAUGHLIN, S.B. The roles of parallel channels in early visual processing by the compound eye. Invited speaker, NATO-ASI on Photoreception and Vision in Invertebrates, Lennoxville, Quebec, Canada, July.

LAUGHLIN, S.B. Matched coding enhances neuronal information capacity. The Association for Research in Vision and Ophthalmology, Annual Spring Meeting, Sarasota, Fla., USA, May.

LAUGHLIN, S.B. Matching coding to scenes to enhance efficiency. Invited speaker at The Rank Prize Symposium on Physical and Biological Processing of Images, London, UK, Sept.

HILL, K.G. The physiology of locust auditory receptors. IV International Meeting on Insect Acoustics, London, UK, Dec.

HOWARD, J. Dynamics of insect photoreceptors. Invited speaker, Fifth International Congress of Eye Research, Veldhoven, The Netherlands, Oct.

DEPARTMENT OF POPULATION BIOLOGY

Local

- ADENA, M.A. Case control studies. Australian Mathematical Society Conference. Newcastle. May.
- ADENA, M.A. Log linear models. Australian Mathematical Society Conference. Newcastle. May.
- BENZIE, J.A.H. Variation in the genus Daphnia in Australia. Australian Society for Limnology Conference. Griffith, N.S.W. May.
- CHRISTIDIS, L. Chromosome studies in Australian Finches. 80th Annual Royal Australian Ornithological Congress, Armidale. Nov.
- COATES, D.J. and SHAW, D.D. Patterns of chiasma distribution in a new chromosomal taxon and their relationship to hybrid breakdown in Caledia captiva. Genetics Society of Australia 29th General Meeting, Melbourne. May.
- COATES, D.J. A hybrid zone in the Trigger plant Stylidium caricifolium. Discussion meeting on "Evolution significance of hybrid zones", Australian Academy of Science, Canberra. Jul.
- GIBSON J.B. Genetic factors in alcohol metabolism. Invited paper, International Workshop on Addictive Behaviour, Melbourne. May.
- GIBSON, J.B. Genetic factors in alcohol metabolism. Invited paper, Human Genetics Society of Australasia Adelaide. May.
- HONEYCUTT, R.H. Hybrid zones between chromosomally defined races of the Plains pocket gopher, Geomys busarius. Discussion meeting - Evolutionary Significance of Hybrid Zones. Australian Academy of Science, Canberra. Jul.
- JARDINE, R. Pedigree analysis of spatial ability. Workshop on methods for the analysis of family and pedigree data, Melbourne. Aug.
- KING, M. Karyotypic evolution in Gehyra australis. Australian Herpetological Society Meeting. Birrigai, N.S.W. May.
- MARTIN, N.G. Genetic factors in susceptibility to alcohol. International Workshop on Addictive Behaviour, Melbourne, May.
- MARTIN, N.G. Genetic factors in susceptibility to alcohol. Invited paper, Human Genetics Society of Australasia, Adelaide, May.
- MARTIN, N.G. Alpha-1- antitrypsin, DZ twinning and the common cold: ingredients for a selectively balanced polymorphism? Genetics Society of Australia 29th General Meeting, Melbourne, May.
- MARTIN, N.G. Methods for the analysis of the causes of covariation in regular pedigrees. Workshop on methods for the analysis of family and pedigree data, Melbourne. Aug.
- MENGDEN, G.A. Chromosome evolution in elapid snakes. Australian Herpetological Society Meeting, Birrigai, N.S.W. May.

MORITZ, C. Sex, chromosomes and allozymes in an Australian gecko, Heteronotia binoei. Genetics Society of Australia 29th General Meeting. May.

MORITZ, C. Parthenogenesis in the endemic Australian gecko, Heteronotia binoei. Australian Society of Herpetologists Conference. May.

SHAW, D.D. and WILKINSON, P. Increased chromosomal mutation rate after hybridisation between two subspecies of Caledia captiva. Genetics Society of Australia 29th General Meeting, Melbourne. May.

SHAW, D.D. and WILKINSON, P. Chromosomal repatterning and the maintenance of the hybrid zone in the grasshopper Caledia. Discussion meeting on "Evolutionary significance of hybrid zones", Australian Academy of Science, Canberra. Jul.

Overseas

EASTEAL, S. The effective size of introduced populations of the giant toad Bufo marinus. Society for the Study of Evolution and the American Society of Naturalists meeting. State University of New York at Stonybrook. Jun.

GIBSON, J.B. and OAKESHOTT, J.G. Tests of the adaptive significance of the alcohol dehydrogenase polymorphism on Drosophila melanogaster: paths, pitfalls and prospects. US/Australia Co-operative Science Program Workshop on the Cactus-Yeast-Drosophila Model System. Tuscon, Arizona, U.S.A. Jan.

JOHN, B. Through the looking glass: a sceptical cytologist in a molecular wonderland. Second Kew Conference, Jodrell Laboratories, Royal Botanic Gardens, Kew. Sept.

MENGDEN, G.A. Chromosome banding analysis in the phylogeny of Australian elapid snakes. 25th anniversary symposium "Molecular and Genomic Evolution of Amphibians and Reptiles 1982 Joint Annual Meeting Society for the Study of Amphibians and Reptiles and Herpetologist League. Raleigh, North Carolina. Aug.

SHAW, D.D. and COATES D.J. Chromosomal variation and the concept of the coadapted genome - a direct cytological assessment. Invited paper at the 2nd Kew Conference, Jodrell Laboratories, Royal Botanic Gardens, Kew. Sept.

WHITE, M.J.D. Chromosomal mechanisms in animal reproduction. Symposium on evolution of reproductive strategies in animals. 49th Conference of the Unione Zoologica Italiana. Bari, Italy. Oct.

WHITE, M.J.D. Genetics and ecology of populations in contact zones. Summary at conclusion of the symposium on evolution of reproductive strategies in animals. 49th Conference of the Unione Zoologica Italiana. Bari. Italy. Oct.

TAXONOMY UNIT

Local

HATTERSLEY, P.W. The geographic distribution of C₃ and C₄ grasses in Australia in relation to climate. 22nd Meeting of the Australian Society of Plant Physiologists. Aug.

WATSON, L. Taxonomic patterns in grass pollen antigens and allergens, and their potential significance. 3rd Meeting of the Sydney Allergen Group. Sep.

Overseas

WEBSTER, R.D. A practical application of the DELTA computer system. 77th Annual Meeting of the Botanical Society of America. Aug.

VIRUS ECOLOGY RESEARCH GROUP

Local

GIBBS, A. Identification of viruses. National Farmers Federation ANAHL Forum, Geelong, Victoria. Aug.

GIBBS, A. The Australian National Animal Health Laboratory (A.N.A.H.); a scientist's viewpoint. University of New England Forum, Sep. (Abst Aust. Soc. Anim. Product. Fed. Newslett. 31, 2-3.)

Dr. C. Hammer, Human Science Program

Dr. L.P. Davison, Department of Health, Canberra

Dr. Ingar Elianderoff, Institut für Tierreich und Tierverhalten,
Münchhausen (Feb-Jul)

Dr. T. Lund, OCAF

American Professor A.K. McIntyre (Aug-Sep)

Dr. I.S. McLeenan, C.J. Martin Fellow (Nov-May)

Mr. S. Sisker, Psychology Department, Victoria University of Wellington,
New Zealand (July) (jointly with JCBM)

Research Students

Andrew Bell, BA BSc (WA)B

Phillip Coates, BSc (Qld)

Ina Fooks, BA (NSW)

Ann Guppy, BSc

Philip Harrison, BSc, Dip Ed (Tas)

Sarah Ann Healey, BSc (Aristotel) (from Sov)

Janice Kelly, BSc (Winders) (to Feb)

Lidia Meyer, BSc (Winders)

Steven McConnell, BSc (La Trobe)

Nally McFadden, BSc

Elizabeth Rowland, BSc (Syd), MSc

Dady Wye Dvorak, BSc (S. Cal)

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- # visiting research worker
 + not a member of this University
 Ø member of another part of this University
 † member of another Department in RSBS
 * former member
 Δ former visiting research worker

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VIRUS ECOLOGY RESEARCH GROUP

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JOHN, B. Through the looking glass: a cytopathologist in a molecular world. In: *Proceedings of the 2nd New Conference, Royal Botanic Gardens, New. Sept.*

MERSON, G.A. Chromosome banding systems in the physiology of Australian diploid species. *Molecular and Cellular Evolution of Amphibians and Reptiles 1982* Meeting held at the University of North Carolina, Raleigh, North Carolina. Aug.

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- 1 visiting research worker
- 2 not a member of this University
- 3 member of another part of this University
- 4 member of another department in 1982
- 5 former member
- 6 former visiting research worker

STAFF, VISITORS AND STUDENTS

DEPARTMENT OF BEHAVIOURAL BIOLOGY

Professor and Head of Department

Richard Freeman Mark, MMedSc, MB,ChB (NZ), CES Dr3rdCy (Aix-Marseille), FAA

Fellow

Ian George Morgan, BSc (Melb), PhD (Monash)

Senior Research Fellow

John Richard Haight, BS (Ill), MSc, PhD (Mich.State)

Research Fellows

Roger Burslam Coles, BSc, PhD (Monash)
 David Robert Dvorak, BS (New Mexico), PhD (S.Cal)
 John Martin Wild, MA (Cant), PhD (Auck)
 Peter Wilson, BSc (Durh), PhD (N'cle, UK)

Postdoctoral Fellow

Christopher John Denton, BSc (Hull), PhD (Open) (to May)

Visiting Fellows

Dr. G. Bammer, Human Sciences Program
 Dr. L.P. Davies, Department of Health, Canberra
 Dr. Franz Ellendorff, Institut fur Tierzuch Und Tierverhalten,
 Mariensee (Feb-Jul)
 Dr. T. Lund, CCAE
 Emeritus Professor A.K. McIntyre (Aug-Sep)
 Dr. I.S. McLennan, C.J. Martin Fellow (from May)
 Mr. S. Slater, Psychology Department, Victoria University of Wellington,
 New Zealand (Jan) (Jointly with JCSMR)

Research Students

Andrew Bell, BA BSc (Melb)
 Phillip Comans, BSc (Qld)
 Ian Faulks, BA (NSW)
 Anna Guppy, BSc
 Philip Harrison, BSc, Dip Ed (Tas)
 Sarah Kim Heaney, BSc (Bristol) (from Nov)
 Janice Lally, MSc (Flinders) (to Feb)
 Lidia Mayner, BSc (Flinders)
 Steven McConnell, BSc (La Trobe)
 Sally McFadden, BSc
 Elizabeth Reymond, BSc (Syd), MSc
 Judy Wye Dvorak, BSc (S.Cal)

Research Assistants

L.R. Marotte, MSc (Monash)
 M. Woolston, BSc (Flinders) PhD (to May)

Head Technical Officer

R. Jackson

Senior Technical Officers

M. Canney
R. Geppert
P. Miethke, BSc (Melb) (from Mar)

Technical Officer

G. Stange, Dr rer.nat.(Göttingen)

Laboratory Technicians

M. Devlin
G. Fetingis, BSc (NSW)
B. Hilton
M. Porter, BSc

Secretary

B. Piper

Typist

F. Jackson

CENTRE FOR RECOMBINANT DNA RESEARCHExecutive Director:

Professor John Arthur Pateman, BSc, PhD (Lond), MA (Camb), FRSE, FRS

Associate Director

John Shine, BSc, PhD

Advisory Committee:

Professor B. John (RSBS), Professor J.A. Pateman (RSBS), Dr. J. Shine (RSBS), Dr. G. Grigg (CSIRO), Professor A. Linnane (Monash Uni.), Dr. H. Niall (Howard Florey Institute) Dr. R. Symons (Univ. of Adelaide)

Postdoctoral Fellows

Sue Newton, BSc, PhD (from Sept)
Jacek Plazinski, MSc (Cracov), PhD (Cracov)

Queen Elizabeth Fellow

Jane Badenoch-Jones, BRurSc (NE), PhD (Nott) (from Mar)

Research Assistants

J. Tellam, MSc (Griffith)
J. Hardman, BSc

Laboratory Technicians

C. Bates, BSc (from Feb)
 C. Hayes, BRTC (from Feb)
 B. Matheson (from Feb)

Members of RSBS who worked in the CRDR during 1982

Dr. J. Badenoch-Jones (to Feb)
 Dr. J. Blok
 Ms. M. Cronk
 Dr. B. Evans
 Ms. K. Harrison
 Ms. A.M. Mackenzie
 Mr. A. Mason
 Dr. R.I. Richards
 Mr. P. Schofield
 Mr. K.F. Scott
 Dr. J. Shine
 Dr. J. Watson
 Mr. P.L. Whitfeld

Visitors

Dr. F. Fellows (U of Melb)
 Dr. M. Skotnicki, (U of NSW)
 Ms. A. Goodman (U. of NSW)
 Dr. P. Ernst (Mauri Brothers, Sydney)
 Dr. J. Mathews (U. of Melb)
 Dr. R. Simpson (St. Vincent's Medical Research Centre, Melbourne)
 Dr. P. Fuller (Medical Research Centre, Prince Henry Hospital, Melbourne)
 Dr. B. Scott (DSIR, New Zealand)
 Dr. B. Lee-Reichel (U. of NSW)
 Mr. D. Catanzaro (U. of Sydney)
 Dr. Thai Nguyen (U. of California)

DEPARTMENT OF DEVELOPMENTAL BIOLOGY

Professor and Head of Department

Brian Edgar Scourse Gunning, MSc, PhD (Belf), DSc, FAA, FRS

Senior Fellow

David Stuart Letham, MSc (NZ), PhD (Birm)

Fellow

Richard Edward Williamson, MA, PhD (Camb)

Senior Research Fellow

Wolfgang Wernicke, DiplBiol, PhD (Frankfurt)

Research Fellows

Adrienne Ruth Hardham, BSc (Monash), BSc, PhD (from May)
 Lok Man Singh Palni, MSc (Gorak), PhD (Wales) (from Aug)
 Susan Mary Wick, BSc (Oregon State), PhD (Stan)

Postdoctoral Fellows

Jane Badenoch-Jones, BRurSc (NE), PhD (Nott) (jointly with Genetics to Feb)
 Robert John Cork, BSc, PhD (Leeds) (from Nov)
 Martin Victor Palmer BSc (London), PhD (Wales) (from Jan)

Visiting Fellows

Dr W. Breed, University of Adelaide (Dec)
 Mr Chen Wei-lun, Institute of Botany, Academia Sinica, Peking (Apr-Dec)
 Professor P.B. Green, Stanford University (from Sep)
 Professor P.K. Hepler, University of Massachusetts (to Jan)
 Professor S.J. Knypl, University of Lodz, Poland (to Jun)
 Dr T. Offler, University of Newcastle (Dec)
 Dr D.D. Sabnis, University of Aberdeen (to Aug)
 Mr V. Sarafis, Hawkesbury Agricultural College (Dec)
 Mr Tao Guo-qing, Institute of Botany, Academia Sinica, Peking (to Sep)
 Dr P. Warren Wilson
 Dr P. Jameson, Otago University (from Nov)

Research Students

David Flanders, BSc (N'cle, UK)
 Stuart Craig, BSc (Monash)
 Charles Hocart, MSc (WA)
 Roland Jahnke, BSc (La Trobe)
 David McCurdy, BSc (La Trobe)
 Jon Gavan Millard, BSc, BEd (La Trobe)
 Toshinobu Suzuki, MSC (Hiroshima)
 Suresh Tiwari, BSc (Delhi)

Research Assistant

J. Perkin BAPSc (RMIT)

Head Technical Officer

R.D. Bray (jointly with Population Biology)

Senior Technical Officers

C.W. Parker, MSc
 E. Hines

Technical Officers

C. Busby, BSc (Monash)
 J. Duniec, MSc (Warsaw)
 L. Milkovits
 F. Sek, BAPSc (CCAE)

Laboratory Technicians

C. Bates, BSc (to Mar)
 U. Hurley, BSc (Natal)
 D. Pianca, BSc (from June)

Trainee Laboratory Technicians

J. McMenamin
S. Kirby

Secretary

P. Vest

Word Processor Operator

V. Rawlings

DEPARTMENT OF ENVIRONMENTAL BIOLOGY

Professor and Head of Department

Charles Barry Osmond, MSc (NE), PhD (Adel), FAA

Professor

Ralph Owen Slatyer, DScAgr (W Aust), FAA, FRS, OA

Professorial Fellow

Ian Roy Cowan, MSc (Lond), PhD (Nott)

Fellows

Graham Douglas Farquhar, BSc (Qld), BSc, PhD
Ian Roy Noble, BSc, PhD (Adel)
Ivan James Ryrie^o, BSc, PhD (Syd)

Senior Research Fellow

Murray Ronald Badger, BScAgr (Syd), PhD

Research Fellows

Hugh Nicholas Comins, BSc, PhD (Syd)
Kam Chau Woo, BSc (Adel), PhD
Suan Chin Wong, MSc (Nanyang), PhD

Postdoctoral Fellows

Kent J. Bradford, BSc (Mich. State), PhD (UC, Davis) (until Jul)
David Alexander Day, BSc, PhD (Adel) (until Dec)
Thomas David Sharkey, BSc, PhD (Mich. State) (until Aug)
Jeffrey Randall Seemann, BA, PhD (Stanford) (from Jul)

Visiting Fellows

Dr. M.P. Austin, CSIRO Land Use Research, Canberra (Jan-Dec)
Professor D.J. Carr, RSBS (Jan-Dec)
Mrs. S.G.M. Carr, RSBS (Jan-Dec)
Dr. R.K. Chopra, AIRI, New Delhi (Jul-Oct)
Dr. L.R. Fox, University of California, Santa Cruz (to Mar; from Dec)
Dr. K. Imai, Tokyo University (Oct-Nov)
Dr. P.E. Kriedemann, CSIRO Soils Division, Glen Osmond (Apr-Jul)

Dr. H. Lambers, University of Groningen (until Apr)
 Dr. P.A. Morrow, University of Minnesota (until Mar)
 Dr. T.F. Neales, Melbourne University (Feb-May)
 Dr. I. Noy-Meir, Hebrew University (Oct-Nov)
 Dr. M. O'Leary, University of Wisconsin (from Aug)
 Dr. D.C. Potts, University of California, Santa Cruz (to Mar; from Nov)
 Professor T.C.R. White, Riverina CAE (from Jul)
 Dr. E.E. Werner, Michigan State University (from Nov)
 Dr. P.A. Werner, Michigan State University (from Nov)

Dr. Ryrrie holds an appointment as a Fellow in the Department of Applied Mathematics, Research School of Physical Sciences, but conducts his research in the Department of Environmental Biology.

Research Students

Douglas Graham Abrecht, BRurSc (NE)
 Helen Margaret Armstrong BSc (Edin) (from Jan)
 Joaquín Azcón-Bieto, MSc (Barcelona)
 Mary Elizabeth Bassett, BSc (Dundee) (from Sep)
 Anna Brooks, BSc (Adel)
 John Richard Evans, BSc
 Robert Thomas Furbank, BSc (W'gong) (until Dec)
 Uwe Franz Kirschbaum (from Feb)
 Jennifer Jill Landsberg, B.Pharm. Dip.Ed. BSc (Qld) (from Mar)
 Stuart F. Ledgard, BAgSc (Lincoln Coll., NZ)
 Maria Antonieta Sobrado, LicBiol (UCV., Venezuela)
 David Mark Stafford Smith, BA (Camb)
 Annie Termaat, BSc (from Jul)
 Paul William Weiss, MSc (NSW)

Research Assistant

P.J. Ferrar, MSc

Head Technician

Z. Roksandic, BAppSci (CCA), BRTC, AIST

Senior Technical Officer

W.S. Coupland

Technical Officers

P.M. Cochrane, BSc
 A. Gallagher, BRTC, AIST
 P.J. Kell, BRTC
 B. Weir, BSc (W'gong), BRTC, AIST

Laboratory Technicians

D. Everitt, BSc (UCNW), MSc (S'ton) (until Dec)
 P. Groeneveldt, BSc
 S.K. Wood

Laboratory Assistant

J.E. Hardy (part-time)

Secretaries

D.E. Lee
 S. Cater (Jan-May)
 J. Gregory-Smith (part-time) (Jun-Dec)

DEPARTMENT OF GENETICS

Professor and Head of Department

John Arthur Pateman, BSc, PhD (Lond), MA (Camb), FRSE, FRS

Senior Fellows

Colin Herbert Doy, BSc (Wales), PhD (Melb), CChem, FRACI, FRSC
 George Desmond Clark-Walker, MSc (W Aust), DPhil (Oxf)
 Ernest Howard Creaser, MA PhD (Camb)

Fellows

Barry Garth Rolfe, BAgSc, PhD (Melb)
 John Shine, BSc, PhD

Research Fellows

Kadaba Srinivasa Sriprakash, MPharm (Ban), PhD (IISc)
 John McRae Watson, DipAppChem (RMIT), DipAppBiol (RMIT), PhD
 (Monash)

Postdoctoral Fellows

Jane Badenoch-Jones, BRurSc (NE), PhD (Nott)
 (jointly with Developmental Biology, to Feb)
 Bronwyn Evans, BSc, PhD
 Robert Ian Richards, BSc, PhD (Adel)

Visiting Fellows

Dr. G. Air, JCSMR (until Feb)
 Dr. P. Dart, (ICRISAT), India (from Mar)
 Dr. Florence Fellows, University of Melbourne (Feb-Aug)
 Prof. P.L. Kuempel (from Sep)
 Dr. J. Langridge, CSIRO
 Dr. S. Newton, JCSMR (Jun.-Jul)
 Dr. A-C. Schenberg-Frascino, University de Sao Paulo (until Jan)
 Dr. B. Scott, DSIR, New Zealand (from Nov)
 Dr. K. Watson, James Cook University (from Nov)

Research Students

Michael Anthony Djordjevic, BSc (Qld)
 Robert John Evans, BSc (Sus)
 Peter Hoeben, BSc (Amst), MSc (D'dorf)
 Anthony John Mason, BSc (Monash)
 Nigel Morrison, BSc (Qld)
 Robert Ridge, BA (WA), BSc (WA)
 Peter Schofield, BAgSc (Syd)
 Kieran Francis Scott, BSc (Massey)
 Peter Lawrence Whitfield, BSc

Research Assistants

M. Cronk, BAppSc (CCAE)
H. Kane, BSc, PhD

Head Technical Officer

N.A. Gowen, BRTC

Senior Technical Officer

C. R. McArthur, BSc (Flin), MSc

Technical Officers

J. Ada, BSc
C. Batum, BSc
K. Harrison
J. McIver

Senior Laboratory Technician

E. Wimmer

Laboratory Technicians

G. Bender, BSc
A. Davey, BSc, (from Nov)
E. Gartner
R. Porter
A. Plazinska, MSc (Cracov) (from Oct)
E. Thompson, BSc (to Nov)

Secretary

J. Madden

Laboratory Attendant

J. Atkinson

MOLECULAR BIOLOGY UNITProfessorial Fellow and Head of Unit

Hiroto Naora, BSc (Tokyo University of Literature and Science),
DSc (Tokyo)

Research Fellow

Nicholas John Deacon, BSc, PhD (Lond)

Postdoctoral Fellow

Antony Wharton Braithwaite, MSc (Auck), PhD (from Feb)

Visiting Fellows

Professor V. Holoubek, University of Texas, Galveston (to Mar)
Dr. K. W. Bentley, University of Sydney (from Jul)

Research Assistant

D.W. Buckle, BSc (Melb), MSc (Auck)

Laboratory Technicians

J.A. Fernance, DipAppSc (CCAEE)
F. Driver, BSc
S. LeJeune, HNC

Secretary

G.M. Hines, BA (Edin) (jointly with Taxonomy and VERG)

DEPARTMENT OF NEUROBIOLOGY

Professor and Head of Department

George Adrian Horridge, MA, PhD, ScD (Camb), FAA, FRS

Senior Fellows

Andrew David Blest, BSc (Lond), DPhil (Oxf)
Jacob Nissim Israelachvili, MA, PhD (Camb), FAA (jointly with RSPhysS,
until Dec)
David Cartner Sandeman, MSc (Natal), PhD (St And) (until Feb)

Fellows

Eldon Edward Ball, AB (Stan), PhD (Calif)
Simon Barry Laughlin, MA (Camb), PhD

Senior Research Fellow

Michael Francis Land, MA (Camb), PhD (Lond), FRS (from Sep)

Research Fellows

Kenneth George Hill, BSc, PhD (Melb)
Peter Donald McIntyre, BSc, PhD
Mandyam Veerambudi Srinivasan, BE (B'lore), PhD (Yale)
(jointly with RSPhysS, until Mar)
Lon Allan Wilkens BA (Kansas), PhD (Flor) (until Jan)

Postdoctoral Fellows

Sally Jane Stowe, MSc (Auck), PhD
Heinz Gert de Couet, DipBiol, Dr rer nat (TH Darms)

Visiting Fellows

Prof. K. Aoki, Sophia University, Tokyo (until Jan)
Mr. K. Arikawa, Sophia University, Tokyo (until Feb)
Dr. G.S. Boyan, Max-Planck Institut, Germany (until Feb)
Dr. S. Caveney, University of Western Ontario, Canada (until Apr)
Dr. L.H. Field, University of Canterbury, N.Z. (May-Jun)
Dr. R.R. Jackson, University of Canterbury, N.Z. (until Feb)
Dr. W.A. Ribbi, Max-Planck Institut, Tübingen (from Dec)
Prof. Y. Tominaga, Fukuoka University, Fukuoka, Japan (until Oct)
Prof. R.Y. Zacharuk, University of Regina, Canada (until Mar)

Research Students

Kim Pamela Bryceson, BSc (Aberd) (until Nov)
 Fred Ewald Doujak, BSc (Vict, BC) (from Aug)
 Jonathon Howard, BSc (until Dec)
 Teddy Lee Maddess, BSc (UBC)
 Tomislav Matic, BSc (Zagreb)
 Brian Phillip Oldfield, BSc (WAIT), MSc (WA) (until Dec)
 Daniel Colaco Osorio, BA (Camb) (from Oct)
 David Salter Williams, BSc (Cant) (until Mar)

Research Assistant

L. Marcelja, BSc (Zagreb)

Head Technical Officer

K. Downing

Senior Technical Officers

I. Kradzins, E & C
 P. Gibbon, DipEd, E & C
 R. Welsh, E & C, (until Feb)

Technical Officers

W. Eddey, BSc
 B. Ham, BSc (Melb)
 R. Jahnke, BSc (La Trobe)
 K. Ruth

Technicians

R. Bhati, BSc (from Dec)
 R. Stone (until Jun)

Secretary

T. Falconer

Clerk/Typist

P. Coote

DEPARTMENT OF POPULATION BIOLOGY

Professorial Fellow and Head of Department

John Bryan Gibson, BSc, PhD (Sheff), MA (Camb)

Professor

Bernard John, MSc, PhD (Wales), DSc (Birm), FIBiol

Fellows

George Leslie Gabor Miklos, BSc, PhD (Syd)
 David Dobson Shaw, BSc (Durh), MSc (Birm), PhD (S'ton), MIBiol

Research Fellows

Nicholas Gordon Martin, BSc (Adel), PhD (Birm)
 John Graham Oakeshott, BSc, PhD (Adel)
 Robyn Joyce Russell, BSc (Monash), PhD (Melb) (from Jun)

Postdoctoral Fellows

Michael Anthony Adena, BSc (Melb), PhD (until Jun)
 Ian Adrian Boussy, AB (Sonoma State, Calif), MS, PhD
 (UC, Davis) (from Dec)
 David Jack Coates, BSc, PhD (W.Aust)
 Donald James Colgan, PhD (Melb), BSc (from Nov)
 Christopher Collet, BSc, PhD (La Trobe) (from Sep)
 Simon Eastal, BSc (St. And.), PhD (Griffith)
 (from Feb)

Research Associate (ARGC)

Rodney Lee Honeycutt, BA (Texas), MSc (Texas A&M), PhD
 (Texas Tech)

Visiting Fellows

Professor L. Bullini, Citta Universitaria, Italy (Jan-Mar)
 Professor M.M. Green, University of California, Davis, U.S.A.
 (from Oct)
 Professor P.D.N. Hebert, University of Windsor, Ontario,
 Canada (from Nov)
 Dr D. Loesch, Psychoneurological Institute, Warsaw (from Jul)
 Dr R.J. Russell, Pennsylvania State University College of
 Medicine (Mar-Jun)
 Dr S. Schwartz, University of Windsor, Ontario, Canada (from
 Nov)
 Emeritus Professor M.J.D. White, FAA, FRS

Research Students

Michael Lynn Arnold, MSc (Texas Tech)
 Douglas Gordon Anderson, BSc
 Philip Ronald Anderson, BSc
 John Alexander Hay Benzie, BSc (Aberd)
 Leslie Christidis BSc (Melb)
 Marion Joy Healy, BSc
 Rosemary Jardine, BSc
 Wayne Robert Knibb, BSc (Qld)
 Craig Charles Moritz, BSc (Melb)
 Gregory Allen Mengden, BSc (Texas Tech) (until Nov)
 Paul Redpath Simpson, BSc (London) (from May)
 Edna Madge Watson, DipEd (Syd), BA MSC

Research Assistants

M. E. King, BSc (La Trobe), PhD (Adel)
 D. M. Rowell, BSc

Head Technical Officer

R.D. Bray (jointly with Developmental Biology)

Senior Technical Officers

P. Wilkinson, C&GLTC, AdvZool, AdvChem (B'ham), BAppSc (CCAEE)
 A.V. Wilks, MSc (Melb)

Technical Officers

N. Contreras, BSc (Chile)
 J. Higginbotham, BSc
 D. Willcocks, DipApSci (Biol) 9CCAEO
 V.L. Ross, BA

Laboratory Technicians

E. McGahey, BRTC
 H.J. Montesin, BSc (until July)
 T.H.A. Nguyen, BLet (Saigon)
 M.E. Olsen
 G. von Schill

Laboratory Attendant

U. Smith

Secretary

E. Lockwood

TAXONOMY UNITSenior Fellow and Head of Unit

Leslie Watson, MSc (Manc)

Research Fellow

Paul Wayne Hattersley, BSc (Lond), MSc (Liv), PhD

Postdoctoral Fellow

Robert D. Webster, BSc (Northwestern State),
 MSc (Mississippi State), PhD (Texas A & M)

Visiting Fellows

Dr. Yeoh Hock-Hin (University of Singapore) (May-Jun)
 Mr. R. J. Pankhurst (British Museum) (Sep-Oct)
 Dr. R. Dengler (University of Toronto) (from Sep)
 Dr. N. Dengler (University of Toronto) (from Sep)

Research Assistant

N.E. Stone, BSc, PhD (Camb)

Senior Technical Officer

C.R. Johnston, BAgSc (Melb)

Laboratory Technician

S. Perry, DipAppSc (CCAEE)

Secretary

G.M. Hines, BA (Edin) (jointly with VERG and MBU)

VIRUS ECOLOGY RESEARCH GROUP

Senior Fellow and Head of Group

Adrian John Gibbs, BSc, PhD (Lond), ARCS

Postdoctoral Fellow

Janet Blok, BSc (Sussex), PhD

Research Students

Denis L. Anderson, BSc

Paul Guy, BSc (until Mar)

Research Assistant

K.F. Boswell, BSc (Lond)

Senior Technical Officer

P.M. Miethke, BSc (Adel) (until Mar)

Technical Officers

A.M. Mackenzie, BSc (Melb)

M. Torronen, BRTC

Secretary

G.M. Hines, BA (Edin) (jointly with MBU and Taxonomy)

SCHOOL SERVICES STAFF

Administration

Assistant to Business Manager
 Administrative Clerk
 Clerks

S. King
 S. Stephens
 L. Hayes
 C. Barmin
 P. Graham
 B. Johnston

Security and Cleaning

Head Watchman/Janitor
 Janitors

T. Durrant
 A. Kyle
 W. Kyle

Cleaners

J. Williams
J. O'Rourke
R. Payne

C. Brodrozic
E. Versegi
S. Skrobot
S. Skrtic
T. Nelson
D. O'Rourke

Store

Chief Storeman
Store Supervisor
Clerk
Storeman

W. Friedrich
R. Hassall
A. Thaller
J. Miliano

CENTRAL SERVICESAmino Acid Analyser and Analytical Ultracentrifuge

Senior Technical Officer

K. Britt, BSc

Computer

Programmer
Assistant Programmer

D. Sandilands, BSc
D. Smith

Electron Microscopy Unit

Head Technical Officer
Senior Technical Officers

G. Weston
D. Llewellyn
M. Kovacs
N. Pigram
W. Hall

Laboratory Technicians

Gas Chromatograph/Mass Spectrometer

Research Officer
Senior Technical Officer

R. Summons, BSc, PhD (NSW)
J. Wicks

Photography and Illustration

Senior Technical Officer
Technical Officer
Laboratory Technician
Illustrator

B. Parr
M. Whittaker
G. Perceval
G. Brown

Plant and Animal Culture

Technical Officers

R. Lamb, BSc(For)
R. Dencio
P. Fokker
D. Ferguson
R. Cameron
W. Rose

Laboratory Technicians

Labourer

Word Processing Facility

Supervisor

V. Rawlings

WORKSHOP

Head Technical Officer

W. Krause

Senior Technical Officers

W. Pfluger

D. Crawford

J. Carr

R. Dwyer

Technical Officer

D. Turnbull

Senior Laboratory Craftsmen

G. Aschenberger

P. Cairns

Z. Daroczy

T. Rudczuk

S. Jovanovic

L. Palmer

P. Barty

P. Larsen

R. Shawyer

T. Edlington

J. Reyn

Laboratory Technician

K. Richens

Adult Storeman

G. Edwards

Apprentices

E. Tynkkynen

M. Olthof

Junior Laboratory Technician

S. Hodgkin



28