annual report for 1958

AUSTRALIAN
NATIONAL
UNIVERSITY

COMMONWEALTH OF AUSTRALIA

REPORT OF THE COUNCIL

OF

THE AUSTRALIAN NATIONAL UNIVERSITY

FOR THE YEAR ENDING 31ST DECEMBER, 1958

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1959

THE AUSTRALIAN NATIONAL UNIVERSITY.

REPORT OF THE COUNCIL FOR THE PERIOD 1ST JANUARY, 1958, TO 31ST DECEMBER, 1958.

To His Excellency Field-Marshal Sir William Slim, K.G., G.C.B., G.C.M.G., G.C.V.O., G.B.E., D.S.O., M.C., Kt.St.J., Governor-General and Commander-in-Chief in and over the Commonwealth of Australia.

MAY IT PLEASE YOUR EXCELLENCY:

I have the honour to transmit to Your Excellency the report of the Council of The Australian National University for the period from 1st January, 1958, to 31st December, 1958, furnished in compliance with Section 33 of the Australian National University Act 1946-1947.

THE COUNCIL.

The Council met six times during the year in January (special meeting), March, May, July, September and November. Dr. H. C. Coombs continued to act as Deputy Chairman of the Council.

The terms of office of Mr. K. E. Beazley, Mr. P. E. Joske, Sir Allen Brown, Mr. N. L. Cowper, Mr. H. J. Goodes, Mr. I. M. McLennan, Mr. A. J. L. Catt and Mr. P. D. Marchant expired on 30th June, 1958.

Elections took place and appointments were made in accordance with the provisions of the University Act, and the following Councillors took office as from 1st July, 1958:—

Members elected by the House of Representatives—

*Kim Edward Beazley, B.A.(W.A.).
*Percy Ernest Joske, M.A., LL.M.(Melb.), Q.C.

Members appointed by the Governor-General—

Sir Allen Stanley Brown, C.B.E., M.A., LL.M.(Melb.).
Norman Lethbridge Cowper, C.B.E., B.A., LL.B.(Syd.).
Herbert John Goodes, C.B.E., B.A.(W.A.).
Ian Munro McLennan, C.B.E., B.E.E.(Melb.).

Members elected by the Students—

Hsin Yuan T'ien, M.A.(Pennsylvania).
Thorburn Stirling Robertson, B.Sc., M.B., B.S.(Adel.).

The resignation from the Council of Dr. T. S. B. Robertson was accepted by the Council on 14th November, 1958.

At a meeting held in accordance with the provisions of the University Act on 11th July, 1958, it was resolved to co-opt the following for the periods shown:—

The Right Honourable Viscount Bruce of Melbourne—one year from 1st August, 1958.
Professor Sir Mark Oliphant—one year from 1st July, 1958.
Professor A. D. Trendall—three years from 1st July, 1958.

THE DEVELOPMENTS OF 1958 IN SUMMARY.

General Development.

The new laboratories of the John Curtin School of Medical Research which were occupied early in 1957, were officially opened on 27th March, 1958, by Sir Howard Florey, F.R.S., in the presence of the Prime Minister, the Rt. Hon. R. G. Menzies, C.H., Q.C.

The Council received from the Board of Graduate Studies a report on the work of the Research School of Pacific Studies and its role within the University, which demonstrated that the work of the School had developed along sound lines involving close co-operation between the departments and individual members of that School and with members of the Research School of Social Sciences.

Council approved in principle the development of a new Department of Economics to carry out studies in the economics of Pacific and South-East Asian countries to complement work already being done in the fields of anthropology, geography, history and government. Council also approved the establishment of a committee to develop and co-ordinate inter-disciplinary research projects and a New Guinea Research Unit within the School to assist in carrying out such projects.

* Membership of these persons ceased on 14th October, 1958 on the dissolution of the House of Representatives.

In the John Curtin School of Medical Research a new Department of Physical Biochemistry was approved.

An order was placed for the manufacture of a 12 MeV tandem electrostatic generator—a major piece of equipment for the Department of Nuclear Physics.

The Council approved supplementary provisions to the University Superannuation Scheme to alleviate hardship to widows of members who die in the University's service, or to members who break down in health or are otherwise inadequately provided for when they retire.

The University has continued its study of the report of the Committee on the Australian Universities, having in mind especially its responsibility to train graduate students for teaching and research posts in the Australian universities.

The University conferred the following degrees *honoris causa*:—

The Rt. Hon. Harold Macmillan, M.P.—Doctor of Laws.
Sir Howard Florey, F.R.S.—Doctor of Science.
Sir Norman Gregg, M.C.—Doctor of Science.

Site and Buildings.

The Government has agreed in principle to the provision of a permanent building for the University's library collection (which is now housed in temporary and relatively unsafe quarters) and gave permission for working drawings to proceed. These are now being developed.

A laboratory and workshop building for the Department of Geophysics and an Optical and Electronics Workshop for the Department of Astronomy (Mount Stromlo Observatory) were completed during the year. Further work has proceeded on the fitting out of research floors of the John Curtin School of Medical Research.

Pressure on existing accommodation has prompted a decision to extend a wing at University House to provide an additional 25 rooms.

Degrees Awarded.

The Degree of Doctor of Philosophy was conferred on Mr. David O. White (Microbiology), Mr. Alan J. F. Boyle (Nuclear Physics), Mr. Halcro J. Hay (Nuclear Physics), Mr. Anthony C. Riviere (Nuclear Physics), Mr. Alexander W. Rodgers (Astronomy), Mr. Norman J. Snelling (Geophysics), Mr. T. Merritt Brown (Economics), Mr. Thomas M. Perry (Geography), Miss Marie O. Reay (Anthropology and Sociology), Mr. Richard F. Salisbury-Rowswell (Anthropology and Sociology), and Mr. Noel Barnard (Far Eastern History). Miss Kathleen M. Jupp (Demography) and Mr. Jeremy R. Beckett (Anthropology and Sociology) had the degree of Master of Arts conferred on them.

Enrolments.

Forty-eight new research students enrolled in 1958 and the total number enrolled at the end of the year was 86. Of the new students 22 were Australians, eleven were from the United Kingdom, nine from New Zealand, two from the United States and one each from Eire, India, Japan and Taiwan.

Staff Appointments.

Dr. F. C. Courtice was appointed Professor of Experimental Pathology from the 1st July, 1958. Dr. A. G. Ogston was appointed Professor of Physical Biochemistry and will take up his appointment in 1959. Mr. J. A. Passmore was promoted from Reader to Professor of Philosophy within the Department of Social Philosophy.

Other senior appointments and promotions were—

Dr. H. C. Brookfield, Reader in Social Geography,
Dr. S. Fazekas de St. Groth, Reader in Virology,
Dr. W. V. Macfarlane, Reader in Physiology,
Dr. G. B. Mackaness, Reader in Experimental Pathology,
Mr. J. E. Moyal, Reader in Statistics,
Dr. H. J. F. Cairns, Senior Fellow in Microbiology,
Dr. J. C. Harsanyi, Senior Fellow in Social Philosophy,
Dr. Bede Morris, Senior Fellow in Experimental Pathology.

Senior Staff Resignations were—

Dr. G. E. de Q. Robin, Senior Fellow in Geophysics, on appointment as Director of Scott Polar Research Institute, Cambridge,

Dr. G. S. Watson, Senior Fellow in Statistics, on appointment as Associate Professor of Mathematics in the University of Toronto.

One Fellow, Dr. E. J. Hannan, resigned on his appointment to the Chair of Statistics at the Canberra University College, while another, Mr. D. B. Shenton, returned to the United Kingdom for family reasons.

Three Senior Research Fellows and three Research Fellows left the University at the expiry of their temporary appointments; two joined other Australian universities, one an American university and one a New Zealand university, while two joined the Commonwealth Public Service.

Study Leave.

The following members of the staff were on study leave for some part of the year:—

Professor A. Albert, Professor of Medical Chemistry,
Professor B. J. Bok, Professor of Astronomy,
Professor Sir John Eccles, Professor of Physiology,
Professor C. P. Fitzgerald, Professor of Far Eastern History,
Dr. S. Fazekas de St. Groth, Reader in Virology,
Mr. J. N. Jennings, Reader in Geomorphology,
Mr. F. Scarf, Reader in Radiochemistry,
Mr. H. J. M. Abraham, Head of the Time Service,
Lord Lindsay of Birker, Senior Fellow in International Relations,
Dr. G. S. Watson, Senior Fellow in Statistics,
Dr. W. Buscombe, Fellow in Astronomy,
Dr. J. H. Carver, Fellow in Nuclear Physics,
Mr. K. Gottlieb, Research Engineer in Astronomy,
Dr. E. K. Inall, Fellow in Particle Physics,
Dr. Germaine A. Joplin, Fellow in Geophysics,
Dr. C. A. Price, Fellow in Demography.

John Curtin School of Medical Research.

The Department of Biochemistry has continued with work along lines established during previous years. In the main this is concerned with special aspects of muscle metabolism, particularly those concerned with the metabolism of phosphorous and guanidine derivatives—chemical studies both synthetic and degradative are also being carried out on these compounds; with several aspects of folic acid metabolism including its role in the metabolism of methyl groups; with the biosynthesis of peptide trends in bacterial systems and the metabolism of certain amino-acids.

The work of the Department of Experimental Pathology has dealt with the mechanisms concerned with the changes in blood pressure observed during pregnancy in hypertensive rats. The activities of the department have been further extended to include investigations into cellular mechanisms of defence against infectious disease and into other aspects of cardiovascular disease, especially the aetiology of atherosclerosis. In this regard, experiments concerning the role of lipid transport and metabolism and the functional significance of the lymphatic system have been initiated.

The Department of Medical Chemistry continued its investigation of the organic and physical chemistry of important cell constituents. These ranged from pyrimidines and purines (vital building blocks of the nucleic acids) to pteridines (which intimately govern cell multiplication and hence are of interest in the cancer problem), to the binding of heavy metal ions by cell constituents, and to the tautomerism of heterocyclic amides and mercaptans and drugs derived from these.

In the Department of Microbiology there have been two major developments during the year. It has been found that poxviruses inactivated by heating can be reactivated by the simultaneous entry of living poxviruses into the same cell. This discovery may lead to the elucidation of the earliest stages of virus infection, just after entry of the particle into the cell. In addition a research team has developed the theory of the neutralization of animal viruses by antibody and has devised an expression for the neutralizing potency (pN) of antisera which is independent of the test system used, and is a compound measure of concentration and " activity " of specific antibodies.

In the Department of Physiology research work is in progress in the following fields:—

(i) Biophysical properties of nerve cells and on the nature of the synaptic excitatory and inhibitory action thereon.
(ii) The pathways and organization of nerve cells in the spinal cord.
(iii) Behaviour of nerve cells under the pathological conditions induced by various surgical procedures.
(iv) Pharmacological investigations on the central nervous system.
(v) The transmission mechanism at the neuro-muscular junction.
(vi) Synaptic excitatory and inhibitory transmitters in the central nervous system.
(vii) The manner in which motor nerve cells control the contraction speeds of the muscles they innervate.
(viii) The electrical responses of the primary afferent fibres in the spinal cord.

The Inorganic Chemistry Unit has prepared a large number of complex metal compounds and commenced the detailed study of their effects in biological systems in conjunction with the Departments of Physiology and Bacteriology of the University of Melbourne.

Research School of Physical Sciences.

The Department of Astronomy at Mount Stromlo Observatory is continuing its research on the Southern Milky Way, stressing in particular studies of the spiral structure of our galaxy; the cataloguing of southern galactic star clusters and emission nebulae; and problems of spectral classification. Good progress has been made with the researches on the Magellanic Clouds. The construction of a large Coude Spectograph is well in hand and the instrument is expected to be in operation on the 74-inch Reflector by the middle of 1959. The Observatory maintains and operates the National Time Service. During 1958 the search for a site for a Field Station for Mount Stromlo Observatory was begun in earnest and routine night tests of cloudiness and sky transparency were initiated at four locations in New South Wales and one in Victoria. At Mount Stromolo only one out of every four nights is of the excellence required for modern astronomical work. A site is needed for a Field Station with preferably twice as many clear nights as Mount Stromlo.

The Department of Geophysics has established a seismological station near Mount Stromlo. It is also processing records from other stations in the Snowy Mountains region in order to locate local earth tremors. Australia-wide surveys of the rate of flow of heat from the earth and of the direction of the earth's magnetic field throughout geological time are in progress. Work on petrology, meteorites, and the deformation of rocks at high pressures continues.

In the Department of Nuclear Physics the experiment to study the capture radiation from $B^{11}(p, \gamma)C^{12}$ mentioned in last year's report has been completed. It was carried out in collaboration with members of the Department of Particle Physics using the 8 MeV cyclotron before this was dismantled and moved to its new site.

Monochromatic Radiation—work has continued using the new thin crystal technique, in which the scintillating crystal itself is used both as target and detector. Following publication of the work on sodium iodide, spectra have been obtained with potassium, caesium and lithium iodide crystals. Some bromide crystals have also been used successfully. The Department is now able to state with reasonable confidence that a 12 MeV tandem electrostatic generator will be installed in Canberra by early 1961.

In the Department of Particle Physics substantial progress has been made with the Proton-Synchroton, and the homopolar generator should be tested within the coming year. The erection of the orbital magnet will shortly be begun. Further work has been carried out, using the 8 MeV Proton Injection Cyclotron, on the use of defining slits near the ion source and on vertical bars attached to the dee and dummy dee, to provide focussing near the ion source and to give accurately defined internal beams.

In the Department of Radiochemistry geochemical studies on Australian rocks have continued. Progress has been maintained in the fields of electrochemistry and nuclear chemistry.

The Department of Theoretical Physics continued calculations on mathematical models of the nucleus. New work started on the classification of the " strange " elementary particles and on the behaviour of gases at very high temperatures.

Research School of Social Sciences.

The Department of Demography continued its studies of post-war immigration and commenced a new project relating to British immigrants. The two other main fields of work were the growth and structure of the Australian population and further studies of the Pacific Islands.

The Department of Economics' central interest is in processes of economic growth and economic fluctuation. Research work is carried on within three sections of the Department. In economic statistics work continues on problems of social accounting, economic forecasting and the analysis of statistics of employment and unemployment. Research in economics continues in the theory of international trade and theoretical and statistical work on consumer demand; theoretical models of capital accumulation and economic growth; the Australian capital market; and studies of productivity, investment and the work force. In economic history, work on the growth of the Australian economy since 1860 has concentrated on three main lines, in studies of institutions, industries and aggregate economic development. The Department also made substantial progress in assembling a collection of basic research material under the care of Business Archives.

In the Department of History, while the emphasis continues to be on Australian political and social history, the programme is being extended to include the history of other Commonwealth countries.

In the Department of Law, work was continued on Australian constitutional and administrative law and on various aspects of private law and legal theory.

During 1958, pursuant to a decision of the Council, the Department of Political Science and the Department of International Relations were combined as a temporary arrangement. The major research activities have been a study of the 1958 Commonwealth election campaign and a study of the origins and functioning of the South-East Asia Treaty Organization. Extensive research has been undertaken in connexion with the Prime Minister's Committee of Enquiry into Commonwealth Public Service Recruitment.

In the Department of Social Philosophy, Professor J. A. Passmore was appointed Professor of Philosophy. On the more purely philosophical side work continued in methodological problems and on the history of ideas; on the side of social theory the emphasis was on legal sociology and on the conception of political freedom.

The Department of Statistics worked on a variety of problems making contributions to statistical and genetical theory, and helped other departments with advice on statistical analysis.

Research School of Pacific Studies.

Professor J. A. Barnes assumed his duties as head of the Department of Anthropology and Sociology. Fieldwork was carried on in social anthropology, archaeology and linguistics at various localities in New Guinea, Australia, India, Sarawak, and the New Hebrides.

The Department of Far Eastern History in which the study of the history of China has by now become firmly established, has taken an important step towards the development of Japanese historical research along similar lines through the appointment of two new staff members, who between them are able to contribute to our knowledge of the development of Japanese cultural and social institutions from the Togugawa period until the present day.

The Department of Geography has extended its work in the Pacific and tropical Australia during the year and members of the Department have worked in Fiji, New Guinea and the Cape York Peninsula. Meanwhile work in coastal and limestone geomorphology has continued in south-eastern Australia. A new departure is a study in transport geography in southern New South Wales, and work on various aspects of agrarian geography in south-eastern Australia has continued.

The Department of Pacific History has been engaged in the study of government and related institutions, and in the study of the economic development and history of the islands of the Central Pacific, Papua-New Guinea, India and Malaysia. Study is also proceeding on the administration of Australian archives.

Financial.

Statements of accounts are attached.

A sum of £3,111 was granted to the University by the Commonwealth Scientific and Industrial Research Organization for research in Biological Inorganic Chemistry. Bayer Pharma Pty. Ltd. made a grant of £105 as a contribution towards the work of the Medical Chemistry Department. The Wool Research Fund made a grant of £10,218 to cover the running expenses of the research on myxomatosis. Rockefeller Foundation of America granted a sum of £222 towards laboratory expenses in the Department of Physiology, and $30,000 to be spent over five years in the Department of Microbiology.

A sum of £5,800 was granted to the University by General Motors-Holden's Ltd. for the award of three Post-graduate Research Fellowships and the Australian Atomic Energy Commission made £1,086 available for the award of a Post-graduate Scholarship.

The Commonwealth Engineering Co. Ltd. continued its support of the work being done by the Nuclear Physics Department with a grant of £500.

The Department of Immigration donated £2,370 to enable the Department of Demography to undertake a research project concerning various short-term problems bearing on immigration, and the Nuffield Foundation continued its support for research on post-war immigration to Australia with a grant of £2,475.

Visiting Research Workers and Visitors.

A list of visitors during 1958 is given on page 8.

Statistics.

The statistical tables furnished to the Commonwealth in respect of the University's operations in 1958 are given on pages 69-74.

The Research Schools, University House, the Library.

Full reports from the Research Schools, from University House and the Library are appended overleaf.

H. C. COOMBS, Deputy Chairman.

VISITING RESEARCH WORKERS.

The university was glad to afford facilities for the work of the following overseas research workers:—

Dr. Terrine K. Adler, University of California.
Prof. Leonard Broom, University of California.
Dr. A. J. Buller, Sherrington School of Physiology, St. Thomas's Hospital, London.
Prof. G. S. Graham, University College, London.
Dr. J. A. Hempel, University of Hamburg and State Migration Office, Brisbane.
Dr. C. F. Howell, California Institute of Technology.
Dr. Hugh Johnson, State University of Iowa.
Dr. K. Krnjevic, University of Edinburgh and University of Washington.
Dr. Keyes Metcalfe, formerly of Harvard University Library.
Dr. David C. Peaslee, Purdue University.
Dr. Marjorie Sweeting, St. Hugh's College, Oxford.
Dr. W. G. Tifft, California Institute of Technology.
Dr. H. Valentin, Free University of Berlin.
Dr. Bengt Westerlund, Uppsala, Sweden.
Dr. J. R. Williams, University of West Virginia.
Dr. F. B. Wood, University of Pennsylvania.

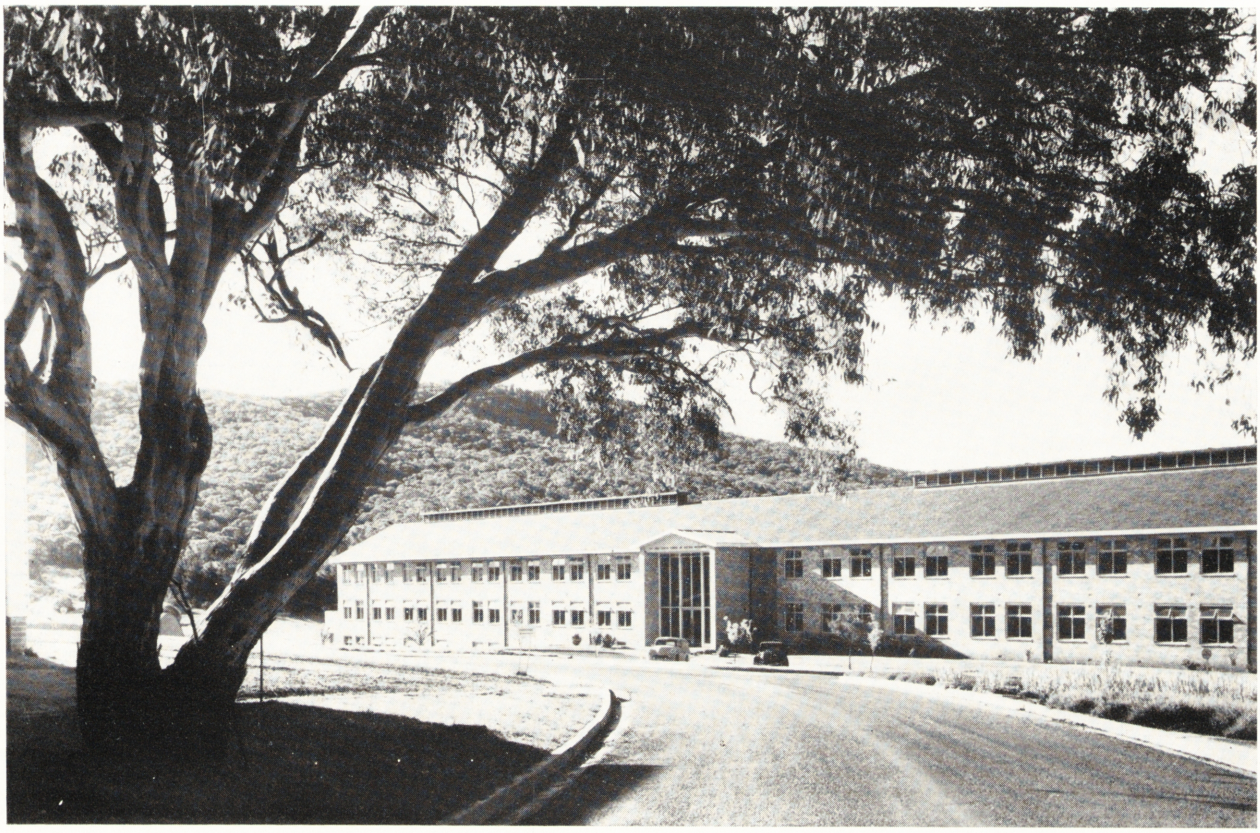
VISITORS.

During the year the University was honoured by the visit of—

The Rt. Hon. Harold Macmillan, Prime Minister of the United Kingdom.

Among other overseas visitors to the University were—

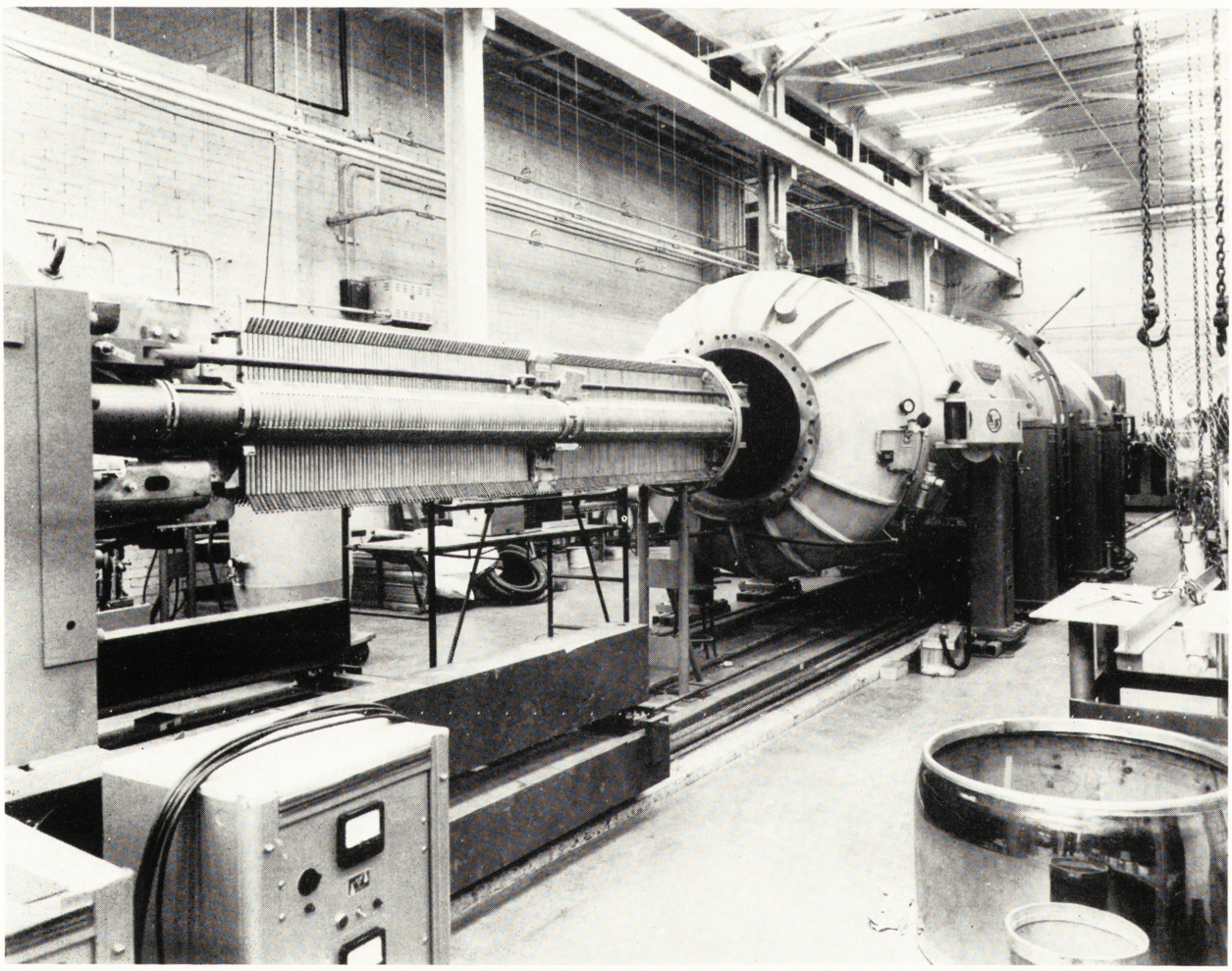
Mr. K. Ambagoakar, Deputy Governor of Reserve Bank of India.
Mr. L. J. F. Brimble, Editor of " Nature ".
Prof. J. M. S. Careless, University of Toronto.
Dr. Tara Chand, The Council of States, New Delhi, former V.C. of Allahabad University.
Sir Alexander Fleck, Chairman, I.C.I. Ltd.
Prof. Sir Howard Florey, Professor of Pathology, Oxford University.
Prof. H. H. Gaddum, Professor of Pharmacology, University of Edinburgh.
Prof. Iizuki, Director of the Toyobunka Kenyujo, University of Tokyo.
Mr. H. V. R. Iangar, Governor of Reserve Bank of India.
Japanese Parliamentary Delegation.
Mr. Kingsley Martin, Editor of " New Statesman and Nation ".
Mr. Tibor Meray, Hungarian Writers' Union.
Prof. R. S. Milne, Victoria University of Wellington.
Sir Steven Runciman, formerly Waynflete Lecturer, Magdalen College, Oxford.
Dr. E. L. Ryerson, Inland Steel Company, Chicago.
Prof. R. R. Wilson, Duke University, Commonwealth Studies Center.
Sir Walter Worboys, Director, I.C.I. Ltd.



The John Curtin School of Medical Research.

The New Geophysics Rock Mechanics Laboratory.

Facing page 8.]



10-12 MeV Tandem Electrostatic Generator—a model similar to one shortly to be installed at the Australian National University.

THE JOHN CURTIN SCHOOL OF MEDICAL RESEARCH.

DEAN'S REMARKS.

The School was officially opened on 27th March by Sir Howard Florey, F.R.S., in the presence of the Prime Minister, the Rt. Hon. R. G. Menzies, C.H., Q.C., and this occasion is referred to elsewhere. It is, however, relevant to record here our appreciation of the interest shown by guests and visitors in the subsequent demonstration of the work and facilities of all departments.

It is a pleasure to record that Sir John Eccles was created a Knight Bachelor in the Queen's Birthday Honours List and that Professor Fenner and Professor Albert have been elected Fellows of the Royal Society and of the Australian Academy of Science respectively.

There have been some slight increases in the staff of certain departments but the most significant developments have been in the Department of Experimental Pathology and in the creation of a Department of Physical Biochemistry.

Dr. F. C. Courtice, F.A.A., who was formerly the Director of the Kanematsu Institute of Pathology, Royal Sydney Hospital, was appointed to the Chair of Experimental Pathology and will continue to develop his own research interests in problems of lymph flow and cardio-vascular disease.

The inauguration of a Department of Physical Biochemistry deserves special mention, particularly as the ramifications and importance of what is a very young discipline are not generally appreciated. The rather rapid and quite striking advances in the knowledge of biological processes over the past 50 years or so have made it abundantly clear that maintenance of the tempo can only be achieved by an increased regard for the physical side of biological problems as distinct from the purely biological and chemical aspects. Physical phenomena are involved in virus infections, in transmission of nervous impulses, in enzyme-substrate interrelations, in the passage of substances across living membranes and in many other phenomena. The study of such topics has been the genesis of what is now known as Physical Biochemistry and the subject has made great strides over the past decade or so. The importance of the subject in modern research was such as to stimulate the School to seek Council's approval for an additional Department and to negotiate for a senior appointment. In the latter the School has been singularly successful and Dr. A. G. Ogston, F.R.S., Reader in Biochemistry, University of Oxford, has been appointed. Dr. Ogston is well known for his contributions in this field and was able to visit Canberra for a short time in December of the present year and to plan the design of his Department. In addition it was possible to complete the initial arrangements for the purchase of equipment to be obtained when the laboratory facilities are completed. By virtue of his commitments in Oxford, Dr. Ogston will be unable to come to Canberra until 1960, but it is hoped to make a senior appointment to the Department so that active research can be initiated under Dr. Ogston's direction and before his arrival.

Arrangements which were initiated in 1956 have resulted in the appointment (for five years) of Dr. F. P. Dwyer, formerly Senior Lecturer in the Department of Chemistry, University of Sydney, as a Visiting Reader in charge of the Unit of Biological Inorganic Chemistry. Approximately one-half of the expenses of this Unit are borne by the Commonwealth Scientific and Industrial Research Organization.

One particularly satisfactory outcome of the occupation of the new building has been the opportunity for expanding the numbers of students and visiting research workers—both have increased appreciably and in the former group, are now nearing maximum levels in at least three Departments (Biochemistry, Microbiology and Physiology).

DEPARTMENT OF BIOCHEMISTRY.

Staff.

Professor	A. H. Ennor, D.Sc., F.A.A.
Fellows	R. L. Blakley, M.Sc., Ph.D. W. H. Elliott, M.A., Ph.D. J. F. Morrison, B.Sc., D.Phil. H. Rosenberg, B.Sc., Ph.D.
Senior Research Fellow	F. D. Collins, M.Sc., Ph.D. (resigned 31st August, 1958).
Research Fellows	Margaret Briggs, B.Sc. D. I. Magrath, M.Sc., Ph.D.
Head Technician	R. Adams.

Student and Teaching Activities.

Mr. D. E. Griffiths, B.Sc., completed his course for Ph.D. and successfully submitted his thesis.

There are six students: M. D. Doherty, B.Sc. (commenced 21st October, 1957) and I. M. Beatty, B.Sc. (commenced 4th March, 1958), who are engaged on research into the biochemistry and chemistry of the substituted guanidines; V. Whittaker, M.B., B.S. (commenced 4th March, 1957) and B. McDougall, M.Sc (commenced 3rd March, 1958), who are working on the in vitro synthesis of thymidine; R. Porra, B.Sc. (commenced 16th June, 1958), who is working on biochemical problems associated with haem proteins, and G. Coleman, B.Sc. (commenced 3rd January, 1958), who is working on protein synthesis in bacteria.

Regular departmental seminars have been held at fortnightly intervals and there have been weekly meetings of the journal club.

Research Programme.

The study of the N-phosphorylated guanidines and the enzymes associated with these compounds has been continued. The experience accumulated in this field has suggested a theory of phosphoryl group transfer (Morrison, Ennor and Griffiths) which is believed to explain the general nature of the reactions involved. Studies (Rosenberg) have been made on the nature of the guanidines present in liver tissue and it has been shown that six such substances are present, although five occur in trace amounts only.

Previous reports have referred to a considerable body of work which has been completed and published and which relates to the enzymes concerned in the transfer of the phosphoryl group from an N-phosphorylated guanidine to adenosine diphosphate, to yield the triphosphate and the free guanidine derivative. Such enzymes have a high degree of specificity. Russian reports on the phosphorylation of ribonucleic acid by N-phosphorylcreatine were therefore of interest and indicated the possibility of additional roles for both ribonucleic acid and the phosphagen. Unfortunately, however, in spite of a very intensive effort (Rosenberg), the Russian results could not be confirmed.

Additional roles for N-phosphorylcreatine are indicated by other results (Morrison, Doherty). Extracts of rabbit muscle catalyse the release of creatine from N-phosphoryl creatine in the presence of diphosphopyridine nucleotide (DPN). Three enzyme components appear to be involved and two have been identified as myokinase and creatine phosphoryltransferase. The third component slowly hydrolyses DPN but it is not clear whether the product is involved in the reaction. If this should prove to be the case, the results will be of some importance in the general field of muscle biochemistry.

The research programme concerned with the synthesis of lombricine (serine-guanidinoethanol-phosphodiester) was discussed earlier (1957 report). The DL- and L-forms of lombricine have now been successfully synthesized (Magrath and Beatty) for the first time and have been compared with the naturally occurring compound which has been isolated in good yield from earthworms (Ennor, Rosenberg). The compounds differ only in their infra red spectra (measured by Dr. Spinner, Department of Medical Chemistry), and optical activity, and the present indication is that the seryl moiety of natural lombricine is of the D-configuration. More information is being sought on this point but if the present indications are confirmed this will be the first occasion on which a D-isomeric form of an amino acid has been found in animal tissue. The successful synthesis of lombricine involved guanylation of seryl-aminoethylphosphodiester (SAEP) and in the course of the work it was found (Magrath and Beatty) that both compounds were readily hydrolyzed in slightly alkaline solution pH 9) in the presence of copper ions. This reaction, which was unexpected, is now being investigated in detail—the information gained may well throw some light on the stability of phosphate esters in general and on the biological role of metals. The reaction may also be of some value in studies of lecthin, which is one of the few compounds known to possess the O-phosphodiester linkage.

The phosphagen, N-phosphoryl lombricine, has also been synthesized (Magrath) by a route involving the preparation of *N*-phosphoryl *O*-methyl *iso*urea and the reaction of this with SAEP to yield the desired product. The yields, however, were rather low and although this approach may be of value in the synthesis of other types of phosphagens (N-phosphoryltaurocyamine and N-phosphorylguanidinoethyl-phosphate have also been prepared) it involves the long and tedious preparation of SAEP. Another synthetic approach has been developed (Magrath) and shows considerable promise. This involves the condensation of *N*-dibenzylphosphoryl guanidinoethyl-benzyl-phosphochloridate with benzyl *N*-carbobenzoxyserine and subsequent removal of the protecting groups to give N-phosphoryl lombricine directly. In this reaction the dibenzylphosphoryl residue serves not only as a protection for the guanidino group throughout the reactions, but also as a stable precursor of the N-phosphoryl group in the phosphagen.

There is no information at present as to the biological origin of lombricine but the postulate that SAEP may be the precursor (Ennor, Morrison) has received some confirmation as a result of the isolation of this compound from earthworms (Ennor, Rosenberg). Additional interest in this isolation is lent by the fact that this is only the second occasion on which SAEP has been found in nature.

Work on the chemistry of the phospholipids has been suspended with Dr. Collins' transfer to the Department of Biochemistry, University of Melbourne, but since the last report considerable progress was made on the identification of the complex phospholipids.

In the previous report (1957) mention was made of the presence of an unidentified compound which was produced by Staphylococcus aureus in the presence of glycine, glucose and oxygen. This has now been identified (Elliott) as aminoacetone and has been shown to arise by two independent pathways; the first involves condensation of acetyl-CoA with glycine and the second oxidation of the β-OH group of threonine. Both of these reactions yield α-amino-β-keto-butyric acid, which is decarboxylated to form aminoacetone. This latter compound has been identified by a variety of means and its recognition has permitted a detailed study of the means by which it is synthesized. As a result the existence of a metabolic cycle for the oxidation of glycine and threonine has been postulated. Work at present in progress should determine the validity of this hypothesis which, if substantiated, will provide a rational explanation for the ease with which glycine is oxidized.

The ability of Bacillus subtilis to synthesize large quantities of extra-cellular amylase is well known and is now being used (Elliott, Coleman) for the study of protein synthesis. Growth conditions for maximum enzyme production have been defined and a synthesis of amylase in suspensions of washed organisms has been obtained. The properties of this system are being studied to gain information which will permit the use of cell-free systems.

Studies on the vitamin, folic acid, have continued (Blakley, Whittaker and McDougall). This compound, a pteridine, has a complex structure and is involved in a variety of important reactions in the body. One of these is linked with the ability of folic acid to react with formaldehyde to yield an " activated " product which can then be used, e.g. in the transformation of glycine to serine. The way in which formaldehyde is activated is now clear (Blakley)—folic acid is first hydrogenated to yield tetrahydrofolic acid, which then reacts reversibly, but non-enzymically, with formaldehyde. The product is then involved in reactions which are catalysed by different enzymes. The synthesis of thymidine is concerned with this product and is being studied (Blakley, Whittaker) in extracts of calf thymus. In this tissue thymidine is transformed into thymidylic acid but it is interesting to note that in bacteria (Blakley, McDougall) the primary product is the latter compound.

As has already been noted, work in the general field of electron microscopy has been associated with this Department for administrative purposes. The electron microscope (Miss Briggs) has been of great value in collaborative studies with the C.S.I.R.O. Division of Entymology and the Division of Plant Industry. With the former Division studies have been made on the five structures of the insect alimentary tract and on the insect transmitters of certain virus diseases. Detailed studies have also been made on the root nodules of the soya bean plant. Within the School the instrument has been used in making particle counts of vaccinia, myxoma and influenza viruses.

Other Activities.

Professor Ennor and Dr. Morrison visited the University of Queensland from 22nd to 26th September and 13th to 17th October respectively to give courses of lectures to final year and Honour students in the Department of Biochemistry. Professor Ennor also gave lectures to the Royal Australasian College of Physicians (in Melbourne) and most members of the Department presented papers on the occasion of the 3rd Annual General Meeting of the Australian Biochemical Society held in Adelaide on 18th to 20th August. Dr. Elliott and Miss Briggs also presented papers to Section N and Ia respectively at the A.N.Z.A.A.S. meeting which was also held in Adelaide, on 20th to 27th August.

Publications.

The following papers written by members of the staff were published during 1958:—

Bergeson, F. J.,* and Briggs, Margaret, J.—" Studies on the bacterial component of soya bean root nodules: cytology and organisation in the root tissue." *J. Gen. Microbiol.*, **19**.

Blakley, R. L.—" The reaction of formaldehyde with tetrahydrofolic acid and related compounds." *Aust. J. Sci.*, **21**, 115.

" The interaction of formaldehyde and tetrahydrofolic acid and its relation to the enzymic synthesis of serine." *Nature*, **182**, 1719.

" Hydropteridines and their biological role." P. 140 in *Current Trends in Heterocyclic Chemistry*, Butterworths Scientific Publications.

Collins, F. D.—" A complex phospholipid from sheep brain." *Aust. J. Sci.* **21**, 109.

" Complex phospholipids." *Nature* **182**, 865.

Collins, F. D., and Wheeldon, L. W.—" Studies on phospholipids. 4. The determination of ethanolamine and serine." *Biochem. J.* **70**, 46.

Elliott, W. H.—" A new threonine metabolite." *Biochem. biophys. Acta*, **29**, 446.
" A new amino compound and its biological formation." *Aust. J. Sci.*, **21**, 112.

Ennor, A. H., and Morrison, J. F.—" The biochemistry of the phosphagens and related guanidines." *Physiol. Rev.*, **38**, 631.
" N-Phosphoryl guanidines—their lability in acid solution and the effect of molybdate." *Aust. J. Sci.*, **21**, 120.

Morrison, J. F., Ennor, A. H., and Griffiths, D. E.—" Phosphagens and phosphoryl group transfer." *Proc. Internat. Sympos. Enzyme Chem.* I.U.B. symposium series, **2**, 113.
" The preparation of barium monophosphotaurocyamine." *Biochem., J.*, **68**, 447.

Wheeldon, L. W., and Collins, F. D.—" Studies on phospholipids. 3. The determination of choline in phospholipids." *Biochem. J.*, **70**, 43.

White, I. G.,* and Griffiths, D. E.—" Guanidines and phosphagens of semen." *Aust. J. exp. Biol.*, **36**, 97.

Whittaker, V. K., and Blakley, R. L.—" The biosynthesis of thymidine and thymidylic acid from uracil derivatives." *Aust. J. Sci.*, **21**, 115.

Theses.—During the year the following thesis was deposited in the library after examination for the degree shown:—

D. E. Griffiths for Ph.D.—" Invertebrate guanidine phosphoryltransferases."

Department of Experimental Pathology.

Staff.

Professor	F. C. Courtice, M.A., D.Phil., D.Sc., L.R.C.P., M.R.C.S., F.R.A.C.S., F.A.A.
Reader	G. B. Mackaness, M.B., B.S., M.A., D.Phil., D.C.P.
Senior Fellow	B. Morris, B.V.Sc., D.Phil. (appointed 1st September, 1958)
Senior Research Fellow	L. F. Dodson, M.B., B.S., D.Phil., D.C.P. (resigned 30th June, 1958)
Research Fellow	N. E. Stone, M.Sc., Ph.D.
Head Technician	J. Harding.

General.

Professor Courtice was appointed to the Chair of Experimental Pathology on 1st July and, with financial aid from the Rockefeller Foundation, made a tour of American and European Universities and medical research institutions before assuming his duties in Canberra in October.

Dr. L. F. Dodson resigned from the Department to take up an appointment as Director of the Commonwealth Biological Standards Laboratory in Canberra.

Mr. T. S. B. Robertson, a student working in the Department, was forced to give up his course owing to ill health.

Research Activities.

The investigation of the fall caused by pregnancy in the blood pressure of hypertensive rats has been continued. A theory that it is caused by development of the foetal kidneys has been re-investigated (Dodson). It was shown that the blood pressure continued to fall after surgical removal of all foetuses. The continued fall under these conditions was not due to surgical shock but to the presence of intact placentae, for when these were removed at the same time there was a prompt rise in blood pressure and a return of hypertension. Pregnant animals which had undergone operation for foetal ablation also showed the same refractoriness to the pressor action of renin which has been previously recorded to occur in unoperated pregnant rats.

Following last year's finding that the natriuretic response to renin is diminished in pregnant rats measurements have been made of glomerular filtration rate during a renin response (Mackaness). The results confirmed the finding of previous workers and showed that under our conditions of test natriuresis can occur in the absence of any change in glomerular filtration rate. This is the main evidence proving that natriuresis is independent of the vascular response and is due to a direct effect of hypertensin upon the renal tubule. Since pregnant rats shows a comparable loss of both natriuretic and pressor responses to renin it follows that the impaired response of pregnancy is not primarily a loss of vascular reactivity. This points to the existence of a defect in the renin-hypertensin reaction during pregnancy. Progress in the investigation of this defect has been made.

* Not a member of the Australian National University.

The renin substrate content of the blood of normal and pregnant rats has been measured (Mackaness). In the non-pregnant female rat it was found to be 0.58 ± 0.05 μg hypertensin equivalent per ml. of plasma. The corresponding value for the late pregnant animal was 0.26 ± 0.3 μg/ml. Whether this reduction in level is enough to account for all of the loss of responsiveness to renin is not known. It has been shown, however, that renin does in fact react with its substrate *in vivo* in the pregnant rat. This was demonstrated by measuring the hypertensinogen concentrations of the blood of normal and pregnant rats following standard injections of renin. In both cases renin injections caused substrate levels to fall. In some pregnant animals renin caused almost complete destruction of substrate without producing a detectable rise in blood pressure. Since pregnant rats respond normally to hypertensin it is likely that the fall in substrate level is largely responsible for the diminished response to renin during pregnancy. It remains to be found whether the same explanation can be given for the fall in blood pressure of hypertensive animals during pregnancy.

Further progress has been made in the purification of renin by N. E. Stone who has been a guest worker during the year in Professor W. S. Peart's laboratory at St. Mary's Hospital, London. The enzyme, partially purified by ethanol fractionation followed by chromatography on a cellulose ion-exchanger and on amberlite XE-97, gives a product which appears by starch gel electrophoresis to contain one or two protein impurities as well as renin. Preliminary experiments now suggest that electrophoresis on a column of ethanolysed cellulose may effect further, and possibly final purification.

An operation has been devised for long-term collection of lymph from the mammary gland of sheep (Morris). This will permit projected studies of fat transport in the mammary gland during lactation.

Publications.

The following paper was published during the year:—

Dodson, L. F.—"The relation of the foetal kidney to the fall in blood pressure of hypertensive rats during pregnancy." *Brit. J. Exp. Path.*, **39**, 405.

Department of Medical Chemistry.

Staff.

Professor	A. Albert, D.Sc., Ph.D., F.R.I.C., F.A.A.
Senior Fellow	D. J. Brown, Ph.D., M.Sc.
Senior Research Fellows	D. D. Perrin, Ph.D., M.Sc., F.R.I.C. E. Spinner, Ph.D., M.Sc.
Research Fellows	Joyce E. Fildes, Ph.D., M.Sc. R. J. Harrisson, Ph.D., M.Sc. F. Reich, Dr. rer. nat., Dipl. Chem.
Hon. Research Fellows	Terrine K. Adler, Ph.D., M.S. (Public Health Service Research Fellow, U.S.A.; returned to U.S.A. on June 26th, 1958.) C. F. Howell, Ph.D., B.S.; Fullbright Scholar. (From 5th October, 1958.)
Head Technician	E. P. S. Serjeant.

Student and Teaching Activities.

Mr. G. B. Barlin (Research student) was awarded a General Motors-Holden Fellowship. Mr. S. Matsuura (University of Nagoya) was enrolled for the Ph.D. degree (subject: The reduction of pteridines). Seminars were held in the Department at fortnightly intervals.

Research Programme.

Hydrogenated pteridines play an important role as coenzymes, e.g. in catalysing the incorporation of single-carbon intermediates into vital cell-constituents. However, little is yet known about the positions taken up by hydrogen atoms when pteridines are reduced, and the structural features which control stability are quite unknown. Hence a programme designed to reveal this information has been begun (Albert and Matsuura).

The work on 2-hydroxypteridine has revealed that the purple material formed by the action of acid differs from that formed by alkali. Some progress was made in assigning constitutions to these dimers, which are oxidized by air to dihydroxypteridines in alkaline solution (Albert and Reich).

The work on the tautomeric equilibria of the mercaptopyridines has been extended to mercapto-derivatives of quinoline, *iso*quinoline, pyrazine, pyrimidine and quinoxaline. The tendency for a hydrogen atom to leave sulphur for nitrogen is so strong that even in 3-mercaptopyridine where no isomer having doubly-bound sulphur is possible, no fewer than 500 molecules have hydrogen on nitrogen for every one with hydrogen on sulphur. This is a surprising discovery and quite contrary to what had been supposed in the literature (Albert and Barlin).

The constitutions of some adducts of 6-hydroxypteridine were investigated. The adduct formed with acetone was shown to be 7-acetonyl-6-hydroxy-7:8-dihydropteridine (Albert).

Four of the naphthiminazoles described in last year's report were submitted to Dr. I. Tamm of the Rockefeller Institute, N.Y. Dr. Tamm reported that both 1:2- and 2:3-naphthiminazoles inhibited the multiplication of Influenza B virus, and asked for further substances. A preliminary study of structure-action relationships suggested that the hitherto unknown 5:6:7:8-tetrahydro-2:3-naphthiminazoles may have this biological activity. Hence representative members have been synthesized and recently forwarded for testing (Brown and Harrisson).

After six years of intermittent attempts, the synthesis of 3-methyl-5-nitrocytosine has been achieved. This long-sought intermediate for purine and pteridine work, has enabled the structure of the methylation product of 2-hydroxypteridine to be finally established. From it, a number of 3-methylpurinones have been prepared for Prof. F. Bergmann (Jerusalem) to explore further his hypothesis of the mode of action of mammalian xanthine oxidase (Brown).

C-phenylsydnone was found to be a highly active inhibitor of mouse carcinoma by the Cancer Chemotherapy Center, Bethesda, U.S.A. The Center accordingly requested a larger quantity of the material, which was prepared (Brown) and sent for further tests.

Stability constants for the complexes of heavy metal ions with salicylic acid and its derivatives have been determined. These constants reveal the conditions under which complex formation could have possible biological significance, e.g. in their anti-arthritic and fungicidal applications (Perrin).

The oxidation-reduction potential of the ferrous and ferric complexes of α-amino-acids was found to vary linearly with the proton dissociation constants of the acids (Perrin).

The variation of oxidation-reduction potential in the presence of a complex-forming species has been shown, from theoretical considerations, to afford evidence of polynuclear complex formation. Potentiometric measurements have confirmed this correlation for the ferric complexes of aliphatic acids which were shown to form *trinuclear* hydroxyl-complexes. A method for estimating ferric iron has been based on the ready formation of this acetate complex (Perrin).

The infrared and Raman spectra of the hydrochlorides of urea, thiourea and acetamide reveal that the proton is attached to the nitrogen atom, and not to oxygen or sulphur as resonance theory would predict. The vibration-spectral evidence is that the C-N bonds in urea and acetamide are pure single bonds (Spinner).

The infrared spectra of mercapto-derivatives of 6-membered heteroaromatic rings show that the γ-isomers exist principally in the thiocarbonyl form in the solid state and in chloroform solution, as Albert and Barlin have shown for aqueous solutions. The α-isomers seem to be similarly constituted, Location of the highly controversial frequency of the thiocarbonyl group at about 1140 $cm.^{-1}$ has been confirmed (Spinner).

Study of the infrared and Raman spectra of hydroxypyridines and hydroxypyrimidines has confirmed previous work in the Department that the α- and γ-derivatives are mainly in the carbonyl-form. Less expectedly, the carbonyl-group has been found in the *cations* of these substances, and even more surprisingly in their *anions*. Thus, the proton and the negative charge are both located on a nitrogen atom contrary to the results predicted by resonance theory (Spinner).

The determination of nitrogen in heavy-metal organic complexes presents difficulties. A modification of the Dumas combustion procedure was sought, and, as a result, repeatable results can now be obtained in most cases (Fildes).

Two of the four possible *Bz*-azaindoles have been obtained and their ionization constants and spectra correlated with structure (Adler).

A project to obtain analogues of folic acid and its tetrahydro-derivatives to assist biochemical workers in this field has been begun (Howell).

Other Activities.

Drs. E. Spinner and F. Reich presented papers at the A.N.Z.A.A.S. meeting in Adelaide. Prof. A. Albert went abroad on study leave for six months commencing in April, 1958, and lectured in the following institutes:—Birkbeck College, Ciba Foundation, Guy's Hospital, London Hospital Medical School, University of Cambridge, University of Exeter, Gesellschaft der deutscher Chemiker (Hamburg), Harvard University Medical School, Yale University Medical School, National Institutes of Health (Bethesda), University of Illinois Medical School, University of California Medical Center.

During the year, the technical laboratory of the Department came into operation, and a number of intermediates, otherwise unobtainable, were manufactured on the kilogram scale.

The routine microanalytical service, under Dr. J. Fildes, completed 1100 requests for analyses on the 430 samples submitted in 1958. Of these 53 per cent. came from this Department, 40 per cent. from the Unit of Inorganic Chemistry and 7 per cent. from the Departments of Biochemistry and Physiology.

A number of routine determinations of ionization constants were made. Potentiometric evidence supporting the postulated structure of lombricine was obtained for the Department of Biochemistry (Perrin).

Publications.

During the year, the following work by members of the staff was published:—

Adler, T. A.—" Biotransformation products of ^{14}C-labelled codeine and morphine." *Current Trends in Heterocyclic Chemistry.* London: Butterworths; p. 151.

Albert, A.—" Addition to double-bonds in N-heteroaromatic six-membered rings." *Current Trends in Heterocyclic Chemistry.* London: Butterworths; p. 20.
" Metal-binding agents in chemotherapy: the activation of metals by chelation." *The Strategy of Chemotherapy.* Cambridge: The University Press; p. 112.
" Chemical aspects of selective toxicity." *Nature,* **182**, 421-3.

Albert, A., and Barlin, G. B.—" Quantitative studies of tautomerism in heterocyclic mercaptans." *Current Trends in Heterocyclic Chemistry.* London: Butterworths; p. 51.

Brown, D. J.—" Some 2-substituted linear naphthiminazoles." *J. chem. Soc.*, **401**, 1974.
" The linear naphthiminazoles." *Current Trends in Heterocyclic Chemistry.* London: Butterworths; p. 75.

Mason, S. F.—" The tautomerism of N-heteroaromatic hydroxy-compounds, Part III., Ionization constants." *J. chem. Soc.*, p. 674*.
" The infrared spectra of N-heteroaromatic systems, Part I., The porphins." *J. chem. Soc.*, p. 976*.
" The frequencies and intensities of the NH-stretching vibrations in primary amines." *J. chem. Soc.*, p. 3619*.

Perrin, D. D.—" The Ion, $Fe(CNS)_2^+$. Its association constant and absorption spectrum." *J. Amer. chem. Soc.*, **80**, 3852.
" Complex formation between ferric ion and glycine." *J. chem. Soc.*, p. 3120.
" A spectrophotometric study of some molybdenum thiocyanate complexes." *J. Amer. chem. Soc.*, **80**, 3540.
" The stability constant of the ferric glycine complex." *J. phys. Chem.*, **62**, 767.
" Stability of metal complexes with salicylic acid and related substances." *Nature,* **182**, 741.
" The stability of complexes of ferric ion and amino-acids." *J. chem. Soc.*, 3125.
" The effect of hydrolysis on the determination of stability constants of ferric complexes." *Aust. J. Chem.*, **11**, 612.

Spinner, E.—" The causes of secondary hydrogen isotope effects." *Chem. and Ind.*, p. 827.

Department of Microbiology.

Staff.

Professor	F. J. Fenner, M.B.E., M.D., D.T.M., F.A.A., F.R.S.
Reader in Virology	S. Fazekas de St. Groth, M.D., Sc.M. (appointed 8th August, 1958; formerly Senior Fellow).
Senior Fellow	H. J. F. Cairns, M.A., M.D. (appointed 11th July, 1958; formerly Senior Research Fellow).
Fellow	W. K. Joklik, M.Sc., D. Phil.
Research Fellows	I. D. Marshall, B.Ag.Sc., Ph.D. C. A. C. Mims, B.Sc., M.B., B.S. D. W. Howes, M.Sc. W. G. Laver, M.Sc., Ph.D. (appointed 15th September, 1958). G. M. Woodroofe, M.Sc. (appointed 1st December, 1958; formerly Research Assistant).
Departmental Assistants	Anne Gemmell, B.Sc. Norma Easterbrook, B.Sc. (appointed 18th December, 1958).
Head Technician	A. Logie, F.I.M.L.T.

* Work carried out in 1956.

Students and Teaching Activities.

The degree of Ph.D. was conferred on David Ogilvie White, M.B., B.S., on 9th May, 1958.

There were six research students enrolled for the Ph.D. degree and one for the degree of M.Sc.

K. J. Lafferty, B.Sc. (commenced 4th March, 1957) and J. Withell, B.Sc. (commenced 4th March, 1957) are working on the neutralization of viruses by antibody; K. Schell, D.V.M. (commenced 4th February, 1957) on the mechanism of innate resistance of mice to mousepox; R. Barry, B.V.Sc. (commenced 19th February, 1957) on the kinetics of the interference reaction with influenza virus; I. H. Holmes, B.Sc. (commenced 10th March, 1958) on the biochemistry of vaccinia virus infections; Miss P. Abel, M.Sc. (commenced 5th February, 1958) on the genetics of vaccinia virus and Mrs. A. Gemmell, B.Sc. (commenced 26th February, 1957) on variation in vaccinia virus.

Regular seminars were held each week during the lunch period, and fortnightly during the evenings.

It is with deep regret that we record the death of a research student, Mr. J. M. Rodrick, who was killed in an automobile accident on 5th May, while collecting rabbits for use in his investigations on the biochemistry of vaccinia virus infections.

Visits Abroad.

Dr. Fazekas de St. Groth spent the whole of the year abroad on study leave. He worked for six months at the Institut Pasteur, Paris, and then visited laboratories in Europe and U.S.A. His travel through the United States of America was assisted by a grant from the Carnegie Corporation.

Dr. Joklik spent three months on study leave in Europe, and participated in the 7th International Congress of Microbiology in Stockholm and the 4th International Congress of Biochemistry in Vienna, as well as visiting research laboratories.

Research Programme.

Studies in virus diseases are being carried out at all levels of complexity; the reaction of individual cells to infection, the response of cell populations, the pathogenesis of virus infections in intact animals, and the epidemiology and evolution of a naturally-occurring virus disease. During the last year much more extensive use has been made of tissue cultures for the analysis of problems of cell-virus interaction. Brief accounts of the work accomplished during the last year in each field follow.

Epidemiology of Myxomatosis (Marshall).

The evidence for the increasing resistance of wild rabbits to myxomatosis reported in previous years was obtained from experiments carried out under standard conditions in the Animal House. To relate these findings to the field situation, similar groups of rabbits were tested concurrently in large field enclosures and in the laboratory. It was found that recovery is even more frequent under natural conditions than under the controlled environment of the Animal House. This not only confirms the validity of our earlier conclusions as to the increase in the innate resistance of wild rabbits, but also suggests that some environmental factor can influence mortality. As the groups in the field were exposed to fairly high mid-summer temperatures, this factor seemed the most promising aspect to investigate.

In controlled experiments it was found that the mortality rate in infected rabbits is very much higher at low temperatures than at high, and the rabbits held at the usual mild temperatures of the Animal House suffer an intermediate mortality rate. The high and low temperatures were approximations of summer and winter conditions in Australia, and fluctuations were introduced to simulate natural variations between night and day. The sparing effect of sustained high temperatures has been reported by other workers, and this was thought to be due to the failure of the virus to proliferate under these conditions. Although this is almost certainly an important factor, present results suggest that a more fundamental reason might be the effect of temperature on the defence mechanism of the animal, and this aspect is being pursued at present.

The location of myxoma virus on the mosquito vector is being investigated by the titration of virus on the dissected mouth parts of individual infected mosquitoes at varying intervals after the acquisition feed. Although most virus is associated with the stylets, it can be found on the labium and in the head for several days, and there is some evidence of translocation between these parts. No evidence has been found of virus multiplication in the vector.

The examination of the virulence of strains of myxoma virus obtained in the field in Australia has been continued and, although strains of slightly reduced virulence are still dominant, an increased incidence of extremely attenuated strains is becoming evident.

Genetics of Vaccinia Virus (Fenner, Woodroofe, Gemmell, Abel).

Several aspects of the genetics of vaccinia virus have been studied, using the virus strains selected as a result of work carried out in previous years. An intensive study of the white variants of rabbitpox virus has shown that these are genetically different although sometimes phenotypically alike. Recombination analysis has allowed a start to be made on the construction of a genetic map of this virus.

Recombination between different strains of vaccinia virus has been shown to occur in isolated cells, and a detailed examination has been made of the yields from single cells.

A situation analogous to Berry-Dedrick " transformation " has been shown to occur with vaccinia virus. The more extensive genetic markers available with vaccinia virus have allowed a more penetrating analysis to be carried out, and preliminary results suggest that the initial phenomenon is the " activation " of the heat-killed virus. This promises to allow a study to be made of the earliest intracellular processes in virus infection of animal cells.

Biochemical Studies of Poxvirus Multiplication (Joklik, Laver, Holmes).

Studies on the incorporation of adenine into subcellular fractions of HeLa cells infected with vaccinia virus have been continued. The site of the increased amount of adenine incorporated by infected cells has been established as being ribonucleic acid of microsomes. Experiments were carried out to determine what proportion of cells became infected under the conditions used in these biochemical experiments; they involved estimation of the rate of absorption, infective centre counts and measurements of growth curves. It appears that well over 50 per cent. of the cells become infected.

Extensive large-scale isolation of five strains of poxviruses has been carried out and the purine-pyrimidine base composition of their nucleic acid is being studied by means of two-dimensional paper chromatography.

An investigation of the mechanism of the reactivation of inactivated poxviruses in cells supporting the multiplication of a related virus has been started. Methods of preparing virus suspensions active in this respect and assays for them have been worked out. The suspensions have been subjected to a variety of chemical and enzymic treatments in attempts to disrupt the virus particles into smaller units while at the same time preserving their ability to resume multiplication in infected cells.

Preliminary experiments have been carried out on the radioactive labelling of the nucleic acid of vaccinia virus.

Analysis of the Growth of Poxviruses in Experimental Animals (Mims, Schell).

Viruses are sometimes said to be " neurotropic " because after injection into the brain of an experimental animal they produce signs and symptoms of nervous involvement. Poxviruses have long been known to be neurotropic in this sense. The precise site of growth of virus (mousepox or rabbitpox) in a mouse's brain has recently been studied using the fluorescent microscopy technique. It has been found that these viruses grow only in the system of membranes (meninges) enclosing the brain and its blood vessels, and not at all in the nerve cells themselves. Such viruses are therefore not neurotropic in the way that poliomyelitis virus, for instance, is neurotropic, and mice die of acute meningitis rather than with encephelitis and paralysis.

The fluorescent microscopy technique, in which a thin section of an organ can be studied and the exact cells which support virus growth identified, has also been used to analyse the growth of poxviruses in the mouse liver. The relative roles of the cells lining the blood vessels of the liver, and the liver cells proper, have been evaluated, and some interesting observations made on the focal growth of viruses in the liver.

Work has been continued on the differences in the response of susceptible and resistant lines of mice to infection with mousepox. Contrary to expectation, the antibody response in the susceptible mice was better than in the resistant line, and it seems likely that the difference in resistance resides in differing cellular susceptibility. An examination of this by the use of tissue cultures has been commenced.

The Multiplication of Influenza Virus (Cairns, Barry).

A new approach has been made to the problem of the nature of those virus particles in any preparation of influenza virus which are incapable of causing infection. Influenza virus has been banded in a caesium chloride density gradient and it has been found that influenza virus behaves like a relatively homogeneous species, all the particles being contained within a single relatively narrow band. This implies that there is no major difference in composition between the infective and the non-infective particles.

Experiments designed to determine the nature of the interference reaction have demonstrated that it is exceedingly complex, and it is possible that a satisfactory system for the study of this reaction has yet to be found.

Work on the nature of incomplete virus formation has come to a temporary halt and awaits the completion of the study on the non-infective virus particle.

The Neutralization of Animal Viruses by Antisera (Fazekas, Lafferty, Withell).

This work was begun last year by Dr. Fazekas and has been continued in his absence by his research students, who have used influenza and vaccinia viruses. Their studies showed that the reaction between virus and antibody is a two-stage process. The first stage is reversible, all the virus activity being recovered on dilution of a neutral mixture. This reversible neutralization is not due to the presence of excess antibody in the assay system. The second stage is irreversible in the sense that all the virus activity is not recovered on dilution.

It was shown that irreversibly neutralized virus is not killed by antibody, for infectivity can be recovered by treating it with ultrasonic vibrations. These are capable of splitting the bond between the antibody molecule and the virus particle leaving the biological activity of both unaltered.

It was found that a small proportion of virus particles can be neutralized reversibly but not irreversibly; this corresponds to the " persistent fraction " of other workers. The persistent fraction is not an intrinsically different type of virus which cannot be neutralized, nor is it due to reactivation of virus on the tissue of the assay system. Rather it appears that this fraction of virus is in some protected state which prevents irreversible neutralization.

Growth of Polioviruses in Cultured Cells (Howes).

Studies of the growth cycle of Type 1 poliovirus in monkey kidney, HeLa and ERK cell suspensions have shown that virus production follows an approximately linear course for cell populations, beginning after a 4-hour eclipse period, and reaching completion between 10 and 12 hours after infection.

Virus release begins within an hour of the start of production, but occurs at a slower rate than virus production, so that the majority of the virus yield accumulates in association with the cells, and is not released until after virus production has apparently ceased. Cell associated virus cannot be neutralized by antibody, which suggests that it occupies an intracellular location.

Studies of virus release from single cells in microdrops suggests that although virus may be retained within a cell for many hours after production has ceased, it is then released over a short time interval.

Other workers have shown that cells which release virus during the early stages of virus production, release the normal amount of virus by a process likened to lysis. If much of the cell-associated virus present early in the cycle belongs to the majority of cells which release late, it follows that cells which release virus very early have produced their yield of mature virus over a very short time interval. This possibility is being investigated further.

Financial Support.

The Wool Research Fund made a grant of £10,511 to cover the running expenses of research on myxomatosis.

The Rockefeller Foundation made a grant of $30,000 available over a five-year period, for the purchase of equipment and supplies obtainable only in the United States of America.

Other Activities.

Professor Fenner gave the Listerian Oration to the South Australian Branch of the British Medical Association in April, and the opening address to a Rabbit Control Conference sponsored by C.S.I.R.O. in September.

Dr. Fazekas and Dr. Joklik gave papers at the 7th International Congress of Microbiology in Stockholm, and Dr. Joklik gave a paper at the 4th International Congress for Biochemistry in Vienna.

Professor Fenner, Dr. Mims, Dr. Marshall, Mr. Howes, Mr. Lafferty and Mr. Withell gave papers at the A.N.Z.A.A.S. meeting in Adelaide in August, 1958.

Publications.

The following papers written by members of the department were published during 1958:—

S. Fazekas de St. Groth and Doris M. Graham.—" The teratology of influenza viruses." VIIth International Congress for Microbiology, 1958. Abstract 13h.

S. Fazekas de St. Groth, D. M. Graham and I. Jack.*—" The serology of mumps infections. I. A new source of antigen and a simplified complement fixation test." *J. Lab. & Clin. Med.*, **51**, No. 6, 883.

S. Fazekas de St. Groth and I. D. Marshall.—" The infectivity of 'killed' influenza virus." VIIth International Congress for Microbiology, 1958. Abstract 16c.

S. Fazekas de St. Groth, and A. F. Reid.†—" The neutralization of animal viruses. II. A critical comparison of hypotheses." *J. Immunology*, **80**, No. 3, 225.

S. Fazekas de St. Groth, D. O. White.—" The dose-response relationship between influenza viruses and the surviving allantois." *J. Hyg.*, **56**, No. 4.

" Comparison of the infectivity of influenza viruses in two host systems: The allantois of intact eggs and surviving allantois-on-shell." *J. Hyg.*, **56**, No. 4.

" An improved assay for the infectivity of influenza viruses." *J. Hyg.*, **56**, No. 1, 151.

* Not a member of Australian National University staff. † Department of Radiochemistry.

S. Fazekas de St. Groth, J. Withell and K. J. Lafferty.—" An improved assay method for neutralizing antibodies against influenza viruses." *J. Hyg.*, **56**, No. 3, 415.
" The mechanism of virus antibody union." VIIth International Congress for Microbiology, 1958. Abstract 11h.

S. Fazekas de St. Groth, G. S. Watson* and A. F. Reid.†—" The neutralization of animal viruses. I. A model of virus-antibody interaction." *J. Immunology*, **80**, No. 3, 215.

Frank Fenner.—" The biological characters of several strains of vaccinia, cowpox and rabbitpox viruses." Virology, **5**, No. 3, 502.
" Listerian oration—' The seed and the soil: Host susceptibility in infectious diseases '". *Med. J. of Aust.*, **2**, No. 15, 477.

Frank Fenner and B. M. Comben.—" Genetic studies with mammalian poxviruses. I. Demonstration of recombination between two strains of vaccinia virus." Virology, **5**, No. 3, 530.

I. D. Marshall and Frank Fenner.—" Studies in the epidemiology of infectious myxomatosis of rabbits. V. Changes in the innate resistance of Australian wild rabbits exposed to myxomatosis." *J. Hyg.*, **56**, No. 2, 288.

Theses.

During the year the following thesis was deposited in the library after examination for the degree shown:—

D. O. White for Ph.D. " The behaviour of influenza virus in a new system of surviving cells."

Department of Physiology.

Staff.

Professor	Sir John Eccles, M.B., B.S., M.A., D.Phil., F.R.A.C.P., F.R.S.N.Z., F.A.A., F.R.S.
Reader	W. V. Macfarlane, M.D., M.A.
Fellows	J. S. Coombs, M.Sc. D. R. Curtis, M.B., B.S., Ph.D.
Research Fellows	Rosamond M. Eccles, M.Sc., Ph.D. J. C. Watkins, M.Sc., Ph.D.
Visiting Fellow	K. Krnjevic, M.B., Ch.B., Ph.D.
Royal Society and Nuffield Bursar . .	A. J. Buller, M.B., B.S., B.Sc.
Rockefeller Fellow	R. Miledi, M.D.
Head Technician	G. J. Winsbury, A.M.I.E.E., A.M.I.E.

Staff and Student Appointments.

Dr. W. V. Macfarlane formerly Professor of Physiology of the University of Queensland was appointed a Reader on 1st September. Dr. Miledi left on 29th January, Dr. Krnjevic on 19th November and Dr. Buller on 24th December. Mr. Phillis and Dr. Westerman commenced their scholarships on 6th January and 17th February respectively, and Dr. Hubbard on 5th November.

Research Activities.

Much of the work reported for 1957 was completed and written up in 1958 and appears in the appended list of published papers. Other previously reported work that has been completed and submitted for publication includes pharmacological investigations on inhibition (Curtis), biophysical investigations on the motoneurone (Coombs, Curtis and J. C. Eccles), the study of polysynaptic reflex actions of the slower types of muscle afferent fibres and of the effect of spinal cord section on these reflexes (R. M. Eccles and Lundberg), the prolonged depression that the severance of afferent nerves produces on the efficacy of their central synaptic action (J. C. Eccles, Krnjevic and Miledi), and the fatigue processes at the neuromuscular junction (Krnjevic and Miledi).

A new field of investigation has been opened up by studying the effect of nerve on the contraction properties of muscle. It has long been known that limb muscles are of two types: fast contracting muscles that are used for all quick movements such as jumping and running; and slow contracting muscles (about three times slower) that are used in the maintenance of postures such as standing. In the new-born animal all muscles are equally slow, but in the next few weeks differentiation occurs into the adult condition. As mentioned in last year's report it has been shown that fast and slow muscles are innervated by motoneurones that have appropriate properties, the fast muscles by motoneurones that can fire impulses at high frequencies and the slow muscles by low frequency motoneurones. By nerve cross-union experiments an unequivocal answer has been obtained to the question arising from this functionally appropriate relationship: Do the muscles determine the speed of their motoneurones or do the motoneurones effect the differentiation of the muscles? When a

* Department of Statistics. † Department of Radiochemistry.

nerve from fast motoneurones has been cross-unioned so as to innervate a slow muscle, it quickly changes the slow muscle to the fast type, and likewise slow motoneurones quickly convert fast muscles to slow. This change occurs just as effectively when the cross-union is performed in adult animals. A remotely possible explanation is that the frequency of impulses firing from the motoneurones is responsible for the differentiation of muscle function, fast rates of firing producing fast contracting muscles, and slow rates slow muscles. By operative procedures it is possible to prevent all impulse discharge from motoneurones and then, surprisingly enough, the cross-union of nerves no longer effects the change in muscle. All muscles preserve the speed of contraction they had before the impulses were cut off. They do not become very slow, as would be predicted on the above explanation. The most likely hypothesis appears to be that fast and slow motoneurones secrete from their nerve terminals specific substances that act on muscle fibres causing and maintaining the differentiation into fast and slow types, and the pumping action of muscle contractions is required to propel these substances along the whole length of the muscle fibres where they exert their action. This hypothesis as well as various other hypotheses are now being systematically investigated. After nerve cross-union there has been no detectable influence in the reverse direction, i.e. on the conduction velocity of motor nerve fibres or on the duration of after-hyperpolarization of motoneurones. (Buller, J. C. Eccles, and R. M. Eccles.)

Investigations have continued into the nature of the chemical substances responsible for the excitation and inhibition of spinal neurones. Various substances present in extracts of nervous tissue have been tested, as it is probable that transmitter agents would also be present in such extracts. These chemicals have been applied ionophoretically to the external surface of single cells within the spinal cord, the evoked responses being recorded either extracellularly, using one barrel of a multi-barrel electrode, or intracellularly by means of the central barrel of a co-axial electrode assembly. A wide range of amino acids has been investigated. Certain mono-amino mono-carboxylic acids have a depressant action upon interneurones, motoneurones and Renshaw cells, in contrast to the excitatory action that some mono-amino dicarboxylic acids have upon interneurones and motoneurones. Apart from the excitatory effect of acetylcholine upon Renshaw cells, centrally located nerve cells are not affected by substances such as adrenalin, noradrenalin, histamine and 5-hydroxytryptamine, which have known actions at peripheral synapses (Curtis, Phillis and Watkins).

By intracellular recording a detailed study has been made of the membrane potentials, the spike potentials and the slow after-potentials of the primary afferent fibres. The effects on these potentials both of polarizing currents and of conditioning by prolonged repetitive stimulation have been used in explaining the mechanism of production of the dorsal root potentials and of post-tetanic potentiation (J. C. Eccles and Krnjevic).

Related thereto has been an investigation of the intensity of both excitatory and inhibitory synaptic actions when the frequency of stimulation is varied over a wide range. The intensity decreased as the frequency was raised to about 10-20 a second, and then, unexpectedly, was found to increase again to a high level with further raising of the frequency. Presumably there is some process of mobilization of the synaptic transmitter substance (Curtis and J. C. Eccles).

The effects of use and disuse on synaptic function have been studied by methods that avoided the complications previously introduced by the procedures of causing disuse by cutting the afferent pathway. When a muscle was subjected to increased usage by denervating the synergic muscles, there was a significant increase in the monosynaptic reflexes produced by the stretch receptors of that muscle. Various attempts to produce a relative disuse of monosynaptic reflex pathways have so far failed to give any significant change relative to the control side (R. M. Eccles and Westerman).

The electrical responses of the isolated toad's spinal cord have been employed in the pharmacological testing of various substances that influence synaptic transmitter action in the spinal cord (Kiraly and Phillis).

Other Activities.

Five members of the department attended the A.N.Z.A.A.S. meeting in Adelaide and several papers were presented. Sir John Eccles was overseas from 29th August to 8th October, attending by invitation three international conferences at which four papers were contributed: First Conference of the Collegium Internationale Neuro-psycho-pharmacologicum in Rome from 8th to 16th September; a Conference on Molecular Biology at the Rockefeller Institute, New York, from 25th to 30th September; the second Conference of the Physico-Chemical Basis of Nerve Activity, at the New York Academy of Sciences from 2nd to 4th October. In addition Sir John Eccles gave lectures at the Karolinska Institute, Stockholm, the National Institutes of Health, Bethesda, U.S.A., and the Johns Hopkins Medical School, Baltimore. Dr. Rosamond Eccles was awarded a Lalor Fellowship and carried out research at the Woods Hole Marine Biology Laboratory, U.S.A., from June to September. She gave two lectures at Woods Hole and also presented a paper to the Physiological Society and lectured at the National Institutes of Health. Dr. J. H. Gaddum, F.R.S., formerly Professor of Pharmacology, Edinburgh University and now Director of the A.R.C. Institute of Animal Physiology, Babraham, paid a short visit in May. He gave two seminars, and one lecture " The Pharmacological Analysis of tissue extracts ". Several members of the Physiology Departments of the University of Melbourne and the University of Otago paid short visits to the department.

Publications.

During the year the following work by members of the staff was published:—

Brock, L. G.,* and Eccles, R. M.—" The membrane potentials during rest and activity of the ray electroplate." *J. Physiol.*, **142**, 251.

" The membrane potentials during rest and activity of the electroplate of Raia Clavata." *Biol. Bull.*, **115**, 330.

Buller, A. J.,* Eccles, J. C., and Eccles, R. M.—" Controlled differentiation of muscle." *J. Physiol.*, **143**, 23P.

Coombs, J. S., Eccles, J. C., and Fatt, P.—" Propriétés électriques de la membrane de surface d'un motoneurone." *Colloques Internationaux du Centre National de la Recherche scientifique*—No. **67**, 73.

" Nature due potentiel post-synaptique inhibiteur." *Colloques Internationaux du Centre National de la Recherche scientique.* No. **67**, 281.

Curtis, D. R., Eccles, J. C., and Lundberg, A.—" Intracellular recording from cells in Clarke's column." *Acta physiol. scand.*, **43**, 303.

Curtis, D. R., and Eccles, R. M.—" The excitation of Renshaw cells by pharmacological agents applied electrophoretically." *J. Physiol.*, **141**, 435.

" The effect of diffusion barrier upon the pharmacology of cells within the central nervous system." *J. Physiol.*, **141**, 446.

Curtis, D. R., Krnjevic, K., and Miledi, R.—" Crossed inhibition of sacral motoneurones." *J. Neurophysiol.*, **21**, 319.

Curtis, D. R., and Phillis, J. W.—" Gamma-Amino-*n*-Butyric acid and spinal synaptic transmission." *Nature*, **182**, 323.

Eccles, J. C.—" Some aspects of Sherrington's contribution to neurophysiology." *Notes and Records of the Royal Society of London.* **12**. 216.

" The behaviour of nerve cells." Ciba Symp. " Neurological Basis of Behaviour ", 28-47.

" Problems of plasticity and organization at simplest levels of mammalian central nervous system." *Perspectives in Biology and Medicine*, **1**, 379.

" The Physiology of imagination." Scientific American, **199**, 135.

Eccles, J. C., Eccles, R. M., and Lundberg, A. " The action potentials of the alpha motoneurones supplying fast and slow muscles." *J. Physiol.*, **142**, 275.

Eccles, J. C., and Jaeger, J. C.†—" The relationship between the mode of operation and the dimensions of the junctional regions at synapses and motor-end organs." *Proc. Roy. Soc. B*, **148**, 38.

Eccles, J. C., Libet, B., and Young, R. R.—" The behaviour of chromatolysed motoneurones studied by intracellular recording." *J. Physiol.*, **143**, 11.

Eccles, R. M., and Lundberg, A.—" Significance of supraspinal control of reflex actions by impulses in muscle afferents." *Experientia*, **14**, 197.

" The synaptic linkage of ' direct ' inhibition." *Acta physiol. scand.*, **43**, 204.

" Integrative pattern of Ia synaptic actions on motoneurones of hip and knee muscles." *J. Physiol*, **144**, 271.

Krnjevic, K., and Miledi, R.—" Motor units in the rat diaphragm." *J. Physiol.*, **140**, 427.

" Failure of neuromuscular propagation in rats." *J. Physiol.*, **140**, 440.

" Some effects produced by adrenaline upon neuromuscular propagation in rats." *J. Physiol.*, **141**, 291.

" Acetylcholine in mammalian neuromuscular transmission. *Nature*, **182**, 805.

Libet, B., Eccles, J. C., and Young, R. R.—" Responses of single chromatolyzed motoneurones." *Fed. Proc.*, **17**, 96.

Lundberg, A.—" Electrophysiology of salivary glands." *Physiol. Rev.*, **38**, 21.

UNIT OF BIOLOGICAL INORGANIC CHEMISTRY.

Staff.

Visiting Reader	. . F. P. Dwyer, D.Sc., F.R.A.C.I.
Research Fellow	. . A. M. Sargeson, B.Sc., Ph.D.
Honorary Research Assistant	. . J. W. Hogarth, B.Sc.

Students and Teaching.

Activities.

There are two students:—J. A. Broomhead, M.Sc. (commenced 1st March, 1958), who is working on the kinetics of racemisation and dissociation reactions; and F. L. Garvan, B.Sc., who is completing his research on the metal complexes of amino-polycarboxylic acids for the Ph.D. degree in the University of Sydney.

* Not a member of Australian National University staff. † Department of Geophysics.

Research Programme.

Broadly the group has been concerned with the fundamental chemistry and the preparation of complex metal compounds and their application to biological systems. The biological aspects of this work are being studied in the Department of Experimental Pathology, A.N.U., the Departments of Physiology and Bacteriology in the University of Melbourne, the Institute of Dental Research, Sydney, and the Division of Industrial Chemistry, C.S.I.R.O., Melbourne.

A re-examination of the " principle of stereospecific limitation ", first enunciated some 30 years ago, has been made on five distinct systems (Dwyer, Garvan, Sargeson). In general, it has been shown that the predominance of one optical isomer during the synthesis of metal complexes containing optically active groups is not nearly as great as predicted by the theory.

From considerations of the nature of the interaction forces involved, the estimated free-energy differences between isomers should be of the order of 1-2 Kcal. This value has been shown to be consistent with the equilibrium concentrations. Certain chelating agents such as *d*-1,2-propanediamine tetraacetic acid and *d*-cyclohexanediamine tetraacetic acid have been prepared and because of unique spatial features have been found to be completely stereospecific, producing only one optical isomer.

Metal complexes containing two different molecules (phenanthroline and bipyridine) have been prepared and separated into the optical isomers (Broomhead). The rates of racemisation suggest that the bond-breaking energy is concentrated in one molecule and not spread over all three.

A number of metal complexes containing, for example, iron and cobalt, have been found to possess pronounced effects in biological systems. The enzyme system responsible for the production of lactic acid in the mouth is inhibited by concentrations of one part in 10,000,000 of tris(5,6-dimethyl-1,-10-phenanthroline) iron sulphate. Bis(2,2,2″-terpyridine) ruthenium perchlorate acts as a powerful curare-like drug approximating, on a molar basis, the efficacy of curare itself. Some positively charged metal complexes have been found to inhibit the respiration of intact brain cells, and of the same nature has been the discovery of catalase activity by collaborators at the C.S.I.R.O.

Three groups of metal complexes have been tested for anti-bacterial activity with encouraging results. One class of substance similates the arsenical drugs by providing vacant or labile sites on the complex.

Attachment can then take place to sulphur or nitrogen atoms on the surface of protein. The *in vitro* screening tests have shown activity comparable to streptomycin with a number of gram positive organisms and also T.B. Nothing is known as yet about the toxicity of these substances or of their efficiency against organisms in living animals (Dwyer and collaborators at other institutions).

Tertiary amine oxides which occur in small amounts in animal and plant systems are known to undergo a rearrangement to the amine and formaldehyde in the presence of iron compounds. The conditions necessary for the reaction and the mechanism have now been elucidated. The reaction is not only characteristic of iron compounds but also occurs in the presence of other metals such as vanadium. The complex which causes the reaction must be capable of oxidation (E_0 = about — 1.0 volt), and must provide two vacant sites, one for the addition of the amine oxide and the other for the addition of water or hydroxyl (Dwyer and collaborators at Sydney University).

Other Activities.

The appointment of Dr. Dwyer to the Editorial Board of " Inorganic Syntheses ", New York, has necessitated the checking and correction of a number of synthetic methods (Hogarth and Reid). Dr. Dwyer gave three lectures at the University of Adelaide and the R. K. Murphy Lecture (1958) at the University of New South Wales.

Publications.

The following papers written by members of the unit were published during 1958:—

Dwyer, F. P., and Garvan, F. L.—" The resolution of the quinquidentate Cobalt (III) complexes with ethylenediaminetetraacetic acid." *J. Amer. Chem. Soc.*, **80**, 4480.

Sargeson, A. M., and Sasse,* W. H. F.—" The formation of a pyrrole derivative from pyridine under the influence of degassed Raney nickel." *J. Chem. Soc.*, **150**.

ANIMAL BREEDING ESTABLISHMENT.

Staff.

W. K. Whitten, B.Sc., B.V.Sc.

General.

During the year over 30,000 animals were issued and, after meeting the requirements of the School, some stock was supplied to other organizations.

* Not a member of the Australian National University.

Research Activities.

The effect of environmental factors on sexual periodicity of mice was further studied. Evidence has been obtained that a substance excreted by males modifies the oestrous cycle of females. Methods of assaying this substance and the female acceptor mechanism are being examined.

Publications.

Whitten, W. K.—" Endocrine studies on delayed implantation." *J. Endocrin,* **16**, 435.
" Modification of the oestrous cycle of the mouse by external stimuli associated with the male." *J. Endocrin,* **17**, 307.
" The occurrence of anoestrous in mice caged in groups." *J. Endocrin,* **18**, 102.

THE RESEARCH SCHOOL OF PHYSICAL SCIENCES.

DIRECTOR'S REMARKS.

During 1958 over 60 papers were published in journals of science in Australia and overseas and many technical and general articles were written for various periodicals.

The arrangements made in the summer of 1957-58 for the Department of Astronomy to provide an introduction to astronomy for a number of vacation students proved very successful and this summer Astronomy, Geophysics and Nuclear Physics are taking vacation students. Undergraduate students at the state universities are invited to apply for these opportunities to become acquainted with work in progress in the various departments. The hope is that some of the best of them will later become research students in this School.

Buildings.

The seismological observatory of the Department of Geophysics, near the Observatory, came into operation early in the year. A building to house rock-cutting equipment, a rock store, a workshop and to serve for the storage of field equipment for Geophysics, is nearing completion on the University site.

The new electronic, optical, and photographic workshop of the Department of Astronomy was completed and handed over to the Observatory at the end of the year.

Special Equipment.

The Government announced in September that it would meet the request of the University for a sum of £600,000 to provide a tandem electrostatic accelerator for use in the Department of Nuclear Physics. The sum will be spent over the next two years upon the equipment and building to house it. Acquisition of this apparatus will enable the precision work on nuclear spectroscopy, and low-energy nuclear physics generally, to be extended to heavier elements and some more informative techniques will become practicable.

Observatory Site Testing.

In the last report it was stressed that the amount of cloud cover at the Observatory at Mount Stromlo was considerably greater than was desirable. It was reported that a program of searching for a site for an out-station with better observing conditions was being pursued in collaboration with the Yale-Columbia Observatory.

During the past year the necessity for a better site has been emphasized by the prevalence of cloudy conditions over long periods. Unfortunately, the co-operation with Yale-Columbia Observatory has not eventuated and the site-testing programs of the two observatories are proceeding independently. Several promising areas, within reasonable distance of Canberra, have been inspected and arrangements have been made for continuous testing over an extended period.

Chemistry.

A review is being made of the development of chemistry within this School. Organic chemistry is well represented in several departments of the Medical School and in all other Australian universities. It seems desirable, therefore, in a School of Physical Sciences, that emphasis should be placed upon modern inorganic and physical chemistry, including geochemistry. Enquiries are proceeding and it is hoped that action can be taken in the coming year.

Staff.

Mr. F. Scarf will retire from his Readership in Radiochemistry in February, 1959.

Professor E. W. Titterton, Dr. G. Joplin, Mr. F. Scarf, Dr. J. H. Carver, Dr. P. B. Treacy, Professor Bart J. Bok, Dr. Buscombe, Mr. Abraham, Dr. E. K. Inall and Mr. Gottlieb were on study leave during part of the year.

Professor E. W. Titterton visited America in November to negotiate arrangements for manufacture of the tandem accelerator.

Professor Bok led the Australian delegation to the Tenth Congress of the International Astronomical Union in Moscow in August.

Professor Oliphant was leader of the Australian Delegation to the Second International Congress on the Peaceful Uses of Atomic Energy in Geneva. He was President of the Adelaide Congress of A.N.Z.A.A.S. in August and attended the second and third "Pugwash" International Congresses of scientists to consider the threat to humanity of the nuclear arms race and ways of diminishing this threat.

DEPARTMENT OF ASTRONOMY.

Staff.

Professor of Astronomy and Director of Observatory	Bart J. Bok, Ph.D.
Reader and Assistant Director . .	A. R. Hogg, D.Sc., F.Inst.P., F.A.A.
Readers	S. C. B. Gascoigne, M.Sc, Ph.D. T. Dunham Jr., Ph.D.
Head of Time Service	H. J. McK. Abraham, M.Sc.
Fellows	W. Buscombe, M.A., Ph.D. H. R. F. Gollnow, Dr.Phil. A. Przybylski, Dr.sc.tech., Ph.D.
Research Engineer	K. Gottlieb, Dip.Ing.
Research Fellow	A. W. Rodgers, Ph.D.
Research Assistant	G. Hagemann, Dr. rer.nat. (resigned 21.12.58).
Research Students	R. A. Bell, B.Sc. C. Campbell, B.Sc.(Hons.). J. B. Whiteoak, B.Sc.
Honorary Professor	R.v.d.R. Woolley, F.R.S., Astronomer Royal.

Dr. Hagemann has resigned as of 31st December, 1958, for reasons of health.

Mr. J. D. Balfe, Lecturer in Physics at the Royal Military College at Duntroon, is seconded ror a two-year period to act as a Scientific Officer in the Time Service.

Dr. B. E. Westerlund continued in residence as the Uppsala observer. In recognition of his valuable contributions to Mount Stromlo Observatory, he was appointed as Honorary Fellow of the A.N.U.

Mr. C. Jackson continued in residence as the Yale-Columbia observer.

Professor F. B. Wood of the University of Pennsylvania completed his year's work at Mount Stromlo Observatory under a Fulbright Award, and returned to the United States.

Two new American visitors arrived during 1958. Dr. W. G. Tifft of the California Institute of Technology, who is at Mount Stromlo with a Fellowship of the U.S. National Science Foundation, is a Visiting Research Fellow. Dr. H. M. Johnson, who is employed by the A.N.U. under a contract with the U.S. Office of Naval Research, is a Visiting Fellow. Dr. T. K. Menon visited the Observatory in October.

Instrumental Developments.

The 74-inch reflector has been in uninterrupted use during the year. The astigmatism in the primary mirror, to which reference was made in last year's Annual Report, has not yet been removed. The mirror will be sent to Grubb Parsons in Great Britain for refiguring as soon as a suitable temporary replacement mirror can be provided. The performance of the 74-inch reflector is excellent in every other respect. The mirror was aluminized in the course of the past year. The right wing of the observing carriage has been modified according to a plan not unlike that executed last year for the left wing.

The extensive mechanical and electrical work on the 50-inch Melbourne reflector has been completed. The telescope is at present fitted with an f/2 spherical mirror and Gregorian secondary and it is being used quite successfully for photoelectric research. The mirror system provides too small a field of good definition, and is therefore not satisfactory for work on faint stars, or for photographic research. A paraboloid 50-inch f/4 primary, with a secondary mirror, to provide an f/18 Cassegrain arrangement, is now on order from Grubb Parsons. It is intended to fit this combination with a Meinel field corrector so that in future the instrument should be capable of first-rate photoelectric, spectrographic and photographic research.

The 30-inch Reynolds reflector and the 20-inch Catts reflector have long been in need of a complete mechanical and electrical overhauling and it is hoped to begin this work in the course of 1959.

During 1958 a number of improvements were made on the 8-inch f/1 Schmidt camera; the instrument has been in continued operation throughout the year.

The Stromlo photographic zenith tube, constructed by Grubb Parsons, required considerable mechanical and electrical work before operating satisfactorily. Both the PZT and the 3-inch transit instrument are in full-time operation.

The installation and placing into operation of the Moon camera on the 9-inch Oddie refractor has not proved to be a simple matter; further work will need to be done before the camera can be said to be in full-time operation.

The Department continues to concentrate on provisions for first-rate auxiliary equipment for the telescopes. During 1958 full-scale work was begun on the coudé spectrograph for the 74-inch reflector, and is now well under way. Plans for modifications to the pier of the 74-inch building have now been completed and accepted, and construction is in progress. The new coudé housing will protrude northwards from the 74-inch building; the inside dimensions will be, width (east-west) 12 feet, length (north-south) 33 feet and height 29 feet. Approximately 200 cubic yards of rock are being removed. The Department of Works has designed modifications to the steel supporting structure of the dome, and has also completed the fabrication of the steel frame for the spectrograph.

The tests made by Dr. Gollnow with the Zeiss-Newtonian spectrograph for the 74-inch reflector have been completed and the spectrograph is suitable for precision radial velocity work. It provides notably high quality spectra for luminosity classification, but is slow by modern standards. There remains, therefore, urgent need of an efficient spectrograph to be employed on faint stars and nebulae. It is hoped that soon a relatively simple, fast, nebular spectrograph will be provided.

The Cassegrain spectrograph on the 30-inch Reynolds reflector is in continued use. Early in 1959 delivery is expected of a new collimator and camera objective for this instrument.

Photoelectric equipment is also being developed. An additional photometer head has been constructed and one of the existing heads is being modified. A new amplifier was constructed in the electronic workshop for use on the 74-inch reflector. Dr. Tifft brought with him from the United States of America a new refrigeration unit and amplifier, and has since tested various commercial amplifiers.

Buildings and Grounds.

The most important event of the year was the completion of the new electronic, optical and photographic workshop. All the workshops now have adequate housing and within budgetary limitations, every effort is being made to equip and furnish the new building.

In the course of the year, much work has been done on the maintenance and improvement of existing buildings and of staff housing. Considerable effort is being made to improve the condition of the roads on the Observatory site. The long access road to the top of Mount Stromlo has been widened and improved; all who live, work or visit Mount Stromlo hope fervently that the sealing of the improved road will not be long delayed

Additional office space is needed at Mount Stromlo. The best solution appears to be the construction of a building to contain a conference room, offices and the Time Service.

Student Activities.

1958 will be remembered as the year in which the Graduate School in Astronomy came actively into being. At the end of the year there were three scholars in residence and a fourth will arrive shortly. The aim is eventually to have at Mount Stromlo Observatory six scholars from Australian universities, and possibly one or two from abroad. One of the principal handicaps encountered in attempting to establish an Australian tradition of graduate education in astronomy is the absence of anything more than casual undergraduate training in the field at the major State Universities. While there is every prospect that the situation will be remedied shortly at three, and possibly four, State Universities, at present students with an adequate background in physics and mathematics, but without previous astronomical training are accepted here. To overcome this lack of undergraduate training, a two-year programme of seminars has been undertaken, which serve as an introduction to some of the major areas of astronomical research. Each senior member of the Observatory staff has taught at least one of these. The seminars consist of fairly formal lectures, each seminar meeting generally once a week, and at the end of each unit there is a written or an oral test.

One of the problems is to have a sufficiently large pool of potential scholars from which to make a final selection. The intimate contacts established with the Physics Departments of the several State universities are helpful in this respect, and the Observatory is benefitting greatly by the results of visits of its staff members to other universities. To supplement these activities a programme of summer vacation scholarships was initiated in 1957, aimed at bringing to Mount Stromlo Observatory each summer seven or eight undergraduates of promise, preferably at the end of their second or third year of undergraduate study. There was a very fine group of seven vacation scholars during the summer of 1957-58, and the Department is fortunate in its selection of eight, including one young woman, for the summer of 1958-59. Each Summer Vacation scholar is assigned to a staff member, and half his time is spent on work as directed by the staff member in charge. During the remainder of the time, the student is free to work as he wishes, to study or partake in night observing, or generally to profit in any way that is practicable by the facilities and personal contacts available at Mount Stromlo Observatory. A weekly colloquium series is organized especially for the summer vacation scholars; these special colloquia are given at the School of Physical Sciences seminar room in Canberra, so that other members of the University can attend.

The Site Testing Programme.

The available statistics for the twelve months of 1958 show that observations were made on 173 nights, and that cloud prevented observations on 186 nights. On many nights the observations were interrupted or stopped by clouds, and all told astronomical work was done during the twelve month period for a total of 1,217 hours. About two-thirds of this time was suitable for photoelectric work. The Observatory obviously needs a Field Station with better conditions for night work than at Mount Stromlo.

In last year's Annual Report, reference was made to the Yale-Columbia Site Testing Survey, and it was suggested that it was desirable to see the Stromlo Survey carried on in close collaboration with that of the Yale-Columbia group. This has not proved practicable, and collaboration has been limited at present to an exchange of information and reports; the survey is aimed solely at locating a good site for a Field Station for the Observatory.

The following factors, listed roughly in order of priority, have been considered in the search for potential sites:—

1. The site should have at least 50 per cent. more, and preferably twice as much, clear sky at night as Mount Stromlo Observatory. The sky conditions should be especially favourable from September to March, the season for observation of the Magellanic Clouds.
2. The site should be as far south as possible, preferably below latitude 30° South.
3. Preference is to be given to a relatively isolated hilltop or mountain range, not less than 800 feet above the surrounding plain.
4. Freedom from dust and bushfire smoke is an important factor.
5. The site should not be too isolated, if possible within 30 to 40 miles of a fair-sized town.
6. Sites within relatively easy driving distance of Canberra (6 to 10 hours) are to be given preference over more remote sites. A site within New South Wales would be desirable, to permit close future collaboration with Sydney University and the Radiophysics Laboratory of the C.S.I.R.O.

The above considerations have led to a concentration of effort during the past year principally on sites in New South Wales and Victoria, but sites in South Australia (Flinders Range) or Western Australia (to the north and east of Perth) will be considered if it can be shown that the New South Wales and Victorian sites are inferior.

The sites were chosen by parties of Mount Stromlo staff, with the aid and guidance of Mr. Harley Wood, the N.S.W. Government Astronomer. Local residents have willingly co-operated in the collection of meteorological data, including estimates of cloud cover, vertical visibility, stellar scintillation and wind force. A parallel set of observations from Mount Stromlo is being used for monitoring purposes.

The data are summarized below—

Site.	Altitude.		Access.	A.	AA.	AAA.	Total Nights.
	Above Sea Level.	Above Surroundings.		%	%	%	
Mount Ural, Lake Cargellico, New South Wales	1,810	1,000	fair ..	37	37	28	226
Mount Boona, near Condobolin, New South Wales	1,520	800	easy ..	48	47	20	204
Kadina Trig, near Alectown, New South Wales	2,391	1,000	reasonable	39	39	39	180
Mount Bingar, near Griffith, New South Wales	1,494	800	reasonable	54	49	46	207
Mount Arapiles, near Natimuk, Victoria ..	1,176	750	good ..	58	53	36	63
Mount Stromlo	2,560	700	..	28	23	20	226

("A" denotes cloudless nights; "AA" those without cloud or haze; "AAA" those without cloud, haze or marked scintillation. The final column shows the number of nights observed.)

In the course of 1959 several sites will be tested in earnest. Before the middle of March one of the five sites will be selected as the Head-quarters Site for seeing tests. The 20-inch Catts reflector will be mounted at the site (after renovation) and late in 1959 continued research and testing will be initiated with this instrument, the testing period to extend over at least eighteen months. Smaller instruments—notably the 5-inch Zeiss Camera—will also go to the site and a portable seismograph may be operated at the Head-quarters Site for the Department of Geophysics. Portable equipment will visit the other sites for intervals of about two weeks, and this equipment will be operated also at times at the Head-quarters Site, which should provide a sound basis for comparative studies of seeing conditions at the sites. In addition to the five sites in the above table, in all probability three mountain sites in New South Wales will also be tested.

For the time being it is not the intention to move major equipment from Mount Stromlo to the Field Station, but it is hoped to find the funds to erect a 40-inch reflector of modern design as a new first piece of equipment at the site.

Sydney University is expressing great interest in this site testing project in connexion with the establishment of a Field Station for its Department of Astronomy. The possibilities of a joint effort at the ultimate site for the Field Station are being examined, with, however, each group having its own equipment.

Research Activities.

Dr. Hogg has made a definitive reduction of his photoelectric measurements and colours of 244 bright stars. He is continuing his photometric studies of galactic star clusters by photoelectric and photographic means. He is preparing an atlas of southern galactic clusters, to include photographs with the 74-inch reflector of all clusters south of declination $-50°$. Two eclipsing binaries are being observed photoelectrically with the 50-inch reflector.

Dr. Gascoigne is continuing his researches on the Magellanic Clouds. He was appointed the first President of the newly created Sub-Commission on the Magellanic Clouds of the International Astronomical Union. The results of his photoelectric observations of cepheids are being prepared for publication. A preliminary account of this work was presented at the Joint Discussion on the Luminosity of Cepheids held during the Moscow meeting of the International Astronomical Union. Observations of fainter cepheids will be continued. Much preliminary work has been done on the Mount Stromlo-Uppsala Atlas of the Magellanic Clouds. The wide field photometer has been used throughout the year for the photometry of globular clusters. The search for variables in southern globular clusters is continuing.

Dr. Dunham has been extremely busy with the work on the coudé spectrograph for the 74-inch reflector. He is, in addition, the Observatory's principal advisor on optical problems. In preparation for his researches with the coudé spectrograph, he has made a general study of the distribution of interstellar calcium and sodium in our Galaxy, and work is continuing on an extensive card catalogue of southern stars.

Professor Bok, Mrs. J. M. Basinski and Mr. Gottlieb have completed a survey of optical features possibly related to discrete radio sources discovered by Mr. B. Y. Mills at the Radiophysics Laboratory of the C.S.I.R.O. in Sydney. A report on the work was presented at the International Symposium on Radioastronomy held in Paris in 1958. The programme of photoelectric photometry begun last year as a joint undertaking by Professor Bok and Dr. P. F. Bok is being brought to a conclusion. Measures of colours and magnitudes for O, B and A stars, and for certain cepheid variables are under way for the Large Magellanic Cloud and the Carina-Centaurus region. Supplementary photographic studies are being carried out in collaboration with Mrs. Basinski.

Dr. Gollnow, with Dr. Przybylski and Dr. Hagemann, continue their long range radial velocity programme. Jointly with Dr. Przybylski and Mr. J. B. Whiteoak, Dr. Gollnow is engaged upon a spectroscopic and photoelectric study of the Theta Carinae cluster.

Dr. Przybylski is working on a programme of spectral classification and photoelectric observations of 170 southern high velocity stars, and he is also giving attention to photometry and spectroscopic studies of two novae. He is rounding off his theoretical researches on model stellar atmospheres and he continues his work on artificial satellites.

Dr. Hagemann's major effort was in connexion with radial velocity measurements from plates made with the 30-inch Reynolds reflector. He has computed a spectroscopic orbit of Zeta Phoenicis; absolute values for the components were derived from a comparison with Dr. Hogg's photometric elements.

Dr. Buscombe has completed and published his finding list of southern stars of high velocity, a joint project with Miss P. M. Morris. He and Miss Morris co-ordinate activities in the field of spectral classification with the Zeiss-Newtonian spectrograph. At the Moscow meeting of the International Astronomical Union, Dr. Buscombe presented to Commission 30 a list of 89 radial velocities determined from measurements made on plates taken with the Cassegrain spectrograph on the 30-inch Reynolds reflector. Dr. Buscombe has completed an analysis of velocity residuals for the Cassegrain programme and he has also prepared a review article on subdwarf stars.

Dr. Rodgers has completed a research on three-colour photometry in the Southern Coalsack. He is also working on an H-alpha and comparison band survey with suitable colour filters of the southern Milky Way, using the 8-inch Schmidt camera and the Zeiss-Newtonian spectrograph on the 74-inch ref. One hundred new H II regions have been detected and listed; a catalogue for 168 H II regions has been distributed. The 8-inch Schmidt is also being used for surveys of known southern dwarf galaxies and for studies of the Magellanic Clouds. Uppsala Schmidst photographs have been searched for possible exciting stars of H II regions in the Milky Way. Spectra of 70 OB stars were photographed with the Zeiss-Newtonian spectrograph and slit spectra were also obtained for eight globular clusters. Work continues on an H-alpha atlas of the southern Milky Way.

The Uppsala observer, Dr. Westerlund, continues to work in close collaboration with the Mount Stromlo Staff members. Telescope time is exchanged with him whenever he wishes to use one of the instruments, and this has enabled Mount Stromlo Observatory staff to make effective use of the Uppsala telescope. Dr. Westerlund's presence at Mount Stromlo is very much appreciated by staff and students. His helpful participation in colloquia and group discussions and his advice with regard to observing programmes and their execution are proving a great help in scientific work at Mount Stromlo.

Dr. Westerlund has kindly given permission to list briefly some of the researches on which he is engaged. He is stressing photometry and spectral classification in the infrared and red regions. The Magellanic Clouds, the globular cluster 47 Tucanae, the region of the Southern Coalsack, a region in Carina and a complex region at the junction of Norma and Scorpius are being investigated by these techniques. Supplementary H-alpha surveys are being carried out. The 30-inch Reynolds reflector and the 20-inch Catts reflector have been used by Dr. Westerlund for photo-electric observations of relatively bright A stars within 15° of the south Galactic Pole; bright blue supergiants; bright M stars classified at Mount Wilson; and selected red stars from the Schmidt surveys. Work on two photo-electric magnitude sequences is also well advanced.

Dr. Wood left Mount Stromlo Observatory about the middle of the year after having completed his intensive studies of light curves of southern eclipsing variable stars. Dr. Tifft is initially concentrating his efforts on photographic and photoelectric studies of colour magnitude arrays for several globular clusters in the Magellanic Clouds, and he is working on a combined photographic and photoelectric survey of cepheids in one section of the Large Magellanic Cloud. Dr. Johnson is especially interested in problems related to the nucleus of our Galaxy, and an infrared study is planned for this part of the sky and also for the Large Magellanic Cloud. His principal programme will be a photographic study of photometry in H-alpha, in a comparison pass band, and in H-beta of several sections of the southern Milky Way. A special study is being planned of the radio source Centaurus A.

The three scholars are firmly embarked on their thesis projects. Mr. Bell has begun a spectroscopic survey of southern white dwarfs. Identification charts have been prepared and the first group of spectra has been obtained. To supplement this work, photo electric colours and magnitudes are being determined. Mr. Campbell participated in the H-alpha survey of the southern Milky Way and took part in the search for new H II regions. His major project is, however, infra-red photoelectric photometry. In addition to participating in the study of certain southern OB associations and the associated emission nebulosity, Mr. Whiteoak has taken part in the southern Milky Way Survey. He is now concentrating on two associations in the Milky Way near Right Ascension 16^h. The areas to be studied are delineated on the basis of spectra classified by Dr. Rodgers.

The National Time Service.

The National Time Service has continued to make astronomical time determinations and to provide the time signals for transmission by Belconnen Naval Wireless Station; to measure and report on time signals received by radio, and on clock signals received by land line from the National Standards Laboratory, Sydney, the Postmaster-General's Research Laboratories, Melbourne, and the Adelaide Post Office.

Transit Instrument.—The time determinations are made with the transit instrument. Normal evening observations are supplemented for the International Geophysical Year programme by an equal number after midnight.

Photographic Zenith Tube.—An examination of extra-focal images indicated that there was a fault in the adjustment of the components of the objective. This has been corrected, thanks to the National Standards Laboratory, where it was shown that wear on the lens seatings during delivery had created a problem. In addition, much effort has been devoted to finding and eliminating sources of mechanical and electrical faults. This work was done by Mr. and Mrs. Wehner and Mr. D. G. Thomas.

The star list is being made more comprehensive so that the apparent places of stars for both present and future use can be calculated together for several years in advance. Mrs. Wehner is in charge of the routine PZT photography and measurements.

The Moon Camera has been fitted on the Oddie 9-inch Refractor. Checks were made on the interval between the times of the contacts and the time at which the moon filter is parallel to the photographic plate. Plates which have been obtained during timed observations are being examined. Mr. Balfe is in charge of the work.

Melbourne Catalogue of Fundamental Stars.—A generous offer from Pulkovo Observatory and the Academy of Sciences of the U.S.S.R. to reduce and publish this catalogue has been accepted.

Computing Developments.—Mr. J. M. Boots and Mr. J. I. Grenot are taking a special interest in the application of modern computing techniques to the problems of the Time Service. The processing of data collected by the Time Service is greatly in need of modernization. Since new computing facilities are becoming increasingly available in Australia, it should be possible to carry out reductions by modern machine methods fairly soon.

Travel and Scientific Meetings.

Professor Bok, Mr. Abraham, Dr. Buscombe and Mr. Gottlieb attended the Tenth Congress of the International Astronomical Union in Moscow. Professor Bok visited the United States for six weeks prior to the Moscow meeting, and attended the International Symposium on Radio Astronomy in Paris in August. He visited the Uttar Pradesh State Observatory at Naini Tal in India. Mr. Abraham visited observatories and Time Services in the United Kingdom and Western Europe prior to the Moscow meeting. He was a member of the Australian delegation to the meeting of the I.G.Y. in Moscow. He is now spending six months at the Dominion Observatory in Ottawa, Canada, and

will return to Australia via the United States. Dr. Buscombe also visited the Uttar Pradesh State Observatory, and observatories in Western Europe. He spent four months at the University of Toronto and the David Dunlap Observatory. Mr. Gottlieb visited Western Europe and United Kingdom observatories before attending the Radio Astronomy Symposium in Paris and the meetings of the I.A.U. in Moscow. He spent three months in the United States, a visit made possible by a Carnegie Corporation Travel Grant. Dr. Buscombe and Mr. Gottlieb attended the symposium on Image Converters, held at the Imperial College, Kensington.

Dr. Hogg, Dr. Dunham and Dr. Gollnow, with Dr. Westerlund, attended the meeting of A.N.Z.A.A.S., held in Adelaide in August, 1958. All of them presented papers at the Symposium on " The Measurement of Astronomical Distances and the Scale of the Universe " which was organized by Dr. Hogg.

During 1958 close working relations were continued with the Radiophysics Laboratory of the C.S.I.R.O. in Sydney. Five colloquium talks were given at Mount Stromlo by members of the Radiophysics Laboratory, and two Radiophysics staff members, Dr. C. S. Gum and Dr. C. Wade, made visits of two weeks to Mount Stromlo, participating in the Observatory programmes. In November, 1958, a joint symposium was held at Mount Stromlo on " Observational Problems of H II Regions ".

Lectures and Public Relations.

The Observatory continues the policy of being open to visitors at set times during the day and on certain special nights. On weekdays the 74-inch telescope is shown to visitors by Mr. N. J. Cunynghame at 11 a.m. and 3 p.m. On Saturdays, Sundays and public holidays there is a regular afternoon showing. Mr. Wehner is in charge of the Wednesday evening visits for parties of ten to fifteen people. In addition there have again been eight monthly visitors' nights, each with an average attendance of 125 to 150 persons. The number of day-time visitors approached 6,000, and approximately 1,700 have visited the Observatory at night. To prevent interference with important scientific work at the telescopes at night, visitors are discouraged from coming to the Observatory outside the stated times. The Mount Stromlo Observatory booklet has gone through three printings of 2,000 in the course of 1958.

Occasional lectures before university groups, schools, clubs and church groups have continued. Professor Bok has given up to three of these lectures a month. In October he delivered the Second Einstein Memorial Lecture of the Institute of Physics in Adelaide. Dr. Hogg lectured to the amateur astronomers in Adelaide and Dr. Gollnow to the group in Melbourne.

Publications.

Bok, B. J.—" The Astronomer's Universe ". Melbourne University Press, 1958.

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Dunham, T. Jnr.—" Methods in stellar spectroscopy ". *Vistas in Astronomy* **2**, 1223, Pergamon Press, 1958.

Przybylski, A.—" Original orbit of Comet 1919 V (Metcalf Borelly) ". *Acta Astronomica*, **7**, 246, 1957. (*Mount Stromlo Reprint No.* 9).

" On the visibility of artificial satellites with highly inclined orbits ". *Aust. Jnl. Science*, **20**, 193, 1958. (*Mount Stromlo Reprint No.* 13).

" Note on planetary aberration ". *Acta Astronomica*, **7**, 241, 1957.

" The effect of blanketting on the structure of the solar atmosphere ". *MN R.A.S.*, **117**, 483, 1957. (*Mount Stromlo Reprint No.* 6).

" Model solar atmosphere deduced from observation of limb darkening ". *MN R.A.S.*, **117**, 600, 1957. (*Mount Stromlo Reprint No.* 8).

Symposia.

1. A.N.Z.A.A.S. Symposium, Adelaide, 1958, on " The measurements of astronomical distances and the scale of the Universe ".

   Dunham, T., Jnr.—" Interstellar matter and distance ".

   Gollnow, H. R. F.—" Spectroscopic methods of distance determination ".

   Hogg, A. R.—" A survey of optical contributions ".

2. I.A.U. Joint Discussion on the Luminosity of Cepheids, Moscow, 1958.

   Gascoigne, S.C.B.—" Photoelectric observation of Magellanic Cloud Cepheids ". Edited proceedings of this discussion.

3. Joint I.A.U.-U.R.S.I. Symposium on Radio Astronomy, Paris, 1958.

   Basinski, J. M., Bok, B. J. and Gottlieb, K.—" Optical identification of southern radio sources."

Abstracts.

Bok, B. J. and Bok, P. F.—" Four photoelectric sequences of the southern hemisphere." *Astron. Journal*, **63**, 303, 1958.

Gascoigne, S. C. B. and Eggen, O. J.*—Cepheids, absorption and galactic rotation. *Astron. Journal*, **63**, 199, 1958.

* Not a member of Australian National University staff.

Department of Geophysics.

Staff.

Professor	J. C. Jaeger, M.A., D.Sc., F.Inst.P., F.A.A.
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Research Fellows	H. Doyle, B.Sc. J. F. Lovering, M.Sc., Ph.D. F. D. Stacey, B.Sc., Ph.D.
Research Assistant	Katrine Urquhart, B.Sc.
Research Students	R. Green, B.Sc. L. Howard, M.Sc. D. S. Kemsley, M.Sc. I. MacDougall, B.Sc. P. M. Stott, M.Sc.
Fulbright Student	E. A. Flinn, S.B.

Study Leave.

Dr. Joplin left in July, 1958, for a year's study leave to be spent mostly in the Universities of Cambridge and California.

Buildings.

A new workshop is under construction. It will house the rock cutting equipment and rock store, portion of the workshop, field equipment and the seismological section.

Research Activities.

Conduction of Heat.—The rate of flow of heat from the interior towards the Earth's surface is one of the few geophysical quantities which provide primary information about conditions in the interior. An attempt to survey its variation over the continent is in progress and an extensive series of temperature measurements in mines and diamond drill holes is being made. Broken Hill, Victoria and South Australia have been covered; the equipment is at present in Western Australia; it is hoped to complete work in the Northern Territory and Queensland during the present field season. It is hoped that this work may be of economic importance but this will not be known until the results have been evaluated. Theoretical work on the topographic correction and the reduction of observations made in the Snowy Mountains region is almost complete.

Previous work on the temperatures near igneous intrusions has been extended to the cases of dissimilar rock types and of intrusion into wet sediments.

New methods for the rapid determination of the thermal conductivity of rock samples have been developed.

In co-operation with the Department of Physiology a study of the diffusion of quanta of transmitter substance in branching regions such as those which occur in the neuro-muscular junction has been made.

Deformation of Rocks and Single Crystals.

The new high pressure deformation apparatus has been brought into operation in its full pressure range of 10,000 atmospheres for tests in compression and extension. Both load and displacement are automatically recorded during tests. In exploratory experiments permanent deformation has been achieved in varying degrees in limestones, granites and serpentine. It has been found that in all these materials there is a recovery of some of the plastic strain during removal of the confining pressure. A detailed study of this new effect is being made on limestone.

Work on the effect of plastic deformation on X-ray line broadening in calcite was completed during the year. It is now proposed to study the effect of annealing on this line broadening. Some preliminary experiments on annealing at relatively low pressures have not reproduced the recrystallization of deformed limestone which occurs on heating at higher pressures.

An extensive series of experiments on slip over natural and artificial joint surfaces has been made in an attempt to determine the values of the cohesion and the coefficient of friction likely to occur in practical problems of rock mechanics.

The influence of plastic strain amplitude on strain hardening of copper single crystals in reversed deformation has been studied. It has been found that the rate of strain hardening decreases with the strain amplitude, the effect being very marked in some orientations. Polycrystalline copper similarly shows a decreased hardening rate under small strain amplitudes. Experiments on zinc are now being undertaken.

Meteorite Studies.

A new development which is believed to be of great promise is the study of the magnetic properties of meteorites. The remanent magnetization of the Moore Country eucrite has been studied and from the results deductions have been made about the magnetic field in a primary meteorite body. Measurements of the remanent magnetization of two chondritic meteorites have also been made and the magnetic fields in a secondary meteorite body discussed.

The alteration zones near the surfaces of iron meteorites have been studied and the temperature of the phase-change involved has been determined. From this an estimate of the amount of ablation from meteorites in the Earth's atmosphere has been made.

The study of the process of solidification of the metal core of a primary meteorite body is being continued.

Tektites form a curious group of anomalous chemical composition. A theory to account for this has been developed and in collaboration with scientists at the Broken Hill School of Mines, using their solar furnace, attempts to produce artificial tektites have been made. The preparation of melts has been completed and analysis of the results is now in progress.

Twelve previously undescribed meteorites have been lent by the South Australian Museum for study.

The counting of meteoric dust particles at high altitudes is of great importance. Equipment for this purpose has been built and sent to Woomera for inclusion in the first available rocket firing.

Oceanography.

In connexion with the International Geophysical Year a number of tide gauges and recorders of long ocean waves has been established at various islands and points of the coast. They will be continued during 1959, the year of International Geophysical Cooperation. Analyses of tides and mean sea level have been made and a study of the behaviour of long period oscillations is in progress.

Petrology and Geochemistry.

A new hypothesis on the nature of the crust-mantle change (Mohorovicic discontinuity) in the Earth has been developed. This suggests that this transition is due to a phase change from a material similar to basalt to one of which eclogite is an unstable form. In connexion with this work a study of granulitic, eclogitic and ultra-basic inclusions in the basic igneous pipes occurring in Eastern Australia is being made.

An emission spectrographic technique for determining cobalt, chromium, copper and nickel in basic rocks has been developed. This and other methods are being applied in an intensive survey of methods of distinguishing between calc-silicate and basic igneous rocks.

A collation of published analyses of Australian igneous rocks has been made for inclusion in a world-wide compilation which is being made by the U.S. Geological Survey.

A careful investigation of the recently developed " rapid " methods of silicate analysis has been made. It has been found that, while adequate for some constituents, they are not altogether satisfactory for accurate determination of others. The study of the differentiation of dolerite magmas continues. A careful study, both chemical and petrographic, of the Red Hill dolerite and its associated granophyre is being made.

A further study of the petrology of the Precambrian granites of north-west Queensland has been completed.

Rock Magnetism.

The survey, now four years old, of the palaeomagnetism of rock formations in Australia, has been extended with further work in the Pre-Cambrian, Cambrian, Silurian, Devonian, Carboniferous and Permian, and the pattern of polar movements relative to Australia in the remote past is becoming clearer. It has been shown that the results from any one land-mass when considered as a time sequence have the form of a random-walk on a sphere. The results from different continents do not however agree and this may be attributed to large scale relative continental movements at a rate of the order of 10 cms. per year. A method for predicting past continental positions has been devised.

An a.c. demagnetizing apparatus for removing the unwanted secondary magnetization in rocks has been completed.

A spinner magnetometer for heated rock specimens has been completed and has been in use for several months. Thermal demagnetization experiments with this equipment have revealed several different types of behaviour in various Australian igneous rocks, some of which have demonstrably stable thermo-remanent magnetization while in others the results are complicated by secondary magnetic moments which make them unsuitable for direct palaeomagnetic work. Stable magnetic moments of apparently thermal origin have also been found in two secondary meteorites, which are thought to have remained cold throughout their formation and subsequent history.

Some progress has been made towards a theoretical explanation of the magnetic properties of rocks in terms of a multidomain structure of the ferromagnetic minerals. Data on thermoremanence and coercive force give quantitative agreement with this picture.

A direct experiment has been made in which rocks are cooled from a high temperature in a magnetic field while under stress. Experiments on a wide range of igneous rocks which have been used for palaeomagnetic work in Australia show that these become magnetized in the direction of the field in which they cool, being negligibly affected by stress. This experiment is of considerable importance since it has been suggested that magnetostrictive effects might invalidate some of the conclusions of palaeomagnetism.

The use of magnetic measurements to determine whether rock in or near talus slopes is in situ or has moved slightly has been developed further. This work, which has been done in collaboration with the Hydro-electric Commission of Tasmania has been of value in predicting rock conditions likely to be encountered in underground excavations.

Seismology.

The seismological observatory at Spring Valley came into operation in March. It is equipped with Benioff seismometers with long and short period recorders. Regular weekly preliminary bulletins as well as monthly bulletins are now being sent out. Unfortunately the connexion to the time-service at Mount Stromlo has not yet been made so that the accuracy of timing in the early bulletins is not all that could be desired.

In collaboration with the scientists of the Snowy Mountains Authority records are also being processed for stations at Wambrook, Cabramurra, Geehi and Jindabyne. A subsidiary station has also been established at St. Michael's College, Inveralochy. The records from this network are being analysed in order to locate small local earth tremours about a hundred of which have already been detected. When information of this type has accumulated it is hoped to be able to correlate the occurrence of earth tremours with local geological features.

A number of portable seismographs has been built and are being used for reconnaissance surveys in various parts of the country.

Observations of the recent series of nuclear explosions in the Pacific have been made but the results have not yet been evaluated. Observations of crustal thickness using quarry blasts have continued.

List of Publications.

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* Not a member of Australian National University staff. † Department of Physiology.

McDougall, I.—" A note on the petrography of the Great Lake dolerite sill." *Dolerite: A Symposium,* p. 52 (Univ. of Tas. Press).

" The Red Hill granophyre." *Ibid.* p. 70.

McDougall, I., and Green, R.—" The use of magnetic measurements for the study of the structure of talus slopes." *Geol. Mag.,* **95**, 252.

Paterson, M. S.—" The melting of calcite in the presence of water and carbon dioxide." *Amer. Min.,* **43**, 603.

" Experimental deformation and faulting in Wombeyan marble." *Bull. Geol. Soc. Amer.,* **69**, 465.

Snelling, N. J.—" Further data on the petrology of the Saxa Vord schists of Unst, Shetland Isles." *Geol. Mag.,* **95**, 50.

" A note on the possible sedimentary origin of some amphibolites from the Cooma area, New South Wales ", *J. and Proc. Roy. Soc. N.S.W.,* **92**, 43.

Stacey, F. D.—" The ionization of liquid argon by α-particles." *Aust. J. Phys.,* **11**, 158.

" The effect of stress on the remanent magnetism of magnetite-bearing rocks." *J. Geophys. Res.,* **63**, 361.

" The fluctuating field ferromagnet at low temperatures." *Aust. J. Phys.,* **11**, 310.

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" Thermo-Remanent Magnetisation (T.R.M.) of Multidomain Grains in Igneous Rocks." *Jnl. Phil.,* **3**, 36, 1391.

Stacey, F. D., and Parry, L. G.*—" A modification of the method of E. R. Deutsch for the magnetic hysteresis of rocks." *J. Geomag. Geoelect.,* **9**, 157.

Department of Nuclear Physics.

Staff.

Professor	E. W. Titterton, C.M.G., M.Sc., Ph.D., Dip.Ed., F.R.S.A., F.A.A.
Fellows	P. B. Treacy, B.Sc., Ph.D. (since May, 1958).
	J. H. Carver, B.Sc., Ph.D.
Research Fellows	R. D. Edge, M.A., Ph.D. (until July, 1958).
	W. E. Turchinetz, B.Sc., M.Sc., Ph.D.
	I. F. Wright, M.Sc.
	R. N. Glover, B.Sc, Ph.D. (since November, 1958).
Research Assistant	K. H. Lokan, B.Sc.

Research Students and Teaching Activities.

Eight research students—T. R. Ophel, B.Sc., D. S. Gemmell, B.Sc., K. H. Purser, M.Sc., B. Mainsbridge, B.Sc. (Australian Atomic Energy Commission fellow), T. R. Sherwood, M.Sc., A. G. Gregory, B.Sc., R. B. Taylor, B.Sc., and G. E. Coote, M.Sc.—were at work during the year. K. H. Lokan and T. R. Ophel successfully completed Ph.D. courses, the latter leaving the University in April, 1958, to take up a research fellowship at Harvard University, U.S.A. Dr. Edge left in July to take up a position as Associate Professor at the University of South Carolina, U.S.A.

Mr. D. S. Gemmell is at present completing his Ph.D. course and will submit a thesis early in 1959.

Well-attended courses were presented by the staff of the Department and by other members of the Physics School, embracing Workshop Practice and Glassblowing, lectures on techniques (vacuum physics, elementary electronics, scintillation counters, Szilard-Chalmers techniques, accelerating machines, gas counters and nuclear emulsions), elementary nuclear physics, and parity failure in weak interactions. In addition, research progress meetings were held from time to time to discuss current work.

A 3-day Nuclear Physics Conference, organized by the Department in collaboration with the Department of Theoretical Physics, was held from March 6th to 8th. Sixty physicists attended, including representatives from the Universities of Sydney, Melbourne, Adelaide, Tasmania and New Zealand. Two dozen papers were read during the meeting, which led to a most useful exchange of information.

* Not a member of Australian National University staff.

Research Equipment.

The three accelerating machines have operated satisfactorily throughout the year, only minor repairs being necessary.

In September, the Government advised the University that it would make £600,000 available to the Department for the purchase and installation of a 12 MeV tandem electrostatic generator. This was extremely good news, and will allow a greatly expanded research programme to be undertaken; addition of this machine to the present three will bring the Department's facilities to the level of the best low-energy nuclear physics laboratories overseas. Planning of the new installation proceeded rapidly after the decision was made, and Professor Titterton flew to the U.S.A. in November for four weeks to settle details of the contract with the High Voltage Engineering Corporation, who are to build the machine.

In designing the layout, the shielding problem has been given great attention. Specially designed experiments, made with the 600 keV and 1200 keV machines, have shown the importance both of " skyshine " and " ground shine " in the fast neutron case. The results indicate that the best policy will be to shield effectively at the neutron sources themselves—the analysing magnet, slits, targets and possibly the stripper.

Acceptance tests of the machine are expected to take place in Boston in April, 1960, and it is hoped to have the machine installed and operating in Canberra by the end of that year.

Research Programme.

Fast Neutron Studies.—As a contribution to the International Geophysical Year, the altitude dependence of atmospheric cosmic-ray neutrons has been measured over Canberra up to 24,000 feet. The law is found to be $e^{\frac{-x}{160}}$ where x is the atmospheric depth in gm/cm^2, and this experiment resolves discrepancies in earlier data where differences of a factor of 100 had been present. The Szilard-Chalmers reaction in sodium permanganate solution was employed. The same method has been applied to the determination of the slow neutron cosmic-ray flux below a water surface, and has allowed a verification to be made of the Bethe theory.

The preponderance of proton emission at high excitation from medium-weight nuclei is still not completely understood and has been investigated in the photonuclear and fast neutron cases using Ni^{58} as target. In the neutron experiments, cross-sections for the reactions Ni^{58} (n, p)Co^{58}, Ni^{58}(n, 2n) Ni^{57} and Ni^{58} (n, np)Co^{57} were measured at 14.1 MeV, the values found being (560 ± 110), (38 ± 8) and (160 ± 40) millibarns respectively.

Capture Gamma-Ray Studies.—The experiment to study the capture radiation from $B^{11}(p, \gamma)C^{12}$ mentioned in last year's report has been completed. It was carried out in collaboration with members of the Department of Particle Physics using the 7.7 MeV cyclotron before this was dismantled and moved to its new site. The experiments covered the proton energy range 4.0 to 7.7. MeV and allowed the C^{12} giant resonance to be observed through the inverse reaction, for the first time. The measured cross-sections can be related to the $C^{12}(\gamma, p)B^{11}$ cross-sections through the principle of detailed balancing. The experiment locates the maximum of the $C^{12}(\gamma, p)$ giant resonance at (22.55 ± 0.1) MeV but does not resolve individual levels. The cross-section curve, however, is not smooth, and two peaks at C^{12} excitations of 21.4 and 22.1 MeV are suggested. The maximum value of the $C^{12}(\gamma, p)$ cross-section is found to be (29 ± 5) mb.

The reaction $Li^7(p, \gamma)Be^8$ was also investigated over a similar range of proton energies. Transitions to the 2.9 MeV level of Be^8 are found to predominate over those to the ground state throughout the energy range. The experiment suggests that the reaction $Be^8(\gamma, p)Li^7$, if it could be observed, would have a cross-section maximum at 22 MeV.

Measurements were also made with F^{19}, Na^{23}, Al^{27} and P^{31} as targets, to obtain high excitations of the resultant alpha-particle nuclei Ne^{20}, Mg^{24}, Si^{28}, and S^{32}. In all cases, pronounced resonances were observed in the yield of gamma-radiation, and transitions were found to be predominantly to the first excited state of the residual nucleus rather than to the ground state.

The strengths of the observed transitions suggest that the intermediate states decay by emission of electric dipole radiation, so that they occur from 1^-, 2^-, and 3^- states of the compound nuclei with T = 1 (since all of the residual nuclei are self-conjugate with 0^+ ground states and 2^+ first excited states with T = 0). That the transitions are generally to the first excited state (2^+) can be understood since only 1^- compound states can produce E1 transitions to the ground state, whereas 1^-, 2^- and 3^- states can decay by E1 radiation to the first excited state. Even for 1^- levels, the higher statistical weight attached to the 2^+ level will tend to favour transitions to the first excited state in spite of the increased transition probability associated with the higher energy of the ground-state gamma rays.

The proton energy resolution in these experiments ranged from 70 keV at the high-energy end but, due to straggling in the foils used for energy reduction, fell to 300 keV at the low-energy end. As a result, much of the fine structure to be expected in this region was undoubtedly lost. Detailed studies will be undertaken with the tandem generator, where the energy resolution is two orders of magnitude better and where a much greater energy range can be covered.

Photodisintegration Studies.—(a) Monochromatic Radiation.—Work has continued using the new thin crystal technique, in which the scintillating crystal itself is used both as target and detector. Following publication of the work on sodium iodide, spectra have been obtained with potassium, caesium and lithium iodide crystals. Some bromide crystals have also been used successfully.

A summary of results obtained for (γ, p) reactions in K^{39}, I^{127}, and Cs^{133} induced by 17.6 MeV radiation are given in the following table. The work continues.

(γ, p) CROSS-SECTIONS AT 17.6 MeV.

K^{39}		I^{127}		Cs^{133}	
Excited State of Residual Nucleus.	σ mb.	Excited State of Residual Nucleus.	σ mb.	Excited State of Residual Nucleus.	σ mb.
A^{38}	0.9	Te^{136}	0.32	Xe^{132}	0.24
2.16	2.4	0.65	0.20	0.65	
3.75	1.0	1.45	(0.12)	1.45	
4.3	1.4	(1.7)	(0.19)	2.0	
5.0	2.4			2.9	
5.4	1.2				
6.3					
6.6	0.5				
7.3	1.3				
7.8	0.3				
Total σ at 17.6 MeV = 11 mb.		~4 mb. for Cs + I or 3 ~ mb if averaged over both 14.8 and 17.6 MeV components			

(b) Bremsstrahlung Radiation.—Following a private communication from Okamoto pointing out the correlation between width of the giant resonance and the nuclear distortion parameter e, a detailed study of giant resonances in the rare earth region between N = 82 and 108 was undertaken. In all cases the method of induced radioactivities was used, measurements being made with a NaI(Tl) scintillation spectrometer. The most accurate results were obtained from the Ta^{181} (γ, n) reaction leading to the 8.15 hour isomeric level of Ta^{180}, the yield of which was measured with $\frac{1}{2}$% statistical accuracy at 250 keV intervals over the rising part of the activation curve. The giant resonance for the reaction measured in this way has a width of 5.3 MeV and shows no evidence for the splitting into two components predicted by the calculations of Okamoto and Danos on the photodisintegration of spheroidal nuclei. However, in qualitative agreement with these calculations, it was found that the (γ, n) cross-sections for the other distorted nuclei investigated—Nd^{150},Sm^{154} and Gd^{160}—have widths of 5.7, 6.5 and 5.3 MeV respectively, while for the closed-shell nuclei Pr^{141}, Nd^{142} and Sm^{144}, the corresponding (γ, n) cross-sections have widths of 4.3, 5.0 and 4.0 MeV. In addition, it was found that the (γ, n) cross-sections for closed-shell nuclei have substantially larger high-energy tails than do those for spheroidal nuclei.

Studies of the energy distributions of photonucleons have established that a substantial number is emitted with more energy than would be expected if a compound nucleus were invariably formed. This high energy excess is attributed to direct interaction between the incoming photon and the emergent nucleon. The question arises as to whether the cross-section for this direct component displays the usual giant resonance or whether it arises from some separate interaction mechanism. An experiment was designed to test this point. In it, the energy distributions and absolute yields of photo-protons of energy greater than 10 MeV from silver have been measured for maximum bremsstrahlung energies between 16 and 32 MeV. The derived cross-section for this component, which may be identified as arising from direct interactions, passes through a maximum at ~ 22 MeV, considerably above the giant resonance; the integrated cross-section is found to be

(36 ± 9) MeV millibarn. This result is consistent with the idea that most of the emission arises from a 2p—2d transition at 22 MeV, and this interpretation is supported by the angular distribution measured at 30 MeV, which is strongly anisotropic.

Experiments on the competitive modes of decay of medium-weight nuclei bombarded by charged particles and neutrons with energies of between 10 and 20 MeV have shown a preponderance of protons among the reaction products (see fast neutron studies above). It is therefore of interest to see whether a similar preponderance of protons occurs among the photodisintegration products of medium-weight nuclei.

Ni^{58} is a suitable nucleus for this work since the (γ, p), (γ, n), $(\gamma, 2n)$ and (γ, pn) reactions all lead to radioactive products so that a comparison of, in particular, the (γ, p) and (γ, n) yields can be made very simply.

Excitation functions were therefore measured for the (γ, n), (γ, p) and $(\gamma, pn + 2n)$ reactions in Ni^{58} and the (γ, p) reaction in Ni^{62}, from threshold to 32 MeV. A preponderance of protons is found from Ni^{58} with the ratio $\int_0^{32} \sigma(\gamma, p)\, dE / \int_0^{32} \sigma(\gamma, n) dE = 2.35 \pm 0.20$.

The shapes of the (γ, n) and (γ, p) cross-sections are found to be very similar, peaking near 19 MeV with widths of about 4.3 MeV. The Ni^{58} $(\gamma, pn + 2n)$ cross-section increases monotonically from threshold to 32 MeV, and the integrated cross-section is about 12% of the total which is

$$\int_0^{32} [\sigma(\gamma, n) + \sigma(\gamma, p) + \sigma(\gamma, pn + 2n)]\, dE = (0.84 \pm 0.10) \text{ MeV-barns.}$$

The Ni^{62} (γ, p) reaction is found to have an integrated cross-section of (0.13 ± 0.02) MeV-barns and to peak at 22 MeV, with a width of about 5.2 MeV.

Conferences, Visits and Outside Activities.

Professor Titterton was on study leave from mid-April to early August, during which period he visited laboratories in the United Kingdom, United States of America, Switzerland and Holland. He gave the opening paper at the Fifth International Photonuclear Conference held at the Bureau of Standards, Washington, D.C., and read a paper at the May meeting of the American Physical Society. In Europe Professor Titterton attended the High-energy Nuclear Physics Conference held this year in Geneva.

Dr. J. H. Carver left Canberra on study leave in May and will be away for a year working at the Atomic Energy Research Establishment, Harwell. He represented the Department at the Low-energy Nuclear Physics Conference held in Paris in July.

At the Adelaide meeting of A.N.Z.A.A.S. two papers were presented. They were "High Energy Photoprotons from Silver" by K. H. Lokan and "High-energy Gamma Radiation from Proton Capture Reactions" by D. S. Gemmell.

At the Second Australasian Radiobiology Conference held in Melbourne in December, Professor Titterton read a paper "Radiostrontium and Radioiodine Measurements in Environmental Contamination".

During the year, Professor Titterton attended a meeting of the Atomic Energy Commission's Scientific Advisory Committee, a meeting of the Defence Research and Development Policy Committee, and four meetings of the National Radiation Advisory Committee.

Publications.

Carver, J. H., and Turchinetz, W.—"The $(\gamma, 2n)$ and $(\gamma, 3n)$ reactions in ^{181}Ta." *Proc. Phys. Soc.*, **71**, 613.

"Radioactivity of ^{178}Ta, ^{179}Ta and ^{180}Ta." *Proc. Phys. Soc.*, **71**, 618.

Edge, R. D., and Gemmell, D. S.—"Gamma Rays from the 6.89 MeV level in ^{10}B." *Proc. Phys. Soc.*, **71**, 925.

Ophel, T. R.—"The photodisintegration of potassium by ^{7}Li (p, γ) radiation." *Proc. Phys. Soc.*, **72**, 321.

"Response curves of alkali halide scintillators with special reference to the Li^{6} $\propto$ (n, γ) reaction in lithium iodide." *Nuclear Istruments*, **3**, 45.

Ophel, T. R., and Wright, I. F.—"Photodisintegration of sodium by ^{7}Li (p, γ) radiation." *Proc. Phys. Soc.*, **71**, 389.

Titterton, E. W.—"Inverse reactions and the giant resonance." *Proc. Fifth Int. Photonuclear Conf.* (Bureau of Standards), p. 28, 1958.

"The shape of the giant resonance in the region 82 N 108"." *Proc. Fifth Int. Photonuclear Conf.* (Bureau of Standards), p. 52, 1958.

Titterton, E. W., D. W. Keam,* L. J. Dwyer,* J. H. Martin* and D. J. Stevens*.—"Global fallout in Australia during the period 26th November, 1956, to 31st December, 1957." *Aust. J. Sci.*, **21** (No. 1), 8.

"Experiments on the 'sticky paper' method of radioactive fallout sampling." *Aust. J. Sci.*, **21** (No. 4), 99.

Titterton, E. W., W. A. S. Butement,* L. J. Dwyer,* L. H. Martin* and D. J. Stevens*.—"Radioactive fallout in Australia from operation Buffalo." *Aust. J. Sci.*, **21** (No. 3), 63.

Treacy, P. B., M. A. Grace* and R. T. Taylor*.—"The decay of long-lived ^{166}HO." *Phil. Mag.*, **3** (No. 25), 90.

Report—

Titterton, E. W.—"Λ, K°, $\Sigma\pm$ lifetimes; Λ°, K° decay branching ratios." A.N.U., P. 192.

Ph.D. Theses presented—

Lokan, K. H.—"Studies in nuclear photodisintegration."

Ophel, T. R., "Scintillation counter study of photoproton reactions."

Department of Particle Physics.

Staff.

Professor	.. .. ..	Sir Mark Oliphant, K.B.E., M.A., Ph.D., F.R.S.
Senior Fellow	.. .. ..	W. I. B. Smith, B.Sc., Ph.D.
Senior Research Engineers	.. ..	J. Blamey, M.Sc. L. U. Hibbard, B.Sc., M.E., Ph.D.
Fellows	.. .. ..	E. K. Inall, B.E., Ph.D. D. B. Robertson, B.Sc., Ph.D.
Research Engineers	.. ..	P. Carden, B.E. H. Johnson, B.Sc.
Research Fellows	.. ..	R. A. Marshall, B.Sc., B.E., S.M. A. H. Morton, Ph.D.

The Proton-Synchrotron.

Substantial progress has been made with this equipment. The homopolar generator should be tested within the coming year and erection of the orbital magnet begun.

Considerable congestion has occurred due to lack of sufficient space for laying out the large components of the generator. This has led to delays and to errors, but only by providing accommodation which would be of little or no use subsequently could this difficulty be avoided.

Homopolar Generator.—The fabrication, machining, drilling and assembly of the outer copper jet rings and steel trays have been completed, together with some thousands of smaller associated parts.

The inner jets have been modified in design and are now under construction. The top and bottom portions of the generator, which locate two of the inner jets and take severe electrical and mechanical loads, have been designed and fabricated. Machining is also nearly finished. The second pair of rotors were machined to final dimensions.

The cementing of the four steel discs to form two 40-ton rotors has been completed. The first pair was cemented and tested by 5th August and the second pair by 12th December. In each case testing was done at 70° C. with nitrogen gas introduced into the space between the rubber strips. Small-scale tests have shown that, under the combined influence of the tensile stress from the steel-bonded surfaces and the transverse compression effect of the gas pressure exerted on the rubber strip sides, failure will occur in a matter of minutes at 600 p.s.i. gas pressure and in about two weeks at 300 p.s.i. pressure. The test pressure adopted as adequate for the bonded rotors was 300 p.s.i. for half an hour. In addition the elastic and creep effects were observed by measuring movements while raising pressure in three stages involving half an hour at 100, 200 and 300 p.s.i. in turn. The elastic behaviour is a very sensitive indicator of defects in bonding.

The results of the tests applied has been to give complete confidence in the behaviour of the bonded rotors under the worst conditions of service that can be expected.

Development has proceeded with the techniques of insulation of the rotors and the NaK tanks which surround them. This has involved some investigation of the behaviour of materials in NaK and the establishment of procedures for insulating surfaces by spraying with resins, coating

* Not members of Australian National University Staff.

with glass cloth and resin and the cementing on of glass fibre-polyester mouldings as baffles to control the NaK streams. One outcome of this has been the fabrication of composite baffles for the NaK supply tanks and droppers, constructed from phenolic sheet and glass fibre-polyester mouldings.

The successful operation of the generator depends largely on some important phenomena which cannot be analysed theoretically and whose significance can be assessed only by full-scale testing in the machine itself. It has been thought wise to prepare for possible failure of components from these causes by having for installation alternative structures of certain large assemblies which are quite different in principle and therefore have different advantages and disadvantages. A number of such alternatives have been considered and designs drawn up. In one case the alternative, which has some notable advantages and simplifications, is at present under construction. It is also probable that some troubles have been over-rated, in which case certain simpler alternative designs will be more satisfactory from other points of view, e.g., in the case of the inner jets allowing the use of a much diminished quantity of liquid metal with consequent reduction of arcing danger.

The upper guide bearing was installed and tested under light running conditions in the magnet with a rotor disc attached. The lower guide bearing is almost complete and ready for installation.

Nearly all the main elements of the NaK system such as pumps, storage and high pressure NaK tanks, high pressure gas tanks, filters, isolating drops, helium reservoir, gas and NaK pipe lines, valves, &c., have been permanently installed and vacuum tested. The supply pipes, drainage lines and manifolds connecting the generator itself to the outer NaK system have been designed but not yet made.

The hydraulic system for the main NaK control valves for the jet supplies has been modified in design, and portion of it installed.

Busbar arrangements have been reconsidered and most but not all of the copper and aluminium ordered. A design for the main switch has been adopted.

Several types of coil, to act as a test load for the homopolar generator and also as a device for production of high magnetic fields for studying arc discharges, have been considered. These need further study because the powerful currents stress the rather massive coil (30 tons) to its limit.

Radiofrequency System.—During 1958, effort has been concentrated on the low power section which is now about half finished. The details are as follows:—

(1) The B integrator and its associated power supplies are finished and have been tested. Tests show that the integrator is linear to within the accuracy of our test equipment (i.e. a few parts in 10^4).

(2) An experimental swept oscillator has been built, and tracks the required B versus frequency curve to within 1 per cent. without trimming. This is to be compared with 5 per cent. in the Bevatron. Two variable inductances are used instead of one to achieve this accuracy.

(3) A new voltage comparator has been developed for use in the curve corrector and frequency monitoring equipment.

(4) High speed counters and an analogue subtractor have been tested. These are for use in the monitoring equipment. The high power English Electric rectifier set has been tested and meets our specifications. Further work on the high power section is not possible without the ferrite core material which was due to leave Germany in December.

Theoretical and experimental work on the ferrite frames for the cavity has been completed.

Some components for automatic tuning of the cavity have been delivered, but this section is being left until last because improvements in power transistors may simplify the problems.

8 *MeV Proton Injection Cyclotron.*—Further work has been carried out on the use of defining slits near the ion source and on vertical bars attached to the dee and dummy dee, to provide focussing near the ion source and to give accurately defined internal beams.

Early in the year emphasis was placed on obtaining a monoenergetic, well defined external beam of about one microampere to carry out experiments in collaboration with Professor Titterton and Mr. Gemmell of the Department of Nuclear Physics (see report of the Department of Nuclear Physics).

The quadrupole strong focussing magnet was placed in the external beam and its performance was found to be satisfactory and up to design expectations.

The cyclotron is now being installed in its final site adjacent to the housing of the accelerator. A suitable concrete slab foundation was poured during the year. The magnet, shielding walls and roof are now in place. Only minor adjustments of position should be necessary to give the final beam alignment for injection. New deeds and a new ion source are being designed to give more satisfactory performance.

Other Activities.

The usual series of colloquia and progress meetings have been held throughout the year.

Members of the Department have lectured in other universities and to learned societies in Australia and overseas. Professor Oliphant has served on various committees dealing with subjects of importance to Australia or to the physical sciences.

Publication.

Oliphant, M. L.—" Science and the survival of civilization." A.N.Z.A.A.S. Presidential Address. *Aust. J. Science,* **21,** 8, 1958.

DEPARTMENT OF RADIOCHEMISTRY.

Staff.

Reader	F. Scarf, M.Sc. (will retire in February, 1959).
Senior Fellow	H. Berry, M.Sc. (Tech.).
Fellow	R. Mills, M.Sc., Ph.D.
Mass Spectrometrist	J. R. Richards, M.Sc., Ph.D.
Research Students	A. F. Reid, M.Sc. E. W. Godbole, M.Sc.

Research Activities.

Analytical Section.—Over the past twelve months a critical study has been made of the " alpha-lead " and " chemical lead " methods of age determination based on zircon mineral ($ZrSiO_4$) separated from granitic rocks. Investigations have thrown light on some of the anomalies in these methods which have led investigators to discard them in favour of the more recently developed age measurement techniques based on potassium-argon and rubidium-strontium decay schemes.

The lack of a reliable spectrographic method for lead in zircon gave impetus to the development of what is regarded as an excellent chemical technique based on the spectrophotometric measurement of the coloured dithizone-lead complex. A factor which has contributed largely to the efficiency of the new method has been the development of an improved flux which permits perfect and easily-controllable solution of the most refractory zircon at a crucible temperature below 700° C. At this temperature, loss of lead to the platinum of the crucible, a bugbear with other high temperature fluxes, is reduced to a minimum and the melt is easily brought into solution for subsequent lead analysis.

Ages for zircons from three Northern Territory samples have been estimated by the alpha-lead method. At present the figures are tentative.

In no case has it been possible to isolate more than a single gram of high purity zircon and although this has restricted each phase of the investigation, the success achieved in improving both separation and chemical techniques would appear to justify a continuation of the zircon age programme.

Mass Spectrometry Section.—The programme of research into the isotopic composition of lead from Australian ores has been resumed after the interruption caused by the transfer to new quarters. An inter-laboratory check sample, received from the University of Toronto, gave satisfactory agreement only after the application of large correction factors derived from calibration of the amplifier and recorder units. Subsequent modifications have reduced these corrections to values about the same order of magnitude as the observational uncertainties. Further ore samples have been chemically processed to tetramethyl lead.

A considerable improvement in mass spectrometer availability has been achieved by the change-over from dry-ice to liquid-air as cold-trap refrigerant. This has been made possible by the development, in collaboration with K. H. Purser of the Nuclear Physics Department, of a control device of which details are in the course of publication.

Physical Chemistry Section.—Further data for the tracer-diffusion of Na^+ and Cs^+ in various supporting electrolytes have been accumulated and will shortly be published together with Rb^+ results obtained last year. A new equation for data treatment and extensive calibration has brought the continual-monitoring capillary method to the point where dilute solution coefficients are being measured. In view of the importance of obtaining precise data in this region, this programme has been accelerated by designing new apparatus, embodying many improvements, and this is at present undergoing test. Preliminary work associated with the diffusion measurement of C^{14} —labelled pentaerythritol has been completed. This study, which is being undertaken in collaboration with the University of New England, should provide information on the role of viscosity as it affects diffusion.

A kinetic study of chlorine atom exchange between trimethylsiliconchloride and antimony trichloride has been completed this year. Although the experimental methods developed in this work were proven, exchange data obtained in benzene as solvent appeared very complex and not easily explained. In the middle of the year, a change was therefore made to hexane as solvent and the exchange curves were much more regular. It was demonstrated that the system had bimolecular kinetics.

Nuclear Chemistry Section.—Separated isotopes of tin and samarium were submitted to both fast neutron and x-ray irradiation but no success in obtaining new isotopes was achieved. The main work being undertaken by this section at the moment is the development of a liquid-liquid extraction system for separating rare earth elements. This method, which is much quicker than the ion-exchange technique used hitherto, will be employed for cross-section studies with adjacent rare earth nuclides. The same principle can be used to separate the actinide elements.

Other Activities.

During the year, members of the department gave a course of lectures on "Radiochemical Techniques" which was well attended by members of the University and of C.S.I.R.O. and lectures have been given to learned societies.

A member of the University of New England, Mr. L. A. Woolf, has completed a six weeks' course in the department gaining experience in radiochemical aspects of diffusion.

The mass spectrometer group have carried out a number of analyses of gas samples for members of the University and for the Canberra and Melbourne sections of C.S.I.R.O.

Publications.

Fazekas de St. Groth†, S., Watson, G. S.,* and Reid, A. F.—"The neutralization of animal viruses. 1. A model of virus—antibody interaction." *Journal of Immunology,* **80,** 215 (1958).

Fazekas de St. Groth,† S., and Reid, A. F.—"11. A critical comparison of hypotheses." *Journal of Immunology,* **80,** 225 (1958).

Mills, R.—"Radiochemical method for the detection of fast neutrons." Aust. Atomic Energy Symposium (1958).

Mills, R., and Godbole, E. W.—"The precision measurement of single ion diffusion measurements." *Australian Journ. Chemistry,* **11,** 1 (1958).

Reid, A. F.—"Micro-potentiometric determination of periodate by arsenite-iodine titration." *Mikrochimica Acta,* **2,** 236 (1958).

Department of Theoretical Physics.

Staff.

Professor	K. J. Le Couteur, M.A., Ph.D.
Fellow	F. C. Barker, M.Sc., Ph.D.
Research Fellow	L. J. Tassie, M.Sc., Ph.D.

Dr. D. C. Peaslee of the University of Purdue was a Fulbright Visitor to the Department from March to December.

Research Students.

Two research students joined the department during the year. Mr. D. Lang is working on the theory of nuclear reactions and Mr. P. Seymour on the behaviour of highly ionized gases.

Research Activities.

Dr. Peaslee gave a series of seminar lectures on "Beta-decay and the weak interaction of Fermi particles". Dr. Peaslee's own research work was devoted to classification of the 32 known elementary particles by means of a six dimensional isotopic-spin space. Although this work is highly abstract, it leads to some predictions about the decay of the elementary particles which can be tested experimentally.

Dr. Barker has continued calculations with the shell model of the nucleus using a potential well of finite depth and realistic shape instead of a hypothetical harmonic oscillator potential. This change greatly multiplies the amount of calculation required to get any results, but makes the work logically self-consistent since the depth of the well is itself calculated from the forces between nuclear particles. Improved agreement with experimental measurements of excited states of light nuclei, such as oxygen, was obtained and many predictions of quantities which have not yet been experimentally measured are possible.

Work has continued on the scattering of high energy electrons by nuclei. Consideration of the effects of centre of mass motion was extended to magnetic scattering and allowance was made for effects of the finite size of the proton. Often the electron transfers energy to the nucleus and the analysis showed to what extent collective motion of the particles within the nucleus and motion of single particles are induced. An attempt is being made to extend this work to the excitation of collective nuclear motions by the inelastic scattering of high energy protons.

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* Department of Statistics. † Department of Microbiology.

Accurate solutions of the integral equations for evaporation of successive neutrons from highly excited nuclei were obtained, and were used to interpret the measured energy spectra of neutrons emitted from nuclei bombarded by 180 MeV protons and 14 MeV neutrons. For nuclei of mass below 100 the high and low energy results are consistent with each other, and with information derived from bombardment by heavy ions, but for heavy nuclei the analysis has become sufficiently accurate to reveal a discrepancy which is being investigated.

The past year has seen an increase in this department's use of electronic computers. Several applications arose from its own work, also the integral equations which connect fundamental nuclear cross sections to reaction yield curves measured with the 33 MeV electron synchrotron, were put into a form suitable for computation on Silliac, so that solutions can now be obtained more accurately and conveniently than by hand.

Other Activities.

In conjunction with the Department of Nuclear Physics a conference was held in the School on March 3rd to 5th, which was attended by many scientists doing related work in the State universities and in New Zealand. Papers were read by all members of the staff.

Professor Le Couteur arranged a symposium on Theoretical Physics at the Adelaide meeting of A.N.Z.A.A.S. and Dr. Peaslee, Dr. Barker and Dr. Tassie also read papers.

Publications.

Barker, F. C., and Tassie, L. J.—" Application to electron scattering of centre of mass effects in the nuclear shell model." *Phys. Rev.*, **111** (1958) 940.

Le Couteur, K. J.—" The statistical model." Chapter VII of *Nuclear Reactions* (Vol. 1). North Holland Publishing Company, Amsterdam.

Tassie, L. J.—" Electron excitation of collective nuclear transitions." *Aust. J. Phys.*, **11** (1958).

RESEARCH SCHOOL OF SOCIAL SCIENCES

DIRECTOR'S REMARKS

It has been customary to compose the Annual Report mainly by the method of aggregating the seven departmental reports. Normally, this may be sufficient; but it will be helpful now and then to consider the School as a whole. During the past year, careful thought was given to the possibilities and prospects of the School's development.

In support of the draft estimates for 1957-58 (and, more tentatively, for 1958-59), the Director presented a paper which contained the following passages:—

In examining the needs of the School, my colleagues and I have had in mind the following criteria:—

1. the strength of individual departments;
2. the strength of the School;
3. the strength of the University.

The first criterion needs no discussion. Although the problems of applying it may sometimes be difficult, it is itself very straightforward. But the other two criteria introduce some complications.

With regard to criterion 2 I shall state dogmatically some of my own assumptions and preferences, because this seems the best way of getting to business.

I assume that this School is *not* a centralized research institute working to a programme (or programmes) determined by a sovereign will: on the contrary, it contains seven departments, each of which enjoys a large measure of autonomy. I assume further that these departments are *not* all equal. From time to time one department may be advancing far ahead of its neighbours, because it possesses unusually creative people who have discovered unusually rewarding tasks: another department, for the opposite reasons, may be lagging far behind its neighbours. In an extreme case there might be good reason for knocking a laggard department on the head; in other cases, it may be desirable to invest extra money in building up its strength. Generally, however, I should far prefer to " give to him who hath "—to invest in creative power where it has already proved itself. Creative power, however, need not invariably imply the will to expand: " small and good " may under certain circumstances be wise policy. For all these reasons, I see no need to keep all the departments moving forward in a straight line at a uniform pace.

I assume also that the School is something more than an aggregate of Departments. It ought to show a coherent shape and pattern when one stands aside and looks at it from a distance. People working inside it, busy though they are bound to be with their specialist researches, ought to be seeking opportunities of mutual aid across the boundaries of departments. These opportunities—and not merely the internal needs of departments—ought to be born in mind when we are establishing new posts. Our coherence and co-operativeness as a School is a proper object of investment.

As regards criterion 3: we ought, by the same argument, to feel pleased if our growth as a School increases opportunities of mutual aid between ourselves and other Schools.

On the side of the natural sciences, these opportunities are limited by the vast academic distance which separates us from them. The statisticians have done some valuable bridge-building; the philosophers (if they open up work in the philosophy and history of science) may do some more. There may be other practical possibilities which will become apparent as time goes on.

Contrariwise, on the side of Pacific Studies we are suffering the embarrassments of extreme propinquity. We and our Pacific neighbours face two alternative dangers of waste:

(a) through duplicating resources, if we do all the things that we are competent to do.

(b) through missing opportunities, if we don't do the things that we are competent to do.

It should not be beyond the wit of man to combat these dangers.

The immediate purpose of the paper was to explain the short-term plans (within limitations of finance) of each of the seven departments which exist already within the School. The paper then raised the question whether or not the creation of any new departments should be envisaged in the near future. Here again some quotation will be useful—

I have heard it suggested that our School was designed in large measure to fill gaps in the research programmes of the other Australian universities. I doubt whether this suggestion is historically correct. When I submitted the first planning documents to the Interim Council about ten years ago, I had in mind the growth of a coherent School, and I have seen no evidence that this aim was subsequently discarded. As things are now, the School does not look to me at all like a group of disconnected islands; provided its growth continues along the lines set out in this paper, I think it is in a fair way to become a sufficiently coherent body. If we compare ourselves, for example, with the London School of Economics (setting aside the under-graduate responsibilities of that institution) we appear to cover the ground of the Social Sciences very well. There are, of course, some subjects (Geography, Social Anthropology, International Relations) which this University has put not in our School but in the School of Pacific Studies. Besides this, the London School of Economics, unlike ourselves, places considerable emphasis on Sociology. Like ourselves, it makes no provision for Psychology.

Before my arrival here, tentative suggestions had been made for establishing departments of Sociology and Psychology.[1] I have discussed very carefully with my colleagues in the School whether we need a Department of Psychology. There are some problems: e.g., What brand of psychology would be most useful to the rest of us? Should it be a Department of Social Psychology? Or general Psychology? If the former, we must be careful about future overlapping with the anthropologists or sociologists. We are aware that a good Department of Psychology would be fairly expensive to establish.

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[1] See Council Document 861/1956 and Council's Submission to the Government in June, 1957.

We prefer not to rush in here. We will need to consider further how psychology might fit into the work of the School (and possibly into some of the work of other Schools). My colleagues do not feel that their work is at the moment being hampered by the absence of psychologists. Later on we may decide that a Department of Psychology would strengthen us, but we do not want to make a proposal now.

We have thought carefully about sociology also. I would not be interested for the time being in adding a builder of sociological concepts and terminologies; insofar as we need in our School to keep abreast of work of that type, I should much prefer the Department of Social Philosophy to do it for us. On the institutional side, some work of a sociological character is already being done, and we might well, for the time being, encourage existing Departments (e.g., Demography, Political Science, Economics and Law) to extend the range of their inquiries a little further in the direction of sociology. As existing Departments find themselves getting more involved in general questions concerning the working of social institutions, we may then need a Professor of Sociology, to build on their work and bring it within the focus of his own interests. It could be that some members of the staff of existing Departments who had been pushing out into sociological country would transfer to the new Department.

It should not be thought that the possibilities discussed above (for Psychology and Sociology) are the only ones. It may well be that opportunities may arise (both by giving extra depth to the work of existing departments, and by creating new departments) of encouraging the growth of the School in the direction of the Humanities. As Sir Alexander Carr-Saunders has recently pointed out in his Eleanor Rathbone Memorial Lecture, the present fashion of drawing a hard-and-fast line between the Social Sciences and the Humanities is largely the result of historical accident: the division, he believes, is artificial, and some of its consequences are unfortunate. Sir Alexander will be with us from January to June, 1959, as a Visiting Fellow, and the School is bound to draw benefit both from his observations on its past performance and his suggestions for its future policy.

Meanwhile, the relationship between this School and its close neighbour, the School of Pacific Studies, have been considerably clarified during the past year. At the request of the Council, the School of Pacific Studies produced a report upon its own plans. A draft of the Report was considered by the Faculty Board of this School, and some joint discussion of "frontier questions" took place between representatives of the two Schools. Some important conclusions which emerged from the discussions were subsequently endorsed by the Board of Graduate Studies and the Council. They may be summarized as follows:—

(1) Certain "common service departments" will continue to exist and to serve the needs of both Schools. This means, for example, that the School of Social Sciences need not set up a Department of Geography; nor need the School of Pacific Studies set up a Department of Demography.

(2) Nevertheless, it is clear that expansion of the School of Pacific Studies will take place in large measure by the creation of "parallel departments". For example, it is planned to establish in the near future a parallel Department of Economics.

(3) A rigid geographical definition of the respective spheres of parallel departments could not be made or administered. Instead of a precise boundary-line it is necessary to think of a "march", or zone of overlapping activity. This, of course, calls for vigilance to prevent duplication of effort and waste of resources.

The School of Social Sciences believes that it will find these rulings helpful in achieving two objectives which the Faculty Board has thus defined:

"(1) The healthy development of each School as an autonomous body, determining policy and pursuing research within its clearly defined area of responsibility.

(2) On this basis, intimate academic collaboration between the two Schools."

The School also sets great store on close academic collaboration with the State Universities and can report considerable progress in this direction during the past year. Relations of particular intimacy exist with Canberra University College and opportunities of developing them further are under study.

Department of Demography.

Staff.

Professor	W. D. Borrie, M.A.
Fellows	C. A. Price, M.A., D.Phil.
	Norma R. McArthur, B.A., Ph.D.
Research Fellows	J. Zubrzycki, M.Sc., Ph.D. (appointed Fellow in December).
	R. T Appleyard, M.A.
Research Assistant	Ruth M. Dedman, B.Sc.
Departmental Assistants	Lillian Wilson, B.Sc.
	F. L. Jones, B.A.

Professor Leonard Broom, Dean of the Department of Anthropology and Sociology at the University of California, Los Angeles, was associated with the Department from February until August. Besides pursuing his own researches concerning the aboriginal population and class structure in Australia, Professor Broom assisted with the design of field research and participated in departmental seminars.

Dr. J. A. Hempel of the State Migration Office, Brisbane, was appointed a Visiting Fellow for three months from 15th September. Dr. Hempel spent this time writing up the results of extensive research on the settlement of post-war Italian immigrants in Queensland.

Students and Teaching.

No new scholars were enrolled in 1958.

Mr. H. Y. T'ien, M.A., continued his study of differentials in family structure in relation to economic and social status and mobility.

Mr. F. S. Henry, M.A., a second year scholar engaged in a detailed investigation of an immigrant community in an outer-suburb of Brisbane, began his major field study in October.

During the year two former students submitted theses and were recommended for their degrees—Miss K. Jupp for the M.A. and Mr. J. S. McDonald for the Ph.D. (see thesis titles below).

Fortnightly seminars on methods of demographic analyses were held during the first and second terms. Professor L. Broom also led two seminars on the theme of social stratification and the study of minorities.

Research Programme.

The Department continued to give considerable attention to the immigration studies outlined in earlier reports. In the study of post-war immigrants under the supervision of Dr. Zubrzycki the following were the main developments:—

(1) The completion of the manuscript of a statistical monograph based substantially upon census data and covering such items as the age and sex composition of immigrant groups, their occupations, geographical distribution and degree of ethnic segregation.

(2) A survey of the resettlement of displaced persons in Australia based on records relating to their selection, employment and after-care.

(3) The continuation and extension of the content analysis of the foreign-language press: by December a two-year " run " of twelve papers had been completed.

(4) Selection of the sample, design and testing of the questionnaire and pilot interviews for an extensive field survey early in 1959 of immigrants in the Latrobe Valley, Victoria.

With generous financial assistance from the Commonwealth Department of Immigration, a new three-year project was launched in January to study the expectations and achievements of British immigrants. After the design of the project was determined, Mr. Appleyard proceeded to London in July to study the operation of immigration policy there and to complete preparations for the administration of a questionnaire to a sample of 1,000 emigrants leaving the United Kingdom. In connexion with this work the Department wishes to express its appreciation of the help and advice of the officers of the London Office of the Department of Immigration, of the United Kingdom Government's Social Survey and of the Population Investigation Committee at the London School of Economics.

Until his departure in June on study leave, Dr. Price continued his writing on the history and settlement patterns of pre-war ethnic minorities. As an extension of this work, Mrs. Wilson completed a draft report on the Migration of Central and Eastern European Jews to Australia, 1840-1940.

Other fields of research given attention during the year were—

(1) Professor Borrie and Miss Dedman continued studies of the distribution and structure of the Australian population, with particular reference to patterns of urban growth, and to the interrelation between changing age composition and the future growth of the work force and new family formation.

(2) Dr. McArthur, who had given up her post as Research Fellow in 1955 to become Census Commissioner in Fiji, returned to the staff as a Fellow and was thus able to revive her comparative studies of the populations of the Pacific Islands. New work consisted mainly of analysis of data from 1956 censuses. In the course of the year Dr. McArthur also prepared an introductory handbook dealing with the collection and interpretation of population statistics for the use of administrative officers and others working in the territories of the Pacific. This work was done at the request of the South Pacific Commission and will probably be published early in 1959.

Other Activities.

During the year staff members participated in a number of meetings and conferences. Dr. McArthur chaired a discussion of the Statistical Society of Victoria on the uses of Australian demographic data; Professor Borrie delivered a paper on the measurement of population growth and structure to a conference of the New South Wales Statistical Society; and at the A.N.Z.A.A.S. Conference in Adelaide the following papers were read to Section P: Miss Ruth Dedman, "The Population of Australia, 1947-54"; and Dr. J. Zubrzycki, "The Geographical Distribution of Australia's Immigrant Population".

In May Professor Borrie gave three lectures at the University of New England on trends in world population, and in October delivered the George Judah Cohen Memorial Lecture at the University of Sydney on the subject of "The Peopling of Australia".

In June Dr. Price left for the United States where, as a Rockefeller Fellow, he intends to spend approximately ten months continuing his comparative studies of immigrant communities.

Support of Work.

The Department wishes to acknowledge the final payment of the three-year grant from the Nuffield Foundation which has so greatly assisted its research relating to post-war immigration. The Department also wishes to acknowledge the generous financial assistance of the Department of Immigration in relation to the new study of post-war British immigrants.

Publications.

Borrie, W. D.—"British people for the Commonwealth." *Papers of the Ninth Citizenship Convention.* Department of Immigration, Canberra, 1958, 18 pp.

"Australia's changing population." *Current Affairs Bulletin,* xxi, 13, 195-207.

"Immigration." *Australian Encyclopaedia,* V. pp. 65-75. Angus and Robertson, Sydney, 1958.

"Australia." *The Economics of International Migration,* ed. Brinley Thomas, pp. 163-172. Macmillan, London, 1958.

Borrie, W. D., and Dedman, Ruth.—"Population increase and decrease, 1947-1954." Commentary prepared for *Atlas of Australian Resources,* Department of National Development, Canberra, 1958, 27 pp.

Borrie, W. D., and Zubrzycki, J.—"Employment of post-war immigrants in Australia." *International Labour Review, lxxvii,* 3, 239-253.

McArthur, N. R.—*Colony of Fiji. Report on the Census of the Population, 1956.* Legislative Council, Fiji. Council Paper No. 1 of 1958, 224 pp.

Tien, H. Y.—"Taiwan: A case of overpopulation." *Asiana,* I, 2, 61-65.

"Changing trends in the Chinese-American population." *Human Biology,* xxx, 3, 201-209.

"The Chinese in New Zealand." *The Economic Conditions of the Chinese in Australasia,* ed. T. J. Liu, pp. 143-172. Overseas Publishing Co., Taiwan. (In Chinese.)

"A legal history of the constitutionality of segregation in U.S. public education." The *Australian Quarterly,* xxx, 4. 72-86.

Zubrzycki, J.—"Migration and the economy of Eastern Europe." *The Economics of International Migration,* ed. Brinley Thomas, pp. 225-237. Macmillan, London, 1958.

"The role of the foreign language press in migrant integration." *Population Studies,* xii, 1, 73-82.

"Polonia Australijska." *Kultura,* Nr. 3/125, 71-94. (In Polish.)

Theses.

The following theses were submitted and deposited in the library after examination for the degree shown:—

Jupp, Kathleen. For M.A.: "Factors Affecting the Structure of the Australian Population with Special Reference to the Period 1921 to 1933."

McDonald, J. S. For Ph.D.: "Migration from Italy to Australia with Special Reference to Selected Groups."

Department of Economics.

Staff.

Professor	T. W. Swan, B.Ec.
Reader in Economic Statistics	H. P. Brown, B.A.
Reader in Economic History	N. G. Butlin, B.Ec.
Reader in Economic Theory	I. F. Pearce, Ph.D.
Fellow	A. R. Hall, Ph.D.
Research Fellows	J. A. Barnard, Ph.D. K. H. Burley, Ph.D. W. E. G. Salter, Ph.D.
Research Assistants	G. Pursell, B.Ec. S. Zywczak, Dr.Ec. M. Gough, B.Sc. (Econ.).
Archives Section:	
Archives Officer	B. D. Shields, B.Com.
Archives Assistants	D. E. Gollan, B.A. J. A. Fitzpatrick, B.A.

Two members of staff went on study leave during the year: Professor Swan to work at the Center for International Studies, New Delhi, as from May, 1958; and Dr. Hall left in August, 1958, under arrangement with the Colombo Plan authorities, to investigate the capital market in Ceylon. Mr. Shields was appointed Archives Officer. Dr. Zywczak was appointed Research Assistant following the grant of $5,000 from the American Social Science Research Council. Mr. Pursell resigned in September to transfer to a scholarship and Mrs. Gough became a Research Assistant. In Professor Swan's absence Mr. Butlin was appointed Acting Head of the Department.

Students.

Three former students submitted theses and were awarded the degree of Ph.D.—T. M. Brown, W. P. Hogan and J. D. Pitchford.

One other student, A. J. L. Catt, completed his course and submitted a thesis which has not yet been examined. Two students, N. Cain and K. G. Jones, continued work respectively on their topics of the economics of drought and the concept of income in accountancy and economics. Two new scholars were enrolled, I. A. Parker, to study the growth of railways in south-east Australia, and Mr. G. G. Pursell to work on a thesis on "Non-Life Insurance in Australia"; a scholar from the Department of History, J. Robertson, was transferred to the Department of Economics for supervision of his thesis work "The Development of Warrah", and another scholar from the Department of Statistics worked on "A Statistical Analysis of the Cut of Wool" under the supervision of the Department of Economics.

Research.

The Department's central interest is in processes of economic growth and economic fluctuation. Research work is carried on within three sections of the Department. In economic statistics, Mr. Brown continues his work on problems of social accounting, economic forecasting and the analysis of statistics of employment and unemployment. Research in economics continues in the theory of international trade and theoretical and statistical work on consumer demand (Dr. Pearce); theoretical models of capital accumulation and economic growth (Professor Swan, Dr. Pearce and Dr. Salter); the Australian capital market (Dr. Hall); and studies of productivity, investment and the work force (Dr. Salter and Mrs. Gough). In economic history, work on the growth of the Australian economy since 1860 has concentrated on three main lines, in studies of institutions, industries and aggregate economic development. This includes the history of individual business and of the pastoral industry (Dr. Barnard); the Australian coal industry (Dr. Burley); the process of capital formation and economic development since 1860 (Mr. Butlin and Dr. Zywczak).

Other Research Activities.

A Seminar on Australian economic history was organized in which members of the Departments of History and Demography and of the Canberra University College participated. The Department also contributed papers to the Wool Seminar.

Mr. Butlin visited the University of New England to deliver lectures.

Dr. Salter attended the A.N.Z.A.A.S. Conference in Adelaide and delivered a paper on "Growth and the Capital Stock". H. P. Brown also contributed a paper "Recent Trends in Australian Employment".

Dr. Barnard completed and published his book "The Growth of the Australian Wool Market, 1840-1900".

Business Archives.

Mr. Shields made substantial progress in assembling a collection of basic research material, housed in the University's Business Archives. The Department gratefully acknowledges the gifts of extensive records from—John McIlwraith Industries Ltd., The Argus and Australasian Ltd., Patterson Laing and Bruce Ltd., B. J. Ball & Co. Ltd., Allen Taylor & Co. Ltd., Intercolonial Investment Land and Building Co. Ltd., Haymarket Permanent Land Building and Investment Co. Ltd., Australian Mercantile Land & Finance Co. Ltd., Goldsbrough Mort & Co. Ltd. (final transfer), Johns & Waygood Ltd., W. G. Hart & Son, Clarke & Co., Kilmore Free Press (J. D. MacDonnell), Weston & Co. (Kiama Independent), and T. Brunton & Co. Pty. Ltd. In addition, the following permitted access to their records for the purposes of microfilming:—

Registrar-General's Office, New South Wales—Company Registers 1874-1900.
Registrar of Friendly Societies, New South Wales—Registers, 1878-1900.
Titles Office, Company Section, Victoria—Company Registers 1864-1910.
Australian Mercantile Land & Finance Co. Ltd.—Statistical Records 1913-36.

Publications.

Barnard, J. A.—*The Growth of the Australian Wool Market 1840-1900.* (M.U.P. for A.N.U.) Melbourne, 1958.

"Wool in the New Zealand economy: A comment." *Economic Record,* December, 1958.

Burley, K. H.—"Some accounting records of an eighteenth-century clothier." *Accounting Research,* January, 1958.

"An Essex clothier of the eighteenth century." *Economic History Review*, XI (1958), 289-301.

Butlin, N. G.—*Colonial Socialism in Australia.* United States Social Sciences Research Council, N.Y., 1958.

"The shape of the Australian economy 1861-1900." *Economic Record*, April, 1958.
Business Records at the Australian National University. Canberra.

Hall, A. R.—"Institutional investment in listed company securities." *Economic Record,* December, 1958.

"The English capital market before 1914—A reply." *Economica,* November, 1958.

Hogan, W. P.—"Technical progress and production functions." *Review of Economic Statistics,* November, 1958.

Pearce, I. F.—"Demand analysis and the savings function." *Economic Record*, April, 1958.

"The place of money capital in the theory of production." *Quarterly Journal of Economics,* November, 1958.

Pursell, G. G.—"Unity in the thought of Alfred Marshall." *Quarterly Journal of Economics,* November, 1958.

Theses Completed.

The following theses were submitted and deposited in the Library after examination for the Ph.D. degree:—

Brown, T. M.: Theory of Economic Models for Forecasting and Policy.
Hogan, W. P.: Some Aspects of Economic Growth.
Pitchford, J. D.: Cost and Demand Elements in the Inflationary Process.

Department of History.

Staff.

Professor	Sir Keith Hancock, M.A., F.B.A.
Reader	L. F. Fitzhardinge, B.Litt., M.A.
Fellows	R. A. Gollan, M.A., Ph.D. D. A. Low, M.A.
Research Fellow	G. C. Bolton, M.A.
Research Assistants	Mrs. Ann Mozley, B.A. Mrs. Patience Wardle, B.A. (part-time).

Mr. Bolton arrived in Canberra in September and Mrs. Mozley in November. Mr. Low was appointed in November and is expected to arrive in Canberra in June, 1959.

Students and Teaching Activities.

Of the nine scholars and one Fullbright student, enrolled for the Ph.D., working in the Department, six were listed in the 1957 Report. The four additions are—

A. R. Barcan, " History of Public Education in Australia."
D. L. Carrington, " Social History of the Goldfields in New South Wales."
R. J. Lawrence, " The Development of Professional Social Work in Australia."
J. Robertson, " Warrah—The History of a Pastoral Property."

Mr. Barcan commenced work under his scholarship in Britain. He will arrive in Canberra in February, 1959. Three new scholarships have been awarded in the Department for 1959. The names of these scholars and proposed research subjects are—

B. E. Kent, " The Political Effects in Germany of Reparations."
M. J. E. Steven, " Robert Campbell."
I. A. Turner, " Syndicalism and the Australian Labour Movement."

The thesis by E. G. Docker, on " Native Administration in the Northern Territory ", submitted for re-examination, failed to satisfy the examiners.

During the year Professor C. M. H. Clark, of the Canberra University College, has assisted in the supervision of scholars.

Research Programme.

As opportunity offers, the programme is being extended beyond the field of Australian history. In accordance with this policy, Mr. Low has been appointed to work on Commonwealth history. This does not mean that any retreat from Australian studies is envisaged. On the contrary, it has been decided—if encouragement and help are forthcoming from other Australian universities—to press ahead with work for *A Dictionary of Australian Biography*. Mrs. Mozley will assist with this work.

Professor Hancock: as reported in 1957.

Mr. Fitzhardinge: (1) as reported in 1957, (2) edition of Tench in course of publication.

Dr. Gollan: (1) as reported in 1957, (2) " Radical and Working Class Politics in Australia 1850-1910 " in course of publication.

Mr. Bolton: A Social History of North Queensland. " The Parliamentary Background of the passing of the Irish Act of Union ", has been submitted for the degree of D.Phil. (Oxford).

Mrs. Mozley: see above.

Mrs. Wardle: as reported in 1957.

Seminars.

(1) The seminar on wool met fifteen times during the year and again considered a wide range of topics connected with wool in Australia. It was decided that the seminar should lead to the preparation of a two-volume work. Volume I. would be a critical history of the industry from about 1850 to the present day. Volume II. would consist of special studies grouped under various headings, e.g., applied science, economics, statistics. The first meeting in 1959 will discuss a paper by Professor Hancock and Dr. Barnard on a suggested outline of the two volumes.

(2) A work in progress seminar was held for scholars of the Department and some others.

(3) Members of the Department participated in seminars conducted elsewhere, most notably the Departments of Economics and Political Science.

Other Activities.

Professor Hancock read papers to the Second International Congress of Historians of the United States and Mexico (Texas), and to the A.N.Z.A.A.S. Conference in Adelaide. He also lectured and conducted seminars in the University of Tasmania from 18th April to 26th April.

Mr. Fitzhardinge conducted a full course of lectures in Ancient History at the Canberra University College.

Dr. Gollan spent third term lecturing on Australian History in the University of Melbourne. He also read a paper to the Royal Australian Historical Society on " Newcastle Miners and Colliery Proprietors 1860-80 ".

Publications.

Bolton, G. C.—*Alexander Forrest: His Life and Times.* Melbourne: Melbourne University Press, 1958.
Hancock, W. K.—" Trek." *The Economic History Review,* X, 3 (December, 1958).
O'Farrell, P. J.—" The Australian Socialist League and the Labour Movement, 1887-1891." *Historical Studies,* Vol. 8, No. 30.
Roe, O. M.—" Australia's Place in ' The Swing to the East ', 1788-1810." *Historical Studies,* Vol. 8, No. 30.
Ward R. B.—*The Australian Legend.* Melbourne: Oxford University Press, 1958.

Department of Law.

Staff.

Professor	.. .. ..	G. Sawer, S.M.; B.A., LL.M., of the Victorian Bar
Senior Fellow	.. .. ..	S. J. Stoljar, LL.B., LL.M., Ph.D., of Gray's Inn, Barrister-at-law.

Students and Teaching Activities.

Mr. R. J. L. Hawke (supervised by Professor Sawer) completed his work on the assessment of the basic wage in Australia. He was appointed to the position of Research Officer and Advocate with the Australian Council of Trade Unions.

Mr. A. Harari (supervised by Dr. Stoljar) continued his work in the field of the law of torts.

Mr. D. K. R. Singh was enrolled for the Ph.D. under the supervision of Professor Sawer, his field of work being a comparative examination of problems of excess of power and breach of prohibitions under federal constitutions.

During the third term, the Department held a series of joint seminars on sociological theories, at which papers were delivered by Dr. Stoljar and Professor Sawer, and by the following visiting lecturers; Mr. E. K. Braybrooke, Reader in Law at the University of Western Australia; Professor Norval Morris, Dean of the Faculty of Law at Adelaide and Professor Julius Stone, Challis Professor of International Law at the University of Sydney. Papers were also delivered by Professors Partridge and Passmore and Dr. Pappe of the Department of Social Philosophy, and Professor Barnes of the Department of Anthropology. It is intended to publish a revised selection of these papers.

Research Programme.

Dr. Stoljar continued his researches into the laws of contract and personal property as well as work on his book on the law of agency.

Professor Sawer continued his work on Australian public law. In his federal political and constitutional history, he dealt particularly with the later Lyons and the first Menzies governments.

Other Activities.

Professor Sawer sat on six occasions as Magistrate in the Canberra Court of Petty Sessions, and determined a case as Arbitrator under the Workers' Compensation Ordinance. Dr. Stoljar and Professor Sawer attended the annual conference of the Australian Universities Law Schools Association in Melbourne in September, where Dr. Stoljar presented a paper on a general theory of representation. Later in September Professor Sawer attended a conference on problems of rabbit control organized by the C.S.I.R.O. in Melbourne; he delivered a paper on problems of constitutional and administrative law which arise in connexion with technical methods of rabbit control now being proposed. (This paper will be published.) In October, Professor Sawer was a guest lecturer at the Administrative Staff College at Mount Eliza, Victoria. He continued his editorial activities on *Public Law* and the *Modern Law Review*, to which he contributed current notes on Australian legal developments.

Publications.

Sawer, G.—*Australian Government Today*, Melbourne University Press, 1958, 6th ed., revised, pp. 50.

"Government as Personalized Legal Entity" in *Legal Personality & Political Pluralism* (ed. Leicester C. Webb), 1958, Melbourne University Press, pp. 158-177.

"Judicial Decisions affecting Public Administration" (1957), XVII *Public Administration*, pp. 97-111.

"The Supreme Court and the High Court of Australia" (1958), 6 *Journal of Public Law*, pp. 482-508.

"Some Legal Assumptions of Constitutional Change" (1957), IV *University of Western Australia Annual Law Review*, pp. 1-18.

"Constructive Desertion of Children" (1958), 32 *Australian Law Journal*, pp. 42-47.

Stoljar, S. J.—"The Corporate Theories of Frederick William Maitland" in *Legal Personality & Political Pluralism* (ed. Leicester C. Webb), 1958, Melbourne University Press, pp. 22-44.

"The Internal Affairs of Associations" in *Legal Personality & Political Pluralism* (ed. Leicester C. Webb), 1958, Melbourne University Press, pp. 66-92.

"The Representative Action: The Modern Position" (1957) IV *University of Western Australia Annual Law Review*, pp. 58-73.

"The Delivery of Chattels" (1958), 21 *Modern Law Review*, pp. 27-42.

"The Doctrine of Acceptance in Sales" (1958) I *Melbourne University Law Review*, pp. 483-497.

Department of Political Science and of International Relations.

Staff.

Professor	L C. Webb, M. A.
Reader in Public Administration	R. S. Parker, M.Ec.
Senior Fellow	Lord Lindsay of Birker, M.A.
Fellow	A. L. Burns, M.A.
Research Fellows	D. W. Rawson, M.A., Ph.D. J. A. Modelski, B.Sc. (Econ.), Ph.D. R. Gavin Boyd, B.A.
Research Assistants	Miss R. Groves, B.A. Mrs. N. Heathcote, B.A.

During 1958, pursuant to a decision of the Council, the Department of Political Science and the Department of International Relations were brought together as a temporary arrangement. The members of the former Department of International Relations—Lord Lindsay, Mr. A. L. Burns, Dr. J. A. Modelski, Mr. R. Gavin Boyd and Miss R. Groves—are continuing to function as a unit within the combined Department.

Students.

Mr. R. P. Deane, B.Ec., an officer of the Department of Trade, was awarded in July one of the first Commonwealth Public Service Fellowships at the University, and took up his Fellowship in this department on 1st September. His research project for the year is: " A case study in administrative change—the functions and organization of the Department of Commerce and Agriculture since 1950, and developments leading to the establishment of the Department of Trade in 1956." Mr. Deane has relevant experience in the Departments of the Treasury, Commerce and Agriculture, and Trade, and has been granted access under satisfactory conditions to appropriate departmental records.

Mr. B. D. Graham, M.A., completed his thesis on the Australian Country Party. He was awarded a British Council scholarship and is at present working at St. Antony's College, Oxford, on some aspects of French post-war politics.

Mr. D. W. Hindley, M.A., took up a scholarship in September and is working on some aspects of post-war politics in Indonesia.

Mr. R. M. Martin, M.A., completed his thesis on relations between trade unions and the State in Australia. He was awarded a Rockefeller Fellowship, and is at present continuing his work on trade unionism at Nuffield College, Oxford.

Mr. A. C. Palfreeman completed the case work for his thesis on the administration of the White Australia policy. His scholarship terminates in March, 1959. During the year his knowledge of South-East Asia was of value to those working on the Seato project.

Mr. V. Subramaniam, M.A., B.Sc., is completing his thesis on " Promotion in the Commonwealth Public Service " for submission for the Ph.D. degree. He was awarded a prize in the 1958 essay competition of the A.C.T. Group of the Royal Institute of Public Administration, for a study of staff classification arising out of his Ph.D. research.

Mr. Mao-Tsai Wu, Ll.B., a research scholar enrolled for the M.A. degree, took up his scholarship in September. His research project will probably be concerned with an aspect of local government in Australia.

Research Activities.

Dr. D. W. Rawson, assisted by Mrs. Heathcote, organized a survey of the 1958 Federal election in Australia. This is a further extension of the department's research into political campaigns and voting behaviour, which has so far included studies of the 1951 (Anti-Communist) referendum and of election campaigns in particular electorates. The present project is being carried out with the assistance of workers in the various State capitals, and will include material on how the political parties planned, financed and conducted their election campaigns, as well as an analysis of the results. A particularly intensive study is being made of the Sydney electorate of Parkes. This will consist of a detailed examination of how the campaign was conducted in this area, together with the voters' reactions, as indicated by sampling procedures.

The international relations unit within the Department organized a survey of the origins and functioning of the South-East Asia Treaty Organization and of the impact of the treaty on international relations in the South-East Asia region. During the year Dr. Modelski, who is responsible for the co-ordination of this work, visited Bangkok to study the organization of the SEATO Secretariat and also spent some time in Laos. Miss Groves is working on Indian reactions to SEATO, and Mr. Warren Hogan, a former scholar in the Economics Department and now on the staff of Newcastle University College, has been studying the pattern of economic relationships within the treaty area. In the third

term a seminar was held to enable work done on the SEATO project to be tentatively formulated and discussed. Papers were read by Dr. Modelski, Mr. Hogan, and Miss Groves. Mr. R. G. Boyd, a member of the research side of the SEATO Secretariat in Bangkok, has accepted appointment as a Research Fellow and will be collaborating in the Department's SEATO project.

Mr. R. S. Parker devoted considerable time to research in connexion with the Prime Minister's Committee of Inquiry into Commonwealth Public Service Recruitment, of which he was a member.

Other Activties.

Mr. Parker prepared and delivered the following papers:—" Administration of the A.C.T. and Relations between the Administration and any Local Government Body " (in a Seminar on the Government of the A.C.T., conducted by Mr. S. Encel at the Canberra University College); " Australian Approaches to Federalism " (in a Seminar on Australian Political Thought conducted by the Political Science Department); " Public Enterprise in New South Wales " and " Group Interests and the Non-Labor Parties since 1930 " (both read to Section E. of A.N.Z.A.A.S., 1958 meeting); " Recruitment—Aims, Methods and Problems Emerging " (to the Conference of the Australian Regional Groups, Royal Institute of Public Administration, November, 1958).

In connexion with the first Conference of Australian Regional Groups of the Royal Institute of Public Administration, held in Canberra in November, Mr. Parker delivered the paper mentioned above, assisted in organization, and prepared background papers based on a survey of staff recruitment practices in public services and public corporations throughout Australia. In October he acted on a panel of speakers at a public conference in Melbourne on the subject of " Tomorrow's Executives ", sponsored jointly by the University of Melbourne Appointments Board and the Employers' Federation. As in previous years, Mr. Parker gave lectures in the theory of organization at the Bankers' Administrative Staff College, Melbourne, and at the South-East Asia, New Zealand and Australian Central Banking Course, Sydney; and on public service systems of Australia at Assistant Secretaries' conferences conducted by the Public Service Board, Canberra. He also continued as organizer of research study groups for the A.C.T. Group of the Royal Institute of Public Administration.

Lord Lindsay took the first part of his study leave in Taiwan, where he studied the land reform programme. In August, after spending some weeks in Japan, he went to Yale University as a Visiting Professor in the Department of Political Science. At Yale he has been lecturing in Far Eastern politics. During his study leave Lord Lindsay completed his book on the possibility of peaceful co-existence and extracts from it appeared in *The New Republic.*

In June Mr. A. L. Burns went to Princeton University on a research grant from the Woodrow Wilson Center of International Studies. He is working mainly on the impact of new weapons on the structure of international relations. He also took part in seminars on international relations at the University of Chicago arranged by Professor Morton Kaplan.

A seminar on Australian political thought was held in the second term. Papers were read by Mr. S. M. Ingham (University of New South Wales), " Conservatism in Australia before the Fusion "; Dr. Rawson, " Labour Socialism and the Working Class "; Mr. T. L. L. Suttor, " Catholic Social Thinking in Australian Politics "; Mr. R. S. Parker, " Australian Approaches to Federalism "; Professor P. H. Partridge, " Conservatism Since the Depression ".

Mr. B. D. Graham prepared a paper on " The Interest Backing of the Australian Liberal and National Parties: 1910-1930 ", which was presented on his behalf to Section E of the 1958 A.N.Z.A.A.S. meeting.

Dr. Modelski tabled a paper on " The South-East Asia Treaty Organization " at the A.N.Z.A.A.S. meeting.

Publications.

Burns, A. L.—" The New Weapons and International Relations." *The Australian Outlook,* XII, 2, 32-42.

" The International Consequences of Expecting Surprise." *World Politics,* X, 4, 512-536.

Martin, R. M.—" Legal Personality and the Trade Union " in *Legal Personality and Political Pluralism,* ed. L. C. Webb, pp. 93-142.

" The Rise of the Australian Council of Trade Unions." *The Australian Quarterly,* XXX, 1, 30-42.

Modelski, J. A.—" Communist China's Challenge in Technology." *The Australian Quarterly,* XXX, 2, 57-68.

Palfreeman, A. C.—" The End of the Dictation Test." *The Australian Quarterly,* XXX, 1, 43-50.

Parker, R. S.—" Structure and Functions of Government " and " Executive Development in the Commonwealth Public Service ", being Chapters 3 and 17 respectively of *Public Administration in Australia,* ed. R. N. Spann, Sydney, Government Printing Office, 1958.

" Public Enterprise in New South Wales." *Australian Journal of Politics and History,* IV, ii.

Subramaniam, V.—" The political rights of Commonwealth public servants." *Public Administration,* XVII, i, 22-33.

Webb, L. C.—*Church and State in Italy: 1947-57.* Melbourne University Press and A.N.U., 1958.

" Corporate Personality and Political Pluralism " (pp. 45-65) and " Pluralism and after " (pp. 178-197) in Webb, L. C. (ed.) *Legal Personality and Political Pluralism.* Melbourne University Press and A.N.U., 1958.

Department of Social Philosophy.

Staff.

Professor of Social Philosophy	..	P. H. Partridge, M.A.
Professor of Philosophy ..	..	J. A. Passmore, M.A.
Research Fellows	..	R. R. Brown, B.A., Ph.D.
		H. O. Pappe, Dr. jur.

Students and Teaching Activities.

Three students were engaged on work for the Ph.D. Mr. D. B. Heron, who enrolled in March, has been engaged in preliminary studies for a thesis on empiricist theories of meaning; Mr. D. W. Dockrill, who enrolled in September, began his reading for a thesis on relations between religion and philosophy in the nineteenth century; Mr. N. S. Thornton is now well under way with a thesis which will take the form of a set of studies on individuality, freedom and the State.

Professor Passmore gave a series of lectures throughout the year on the philosophy of Wittgenstein, and Dr. Brown discussed with students recent developments in philosophy. All members of the department participated in a joint seminar with the departments of Philosophy and Psychology at Canberra University College, to which Professor Passmore read two papers (one on " Explanation " and one on " Balancing "), and with the department of Law in a series of seminars on the Sociology of Law, to which Professor Partridge, Professor Passmore and Dr. Pappe read papers on Ehrlich, Hägerström and German Philosophy of Law respectively. The department also participated in seminars on Australian Political Philosophy, to which Professor Partridge read a paper on " Australian Conservative Thought, 1928-56 ".

Research Programme.

Professor Partridge continued his work on recent political and social theory, with special reference to democratic and pluralistic theory. Professor Passmore was mainly concerned to carry further his work on methodology, in preparation for a study of the nature of explanation. He completed for publication a number of articles, mainly on the philosophy of history. Dr. Brown embarked upon the writing of a book on methodological problems in social science. Dr. Pappe, who joined the staff in April, is making a study of recent trends in German social thought, in its relationship to British thought.

Other Activities.

Professor Partridge visited the University of New England to deliver the Occasional Address at the Conferring of Degrees. He spoke on: " The Importance of Science—Physical Science and Social Science ". On the same occasion he delivered a lecture to staff and students on " The Present State of Political Theory ". At the University of Sydney, he spoke on " Liberalism and Authoritarianism ", and, as part of a series of lectures on Darwin, discussed " The Contribution of Darwin to Sociology "; he accepted an invitation from the University of New South Wales to address them on " The Growth of Universities ", and from the Canberra branch of the Royal Institute of Public Administration to talk on " The Politics of Federalism ".

Professor Passmore read papers to history and philosophy seminars at the University of Melbourne, and spoke on " Darwin and Philosophy " to senior science students at the University of Sydney. He participated in editorial work on the forthcoming *Survey of the Humanities in Australian Universities,* to which he has also contributed two chapters. Dr. Brown read a paper on " Unfalsifiable Hypotheses " to the Annual Conference of the Australasian Association of Philosophy; Dr. Pappe addressed the Canberra branch of the Association on " German Philosophical Anthropology ", and Professor Passmore spoke on " Explanation and Law in History ".

Publications.

Bradley, R. D.*—" Free Will: Problem or Pseudo-problem." *Aust. Jnl., Phil.,* XXXVI (1958), pp. 33-45.

Kamenka, E.*—" The Baptism of Karl Marx." *Hibbert Journal,* Vol. 56, No. 4, (July, 1958), pp. 340-351.

Partridge P. H.—" On Liberty—a J. S. Mill Centenary." *Current Affairs Bulletin,* Vol. 23, No. 1 (1958), pp. 3-15.

" Politics as a university subject." *Aust. Journal of Politics and History,* IV (1958), 19-30.

Passmore, J. A.—" Ludwig Wittgenstein." *Current Affairs Bulletin,* XXI (1958), pp. 99-112.

" The Objectivity of History." *Philosophy,* XXXIII (1958), pp. 97-111.

" Contemporary British Philosophy." *Aust. Jnl. of Philosophy,* XXXVI (1958), pp. 57-69.

" History and Sociology." *Aust. Jnl. of Politics & History,* III (1958), 218-228.

" William Harvey and the Philosophy of Science." *Aust. Jnl. Philosophy,* XXXVI (1958), pp. 85-94.

Department of Statistics.

Staff.

Professor . .	P. A. P. Moran, M.A., D.Sc.
Reader . .	J. E. Moyal, Dipl. de l'Inst. de Stat. (Paris).
Senior Fellow . .	G. S. Watson, B.A., Ph.D.
Fellow . .	E. J. Hannan, B.Com., Ph.D.

Mr. J. E. Moyal joined the department as Reader in August and Mr. J. O'Mahony, an officer of the Bureau of Meteorology, as a Public Service Fellow, in October. Mr. C. R. Heathcote joined as a scholar in February. Mr. J. Mallyon spent the year in the department as a Commonwealth Bank scholar, and is jointly supervised with the Department of Economics. Dr. Hannan resigned at the end of the year on being appointed to the Chair of Statistics in the Canberra University College.

A fortnightly seminar was held throughout the year and courses were given on stochastic processes (Professor Moran), time-series analysis (Dr. Hannan) and statistical methods (Dr. Hannan).

Three students, Mr. C. R. Heathcote, Mr. J. S. Mallyon and Mr. G. A. Watterson were working in the Department.

Research Programme.

A. *Population Genetics* (Professor Moran and Mr. G. A. Watterson).—Work continued during the year on a number of aspects of population genetics, in particular, the effect on evolutionary processes of the probability distribution of the number of offspring, and of the partial isolation of subpopulations. Professor Moran began the preparation of a book on the mathematical genetics of natural populations.

B. *Point Processes* (Mr. Moyal).—A general theory of point processes was developed. This is to be published as a monograph by the University of California. The extinction probabilities for the general point process multiplicative chain were found and two papers are in preparation on this subject.

C. *Incomplete Discontinuous Markov Processes* (Mr. Moyal and Mr. C. R. Heathcote).—The theory of such processes, previously developed by Moyal has been extended, and applied to a detailed discussion of the random walk in continuous time, with absorbing and reflecting boundaries. The same theory was applied to obtain a general solution of the n-server queue with exponential arrival and serving times.

D. *Time Series* (Dr. Hannan).—The spectral theory of stationary processes was generalized to processes defined on a locally compact Abelian Group. A book on stationary processes was completed and the manuscript sent to the publishers.

E. *Logistic Processes* (Mr. Heathcote).—A method was found of solving the equations of a stochastic version of the logistic process. Further work is proceeding in an attempt to obtain the solution in a manageable form.

Further Activities.

Mr. Moyal and Dr. Hannan gave lectures at the meeting of the Mathematical Society in August. Professor Moran spent a month at the University of Western Australia and gave a course on population genetics. Dr. Hannan gave short courses on time series analysis at the Universities of New South Wales and Melbourne. Professor Moran gave seminars at the University of New South Wales and the Bureau of Meteorology in Melbourne.

* Work completed while a scholar of the Australian National University.

Publications.

Hannan, E. J.—" The asymptotic powers of certain tests of goodness of fit for time series." *Jour. Roy. Statis. Soc.* (B), XX (1958), 143-151.

Moran, P. A. P.—" Random processes in genetics." *Proc. Cam. Phil. Soc.*, LIV (1958), 60-71.

" A general theory of the distribution of gene frequencies. I. Overlapping generations." *Proc. Roy. Soc.* B. CXLIX (1958), 102-112.

" A general theory of the distribution of gene frequencies. II. Non-overlapping generations." *Proc. Roy. Soc.* B CXLIX (1958), 113-116.

" Inequalities for the Bessel function I_n (x)." *Q. Jour. Math.*, VIII (1957), 287-290.

" Dam storage and the theory of probability." *Jour. Inst. of Engineers, Aust.* (1958), 146-148.

" Another test for heterogeneity of host resistance in dilution assays." *J. Hygiene*, LVI (1958), 319-322.

" The distribution of gene frequencies in a bisexual diploid population." *Proc. Cam. Phil. Soc.*, LIV (1958), 468-474.

" The effect of selection in a haploid genetic population." *Proc. Cam. Phil. Soc.*, LIV (1958), 463-467.

Watterson, G. A., Muncey, R. W.*—" Heating of surfaces by buried pipes: calculation of the steady and periodic states." *Aus. Jour. App. Sci.*, VIII (1957), 271-278.

Watson, G. S.—" On Chi-square goodness-of-fit tests for continuous distributions." *Jour. Roy. Stat. Soc.*, B XX (1958), 44-72.

" On Goldberg's theory of the precipitin reaction." *J. Immunology*, LXXX (1958), 182-185.

Watson, G. S., Binet, P. E.* and Sawers, R. J.*

" Heredity counselling for sex-linked recessive deficiency diseases." *Ann Human Genetics*, XXII (1958), 144-152.

* Not a member of the Australian National University Staff.

The Research School of Pacific Studies.

Dean's Remarks.

Professor J. A. Barnes took up duty as Professor of Anthropology on 1st June, 1958; prior to that date he had been able to assist the work of the Department of Anthropology and Sociology by visits to Canberra and by discussions with staff and students in Sydney. In March, Dr. H. C. Brookfield, formerly a Senior Research Fellow, was appointed Reader in Social Geography.

During the period December, 1957-May, 1958, Professor G. S. Graham, Rhodes Professor of Imperial History in the University of London, was a visitor jointly to the Department of Pacific History and the Department of History in the Research School of Social Sciences.

In May the Dean represented the University at a meeting of the South Pacific Commission Research Council. In September he visited the Territory of Papua and New Guinea and also the head-quarters of the Western Pacific High Commission, at Honiara, in the British Solomon Islands Protectorate, to discuss the development of the School's work in New Guinea and the High Commission territories.

In the annual report for 1957 reference was made to the recommendation by Council to the Board of Graduate Studies that there should be a re-examination of " the role of the Research School of Pacific Studies within the University ". The Board of Graduate Studies, in turn, invited the Faculty Board of the School to consider and report on this subject. In April the Faculty Board began a systematic analysis of the problems of its long-term development and of its relationship with both the Research School of Social Sciences and other institutions outside the University concerned with research in Asia and the Pacific. Towards the end of June a draft report was completed and discussed with the full Faculty of the School and with the Faculty Board of the Research School of Social Sciences. The final report was presented at the beginning of July.

In brief, this report recommended that the organization and work of the School should continue broadly on its present lines. It recognized that there could be no rigid line of division between the field of work of the School and that of the Research School of Social Sciences but that the interests of both would continue to be served best by close co-operation between the departments and the individual members of the two Schools. Within this general framework, certain developments were proposed. The most important of these were—

(1) The establishment of a department of economics for the study of the economics of under-developed areas;

(2) The development of inter-disciplinary research projects, initially in New Guinea, and the establishment of a special New Guinea research unit to assist in the carrying out of such projects;

(3) The establishment of a Readership in Bio-geography;

(4) The development of archaeology, initially within the Department of Anthropology and Sociology, when funds became available.

The report also noted or discussed a number of other matters, including—

(1) The discussions which had already begun between the University and Canberra University College regarding the establishment of an Institute of Oriental Studies under their joint sponsorship and control;

(2) The possibility of obtaining outside financial assistance particularly for the conduct of inter-disciplinary projects;

(3) The appointment of a Director.

This report was considered by the Board of Graduate Studies on 8th July and by the Council on 11th July. It was endorsed by both bodies in principle. Of the major new developments proposed, the School had asked for an early decision on two: the department of economics; and the New Guinea research unit. Authority has subsequently been given for the appointment of an electoral committee to fill the proposed chair of economics. The Board, on 8th July, asked for a fuller explanation of the proposal for a New Guinea research unit. A supplementary report was prepared on this subject and considered by the Board on 26th September and 31st October. At the latter meeting it was approved and submitted to the Council for adoption. The Council endorsed the report on 14th November but asked that further consideration should be given to one matter relating to the staffing of the unit.

One other matter requiring an immediate decision arose in connexion with the report. This was the form of administration of the Department of International Relations during such time as the chair remains unfilled. It will be recalled that in December, 1957, Professor Webb (Professor of Political Science in the Research School of Social Sciences) had been appointed Acting Head of Department. The department then remained in the Research School of Pacific Studies; and, as Acting Head, Professor Webb became a member of the Faculty Board of the School. After further consideration

by a joint committee of both Schools, it was agreed that, during the vacancy in the chair, Professor Webb should remain as Acting Head and that the department should be joined to the Department of Political Science. During this interim period, recommendations regarding appointments (apart from that of a Professor or Reader, which is a matter for the Board of Graduate Studies) will be made by a committee consisting of the Head of the Department, the Director of the Research School of Social Sciences, and the Director or Dean of the Research School of Pacific Studies. When the chair is filled, a decision will be made by the Board of Graduate Studies as to which School the department shall be placed in.

During the latter months of the year, a number of steps have been taken in line with the recommendations of the report. Some preliminary work has been done in seeking outside financial support. A social survey of the native population of Port Moresby has been organized as the first stage in a comprehensive study of the problems of urbanization in that area. Plans have been made for work in the fields of anthropology, economics, history and administration in the Gazelle Peninsula of New Britain. The School has been glad to have the opportunity of co-operating with the Commonwealth Bank in a study which the Bank is proposing to undertake of problems of credit and banking in New Guinea.

In these and in a variety of other ways the year has, thus, been one of re-thinking policy and planning for the future. The ordinary work of the School—in research and teaching—has continued normally. There were 24 students enrolled in the departments of the School (including several for part of the year only). Three former students received the Ph.D. degree in May and one the M.A. One has been recommended for the award of the Ph.D.

Department of Anthropology and Sociology.

Staff.

Professor	J. A. Barnes, D.S.C., M.A., D.Phil. (from 1st June).
Readers	W. E. H. Stanner, M.A., Ph.D. (Comparative Social Institutions). J. D. Freeman, Ph.D. (Social Anthropology).
Senior Fellow	S. A. Wurm, Ph.D. (Linguistics).
Research Fellows	Paula Brown, M.A., Ph.D. A. L. Epstein, Ll.B., Ph.D. (from 19th August). P. Lawrence, M.A., Ph.D. (until 26th May). R. E. C. Penny, B.A. (until 31st March).

Dr. Wurm acted as head of the Department until March, and Dr. Freeman until the end of May. Professor Barnes, formerly Professor of Anthropology in the University of Sydney, took up his duties as head of the Department on 1st June. Dr. Epstein assumed his Research Fellowship on 19th August. Dr. Epstein graduated in Law at Queen's University, Belfast, in 1944 and in 1955 took his Doctorate in Social Anthropology in the University of Manchester. He has carried out extensive field research in urban sociology in Central Africa. Dr. Lawrence resigned his Research Fellowship on 26th May on appointment as Lecturer (Staff Tutor) at the Australian School of Pacific Administration, Mosman. Dr. Lawrence had been absent on leave while acting as Senior Lecturer at A.S.O.P.A. since 1957. Mr. Penny's Research Fellowship expired on 31st March and he then took up an appointment as Lecturer in the Department of Psychology, University of Adelaide.

Dr. Stanner returned to Canberra in August from the Port Keats region of the Northern Territory, where he had been carrying out field research. He returned to the same locality in October. In March, Dr. Freeman returned from fieldwork among the Iban of Sarawak. Dr. Wurm proceeded to the New Guinea Highlands in May to carry out a linguistic survey. Dr. Brown spent the period from April to September in the Chimbu Sub-district, New Guinea.

Students and Teaching Activities.

During the year there were fourteen students enrolled in the Department. Nine of these were at the University for all or part of the year, pursuing a course of study leading to the Ph.D. degree. Four students were completing their theses elsewhere for the degree after leaving this University. One student was awarded the degree of M.A., and then enrolled as a Ph.D. candidate. One Fulbright student was enrolled as not proceeding to a degree here. The degree of Ph.D. was conferred on Miss Marie Reay in May. Two students held Research Scholarships throughout the year. Four new scholarships were taken up, one by a former Fulbright scholar, and one by a successful M.A. candidate. One former scholar and one other student received grants-in-aid.

A former scholar was appointed to a Lectureship in Auckland University. Another scholar went to the University of Queensland as Lecturer in the Department of Psychology, and a third student was made Acting Lecturer in the University of Sydney, Department of Anthropology.

Mr. Beckett's M.A. thesis on part-aborigines in western New South Wales was completed during the year, and articles based on it are being published. Work on several Ph.D. theses continued throughout the year and some are now nearing completion. Mr. Tugby submitted his completed thesis on social organization among the Mandailing of Sumatra, and it will be examined in early 1959.

Seminar papers on recent and projected field research were read and discussed during the second and third terms. One or more papers were presented by: Mr. Sivertsen (caste, economics and politics in a Tamil village of Madras); Mr. Madan (domestic groupings and lineage structure among the Pandits of Kashmir); Miss Munn (symbolism among aborigines of Central Australia); Professor Barnes (marriage in Western Norway); Miss Adler (problems of research among aboriginal women); Dr. Paula Brown (unilineal structure and warfare in Chimbu, New Guinea Highlands); and Dr. A. L. Epstein (a study of Rabaul). Dr. Brookfield of the Department of Geography read a paper on land ownership and utilization in Chimbu, and Dr. T. Scarlett Epstein, wife of Dr. A. L. Epstein, provided two papers on the impact of irrigation on two Indian villages.

Professor Barnes gave a paper on Administrative policies and indigenous polities in the seminar on problems of administration organized by the Department of Pacific History, and read a paper on the Sociology of law in the seminar organized by the Department of Law, Research School of Social Sciences. Professor Barnes also gave a public lecture in the series organized by the Canberra University College, and spoke to a meeting of the Anthropological Society of South Australia in Adelaide, while attending the A.N.Z.A.A.S. meeting there. He lectured at the University of Sydney on the impact of Darwin's *Origin of species* on 19th century anthropology.

Research Programme.

Professor Barnes paid a brief visit to Alice Springs to gain an idea of the conditions under which research might be carried out in that region.

Dr. Stanner returned from Port Keats in August. The interim results of his research on aboriginal rock paintings and artefacts discovered in that region were described in public lectures given in University House, in Sydney to the Anthropological Society of New South Wales, and to Section F, A.N.Z.A.A.S., in Adelaide. Dr. Stanner served as President of Section F at the A.N.Z.A.A.S. meeting and delivered an address dealing with the future prospects for Australian aborigines.

Dr. Freeman returned from Sarawak in March and has been engaged in preparing for publication the results of his researches among the Iban.

Dr. Wurm began a comprehensive survey of the languages of the New Guinea Highlands. He toured almost the whole accessible area of the Highlands and collected material in texts and on tape from 58 languages and dialects. The analysis and publication of this large body of material is expected to be a major task.

Dr. Brown carried out research in the Chimbu Sub-district, New Guinea Highlands, partly in collaboration with Dr. Brookfield, Department of Geography. She paid particular attention to questions of leadership and authority, as affected by the present system of Government-appointed tultuls and luluais, and with Dr. Brookfield to problems of land acquisition and utilization.

In January, Mr. Sivertsen returned from India, where he had been working in a Tamil village in Madras. He has since been engaged in writing his final report in thesis form. Mr. Madan completed his field work in Kashmir and returned to Canberra in March. He has also been working on his thesis. Mr. Peranio continued his fieldwork among the Bisaya of Sarawak. He is expected to return to Canberra in early 1959.

Three new field projects by students were started during the year. In January Mr. Hiatt began a study of contemporary conditions among the aborigines of Northern Arnhem Land, with his base camp at the Government settlement under construction at Maningrida on the Liverpool River. In October Mr. Allen went to Aoba in the New Hebrides to undertake a study of economic enterprise and systems of social control. This inquiry is being undertaken in association with the Colonial Social Science Research Council of the United Kingdom Colonial Office. Part of the cost of the project is being met from Colonial Development and Welfare Funds. Mr. Beckett went to the Torres Strait Islands, Queensland, in October to investigate the working of Native Councils and economic enterprises.

Miss Adler, a Fulbright scholar, was attached to the Department, but was not registered for a degree.

Publications.

Barnes, J. A.—" Social anthropology in theory and practice." *Arts: the proceedings of the Sydney University Arts Association,* 1 : 47-67.

Freeman, J. D.—" Iban pottery." *Sarawak Mus. J.* 8 : 153-176.

" To wake a lexicographer." *Sarawak Mus. J.* 8 : 409-421.

Penny, R. E. C.—" Age and sex differences in motivational orientation to the communicative act." *Child development,* 29 : 163-171.

Stanner, W. E. H.—" On the interpretation of cargo cults." *Oceania,* 29 : 1-25.

Tugby, D. J.—" A typological analysis of axes and choppers from south-east Australia." *American antiquity,* 24 : 24-33.

Theses.

During the year the following theses were submitted and deposited in the Library after examination for the degree shown—

J. R. Beckett.—For M.A.—" A study of a mixed-blood aboriginal minority in the pastoral West of New South Wales ".

Richard F. Salisbury-Rowswell.—For Ph.D.—" Economic change among the Siane tribes of New Guinea ".

Department of Far Eastern History.

Staff.

Professor	C. P. FitzGerald.
Senior Research Fellows	G. Mulder, Drs. T. W. Eckersley, B.A. (from October, 1958).
Research Fellows	N. Barnard, B.A., Ph.D. E. S. Crawcour, M.A., Ph.D. (from 31st July, 1958).
Research Assistant	Sybille M. van der Sprenkel, B.A., M.Sc. (Econ.).

The Research Fellowship left vacant by the appointment of Mr. B. C. McKillop to the Senior Lectureship in the Department of Oriental Studies, the University of Sydney, was filled by the appointment of Dr. E. S. Crawcour, who obtained his doctor's degree in this University in 1955. A new post, a Senior Research Fellowship, was filled by the appointment of Mr. T. W. Eckersley. These posts give the department the much-needed staff for research in Japanese history and supervision of scholars engaged in that subject. During this year Dr. Barnard, appointed to the other vacant Research Fellowship on the expiry of his Australian National University Travelling Scholarship (August), was absent in Japan where he is engaged in the collection of source material for his research into the bronze inscriptions of early Chinese civilisation.

Students and Teaching Activities.

Student numbers increased to four during the year—Mr. de Rachewiltz (third year), and Mr. M. Ward, Mr. A. Fraser and Mr. J. D. Frodsham, who were enrolled in March, April and June respectively. Mr. Fraser, who has taken as the subject of his thesis " The Japanese Bureaucracy 1868-1889 ", proceeded to Japan in August to collect material which cannot be obtained outside that country. Mr. Ward began work on " Sino-Tibetan Relations during the T'ang Period ", and Mr. Frodsham, whose arrival was delayed by difficulties of transport from Iraq where he was working for the British Council in the University of Baghdad, started work upon " Biographies of Hsieh Ling-yun and Pao Chao: two poets of the Liu Sung Dynasty ".

Research Programme.

Dr. Mulder's work on the final draft of " The Imperial Relatives by Marriage of the Former Han " is proceeding.

Mr. Eckersley has been engaged in consulting contemporary Japanese primary and secondary sources for his " Social and Cultural History of Japan of Today " (tentative title).

Dr. Crawcour is engaged in research on the economic history of Japan in the seventeenth century, with special reference to commercial development.

Professor FitzGerald was away for the second half of the year on Study Leave. In the first half he completed a work on modern China entitled " Flood Tide in China ", and at the request of the Editors of the Cambridge Modern History, wrote the chapter covering the period of Chinese history from 1870 to 1901, titled " The Decline of the Manchu Dynasty ".

Other Activities.

Professor FitzGerald left on Study Leave in the first week of June. One month was spent in Malaya, mainly in Singapore, where close contact was made with the Department of History in the University of Malaya. Two lectures were given under the auspices of the Department. After a

brief visit to Thailand and some weeks in Hong Kong, he proceeded to Japan to attend the Congress on the History of Religions, held in Tokyo from 27th August to 5th September. Research tours organized by the Congress included Kyota, Nara, Nikko and points near Tokyo. Returning to Hong Kong in October, he gave five lectures in the Department of History. The leave was rounded off by a two-week visit to Peking mainly devoted to a study of the recent archaeological material displayed in the Palace Museum.

In mid-December, at the request of the Commonwealth National Library, Dr. Crawcour spent a few days in Sydney helping to identify and classify some Japanese language material.

Mr. Frodsham in November addressed the Oriental Society of Australia in Sydney on "Chinese Nature Poetry". He also read a paper on "The Origins of Chinese Nature Poetry" at a joint meeting with the members of the School of Oriental Studies at the Canberra University College and others interested in Chinese and Japanese historical studies.

Publications.

During the year the following work by a member of the staff was published:—

FitzGerald, C. P.—"*Flood Tide in China.*" The Cresset Press, London, 1958, 286 pp.

Department of Geography.

Staff.

Professor	O. K. H. Spate, M.A., Ph.D.
Reader in Geomorphology	J. N. Jennings, M.A.
Reader in Social Geography . .	H. C. Brookfield, B.A., Ph.D., from 13th June, 1958 (formerly Senior Research Fellow).
Research Fellow	F. H. Bauer, M.A. until 30th June, 1958.
Visiting Fellow	H. H. B. Valentin, D.Phil. from 1st March, 1958.
Visiting Fellow	M. M. Sweeting, M.A., Ph.D., from 25th September, 1958.

The creation of the Readership in Social Geography during the year brings the strong interest of the Department in this aspect of the subject to maturity; Dr. Brookfield, already a member of the Department staff, was appointed to the new post. The three year research fellowship financed by C.S.I.R.O. came to an end during the course of the year but Mr. Bauer, who held it, remains with the Department to complete his suspended Ph.D. course. Dr. Valentin of the Free University of Berlin and Dr. Sweeting of Oxford University arrived to take up Visiting Fellowships of a year's duration; these visits are all the more welcome because two vacant research fellowships in the Department have not been filled.

During Professor Spate's absence, Dr. Brookfield and Mr. Jennings successively acted as Head of Department.

Students and Teaching Activities.

During the year Mr. M. Anas and Mr. J. Rutherford completed their scholarship courses and Mrs. E. Tugby left to do field work in Siam as part of the S.E.A.T.O. cultural programme. Two new scholars arrived, Mr. R. M. Frazer and Mr. R. H. T. Smith. Mr. Frazer has undertaken a study of the social and economic geography of a part of Fiji; he is already in the field there and his scholarship has been suspended for a period not exceeding three months while he acts as a research assistant to Professor Spate. The research of Mr. R. H. T. Smith is concerned with commodity movement by rail in a part of New South Wales and is receiving various facilities from the New South Wales State Railways Department which is warmly interested in the study.

Mr. Bird continues his geomorphological work on the East Gippsland lakes and Mr. Bauer has been completing his Ph.D. thesis on the regional geography of Kangaroo Island, S.A., during the second half of the year.

Dr. T. M. Perry, former scholar of the Department, has been awarded an A.N.U. Travelling Scholarship to support a second year in Britain where he is preparing a volume for the Hakluyt Society on certain early inland explorations of Australia.

Research.

Professor Spate was engaged for much of the year on research into the problems of economic and social development of the indigenous people of Fiji at the request of the Government of Fiji, which with the Colonial Welfare and Development Fund is financing the work. After a reconnaissance visit early in the year to plan the work, he returned in August for a six months' stay.

Before going on study leave, Mr. Jennings finished a preliminary report on the karst morphology of the Nullabor Plains and, in collaboration with M. R. Banks of the University of Tasmania, prepared a critique of the previously accepted chronology of the Pleistocene glaciation of Tasmania.

From February to July, Dr. Brookfield was in New Guinea. In Port Moresby he worked on records for the study of the population distribution and labour migration over the whole territory. In the field he studied the settlement, landholding and land use pattern of an area in the Highlands in collaboration with Dr. P. Brown of the Department of Anthropology. This latter forms part of a longer term interest in the great population concentration in the Highlands. The whole of this work has greatly benefited from the willing help of the New Guinea Administration which is interested in the results.

In the first half of the year Mr. Bauer was engaged in writing up more of his material on the development of Northern Australia.

Dr. Valentin's main research task during his visit to Australia will be a regional study of the Atherton Tableland, though he is also gathering material of a more secondary nature for a later work on the regional geography of the Cape York Peninsula as a whole. From April to November he was in the field in this area.

Dr. Sweeting will be engaged in karst studies of selected limestone areas of Australia from the point of view of climatic morphology, some of them in conjunction with Mr. Jennings. In October-November she carried out field work in the neighbourhood of Buchan, Victoria; the co-operation of the Victorian Mines Department, which detached one of its officers to work with her, is gratefully acknowledged.

Other Activities.

In May Mr. Jennings went to Europe on study leave. The summer there was devoted mainly to field work in several countries on the continent of Europe. The major items were his participation in the glaciological and glacial geomorphological work of the Cambridge 1958 Austerdalsbreen Expedition in Norway and in the applied geomorphological programme of the Institut de Géographie of the University of Strasbourg in the Queyras district of the French Alps, undertaken for the Ministère des Eaux et Forêts in connexion with the rehabilitation of the region after the disastrous flood damage of 1957. Mr. Jennings gave a paper on the karst morphology of the Nullarbor Plains to the Second International Speleological Congress at Bari, Italy. The second half of his study leave plan was not carried out since unexpected circumstances required his return to Australia in October.

In January Dr. Brookfield gave the introductory paper on " The Land " in the Summer School of the Australian Institute of Political Science on " Australia in New Guinea ". Maps of economic development in Australian New Guinea prepared by Mr. Anas and exhibited at this conference attracted some interest and were adopted by the Commonwealth Territories Division to illustrate a report to the U.N. Trusteeship Council.

At the Adelaide A.N.Z.A.A.S. papers were read by Dr. Brookfield, Mr. Bauer and Mr. Rutherford. Dr. Brookfield was elected to the Interim Council of the newly formed Institute of Australian Geographers.

Dr. Brookfield temporarily acted as academic editor of *The Australian Geographer* in place of Professor Spate during his absence.

Early in the year the Department, along with the Department of Geophysics, enjoyed a short but useful visit from Professor R. Goldthwaite of the State University of Ohio, whose chief fields of research have been in glaciology and glacial geomorphology.

Publications.

Anas, M.—" Indigenous economic development in the Central District of Papua." *Aust. Geogr.*, VII., iii, 79-84.

Bennett, J. M.—" Vila and Santo: New Hebridean Towns." *Geographical Studies*, IV., ii, 116-128.

Brookfield, H. C.—" The forest industries of New Guinea." *Geography*, XLIII., iii, 210-212.

" The Land ", being Ch. 1, pp. 1-45 (5 maps) in *New Guinea and Australia*, (ed. J. Wilkes), Angus & Robertson, Sydney.

Jennings, J. N., Banks, M. R.—" The Pleistocene Glacial History of Tasmania." *J. Glaciology* III., xxiv, 298-303 (1 map).

Mercer, J. H.,* and Scott, P.†—" Changing village agriculture in Western Samoa." *Geogr. J.*, CXXIV., pt. 3, 347-360 (6 maps).

Spate, O. H. K.—" Aspects of the City in South Asia." *Confluence* VII., i, 116-128.

Contributions to *The Changing Map of Asia* (ed. W. G. East and O. H. K. Spate, Methuen, London, 3rd revised edition): Introduction, pp. 1-28 (2 maps); Ch. II.: India and Pakistan, pp. 125-92 (5 maps); Epilogue, pp. 406-18.

" The end of an old song? The Determinist-Possibilist Problem." *G.R.*, XLVIII. 2, 280-282.

Department of Pacific History.

Staff.

Professor	J. W. Davidson, M.A. Ph.D.
Fellow	J. S. Bastin, M.A., Ph.D., D.Phil.
Senior Research Fellow	H. E. Maude, O.B.E., M.A.
Research Fellows	M. C. Groves, B.A. Ethel Drus, M.A.

Between December, 1957, and May, 1958, Professor G. S. Graham, Rhodes Professor of Imperial History in the University of London, was a visitor to the Department. A Senior Research Fellowship was advertised during the year, and an offer of appointment has been made. In March Mrs. H. Forster began duty as Research Assistant.

Students and Teaching Activities.

There were six Ph.D. students in the Department for the whole or part of the year, including Mr. R. Crocombe and Mr. I. J. Fairbairn, who took up their awards in July and November. The subjects of study related to the administration of Australian archives; to missionary activities in Polynesia prior to 1860; to Western contact and administration in South-eastern Papua; to problems of land tenure in the Cook Islands; and to the economic development of Western Samoa since the war. During the year Mr. K. L. O. Gillion submitted his thesis on " A History of Indian Immigration and Settlement in Fiji ", and has been recommended for the award of the Ph.D. degree. Another scholar, Mr. W. N. Gunson, completed the tenure of his scholarship, and was awarded a British Council Scholarship to engage in further post-graduate study in the University of London.

During the first and second term a series of Seminars on Techniques of Native Administration were organized by Mr. Groves. Among those who read seminar papers were Professor J. Guiart, Professor of the History of Oceanic Religions at the Practical School of Advanced Studies of the Sorbonne; Mr. J. McAuley of the Australian School of Pacific Administration; Mr. D. Shaw of the Bureau of Agricultural Economics; Mr. J. Willoughby, First Assistant Secretary of the Commonwealth Government's Department of Territories; and Mr. C. S. Christian of the C.S.I.R.O.

Research Programme.

The Department of Pacific History is concerned with the study of historical situations involving contact between Western and non-Western cultures, with a particular emphasis on contacts of a " colonial " type in which Europeans have occupied positions of political and economic dominance. This field of research presents one particularly important problem of method. The major part of the documentary evidence consists of records made by Europeans and framed in terms of Western thought. The Department is engaged in devising and testing means to supplement the study of such documentary material in order to reach a fuller understanding of the social processes involved than is possible by convential historical technique alone. This work makes its relations with other branches of the social sciences as close as those with other fields of history.

Since all historical research involves the study of specific situations, the geographical limitations imposed on the Department in its title—Pacific History—does not restrict the breadth of its theoretical preoccupations. On the contrary, it gives an added coherence and compactness to the body of factual knowledge which is subjected to theoretically-directed analysis. The danger of an undesirable narrowing of perception is guarded against both by the variety of situations available for study within the Pacific area and by the previous experience in other fields possessed by all members of the Department.

* Research Scholar—15.4.54-17.5.56.
† Research Fellow—1.12.55-11.12.56.

Between July and September Mr. Maude worked in the Archives of Fiji and the Western Pacific High Commission on historical material relating to the establishment of trade and political relations in the Central Pacific Islands. Later he worked at the Archives of the Kingdom of Hawaii, Honolulu, the Bernice P. Bishop Museum, the Hawaiian Historical Society, and the University of Hawaii Library on Hawaiian relations with the Pacific Islands, with particular regard to early commercial contacts and the history of the Central Pacific guano industry.

During January Mr. Groves continued his field work among the Motu people of Papua, and in the following month visited the Gazelle Peninsula to study Tolai local government councils. He called also at Madang, Lae and Goroka to obtain some comparative idea of administrative problems. Between March and September, Mr. Groves was in Canberra writing up the results of his work, after which he again returned to New Guinea to complete his study of the Motu, and to engage in further field work at Manumanu village. In 1959 Mr. Groves will direct a team conducting a survey of Papuan wage-earners in Port Moresby.

Other members of the Department continued work in Canberra on various projects—Professor Davidson on his biography of Captain Peter Dillon; Dr. Bastin on colonial land systems in Java and Southern India; Miss Drus on her study of " Government and Governed in Fiji, 1874-1902 "; and Mr. Gilson on the political history of Samoa.

During the year arrangements were made by the Department for taking over from the South Pacific Commission the index of social science theses relating to the South Pacific; and, in conjunction with the Commonwealth National Library, of the South Pacific Commission's work relating to the conservation of historical manuscripts.

At the same time, investigations were made by the Department with a view to collecting all important documentary series relating to the Pacific Islands not available elsewhere in Australia. Several important deposits of Pacific material have been located in Europe and U.S.A., and endeavours are being made to have them microfilmed for deposit in the Department's library.

Other Activities.

In August, Miss Drus, Mr. Groves and Dr. Bastin attended the Thirty-third Congress of the Australian and New Zealand Association for the Advancement of Science in Adelaide. Mr. Groves read to Sections E (History) and F (Anthropology), a paper entitled " The Motu and their masters: A study in race relations in and around Port Moresby from 1873 to the present "; and Dr. Bastin contributed a paper to Section E on " Western commercial rivalry and the shifting balance of the early South and South-East Asian pepper trade ".

During May, Professor Davidson attended the 1958 Session of the South Pacific Research Council, and in September visited the Territory of Papua and New Guinea, and the British Solomon Islands Protectorate.

At the end of September the Department convened a conference of persons in Australia interested in the development of Indonesian, Malayan, and Indian Studies. His Excellency the Indonesian Ambassador, Dr. A. Y. Helmi and the Official Secretary of the Office of the High Commissioner for India, Shri J. C. Ajmani, attended the discussions, as well as representatives from the Universities of Melbourne and Sydney, and the Canberra University College. Much attention was paid by the conference to question of establishing suitable undergraduate and graduate courses in the fields of Indonesian, Malayan and Indian Studies in Australian universities, and to the urgent problem of extending the holdings in Australian libraries of material related to these fields of study. The Commonwealth National Librarian, Mr. H. L. White, and the Australian National University Librarian, Mr. A. L. G. McDonald, both attended the conference.

Publications.

During the year the following work by members of the staff was published:—

Drus, E. (ed.).—" A journal of events during the Gladstone Ministry 1868-1874 by John, First Earl of Kimberley." *Camden Miscellany,* XI (1958) xx + 49.

Gilson, R. P.—" The South Pacific Area: Its potentials for Fulbright Grantees." *News Bulletin,* Institute of International Education (New York), 33 (7) (1958) 11-17.

Groves, M. C. (with others).—" Blood groups of the Motu and Koita peoples." Oceania, XXVIII (3) (1958) 222-38.

Maude, H. E.—" In search of a home: From the mutiny to Pitcairn Island (1789-1790)." *Journal of the Polynesian Society,* 67 (2) (1958) 104-131.

Maude, H. E., and Maude, H. C.*—" String-Figures from the Gilbert Islands." *The Polynesian Society, Memoir No.* 13, pp. viii and 161.

Newbury, C. W.†—" Aspects of French policy in the Pacific, 1853-1906." *Pacific Historical Review,* XXVII (1) (1958) 45-56.

West, F. J.†—" Indigenous Labour in Papua-New Guinea." *International Labour Review,* LXXVII (2) (1958) 89-112.

Theses: During the year the following thesis was submitted and deposited in the Library after examination for the degree shown:—

K. L. O. Gillion, for Ph.D.: " A history of Indian immigration and settlement in Fiji."

* Not a member of Australian National University staff. † Based on research carried out while the author was a member of this Department.

JOINT ACTIVITIES OF THE RESEARCH SCHOOLS OF SOCIAL SCIENCES AND PACIFIC STUDIES.

PUBLICATIONS COMMITTEE.

During the year Council increased the membership of the Committee to eight. It now consists of Dr. Bastin, Professor Davidson, Dr. Freeman, Dr. Gollan, Professor Sawer, Professor Spate, Professor Swan and Professor Webb (Chairman).

Staff.

Publications Officer—Miss Patricia Croft, B.A.
Editorial Assistant—Miss Margaret Patrikeos, B.A. (resigned 12.11.58).

Activities.

During the year three monographs were published in the Social Science series: D. W. Rawson and Susan M. Holtzinger, *Politics in Eden-Monaro;* L. C. Webb (ed.), *Legal Personality and Political Pluralism;* and L. C. Webb *Church and State in Italy, 1947-1957.* Three others are in course of publication: M. R. Hill, *Housing Finance in Australia, 1946-1956*; A. W. Martin and P. Wardle, *Members of the Legislative Assembly of New South Wales,* 1856-1901; and G. Modelski, *Atomic Energy in the Soviet Bloc.*

Two impressions of Professor B. J. Bok's book, *The Astronomer's Universe,* were published during the year, one being designed particularly for the Nuclear Research Foundation's Summer School at Sydney in January, 1958. One other book was published: A. Barnard, *The Australian Wool Market, 1840-1900.* Dr. Marie O. Reay's study of the Kuma people of the Whagi Valley, New Guinea, is now in course of publication.

On behalf of Central Administration, the *Annual Report* and the Morrison Oration, *The Chinese Civil Service,* were edited and seen through the press.

THE LIBRARY

1. Accessions.

—	In Library at 31st December, 1957.	Added During 1958.	In Library at 31st December, 1958.		
(*a*) Books and Pamphlets in Western Languages.					
Books	106,031	8,628		114,659	
			Less items written off 1958 ..	6	
					114,653
Pamphlets	6,528	658		7,186	
			Less items written off 1958 ..	1	
					7,185
					121,838
(*b*) Books in Oriental Languages.					
	23,756	255			24,011
			Total ..		145,849

Note.—The figures given do not include those for the library of the Mount Stromlo Observatory for which accurate records of the contents have not yet been made.

The more important accessions were:

Acta mathematica, V. 1-37: 1882/3-1914.
American Bureau of Ethnology. Annual reports 1879-1927.
Zeitschrift fur anorganische chemie (on microcards) V. 1-252: 1892-1944.
Petermann's Geographische Mitteilungen, V. 1-46 and Erganzungshefte, V. 1-27.
Pharmaceutical Society of Japan. Journal, V. 46-73.

2. Gifts.

One thousand eight hundred and sixty items were presented of which the following were notable:—

(a) *Carnegie Corporation of New York.*—During the year the Carnegie Corporation of New York made available to a number of Australian libraries sets consisting of about 350 volumes designed to illustrate various aspects of American life and culture. One such set was presented to the library of the Australian National University.

(b) *Gift of philosophy books from Professor P. A. Moran.*—A gift of 28 philosophical works gave further evidence of Professor Moran's interest in the library.

3. Losses.

It is gratifying to record that losses from the library remain low. Six books and one pamphlet which had been missing for two successive stock-takings were written off.

4. Inquiries and Loans.

Throughout the year the inquiry room staff was kept fully employed in assisting readers with bibliographical information and obtaining by loan or microfilm material not available in the library. One thousand and twenty-two items were borrowed from external sources.

Excluding unbound serials, 11,200 works were borrowed by readers from the library, an increase of 1,000 items over the previous year.

5. Micro Reproductions.

The library continues to increase its holdings of micro reproductions in various forms and requests to use the readers provided are constant, sometimes to the point of competition.

6. Xerographic Reproduction of Out-of-print Books.

In building up a research library at this late stage it is frequently difficult, if not impossible, to locate important out-of-print works at a cost which bears any relation to the original price of publication. It is for this reason that considerable importance must be attached to an agreement entered into between University Microfilms Inc. and some 30 leading American publishers under which the former is permitted to reprint, by what is termed the Xerographic process, single copies of any out-of-print works issued by these publishers, at a present cost of 3-5 cents a page. The field of course is still limited but the library has been able to procure by these means a few titles, urgently required, which would have been difficult to acquire otherwise.

7. Serials.

Previous reports have underlined the importance attached in this university to the provision of serials, especially in the scientific fields, and expressed concern that their individual costs continued to rise. The trend is still upward but in 1958 it was milder than in the immediately preceding years. In 1958 serials accounted for nearly 52 per cent. of the total expenditure on printed materials.

8. Permanent Library Building.

Since the last report the architects have presented elevation drawings which have met with general approval and it is expected that final sketch plans will be presented early in 1959, followed by the immediate preparation of working drawings.

9. Oriental Collection.

A joint working party of the Canberra University College and the Australian National University met several times to study the question of the formation of an Institute of Oriental Studies with the amalgamation into one library of the separate oriental collections. The joint working party has drawn up draft proposals which will be submitted to the governing bodies of the two institutions.

10. Seminar for Senior Librarians Conducted by Dr. Keyes Metcalf, former Librarian of Harvard University Libraries.

In late December Dr. Keyes Metcalf conducted a seminar attended by about 30 senior librarians from all Australian States and New Zealand. The seminar covered the whole field of library practice but undoubtedly the most important single result of the seminar was a decision to investigate ways and means of compiling a union catalogue of monographs in Australian libraries.

During the seminar university librarians meeting as a group prepared a statement on Australian university libraries to be presented to the Vice-Chancellors' Committee.

11. Staff.

The staff position has not been easy. During the year there were four resignations, all due to marriage. Included among those who resigned were two who had served the library for a number of years. One was a senior cataloguer and the other an efficient order officer whose loss was keenly felt. One senior cataloguer has been on leave of absence overseas for practically the whole year but is expected back early in 1959. The Deputy Librarian represented the university at an International Conference on Scientific Information held at Washington in November, 1958. The opportunity was taken to widen his experience by allowing him to spend a short period in the United Kingdom prior to the conference and another period in the United States at the conclusion of the conference. The Carnegie Corporation of New York made a contribution towards his expenses while in the United States. There is little doubt that the library will benefit as a result of the contracts made by Mr. Stockdale with overseas libraries, institutions, and booksellers.

UNIVERSITY HOUSE—1958.

1. Governing Body.

At the end of the year the composition of the Governing Body was as follows:—

Master—Professor A. D. Trendall.

Fellows—

Retiring 15th August, 1959—

Professor B. J. Bok (from 1st December, 1958, in place of Professor P. H. Partridge, resigned).

Dr. Rose M. Eccles (Steward).

Dr. J. D. Freeman.

Mr. E. Irving.

Retiring 15th August, 1960—

Professor J. A. Passmore (Deputy Master).

Dr. W. H. Elliott.

Dr. R. R. Brown (Bursar).

Dr. D. S. Robertson.

The terms of office of Professors F. J. Fenner and P. A. Moran, Drs. J. H. Carver and C. A. Price expired on 15th August. Professor P. H. Partridge resigned on 1st December since he was proceeding abroad for study leave. Dr. R. R. Brown was elected Bursar in succession to Dr. Carver and Professor J. A. Passmore, Deputy Master in place of Professor Partridge.

The Master returned on 7th March from his long vacation trip during which he visited Greece, Italy, Switzerland, France, England and America. He delivered lectures in Basle, Zurich, London and New York on recent archaeological discoveries and on the Greek vases recently acquired by the Felton Bequest for the National Gallery of Victoria. In February he was elected to a Foundation Fellowship of Selwyn College in the University of Otago.

Professor J. T. Burke, Visiting Fellow in 1957, presented a pottery vase by H. LeGrand on leaving the House.

2. Staff.

The Porter, Mr. W. Nay, resigned in December and was replaced by Mr. S. Witt.

3. Members and Residents.

The number of members has now risen to 320; the number in permanent residence has remained fairly constant throughout the year at between 115 and 120, of whom about 100 are members of or associated with the Australian National University. The House is now virtually full and apart from Staircase " D ", which has been set aside for academic visitors, it is now no longer possible to provide accommodation for casuals or for large conferences. Owing to the arrival of an ever-increasing number of new scholars it will be necessary in 1959 to exclude from residence some non-members of the A.N.U.

To meet the increase in the basic wage and the rise in food costs the room rates were raised in May to £8 per week for the Eastern Annexe, £9 for the East and West Wings and £10 for the North Wing.

4. Visitors.

The number of visitors availing themselves of the facilities of the House continues at a high level, though it has no longer been possible to accommodate the same number of conferences as before.

Hospitality has been extended to the following: The Academy of Science, Australian Humanities Research Council, National Planning Development Committee, Australasian Philosophical Association, Committee of Enquiry into Public Service Recruitment, Social Sciences Research Council, the Seismological Conference.

The Chancellor, Viscount Bruce, was in residence for some time early in the year, and Sir Howard Florey, Honorary Fellow, for two weeks in March-April.

Distinguished overseas visitors who have stayed in the House include: Professor D. L. Adler of the San Francisco State College; Mr. L. J. F. Brimble, Editor of *Nature*; Professor L. Broom of the University of California; Professor J. M. S. Careless of the University of Toronto; Dr. Tara Chand, M.P., India; Professor J. H. Gaddum of the University of Edinburgh; Dr. S. S. Huebner of the University of Pennsylvania; Mr. H. V. R. Iengar, Governor of the Reserve Bank of India, and Mrs. Iengar, and Mr. K. Ambagaokar of the Reserve Bank of India; Professors D. L. Kemmerer and D. P. Locklin of the University of Illinois; Mr. Kingsley Martin, Editor of " The New Statesman and Nation "; Mr. Tibor Meray of the Hungarian Writers' Union; Dr. Keyes D. Metcalf, Harvard University; Dr. Nicolaus Pevsner of the University of London; Professor Ruggles Gates, University of London; Mr. and Mrs. Edward Ryerson of Chicago; Dr. Merze Tate of Howard University, Washington, D.C., and Professor R. R. Wilson of Duke University.

On 30th January, we were honoured by a visit from the Rt. Hon. Harold Macmillan, Prime Minister of Great Britain, who received the honorary degree of LL.D. at a ceremony held in the Hall.

5. Buildings and Grounds.

The heavy pressure on accommodation has induced the Governing Body to consider the provision of additional bedroom accommodation, which would in the first instance be designed specifically to meet the needs of visitors for conferences, but so planned as to be readily convertible to scholars' rooms when occasion required. Sketch plans for the additional accommodation have been prepared, and it is hoped to commence building in May.

6. House Library and Record Collection.

There has been a considerable expansion in the Library, which now contains some 2,300 volumes, of which 480 were added during the current year. The number of books borrowed continues to increase steadily. It has been necessary to erect some new shelving in the Library, and this will house the reference collection and the catalogue. Many books have been donated by members, and we are particularly grateful to the British Council for its gift of 70 volumes covering different aspects of British culture. Miss R. M. Burkitt has been appointed Librarian in place of Miss B. Taylor, who has left the House.

The Record Collection comprises about 200 LP records covering a wide range in the classical field. The privilege of borrowing these records has been extended to non-resident members at a small charge, and the revenue will be used to meet replacement costs. Mr. A. G. Gregory has been appointed Record Librarian.

7. Functions and Activities.

The Conferring of Degrees Ceremony was held in the Main Common Room on 9th May, 1958. In November Professor A. R. Davis of the University of Sydney gave the Morrison Oration on " The Narrow Lane ".

The series of luncheons for members of the Academic staff was continued this year, with speakers covering a wide range of topics. After-dinner talks, usually with illustrations, have also been given at regular intervals.

The Chamber Music Society has held five concerts in the Hall, and the available meeting rooms have been in constant use by various societies. It is clear that University House continues to perform a very valuable function in fostering and developing cultural activities both within the University and in Canberra.

The usual House functions—Commencement Dinners and Guest Nights—have been held at regular intervals and have been well attended. The residents have organized several informal dances or supper meetings which have been highly successful.

8. Publications.

Trendall, A. D.—*The Felton Greek Vases,* Canberra, 1958. 20 pp. (10 plates).

" Archaeology in Sicily and Magna Graecia." *Journal of Hellenic Studies,* Suppl. 1958, pp. 26-42 (1 plate).

UNIVERSITY STATISTICS.

No. 1.—STAFF.

Year 1958.

Particulars.	Full-time.			Part-time.		
	Males.	Females.	Total.	Males.	Females.	Total.
(*a*) Teaching and Research—						
1. Professors	22	..	22	..	..	..
2. Readers	18	..	18	..	..	..
3. Senior Fellows and Fellows	41	2	43	..	..	..
4. Senior Research Fellows' and Research Fellows	41	6	47	..	..	..
5. Research and Departmental Assistants	2	17	19	..	4	4
Total	124	25	149	..	4	4
(*b*) Library (including departmental sections)—						
1. Engaged in Professional Work	4	12	16	..	..	..
2. Other Assistants	2	2	4	..	..	..
Total	6	14	20	..	..	..
(*c*) Central Administration—						
1. Chief Administrative Officers	3	..	3	..	..	..
2. Senior Administrative Assistants	8	2	10	..	..	..
3. Clerks, Typists, Telephonists	29	42	71	..	..	..
4. Porters, Messengers, &c.	..	..	..	..	..	..
Total	40	44	84	..	..	..
(*d*) Departmental Clerks and Typists	22	56	78	..	..	..
(*e*) Maintenance—						
1. Cleaners	16	3	19	..	4	4
2. Gardeners	9	..	9	..	..	..
3. Upkeep of Buildings	31	..	31	..	..	..
Total	56	3	59	..	4	4
(*f*) Laboratories—						
1. Adult Assistants	159	33	192	..	..	..
2. Junior Assistants	10	9	19	..	..	..
Total	169	42	211	..	..	..
SUMMARY—						
(*a*) Teaching and Research	124	25	149	..	4	4
(*b*) Library	6	14	20	..	..	..
(*c*) Central Administration	40	44	84	..	..	..
(*d*) Departmental Clerks and Typists	22	56	78	..	..	..
(*e*) Maintenance	56	3	59	..	4	4
(*f*) Laboratories	169	42	211	..	..	..
Total	417	184	601	..	8	8

No. 2.—Details of Teaching and Research Staff.

Year 1958.

Department.	1		2		3				4				5			
	Professors.		Readers.		Senior Fellows and Fellows.				Senior Research Fellows and Research Fellows.				Research and Departmental Assistants.			
					Full-time.		Part-time.		Full-time.		Part-time.		Full-time.		Part-time.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
John Curtin School of Medical Research—																
Biochemistry	1	..	..	..	4	..	..	..	1	..	..	..	..	..	..	..
Experimental Pathology	1	..	1	..	1	..	..	..	..	1	..	..	..	..	..	..
Medical Chemistry	1	..	..	..	1	..	..	..	4	1	..	..	..	..	..	..
Microbiology	1	..	1	..	2	..	..	..	4	1	..	..	..	1	..	..
Physiology	1	..	1	..	2	..	..	..	1	1	..	..	..	..	..	..
Inorganic Chemistry	..	..	1	..	..	..	..	..	1	..	..	..	..	..	..	..
Non-Departmental	..	..	..	..	1	..	..	..	1	..	..	..	..	..	..	..
Research School of Physical Sciences—																
Astronomy	1	..	3	..	5	..	..	..	1	..	..	..	..	2	..	..
Geophysics	1	..	1	..	2	1	..	..	4	..	..	..	..	3	..	1
Nuclear Physics	1	..	..	..	1	..	..	..	3	..	..	..	1	..	..	..
Particle Physics (Director)	1	..	..	..	7	..	..	..	2	..	..	..	..	..	..	..
Radiochemistry	..	..	..	..	2	..	..	..	1	..	..	..	..	..	..	..
Theoretical Physics	1	..	..	..	1	..	..	..	1	..	..	..	..	..	..	..
Research School of Social Sciences—																
Law	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
Economics	1	..	3	..	1	..	..	..	3	..	..	..	1	2	..	1
Political Science and International Relations	1	..	1	..	2	..	..	..	3	..	..	..	..	2	..	1
History (Director)	1	..	1	..	2	..	..	..	1	..	..	..	..	1	..	1
Demography	1	..	..	..	2	1	..	..	1	..	..	..	..	3	..	..
Statistics	1	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..
Social Philosophy	2	..	..	..	1	..	..	..	2	1	..	..	..	..	..	..
Research School of Pacific Studies—																
Anthropology	1	..	2	..	1	..	..	..	1	..	..	..	..	1	..	..
Pacific History	1	..	..	..	1	..	..	..	3	..	..	..	..	1	..	..
Geography	1	..	2	..	..	..	..	..	..	..	..	..	..	..	..	..
Far Eastern History	1	..	..	..	..	..	..	..	4	..	..	..	..	1	..	..
Total	22	..	18	..	41	2	..	..	42	5	..	..	2	17	..	4

No. 3.—Special Research Workers.

Year 1958.

Particulars.	Males.		Females.		Total.	
	Working in Australia.	Abroad.	Working in Australia.	Abroad.	Working in Australia.	Abroad.
Students and others (not being members of the staff as in Table 1 (*a*)) engaged in research—						
Subsidized by—						
1. Commonwealth Government	7	..	..	..	7	..
2. State Government	..	..	..	..	..	..
3. Other Sources	..	..	..	..	..	..
Unsubsidized	2	..	..	..	2	..
Total	9	..	..	..	9	..

N.B.—This return is Supplementary to that showing Teaching and Research Staff—Form Nos. 1 and 2.

No. 4.—Students: Full-Course and Part-Course.

Classification of Students.	Total for Previous Year.	Year 1958.		
		Males.	Females.	Total.
FFull Course	88	85	8	93
PPart Course	..	1	1	2
Total	..	86	9	95

No. 5.—Students.

—	1957.						1958.					
	Ph.D.		M.A. or M.Sc.		Not Enrolled for Degree.		Ph.D.		M.A. or M.Sc.		Not Enrolled for Degree.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
JJohn Curtin School of Medical Research—												
Biochemistry	2	1	..	..	..	..	3	3	..	..	..	..
Experimental Pathology	1	..	..	..	..	..	1	..	..	..	..	..
Medical Chemistry	1	..	..	..	..	..	2	..	..	..	..	..
Microbiology	4	..	3	..	..	..	5	1	1	1	..	..
Physiology	1	..	..	..	1	..	4	..	..	..	..	..
Inorganic Chemistry	..	..	..	..	..	..	2	..	..	..	..	..
RResearch School of Physical Sciences—												
Astronomy	1	..	..	..	..	..	1	..	..	..	..	..
Geophysics	8	..	..	..	..	..	5	..	..	..	..	..
Nuclear Physics	5	..	..	..	..	..	7	..	..	..	..	..
Particle Physics	..	..	..	..	..	..	..	..	..	..	..	..
Radiochemistry	2	..	..	..	..	..	2	..	..	..	..	..
Theoretical Physics	1	..	..	..	..	..	2	..	..	..	..	..
RResearch School of Social Sciences—												
Economics	4	..	..	..	1	..	5	..	..	..	1	..
Demography	3	1	..	1	..	..	2	..	..	..	..	..
History	7	..	..	..	..	..	10	..	..	..	..	..
Law	2	..	..	..	..	..	3	..	..	..	..	..
Social Philisophy	3	..	1	..	..	..	2	..	..	..	..	..
Political Science and	4	7	..	..	..	..	..	..	..	..	..	..
International Relations	3		..	..	..	1	5	..	..	..	..	..
Statistics	1	..	..	..	..	..	3	..	1	..	..	..
RResearch School of Pacific Studies—												
Anthropology and Sociology	8	1	1	..	..	1	7	1	..	..	..	1
Far Eastern History	2	..	..	..	..	..	4	..	..	..	..	..
Geography	5	1	..	..	..	..	4	1	..	..	..	..
Pacific History	3	..	..	..	1	..	4	1	..	..	..	..
	71	2	5	1	3	2	83	7	2	1	1	1
	77		6		5		90		3		2	
	88						95					

No. 5A.—New Students.

—	1957.						1958.					
	Ph.D.		M.A. or M.Sc.		Not Enrolled for Degree.		Ph.D.		M.A. or M.Sc.		Not Enrolled for Degree.	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
John Curtin School of Medical Research—												
Biochemistry	1	1	..	..	..	..	2	2	..	..	..	..
Experimental Pathology	..	..	..	..	..	..	..	..	..	..	..	..
Medical Chemistry	1	..	..	..	..	..	1	..	..	..	..	..
Microbiology	2	..	2	..	..	..	1	1	..	..	..	..
Physiology	1	..	..	..	..	..	3	..	..	..	..	..
Inorganic Chemistry	..	..	..	..	..	..	2	..	..	..	..	..
Research School of Physical Sciences—												
Astronomy	2	..	..	..	..	..	1	..	..	..	..	..
Geophysics	..	..	..	..	..	..	1	..	..	..	1	..
Nuclear Physics	2	..	..	..	..	..	4	..	..	..	..	..
Particle Physics	..	..	..	..	..	..	..	..	..	..	..	..
Radiochemistry	..	..	..	..	..	..	..	..	..	..	..	..
Theoretical Physics	..	..	..	..	..	..	2	..	..	..	..	..
Research School of Social Sciences—												
Economics	..	..	..	..	1	..	4	..	..	..	..	..
Demography	1	..	..	..	..	..	..	..	..	..	..	..
History	2	..	..	..	..	..	4	..	..	..	..	..
Law	1	..	1	..	..	..	1	..	..	..	..	..
Social Philosophy	..	..	..	..	..	..	2	..	..	..	..	..
Political Science and International Relations	..	..	..	..	..	..	2	..	..	..	..	..
Statistics	1	..	..	..	..	..	2	..	..	..	..	..
Research School of Pacific Studies—												
Anthropology and Sociology	2	..	..	..	..	..	2	..	..	..	..	1
Far Eastern History	..	..	..	..	..	..	3	..	..	..	..	..
Geography	1	..	..	..	..	..	2	..	..	..	..	..
Pacific History	..	1	..	..	..	..	2	..	..	..	..	..
	17	2	3	..	1	..	..	..	..	..	..	..
	19		3		1		41	3	..		1	1
	23						44				2	
							46					

No. 6A.—Age Distribution of Male Students Enrolled—(New Students only).

Age as at 1st March, 1958.

Males.

—	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	Total
John Curtin School of Medical Research	..	1	2	..	..	..	3	2	..	..	1	..	..	..	..	..	..	9
Research School of Physical Sciences	..	1	..	1	1	1	3	..	..	..	1	..	..	..	1	..	..	9
Research School of Social Studies	..	2	2	3	1	..	2	1	..	..	..	1	..	1	..	..	2	15
Research School of Pacific Studies	..	..	1	..	1	..	3	..	2	1	..	1	..	..	..	..	..	9
Total	..	4	5	4	3	1	11	3	2	1	2	2	..	1	1	..	2	42

No. 6B.—Age Distribution of Female Students Enrolled—(New Students only).

Age as at 1st March, 1958.

Females.

—	21.	22.	23.	24.	25.	26.	27.	Total.
John Curtin School of Medical Research ..	..	..	1	..	..	1	1	3
Research School of Physical Sciences ..	..	..	..	..	..	..	..	..
Research School of Social Sciences ..	..	..	..	..	..	..	..	..
Research School of Pacific Studies ..	1	..	..	..	..	..	..	1
Total	1	..	1	..	..	1	1	4

No. 7.—New Students Enrolled, 1958.

Particulars.	Males.	Females.	Total.
First Enrolments—			
Graduates	42	4	46
Total	42	4	46

No. 8.—Home Residence Distribution of all Students Enrolled.

Particulars.	Males.	Females.	Total.
Homes of Students—			
(*a*) Australian Capital Territory..	2	..	2
(*b*) New South Wales	14	1	15
(*c*) Other Australian States	26	5	31
(*d*) Overseas	44	3	47
Total	86	9	95

No. 9.—Term Residence Distribution of all Students Enrolled.

Particulars.	Males.	Females.	Total.
Term Residence of Students—			
(*a*) College	51	9	60
(*b*) Houses or flats	33	..	33
(*c*) Oversea	2	..	2
Total	86	9	95

No. 10.—Assisted Students.

—	Government.			University.			Other.		
	Males.	Females.	Total.	Males.	Females.	Total.	Males.	Females.	Total.
1. Fulbright Awards	3	2	5	..	..	..	..	..	..
2. Scholarships	1	..	1	70	6	76	4	..	4
Total	4	2	6	70	6	76	4	..	4

No. 11.—Degrees, Diplomas and Certificates Conferred or Granted.

Particulars.	During Year 1958.			Total number up to and including 1958 (current year).		
	Males.	Females.	Total.	Males.	Females.	Total.
Honorary Degrees—						
LL.D.	1	..	1	5	..	5
D.Sc.	2	..	2	4	..	4
Degrees—						
John Curtin School of Medical Research—						
Ph.D.	1	..	1	6	1	7
M.Sc.	..	..	..	..	1	1
Research School of Physical Sciences—						
D.Sc.	..	..	..	1	..	1
Ph.D.	5	..	5	8	..	8
M.Sc.	..	..	..	..	..	..
Research School of Social Sciences—						
Ph.D.	1	..	1	9	1	10
M.A.	..	1	1	1	2	3
Research School of Pacific Studies—						
Ph.D.	2	1	3	10	2	12
M.A.	1	..	1	2	..	2
Total	13	2	15	46	7	53

THE AUSTRALIAN NATIONAL UNIVERSITY. (I.)

STATEMENT OF ASSETS AND LIABILITIES AS AT 31ST DECEMBER, 1958.

General Funds.

Current Assets—	£	£	£
Cash—			
Commonwealth Bank of Australia, Canberra—			
General Account .. ..*Cr.*	31,211		
Restricted Funds Account	53,528		
Interest Bearing Deposit	150,000		
		172,317	
Held in Imprests		1,118	
			173,435
Sundry Debtors			24,580
Advances against Expenses			25,660
Advances, Department of the Interior and Department of Works			9,284
Prepayments			66,198
Materials in Stores and Service Pools			179,148
			478,305
Fixed Assets—			
Buildings—			
Office and Laboratory Buildings and Service Installations		3,145,071	
Dwellings		1,104,772	
			4,249,843
Research Equipment and Furniture—			
Research Schools and Library		1,579,957	
Administration and General Services		83,960	
Residential Properties		50,221	
			1,714,138
Library—			
Books and Publications			260,632
Halls of Residence—			
University House (V.)—Buildings		907,944	
Equipment and other Assets (Net)		108,701	
			1,016,645
			7,719,563
Liabilities—			
Sundry Creditors			27,152
			7,692,411

Trust and Agency Funds (VII.).

Cash—			
Commonwealth Savings Bank of Australia, Canberra		1,262	
Investments		257,946	
			259,208
			7,951,619

General Funds.

Accumulated Funds as Contra—			
General University Funds (II.)		7,638,883	
Restricted Funds (VI.)		53,528	
			7,692,411

Trust and Agency Funds (VII.).

Reserve Accounts as Contra			259,208
			7,951,619

The above statement of assets and liabilities has been examined and is in agreement with the books. In my opinion it exhibits a true and fair view of the affairs of The Australian National University as at 31st December, 1958.

H. C. NEWMAN,
Auditor-General for the Commonwealth.
22nd May, 1959.

(Signed) L. G. MELVILLE,
Vice-Chancellor.

(Signed) J. RYAN,
Accountant.

THE AUSTRALIAN NATIONAL UNIVERSITY. (II.)

ACCUMULATED FUNDS ACCOUNT
FOR THE YEAR ENDED 31ST DECEMBER, 1958.

	£	£
Balance, 1st January, 1958		7,163,993
Add—		
Transfer from Income and Expenditure Account	21,854	
Commonwealth Grant for Capital Works and Services	452,250	
Buildings on site taken over from Department of the Interior	4,581	
Assets purchased from Restricted Funds	135	
Profit on sale of houses to members of staff	3,021	
		481,841
		7,645,834
Less—		
Loss on adjustment of asset values	1,548	
Equipment on loan from the Australian Academy of Science incorrectly taken on inventory, 1957	4,839	
Buildings and assets lost by fire	564	
		6,951
Balance, 31st December, 1958, as contra to assets in Statement of Assets and Liabilities (I.) ..		7,638,883

THE AUSTRALIAN NATIONAL UNIVERSITY. (III.)

STATEMENT OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31ST DECEMBER, 1958.

	£	£	£
Income—			
Commonwealth Grant for Running Expenses			1,299,400
Rentals received			43,967
Student and Examination Fees Received			889
Sundry Income			6,078
			1,350,334
Expenditure—			
The Research Schools (*See* analysis attached—IV.)—			
John Curtin School of Medical Research	358,757		
The Research School of Physical Sciences	413,332		
The Research School of Social Sciences	163,999		
The Research School of Pacific Studies	119,925		
		1,056,013	
Scholarships and Seminars (General)—			
Scholarships	602		
Visiting Scholars and Seminars	3,512		
		4,114	
The Library—			
Salaries and Wages	24,533		
Pay-Roll Tax	603		
Provision for Superannuation	2,794		
Binding Costs	3,676		
Administrative Expenses	2,993		
		34,599	
Administration—			
Salaries and Wages	76,904		
Pay-Roll Tax	1,877		
Provision for Superannuation	5,135		
Administrative Expenses	25,124		
		109,040	
Miscellaneous—			
Council and Committee	684		
Ceremonial Functions and Expenses	3,113		
Subscriptions, Donations and Grants	3,922		
Bad Debts written off	96		
University Calendar and Public Relations Material	2,145		
Private audit Expenses	2,151		
Legal Expenses	205		
Art Fund Subsidy	200		
Subvention for Facilities Provided by University House for General University Purposes	5,000		
Subvention for Pension Supplementation	10,703		
		28,219	
Maintenance and General Services—			
Repairs and Maintenance—Non-residential Buildings	18,427		
Repairs and Maintenance—Residential Buildings	20,012		
Other Maintenance and Service Expenses	11,436		
Maintenance of Grounds	10,980		
Watchmen	5,270		
Freight, Supply and Disposal Expenses, General	9,234		
Telephone Exchange Costs	5,679		
Pay-Roll Tax—Maintenance and General Service Salaries	1,933		
		82,971	
Halls of Residence—			
University House—			
Operating Profit	*Cr.* 622		
Estimated Depreciation on Equipment	8,385		
Master's Stipend and Secretarial Assistance	5,761		
		13,524	
			1,328,480
Transferred to Accumulated Funds Account (II.)			21,854

THE AUSTRALIAN NATIONAL UNIVERSITY. (IV.)

ATTACHMENT TO INCOME AND EXPENDITURE STATEMENT (III.).—31ST DECEMBER, 1958.

—	Expendable Research Materials.	Salaries and Honoraria.	Pay-roll Tax.	Provision for Superannuation.	Field Research and Travelling Expenses.	Administrative and Service Expenses.	School Scholarship Expenses.	Total.
	£	£	£	£	£	£	£	£
John Curtin School of Medical Research—								
Department of Biochemistry ..	6,564	27,957	..	..	..	..	..	34,521
Department of Physical Biochemistry	1,318	1,838	..	..	..	..	..	3,156
Department of Medical Chemistry	4,878	28,847	..	..	..	..	..	33,725
Department of Microbiology ..	12,611	34,017	..	..	..	..	..	46,628
Department of Experimental Pathology	3,256	13,899	..	..	..	..	..	17,155
Department of Physiology ..	5,204	24,287	..	..	..	1,844	..	31,335
General Administration ..	..	29,579	5,216	19,288	833	61,021	13,693	129,630
Medical School Workshops ..	..	31,130	..	..	..	9,640	..	40,770
Animal Breeding Establishment	..	12,636	..	..	..	4,114	..	16,750
Biological Inorganic Chemistry Unit	2,194	2,893	..	..	..	..	..	5,087
	36,025	207,083	5,216	19,288	833	76,619	13,693	358,757
Research School of Physical Sciences—								
Department of Particle Physics	..	47,801	..	..	..	..	..	47,801
Department of Nuclear Physics	..	23,882	..	..	..	..	..	23,882
Department of Theoretical Physics	..	9,178	..	..	..	..	..	9,178
Department of Geophysics ..	..	24,884	..	..	..	..	..	24,884
Department of Radiochemistry	..	17,995	..	..	..	..	..	17,995
Department of Astronomy ..	..	79,912	..	..	..	..	..	79,912
Administrative and Technical Salaries	..	24,590	..	..	..	..	..	24,590
Workshop Salaries	..	43,509	..	..	..	..	..	43,509
Physics School Expenses ..	40,193	..	6,936	29,805	5,474	46,638	12,535	141,581
	40,193	271,751	6,936	29,805	5,474	46,638	12,535	413,332
Research School of Social Sciences—								
Department of Law	..	8,090	..	..	53	..	..	8,143
Department of Economics ..	484	28,468	..	..	730	..	..	29,682
Department of Political Science and International Relations	402	11,586	..	..	763	..	..	12,751
Department of History ..	31	13,248	..	..	527	..	..	13,806
Department of Demography ..	146	14,352	..	..	132	534	..	15,164
Department of Statistics ..	2	10,182	..	..	..	..	..	10,184
Department of Social Philosophy	..	12,015	..	..	..	25	..	12,040
General Administration ..	..	5,327	2,615	11,151	2,543	17,403	23,190	62,229
	1,065	103,268	2,615	11,151	4,748	17,962	23,190	163,999
Research School of Pacific Studies—								
Department of International Relations	76	8,739	..	..	918	..	..	9,733
Department of Anthropology	110	15,608	..	..	4,002	..	..	19,720
Department of Pacific History..	95	15,528	..	..	1,325	..	..	16,948
Department of Geography ..	174	14,123	..	..	1,312	2,518	..	18,127
Department of Far Eastern History	79	11,314	..	..	63	..	..	11,456
General Administration ..	..	3,194	1,709	7,663	1,351	12,920	17,104	43,941
	534	68,506	1,709	7,663	8,971	15,438	17,104	119,925
	77,817	650,608	16,476	67,907	20,026	156,657	66,522	1,056,013

THE AUSTRALIAN NATIONAL UNIVERSITY. (V.)

UNIVERSITY HOUSE.

OPERATING STATEMENT FOR THE YEAR ENDED 31ST DECEMBER, 1958.

	£	£	£
Income—			
Tariff Received—Residents			51,509
Income for Casual Meals and Catering			7,115
Membership Fees, &c.			1,675
Reimbursement of Board—House Staff			2,398
Subvention from University for Facilities Provided for University Purposes			5,000
Beverage Sales—Net Proceeds			2,024
			69,721
Expenditure—			
Operating Costs—			
Cost of Foodstuffs	19,395		
Fuel, Light and Power	9,535		
Cleaning, Laundry and Sundry Materials	2,226		
Domestic Staff Wages and Gratuities to Staff	26,708		
Losses, Breakages and Replacements	1,288		
Local Transport, Freight and Supply Expenses	87		
		59,239	
Administrative Expenses—			
Administrative Salaries	4,072		
Pay-Roll Tax	795		
Workmen's Compensation	248		
Superannuation Account and Provident Fund Subsidy	425		
Advertising and Appointment Expenses	9		
Travelling Expenses	8		
Posts, Telegrams and Telephones	260		
Stationery, Printing and Office Expenses	224		
Newspapers and Periodicals	67		
Master's and Fellows' Entertainment Expenses	975		
		7,083	
Property Maintenance and Services—			
Rates and General Services	672		
Building Maintenances	1,041		
Sundry Repairs	1,064		
		2,777	
			69,099
Net Operating Profit transferred to University Income and Expenditure Statement (III.)			*Cr.* 622
Estimated Depreciation on Assets transferred to University Income and Expenditure Statement (III.)			8,385
			7,763

STATEMENT OF ASSETS AND LIABILITIES AS AT 31ST DECEMBER, 1958.

	£	£	£
Assets—			
Sundry Debtors			4,012
Stock on Hand (including Glassware, &c.)			8,012
Works of Art and Record Library			1,206
Furniture and Equipment	138,585		
Less Estimated Depreciation	41,397		
			97,188
			110,418
Less—			
Sundry Creditors			1,717
			108,701
Buildings			907,944
Included in University's Statement of Assets and Liabilities (I.)			1,016,645

THE AUSTRALIAN NATIONAL UNIVERSITY. (VI.)

STATEMENT OF FUNDS GRANTED FOR RESTRICTED PURPOSES FOR THE YEAR ENDED 31ST DECEMBER, 1958.

—	Subsidies and Donations Received during 1958.	Funds Disbursed during 1958.	Net Amounts Transferred to Capital of Funds.	Fund Balances 1st January, 1958.	Fund Balances 31st December, 1958.
	£	£	£	£	£
The John Curtin School of Medical Research Reserve ..	..	..	..	1,840	1,840
The Research School of Physical Sciences Reserve ..	..	780	*Cr.* 780	5,000	4,220
The Research School of Social Sciences Reserve	..	..	..	5,000	5,000
The Research School of Pacific Studies Reserve	..	..	..	5,000	5,000
The University Art Reserve	200	152	48	343	391
The University Film Reserve	..	1,206	*Cr.* 1,206	4,000	2,794
The University Publications Reserve	3,664	3,427	237	9,614	9,851
The Mount Stromlo Observatory Reserve for Accumulated Furlough	..	..	..	7,500	7,500
C.S.I.R.O. Grant for Sheep and Wool Research	10,218	10,463	*Cr.* 245	245	..
Bayer-Pharma Grant for Research in Medical Chemistry ..	113	..	113	..	113
C.S.I.R.O. Grant for Biological Inorganic Chemistry ..	3,111	2,892	219	..	219
Rockefeller Grant for Visiting Fellow	222	222	..	..	..
Rockefeller Grant for Research in Microbiology	30	30	..	..	..
Commonwealth Engineering Company Grant for Research in Nuclear Physics	500	500	..	..	..
Commonwealth Government Grant for Accelerator Project	10,500	8,560	1,940	..	1,940
U.S.A. Office of Naval Research Grant, Mt. Stromlo Observatory	300	300	..	..	..
Snowy Mountains Hydro-Electric Authority Grant for Geophysics	833	833	..	..	..
Nuffield Foundation Grant for Research in Demography ..	2,475	808	1,667	1,565	3,232
Department of Immigration Grant for Research into British Migration	4,570	1,786	2,784	..	2,784
Grant-in-Aid—W. M. Hughes Biography	..	66	*Cr.* 66	2,000	1,934
Social Science Research Council Grant for Research in Economics	..	775	*Cr.* 775	2,220	1,445
Australian Banks Grant for Visiting Professor in Economics	..	..	..	1,280	1,280
National Development Grant, Department of Geography ..	..	..	..	50	50
Lady Issacs Donation for Books	..	..	..	4	4
General Motors Holden Ltd., Grant for Scholarships ..	5,800	4,900	900	1,119	2,019
Australian Atomic Energy Commission Grant for Scholarship	1,086	902	184	566	750
Group Assurance Commission	116	..	116	200	316
Vice-Chancellor's Discretionary Fund	1,156	375	781	65	846
	44,894	38,977	5,917	47,611	53,528
Commonwealth Trading Bank of Australia—General Account	..	..	..	..	53,528

THE AUSTRALIAN NATIONAL UNIVERSITY. (VII.)

STATEMENT OF TRUST AND AGENCY FUNDS FOR THE YEAR ENDED 31ST DECEMBER, 1958.

Fund.	Income Received.			Disbursements.	Transferred to Reserve.	Fund Balance 1st January, 1958.	Fund Balance 31st December, 1958.
	Subsidies and Subscriptions.	Interest and Capital Appreciation.	Total.				
	£	£	£	£	£	£	£
Commonwealth Superannuation and Provident Account Fund	47,438	8,368	55,806	721	55,085	150,700	205,785
Rutherford Memorial Trust Fund ..	..	515	515	235	280	6,600	6,880
Research School of Physical Sciences Faculty Trust Fund	54	5	59	6	53	179	232
Research School of Social Sciences Faculty Trust Fund	..	..	..	..	..	10	10
Saionji Memorial Trust Fund	..	2	2	48	*Cr.* 46	74	28
Vice-Chancellor's Fund	500	..	500	..	500	..	500
Morrison Oration Trust Fund	..	18	18	16	2	578	580
Sir Littleton Groom Memorial Scholarship Trust Fund	..	18	18	..	18	792	810
Norwegian-Australian Cultural Trust Fund	..	123	123	110	13	2,247	2,260
Danish-Australian Cultural Trust Fund ..	..	128	128	115	13	2,263	2,276
Swedish-Australian Cultural Trust Fund ..	..	69	69	75	*Cr.* 6	1,689	1,683
Mount Stromlo Observatory Fund ..	..	204	204	..	204	5,861	6,065
Australian National University Superannuation Scheme—Members' Fund ..	9,662	440	10,102	..	10,102	3,220	13,322
Australian National University Superannuation Scheme—Supplementary Pensions Fund	18,218	58	18,276	..	18,276	..	18,276
Fund for Return Fares—Special Deposit ..	500	1	501	..	501	..	501
	76,372	9,949	86,321	1,326	84,995	174,213	259,208

	Face Value.		Purchase Price. Appreciated to date.	
Investments—	£		£	£
Commonwealth Superannuation Fund and Provident Account	213,730	..	205,692	
Rutherford Memorial Trust Fund	7,000	..	6,734	
Morrison Oration Trust Fund	500	..	500	
Sir Littleton Groom Memorial Scholarship Trust Fund	800	..	795	
Norwegian-Australian Cultural Trust Fund ..	2,200	..	2,123	
Danish-Australian Cultural Trust Fund ..	2,200	..	2,143	
Swedish-Australian Cultural Trust Fund ..	1,600	..	1,558	
Mount Stromlo Observatory Fund	6,140	..	6,000	
Australian National University Superannuation Scheme—Members' Fund	14,200	..	13,247	
Australian National University Superannuation Scheme—Supplementary Pensions Fund ..	18,700	..	18,665	
Fund for Return Fares—Special Deposit ..	500	..	489	
	267,570			257,946
Cash at Bank—Commonwealth Savings Bank of Australia—Account No. S.979				1,262
				259,208

By Authority: A. J. ARTHUR, Commonwealth Government Printer, Canberra.