Research Report
of the
Wollongong University College

1968

January, 1969
During 1968 the Departments at Wollongong were amalgamated into six Divisions. These are the Divisions of Biological and Chemical Science, Commerce, Engineering and Metallurgy, Language and General Studies, Physical Science and Social Science.

Major extensions to the Engineering Laboratories have been completed during 1968 and the planning for the Science-Commerce Block due for completion in 1969 is well advanced. With a further extension of the Union next year the physical development of the College, while behind schedule, is proceeding as planned.

Chairs of English and Economics were created and filled in 1968 and three further Chairs of Chemistry, Metallurgy and Electrical Engineering have been approved for 1969. This will give the College nine Professors by the end of next year and provide a healthy and balanced development.

Post graduate studies were given a boost by the introduction of the Diploma of Education at the beginning of the year. Thirty students undertook the course which was run in conjunction with the Wollongong Teacher's College.

Nine students graduated with higher degrees during 1968; six with Master degrees and three with Doctor of Philosophy degrees.

As in previous years, outside finance has supported research at the College. The list below shows Grants and Donations made to the College since 1st January, 1968:

Wollongong Soroptomist Club (Associate Professor E. Gellert) 448.45
Anonymous (Associate Professor E. Gellert) 100.00
Bulli Catholic Womens League (Associate Professor E. Gellert) 30.00
Catholic Womens League - Diocese of Wollongong (Associate Professor E. Gellert) 110.00
Mrs. R. Falconer (Associate Professor E. Gellert) 101.35
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<tr>
<th>Organization</th>
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<tr>
<td>Electricity Commission of N.S.W. - Electrostatic</td>
<td>4,000.00</td>
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<td>Precipitator Research Grant. (Total grant</td>
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<td>$14,000. Received in 1967 $10,000)</td>
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<td>Contribution towards replacement of X-ray Tube</td>
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<td>Substituent Effects in Acid Ionisation Processes</td>
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<td>(Dr. Bolton, Mr. Hall and Mr. Reece)</td>
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<td>Phenanthroindolizidines and anti-leukaemia</td>
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<td>(Associate Professor E. Gellert)</td>
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<td>Joint Coal Board - Grant towards cost of equipment</td>
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<td>of Grain. (Dr. A. Roberts)</td>
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<td>Auger Power Unit. (Engineering)</td>
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C.A.M. Gray,
Warden.
DIVISION OF BIOLOGICAL AND CHEMICAL SCIENCE

Acting Head of Division: Associate Professor E. Gellert, DrPhil. (Basle), F.R.A.C.I.

ACADEMIC STAFF

Department of Chemistry

Professor
Vacancy

Associate Professor
E. Gellert, DrPhil. (Basle), F.R.A.C.I.

Senior Lecturers

Lecturers
J. Ellis, B.Sc.(Syd.), Ph.D.(N.S.W.), A.R.A.C.I.
(Appointed September, 1968)
W.K. Hannan, M.Sc.(Syd.)
G.M. Mockler, B.Sc., Ph.D.(N.S.W.) (Appointed December, 1968)

Senior Tutor
D.J. Campbell, B.Sc., Dip.Ed.(Tas.) (General Biology)

Post-Doctoral Research Fellow
K.N. Trivedi, M.Sc., Ph.D.(Bda.) (Contract completed September, 1968)
Phenanthroindolizidines and related compounds.
(B. Chauncy - enrolled 1967)

Magnetic Studies of Transition Metal Complex Compounds.
(G.J. Hamilton - enrolled 1967)

Thermodynamic Functions of Ionisation Processes.
(F.M. Hall - enrolled 1966)

Catalytic Deuterium Exchange Reactions Between Alkylbenzenes.
(W.K. Hannan - enrolled 1966)

Hydrolysis of Amides.
(G.L. Jackson - enrolled 1967)

Spectroscopic Studies of Molecular Interaction in Solution.
(I.H. Reece - enrolled 1963)

The Constituents of Boletus Species.
(R. Rudzats - enrolled 1966)

Physiological Aspects of Acoustic Behaviour in Crickets.
(D.J. Campbell - enrolled 1965)

Isocoumarines and their Derivatives.
(M.S. Dignan - enrolled 1964, registration suspended 1968)

Substituent Effects on Chemical Reactivity.
(K.A. Fleming - enrolled 1967)

Thermodynamic Functions of Ionisation Processes.
(J. Kudrynski - enrolled 1968)

Hydrolysis of Esters.
(K.J. McCarthy - enrolled 1967)

Substituent Effects in the Hydrolysis of Amides.
(P. Nancarrow - enrolled 1965)

Hydrolysis of Amides.
(J.D. Rees - enrolled 1968)
A Physico-Chemical Investigation of some Transition Metal Complexes.
(G.A. Ryder - enrolled 1968)

Preparation and Physico-Chemical Investigation of Complex Compounds of Transition Metals.
(J.R. Snedden - enrolled 1964, degree conferred 5.4.68)

STAFF RESEARCH ACTIVITIES

Department of Chemistry

1. Natural Products: This field, which incorporates phytochemical investigations in conjunction with the Australian Phytochemical Survey and is helped by C.S.I.R.O. with plant collections, is concerned with the isolation of physiologically and pharmaco logically active constituents.

Tylocrebrine, an alkaloid isolated from the North Queensland plant, Tylophora crebriflora, shows promising antileukaemia activity. A New Guinea Boletus, a mushroom species, is also of particular interest because it affects the human brain but the action observed is not identical with that of mescaline, LSD 25, or psilocybine.

2. Synthetic Organic Chemistry: The synthesis of Phenanthroindolizidines and related material and the exploration of their antitumour activity is actively pursued in conjunction with efforts to correlate chemical structure with physiological activity. This programme is supported by grants of the Leukaemia Research Foundation and the Australian Research Grants Committee and is also supported by local organizations.

3. Physical-organic Chemistry: (a) Kinetic studies of the acidic and alkaline hydrolysis of several series of aliphatic amides and ortho-substituted aryl esters have been made. Various linear free energy relationships are being used to assess the influence of substituents upon the rates, activation energies and entropies of these reactions.

(b) Thermodynamic acidity constants of a wide range of substituted phenols and anilinium ions have been measured by a spectrophotometric technique over a range of temperature, and values of the enthalpy and entropy of these
ionization processes computed. These values are also being assessed in terms of linear free energy relationships and certain molecular orbital calculations.

4. Magnetochemistry: The antiferromagnetic exchange demagnetization of complexes of divalent copper with Schiff's bases and with certain nitrogen heterocyclic compounds is investigated. Temperature variation studies of the magnetic susceptibility of these new complexes indicate that the demagnetization observed is the result of exchange interactions between either two or a large number of paramagnetic centres. Structures consistent with such magnetic behaviour have been postulated for all complexes investigated and the programme is now extended to other complexes e.g. to some transition metal complexes of nitrogenous, exogenous, and sulphurous polydentate ligands.

5. Chemical Spectroscopy: Association studies of molecular interactions have continued. Measurements have been made on the OH valence stretching frequencies of binary systems in the vapour phase and of ternary systems in solution to assess the influence of solvent and proton acceptor. Thermodynamic studies of these systems are also continuing.

6. Catalytic Exchange Processes: Investigation into relative activities of Group 8 transition metals as heterogeneous catalysts in isotopic exchange reactions of a range of aromatic hydrocarbons, heavy water being used as a source of deuterium. The aim is to investigate the mechanisms of exchange reactions and in particular to test the worth of the π complex absorption mechanism.

7. Physiology of Crickets: Techniques were developed for the location of crickets in the field and for the investigation of their singing behaviour. The analysis of the activity of natural population of crickets is now extended to studies under controlled laboratory conditions.

PUBLICATIONS

Department of Chemistry

1. "Substituent Effects on the Thermodynamic Functions of Ionization of Meta-Substituted Anilinium Ions".

P.D. Bolton and F.M. Hall

Thermodynamic acidity constants of the meta-methoxyanilinium, meta-chloroanilinium, meta-bromoanilinium and meta-iodoanilinium ions have been measured spectrophotometrically over the temperature range 5-50° and those of the meta-nitroanilinium ion over the temperature range 5-60°. The thermodynamic functions of ionization, $\Delta G_{25}$, $\Delta H_{25}$, $\Delta S_{25}$, and $\Delta C_p^{25}$, have also been calculated for each ion.

For a series of seven meta-substituted anilinium ions the acidity constants show close obedience to the Hammett equation over the temperature range 10-50° with the reaction parameter $\rho$ being a precise linear function of $1/T$. The same reaction series also shows a well defined isoequilibrium relationship of negative slope.


P.D. Bolton, F.M. Hall and J. Kudryrski.


Thermodynamic ionization constants of 3-ethoxyphenol, 3, 5-diethoxyphenol, 3,5-dichlorophenol, 3,5-dibromophenol, 3, 5-diiodophenol, and 3, 5-dinitrophenol have been measured spectrophotometrically within the temperature range 5-60°, and the thermodynamic functions of ionization $\Delta G_{25}$, $\Delta H_{25}$, $\Delta S_{25}$, and $\Delta C_p^{25}$ calculated.

These results, in conjunction with others measured previously, indicate that, for this reaction series, substituent effects on the free energies of ionization are precisely additive, and on the entropies of ionization closely additive. An assessment of the results in terms of Hepler's internal/external enthalpy theory is made.


F.M. Hall and S.J. Slater


The stability constants for the fluoride complexes of tin (II) have been determined by e.m.f. measurements, over a range of temperature, using both a tin amalgam electrode and the recently available fluoride ion activity electrode.
The significance of the values $\Delta G = -11480$ cal/mole, $\Delta H = 10350$ cal mole$^{-1}$, and $\Delta S = 73.2$ cal deg$^{-1}$ mole$^{-1}$ for the SnF$_3^-$ complex is discussed and compared with those for the chloro and bromo complexes of tin (II).

4. "The Oxidation of Acetylbetulic Acid by Mercuric Acetate".
The oxidation of acetylbetulic acid, previously reported in the literature as resulting in lactonisation onto C13, has been shown to cause lactonisation onto C19 and thus follows the normal pattern of allylic attack.

Papers Presented at Scientific Conferences

5. "Phenanthroindolizidinines".
B. Chauncy and E. Gellert.
Previous syntheses of the phenanthroindolizidine alkaloids, tylocrebrine, tylophorine, and tylophorinine have lead to the formation of racemates. This is because earlier workers abandoned attempts to use optically active starting materials when they failed either to combine 9-phenanthrylmethyl derivatives with L-proline or to cyclize the intermediates obtained. This paper describes the synthesis (in good yield) of N-(9-phenanthrylmethyl)L-proline derivatives and discusses their cyclization to phenanthroindolizidines.

In addition a new phenanthrene synthesis (a variation of the Pschorr-synthesis) discovered during the preparation of the phenanthrene-9-carboxylic acid derivatives is reported.

P. D. Bolton and F. M. Hall.
The ionization of phenols and of anilinium ions are traditionally considered as "deviating" reaction series because their acidity constants do not generally obey the Hammett Equation. When the influence of substituents upon the enthalpies and entropies of ionization is considered, however, the opposite situation is found: phenols and anilinium ions
show extreme regularity of behaviour while the benzoic acids, the reference reaction series of the Hammett Equation, show apparently irrational changes in $\Delta H$ and $\Delta S$ with molecular structure. An attempt was made to account for this in terms of a dichotomy of substituent effects into internal and environmental factors.

Many of the results upon which this discussion was based have already been published, but new data for many anilinium ions and some phenols were presented.

7. "Substituent Effects on the Acid Hydrolysis of Aliphatic Amides".

P.D. Bolton and G.L. Jackson.
The rates of the dilute acid hydrolysis of 14 widely substituted aliphatic amides have been measured over a range of temperature. The results were discussed in terms of the influence of polar, steric and hyperconjugative factors on the reaction and an attempt was made to quantitatively assess the relative contribution of each factor.
DIVISION OF COMMERCE

Acting Head of Division: C.A.M. Gray, Hon.J.M.N.,
B.Sc.,M.E.(Syd.),F.I.Mech.E.,
A.M.I.C.E.,M.I.E.Aust.,
Emeritus Professor, University
of Malaya.

ACADEMIC STAFF

Department of Economics

Professor
K.A. Blakey, B.A.(N.Z.), M.Sc.Econ.(Lond.),D.Phil.(Oxf.),
M.Com.(Melb.)

Lecturers
J.C. Steinke, M.A.(Calif.)
Vacancy

Tutor
Mrs. M. Morrison, B.A.(Sheff.)(Resigned 31.12.68)

Research Assistant
B.W. Ross (appointed 4.4.68)

Department of Accountancy

Lecturers
Vacancy
STAFF RESEARCH ACTIVITIES

Regional economic studies continued to be the major research activity, involving all members of the staff. In general terms, these studies aim to isolate growth sources, growth impediments and problems stemming from growth in Wollongong and the surrounding region.

More specifically, during 1968 research was done on the transportation systems in the Wollongong metropolitan area and Shoalhaven Shire, the economic prospects of the small township of Warragamba, the feasibility of constructing an airfield near Mittagong, and a variety of other regional problems.

In addition, research proceeded on economic aspects of the Australian co-operative movement.

PUBLICATIONS

1. "Warragamba - Economic Problems and Prospects".
   S. Ali.
   Hume Development Committee, Picton, 1968 (mimeographed).

2. "The Alleviation of Peak Hour Traffic Congestion in the Port Kembla Industrial Area".
   B. Ross.
   Illawarra Regional Development Committee, Wollongong, 1968 (mimeographed).

3. "Public Transport in Northern Illawarra".
   J.C. Steinke, B. Ross and M. Morrison.
   Illawarra Regional Development Committee, Wollongong, 1968 (mimeographed).
   This report to the New South Wales state government analyzes
utilization of all forms of mass transport, including the private motor vehicle, in the Wollongong metropolitan area. Original statistical data summarizes local transport patterns, comparisons are drawn with other metropolitan areas and deficiencies analyzed. The report concludes with a series of recommendations for development of an integrated road/rail system.

4. "Transcript of Evidence Given at Fruit and Vegetable Market Inquiry of the Joint Committee on the Australian Capital Territory."

J.C. Steinke.

The Parliament of the Commonwealth of Australia, Canberra, 1968. (As a result of his previous investigations of the proposal for a Wollongong market, Mr. Steinke was asked to give evidence relating to the proposed Canberra markets).

Periodical Publications

5. "Consumers Co-operation in Australia".

J.C. Steinke.


J.C. Steinke.

DIVISION OF ENGINEERING AND METALLURGY

Head of Division: Professor C.A.M. Gray, Hon.J.M.N.,
B.Sc., M.E.(Syd.), F.I.Mech.E.,
A.M.I.C.E., M.I.E.Aust., Emeritus
Professor, University of Malaya.

ACADEMIC STAFF

Department of Electrical Engineering

Professor

Vacancy

Senior Lecturer


Lecturers


Department of Mechanical, Civil and Mining Engineering

Professor

A.M.I.C.E., M.I.E.Aust., Emeritus Professor,
University of Malaya.

Associate Professor

S.E. Bonamy, B.E.(Syd.), M.Sc.(Birm.), Ph.D., A.S.T.C.,

Senior Lecturers

A.W. Roberts, B.E., Ph.D., A.S.T.C., M.I.E.Aust.,
M.I.Mech.E.
P. Van der Werf, M.E., Ph.D., A.S.T.C., M.I.E.Aust.

Lecturers

P.C. Arnold, B.E., Ph.D., M.I.E.Aust.
Vacancy.
Department of Metallurgy

Professor

Vacancy.

Senior Lecturers

G. Brinson, M.Sc.(Melb.), Ph.D.(Sheff.), F.I.M.,
A.M.Aust.I.M.M.
(appointed March, 1968)
N. Standish, M.Sc.(N.S.W.), Ph.D.(Otago), A.S.T.C.,

Lecturers

N. Salasoo, B.Sc. A.S.T.C., A.M.Aus.I.M.M.

Research Assistant

E. Köhn, BESc,(W.Ontario)

Teaching Fellow

S. Marich, B.Sc.
Department of Electrical Engineering

Doctor of Philosophy

An Investigation of the Characteristics of Rotating Machines Operated on a Switched Mode.
(W.H. Charlton - enrolled 1967)

Electrical Characteristics of Contaminated Corona - Discharge Systems.
(Z. Herceg - enrolled 1966)

Electrical Conductivity in Particulate Solids.
(K.J. McLean - enrolled 1966)

Some Aspects of the Forces on Charged Particles in Electrostatic Precipitators.
(O.J. Tassicker - enrolled 1966)

Master of Engineering

Computer Control of the 140 Inch Plate Mill, Port Kembla.
(G.E. Wood - enrolled 1966)

A Study of the Identification and Optimal Control of a Reheat Furnace.
(T.S. Yang - enrolled 1965)

Department of Mechanical, Civil and Mining Engineering

Doctor of Philosophy

An Investigation of Mechanical and Rheological Properties of Wheat Grains.
(P.C. Arnold - awarded 1968)

Study of Unsteady Flow in a Reciprocating Compressor.
(R.W. Upfold - enrolled 1963)

A Study of Shock Propogation in Tubes.
(R.T. Wheway - awarded 1968)

Master of Engineering

Bulk Handling of Granular Materials.
(W.R. Drew - enrolled 1965, registration cancelled May, 1968)

Dynamic Properties of a Structural Frame.
(M.J. Lowrey - awarded 1968)
Master of Engineering (cont.)

An Investigation of Pressure Wave Phenomena in Small Bore Tubes.
(A.J. Sleigh - enrolled 1968)

Master of Engineering Science

An Investigation of Equivalent Elastic Properties of Perforated Sheets.
(B.J. Anger - enrolled 1967)

Control System Identification Utilizing Fluidic Components.
(D.C. Crook - enrolled 1967)

An Investigation of the Stiffnesses of a Plate We Girder under Eccentric Loads Applied to a Flange.
(R.J. Derrington - enrolled 1967)

Investigation of Design Methods for Bulk Transport Containers.
(J.T. Devine - enrolled 1967)

Investigation of Stress Distribution at Changes of Section of Members under Two Dimensional Bending and Direct Stress.
(K. Forbes - enrolled 1966)

Analysis of Non Linear Effects in Control Systems Performance.
(D.A. Hodges - enrolled 1966)

Dynamic Analysis of the Motion of Linkages with Relation to the Upper Extremity Limb.
(N.T. Hodkinson - enrolled 1967)

Performance Analysis of Multiple Conveyor Combinations.
(K. Issa - enrolled 1967)

Photoelastic Investigation of Surface Stress Distributions in a Cylinder Loaded in Compression.
(D.J. Phillips - enrolled 1967)

Investigation of Failure of Crane Runway Rails.
(D.C. Smith - enrolled 1966)
Performance Analysis of Floveyor Grain Conveyor Including Vibration Study.  

Study of Moments in Orthotropic Shells Using Moire Method.  

Creep Testing Using Cantilever Bending.  

Department of Metallurgy

Doctor of Philosophy

A Study of the Martensite in Beta Copper-Tin Alloys.  
(N.F. Kennon – conferred 1968)

The Solidification of Metal-Metal Sulphide Systems.  
(S. Marich – enrolled 1966)

Master of Science

Hanging Phenomena in Packed Beds.  
(J. Drinkwater – enrolled 1968)

Phase Transformations in Ferrous Alloys.  
(R.H. Edwards – enrolled 1968)

A Study of the Influence of Titanium on the Structure of Alloy Steels.  
(T.J. George – enrolled 1968)

Creep in Zirconium  
(E. Kohn – enrolled 1968)

Creep in Ferrous Alloys.  
(R.L. Player – enrolled 1965)

The Solidification of Silver-Oxygen Alloys.  
(N. Salasoo – enrolled 1965)

Distribution of Non Metallics during Solidification of Metals.  
(I.D. Simpson – enrolled 1968)
The Behaviour of Boron in Iron and its Alloys.
(J.L. White - enrolled 1964, registration suspended until 1969).

The Effect of Crystallographic Orientation on the Electrochemical Properties of Tin.
(N. Whiltshire - enrolled 1965).

STAFF RESEARCH ACTIVITIES

Department of Electrical Engineering

1. **Basic Processes in Electrostatic Precipitator** when operated with high-resistivity particles with special reference to:
   - Basic theory of operation
   - Formation and effects of back ionization
   - Electric field patterns
   - Adhesion forces in precipitated layers
   - Mechanism of current conduction through the precipitated layer.

2. **Insulating Materials**: Study of ionic and electronic conduction in insulators with special reference to the effect of metal electrodes and high electric fields.
   - Investigation of adhesion forces between small diameter insulating particles.

3. **Gaseous Discharges**: Investigation of the generation and transport of gaseous ions in a corona discharge system with special reference to the influence of the electrode surface condition.
   - The measurement of corona field patterns by the use of a special micro area probe.

4. **Automatic Control**: (a) Investigation of computer control of furnaces and rolling mills in the steel industry.
   - (b) Investigation of digitally controlled, direct electrically driven bridles in steel industry.
   - (c) Investigation of various methods of switched operation of machines.
(d) Continuous process identification using 2-level chain codes as the perturbing signal.

Department of Mechanical, Civil and Mining Engineering

1. An Examination of Pressure Wave Phenomena in a Uniform Shock Tube Containing Air: Pressure versus time diagrams have been recorded for shock and rarefaction waves propagating through air in a mechanical shock tube using miniature piezoelectric transducers. From an analysis of a large number of such diagrams, using a wide range of pressure ratios, an examination is being made of the variation in amplitude and propagation velocity due to friction and heat transfer.

In particular a study of the wave shapes in the regions behind the shock front and behind the head of the rarefaction wave has been studied in detail. This has revealed that heat transfer takes place across a gaseous interface from "shocked" to rarefied gas in addition to that to and from the tube walls.

A theoretical analysis has been made using the method of characteristics and computer programmes have been written to avoid the usual step by step analysis involving the construction of a state diagram.

Experiments are to be conducted on small bore tubes to examine the effects of boundary layer growth on wave shapes.

2. The Influence of Connecting Passage Geometry on the Measured Output from Transducers: Many pressure transducers are available for recording transients such as shock pulses or repetitive high speed events. These have extremely high natural frequencies of vibration, but unfortunately must be located in many instances at considerable distance from the pressure measuring point, the pressure pulse being propagated to the transducer via a long narrow tube. Such pulses are subject to attenuation due to friction and heat transfer and a relatively large time lag occurs.

A large number of tests have been conducted by recording pulses from an air compressor cylinder through tubes of varying geometry, using capacitance type transducers. A range
of compressor speeds and operating pressures have been used and the results are at present being analysed.

3. **Measurement of High Speed Temperature Fluctuations**: This project is aimed at the experimental determination of charge temperatures in internal combustion engines in order that comparisons can be made with analytical values obtained from a study of theoretical engine cycles. Special thermocouples of high sensitivity and response rates, purchased for the project are being used initially for measurement of temperature fluctuation in a mechanical shock tube containing air.

4. **Erosion of Metallic Surfaces**: An investigation is being made of the basic principles of the erosion process, including a study of fluid flow conditions and particle motion in the fluid, and of the mechanism of material removal for a variety of materials. Apparatus have been designed enabling a quantitative evaluation of erosive wear rates under controlled conditions of fluid flow.

5. **Materials Research Projects**: A number of problems dealing with the strength and properties of materials are under investigation.

   In one project the structural strength of sandwich boards is being determined. The tests include load deflection measurements and artificial aging.

   In another project tests are being conducted to determine the bond strength of steel and concrete for various coatings on the steel.

   Further work undertaken includes concrete and aggregate testing, unconfined and compaction tests of soils, triaxial tests, testing of failures in concrete, testing of concrete additives, and detailed testing of corings from various mines.

6. **Simulation and linear programming applied to Farms**: Work has continued in the farm management area by writing programmes suitably simulating farms on the South Coast. These programmes take into account almost all variables met with on a farm, including accounting.

   Linear programme techniques have been applied to typical South Coast farms in order to show clearly methods of maximising monetary return.
7. The C.C.T.V. Camera as a Research Tool: In many situations, involving either dangerous or awkward situations, a closed circuit television camera is invaluable. Techniques are being developed using the vidicon tube as an image tube multiplier for photoelastic work. For large scale display of Moire patterns produced in stress analysis work, the C.C.T.V. is being used to give immediate patterns.

8. The Analysis of Stress Distribution Produced at abrupt Changes in Section: The application of the complex variable to the analysis of two dimensional stress systems produced at abrupt changes in section on axially loaded members is being investigated. This method leads to a set of infinite equations in an infinite number of unknowns. Methods for the solution of these equations have been investigated using the College computer.

9. Investigation of the Failure of Crane Runway Rails: Photoelastic methods have been used to investigate the stress distribution produced within the head of crane runway rails. Verification of the results are being obtained by load tests.

10. The Investigation of Curvature Produced in Plates with Edge Loading using Moire Fringe Techniques: The curvature of plates under varying types of loads and edge fixations is being investigated by interpreting Moire fringe patterns. These patterns are produced from a double exposure of reflected line patterns. A large scale apparatus, suitable for large plates, has been constructed and the calibration of the apparatus is proceeding.

11. The Development of High Speed Photographic Techniques: Various photographic techniques are being developed for the recording on film of dynamic phenomena. The techniques are developed using combinations of high speed cine cameras, high intensity stroboscopes, and single shot cameras.

12. The Design of Solar Telescopes: An 18" Cassegrain Telescope has been designed, built and installed. This telescope will be used for solar observations from an Observatory also built by the College. The comparatively short length of such large
The secondary mirror requires water cooling with stringent boundary conditions of temperature and pressure in order that its curvature remain constant with fluctuating temperature conditions and height. The design of this cooling system is proceeding.

13. **Bulk Handling of Granular Materials:** The Bulk Handling Research has been supported financially by the Commonwealth Wheat Industry Research Council and Commonwealth Rural Credits Development Fund. The research programme is dealing with a number of problems broadly embraced by the analysis of conveying equipment performance, the properties of bulk materials and the mechanics of bulk material flow. The three main areas of the programme which received attention during the past twelve months are:

(i) **Conveyor Performance Studies.** An analysis of the disc and cable method of conveying grain through an elevated tube was undertaken. The output and power characteristics for a range of speeds were obtained, for a model and prototype conveyor, the power consumption being rather excessive owing to high churning losses in the feed hopper. By employing a casing feed instead of the conventional hopper feed the power consumption can be reduced. Dimensional analysis and dynamic similarity were used to compare model and prototype performance. A vibration study was undertaken to determine the natural frequencies of the disc and cable; the distributed cable mass, the concentrated disc masses, the variable cable tension and the cable velocity were taken into consideration in this analysis. Investigations are also in progress on the performance of multiple auger and conveyor systems. Emphasis is being given to the design of transition pieces and performance optimization.

(ii) **Mechanical and Rheological Properties of Wheat Grains.** Photoelastic and numerical evaluation of the stress distribution throughout a typical symmetrical wheat grain cross section have been performed. The Photoelastic Analysis
formance on large sectional wheat grain models made of "araldite" allowed the isochromatic fringes (difference of principal stresses) to be studied. The isopachic fringes (sums of principal stresses) were determined from a numerical solution of the Laplace Equation. A comparison of the Photoelastic model behaviour with microscopic observations of actual grains indicated that the photoelastic technique provides an acceptable analogy of the stress conditions in load wheat grains.

Determinations of the Elastic Modulus of Wheat grains were made on the basis of core specimens employing Hooke's Law and whole grains employing Hertz theory. The Hertz theory method which allowed for the localised deformations of the grain against the top and bottom loading plates is considered to give the most reliable results. Current research is concerned with the effects of drying rate and rate of moisture absorption on the physical strength of wheat grains.

(iii) Flow of Granular Materials through Chutes. The complexity of the flow behaviour of granular materials through curved chutes can be reduced to a certain extent by utilizing some simplifying assumptions. These assumptions which involve consideration of the material as a lumped system rather than as a distributed system, give satisfactory results for the design of chutes to achieve fast flow. An equivalent friction coefficient is introduced to account for the drag against the chute bottom and side walls. This friction coefficient is not constant but varies with the depth of the flowing stream. The equations of motion are nonlinear in form and have been solved numerically with the aid of the digital computer, for a number of chutes of specified geometric form. Comparison of the theoretical results with those obtained by experiment show good agreement. Recommendations are made for the design of the "best" chute profile or combination of profiles to suit particular design applications.

Current work in the project is concerned with optimization analyses of the chute flow problem utilizing techniques from
the calculus of variations.

14. **Subdivision Computation**: Programmes have been developed for the complete solution of land subdivision layouts on the IBM 1620 digital computer. The co-ordinates of up to 1500 points may be determined during a single run using a variety of coded routines, and allotment details are subsequently produced.

15. **Dynamic Properties of Structural Frames**: An investigation has been made into the effects of significant parameters on the free-vibration properties of elastic framed structures using a digital computer. The resulting information is utilized in proposing simple procedures for approximating natural frequencies of multi-storey and multi-bay frames.

**Department of Metallurgy**

A major interest is the study of the mechanical behaviour of metals at high temperatures, and with the influence of non-metallic inclusions on this behaviour. An understanding of the influence of inclusions on the initiation and development of cracks during deformation at high temperatures is important for several reasons. At rates of straining corresponding to creep conditions, inclusions located at grain boundaries can be responsible for the initiation of cracks which cause failure by creep rupture. With high rates of straining, inclusions can initiate cracks which cause failure during forming operations. This aspect of the work is at present concerned with the effect of oxide, and sulphide inclusions on the initiation and propagation of cracks in ferrous alloys. A further project concerned with mechanical behaviour at elevated temperatures is an investigation of creep in zirconium — a metal of importance in the generation of nuclear power.

The other principal activity is the study of phase transformations including processes involved in solidification. Solidification is a much more complex process than is often realized, and undesirable structures formed during solidification are difficult to eliminate subsequently. In particular, an
unfavourable distribution of inclusions should be minimized and it is hoped that this research programme will suggest means of avoiding undesirable structures. An understanding of transformations in the solid state is central to the effective heat treatment of alloys and several projects in the Department are concerned with this field.

PUBLICATIONS

**Department of Electrical Engineering**

   
   
   The actual performance of an electrostatic precipitator does not always agree with that predicted by the theoretical model devised by Deutsch. One reason for this departure is the variation of the charging and accelerating electric fields for the suspended particles due to the voltage build up across the deposited particle layer on the collecting electrode.

   A theoretical analysis is made of this effect assuming all other variables are constant, and the performance described by means of the precipitating, collecting and overall efficiencies. A numerical example of a laboratory pipe type precipitator is included to illustrate the theory.

   The investigation shows that the sectional and overall performances of an electrostatic precipitator are greatly influenced by the thickness and resistivity of the precipitated layer of particles.

   
   
   The electrostatic precipitation of high resistivity fly-ash introduces special problems in the design and operation of electrostatic precipitators. This Bulletin records the areas of research undertaken by the Electrical Engineering Department and records the progress made.

25.
W. Charlton.
Wollongong University College Bulletin No. 16.
This report describes the circuits designed and preliminary tests made to initiate research into process identification using maximum length sequences as the perturbing signal.

The basis for the method is reviewed and experimental results are given for the identification of first and second order linear systems using varying clock pulse periods and code lengths. The effects of a class of additive noise is examined.

4. "Transmission Line Equations"
W. Charlton.
Starting from an incremental line section expressed in terms of a generalised frequency a useful form of expression for line currents and voltages is obtained as the solution of a first order vector-matrix differential equation.

It is also shown that the same working form of the transmission line equations can be obtained by a direct application of two-part theory.

5. "Slip Measurements in Induction Machines"
W. Charlton.
Relatively cheap and simple digital circuiting is used to obtain a direct measure of the average value of slip. The principle employed is such that knowledge of the synchronous speed is not required and accuracy depends on allowable averaging times.

Department of Mechanical, Civil and Mining Engineering

A.W. Roberts.
The flow of granular materials through curved or straight dis-
charge chutes is classified as either "fast" or "slow". Fast flow is the more efficient and occurs when the material flows in contact with the chute bottom and side walls, but does not make contact with the top. On the other hand, slow flow occurs when the material is in contact with all four faces of the chute. Under fast flow conditions, the grain stream thickness varies along the chute with the minimum thickness occurring near the point where the mean stream velocity is a maximum. The paper investigates the conditions governing fast flow and presents an approximate analysis to account for the grain stream thickness variation. The analysis, based on the assumption of steady flow, involves the solution of nonlinear differential equations. An equivalent friction coefficient is introduced to account for the frictional drag on the chute bottom and side walls; this friction coefficient is not constant but is found to vary with the changing stream thickness. Results of experimental investigations performed on chutes of known geometric shape are correlated with the analytical solutions. High-speed cine photography is used to determine the actual velocities and paths of individual grains in the moving stream, thus enabling the velocity profiles to be determined at different points along the stream. The paper presents data and recommendations for optimum chute design. These data include suggestions relating to the best chute shape to meet a given set of conditions and information concerning the optimum chute cutoff angles to avoid flow obstructions.


Department of Metallurgy

1. "Heat Transfer in Liquid Metal Irrigated Packed Beds Countercurrent to Gasses".
Heat Transfer coefficients have been measured in beds of various packings irrigated with mercury and molten fusible alloy countercurrent to hot gases. The measured coefficients for both systems were found to increase with gas velocities and liquid rates. Correlations were determined which show this dependence and also indicate that heat transfer in these systems is influenced by the liquid flow characteristics and the thermal conductivity of the gas and the solid packings. A heat transfer model has been proposed which explains the various features of the experimental results. On the basis of this study, which gives an insight into the heat exchange in the melting zone of the blast furnace, it was concluded that by comparison with the furnace stack heat transfer coefficients are about 1.5 times higher in the melting zone.


The dynamic hold-up of a fusible alloy (cerrobend) and of wetting and non-wetting water is investigated in beds packed with ½ in. rings and saddles of different material. Liquid flow rates used range from 10 to 100 ft³/hr.ft². Results obtained are compared with reported hold-up data for mercury and for aqueous and organic solutions. It is shown that available correlations for dynamic hold-up of aqueous and organic solutions cannot be used to predict hold-up of liquid metals. A generalized correlation is developed which overcomes this difficulty.


The amount of liquid retained in a porous bed is determined by weighing a column containing the bed. The column is attached to the free end of a cantilevered beam, and changes in weight are determined by calibrated strain gauges (which
form a resistance bridge) attached near the fixed end of the beam. By coupling the output from the strain gauges to an amplifier and a recorder, a continuous record of changes in the drainage characteristics of the bed may be obtained.

An apparatus is described which records the transient behaviour of liquid irrigation in packed beds with and without a countercurrent gas flow. The apparatus measures weight changes of the bed by means of strain gauges mounted on a cantilever beam. The signal from the resistance bridge is amplified and recorded on a chart. Examples of recorder traces show a number of interesting features of holdup and loading phenomena. The apparatus, for which an accuracy of better than 1% is claimed, could be used in conjunction with transient mass transfer studies.

The paper examines the past and the present states of hanging and presents laboratory and operating results which strongly suggest that furnace hanging is a phenomenon similar to flooding in packed columns. On the basis of theory and the available experimental and practical data it is shown that hanging may be controlled by a scheme of individual tuyere control and that such a scheme should result in rational furnace driving at all times. It is argued that since such improvements as burden preparation, H.T.P., fuel injection etc. do not result in hanging-free operation the return on capital invested on these improvements is unnecessarily restricted without hanging control and that with such a control higher and sustained production rates should be possible not only from new furnaces but also from older but still serviceable units. Additional economic advantages which might result are more efficient utilization of the available furnace capacity and longer campaigns.
6. "The Relevance of Stokes Law to the Physical Conditions of Steelmaking."
N. Standish.

S. Marich and G. Brinson.

6th National Foundry Convention, August 1968.
DIVISION OF LANGUAGE AND GENERAL STUDIES


ACADEMIC STAFF

Department of English

Professor

Lecturers
Vacancy

Tutor
Mrs. I.S. Sharp, B.A. Dip.Ed.(Syd.).

Department of General Studies

Lecturers
A.A. Brownlea, B.Ec.(Syd.), M.A. N.E.(Resigned May, 1968)
D.J. Dillon-Smith, M.A. Dip.Ed.(appointed 22.7.68)
1. Professor P.K. Elkin is making the final revisions of a book for the Clarendon Press, Oxford, on *The Augustan View of Satire*. This is an interpretative study of the opinions of writers and critics on the nature and function of satire during the great age of English satire, that is from Dryden's times in the late seventeenth century to Johnson's in the latter half of the eighteenth century. In addition Professor Elkin is presenting the results of his examination of "Eighteenth-Century Imitations and Translations of Juvenal" at the Twelfth Congress of the Australasian Languages and Literature Association in Perth in February, 1969; and, he is reviewing for *AUMLA* No. 31, *Swift, the Man, his Works and the Age, II* by Irvin Ehrenpreis (Methuen) and *Protean Shape* by Susie I. Tucker (Athlone, University of London).

2. Mrs. Sharp is working with Mrs. E. Steibel-Zanotti on a parallel text translation of "Novelle del Novecento", Nineteenth-Century Italian Short Stories.

3. The Linguistic Acculturation of Migrants in the Wollongong-Port Kembla Area: An analysis of the interlingual shifts, lexical, syntactic and phonetic, in the language of migrants from the German, Greek, Italian, Spanish and Yugoslavian communities is at present being undertaken. The study forms part of a longterm survey of the linguistic acculturation of migrants in the district.

4. Audio-Visual Programmes for the Teaching of English to Migrants: An audio-visual programme employing transformational principles has been constructed for the teaching of English to Greek migrant women with little or no English. A similar programme for the teaching of English to Yugoslav migrants is at present being developed.

5. Research Undertaken in Association with the Department of Mechanical Engineering: Research being undertaken in association with the Department of Mechanical Engineering includes the establishment of mathematical models for the sounds of speech, the development of techniques for the
direct recording of speech for subsequent phonemic analysis,
and the comparison and analysis of allophones by digital
computer.
DIVISION OF PHYSICAL SCIENCE

Head of Division: A. Keane, M.Sc.(Syd.), Ph.D.(N.S.W.)

ACADEMIC STAFF

Department of Geology

Senior Lecturer


Lecturer


Vacancy

Tutors


V.E. Thomson, B.Sc.(Hons.)(Syd.) (Resigned March, 1968).

Department of Mathematics

Professor

A. Keane, M.Sc.(Syd.), Ph.D.(N.S.W.).

Associate Professor

C.A. Wilkins M.Sc.(N.Z.), Ph.D.(N.S.W.),

(promoted January, 1968).

Senior Lecturer

A.E. Chapman, M.Sc.(Lond.)

Vacancy

Lecturers

D.J. Clarke, M.Sc.(W.Aust.), M.Sc.(Adel.).


Vacancy

Tutor


Teaching Fellow

C. Chiarella, M.Sc.(Syd.)
ACADEMIC STAFF (cont.)

Department of Physics

Visiting Professor


Senior Lecturer

K.J. Ausburn, B.Sc.(Syd.), M.Sc.(Lond.), Ph.D.(N.S.W.)

D.I.C., A.Inst.P.

Lecturers

J.N. Mathur, M.Sc.(Alig.), Dr.rer.nat.(Kiel)

A.I. Segal, B.Sc.(Melb.), Grad A.I.P.

J.N. Stephens, M.A.(Cantab.), Ph.D.(N.S.W.), Grad A.I.P.,

A.M.Inst.F.

Vacancy.

Tutor

J.L.K. Lising, B.Sc.(N.S.W.)

Vacancy.
HIGHER DEGREE TOPICS

Department of Geology

Doctor of Philosophy

The Variation and Significance of the Rank of Coal in the Southern Coalfield, New South Wales.
(A.C. Cook - enrolled 1965)

Master of Science

The Vertical and Lateral Variations in the Petrographic Composition of the Bulli Seam of the South Bulli Syncline.
(H.W. Read - enrolled 1967)

Department of Mathematics

Doctor of Philosophy

Methods for the Calculation of Heterogeneous Reactor Systems.
(C. Chiarelli - enrolled 1966)

Neutron Transport in Subcritical Lattices.
(B.E. Clancy - enrolled 1967)

Oscillations within and on a Fluid contained by Arbitrary Boundaries.
(D.J. Clarke - enrolled 1967)

Collision Probability Methods in Reactor Lattice Calculations.
(G. Doherty - enrolled 1967)

A Correction to the Narrow Resonance Approximation for the Calculation of Resonance Absorption.
(T.S. Horner - enrolled 1966)

Reactor Theory.
(D.J. McKeegan - enrolled 1968)

Language Translation and Optimization.
(D.J. Richardson - enrolled 1966)

Numerical Methods Used in Neutronics Calculations.
(J.P. Pollard - enrolled 1967)

36.
Doctor of Philosophy (cont.)

Wind Generated Currents in a Basin.
(P.J.O'Halloran - enrolled 1968)

Master of Science

The Energy Levels and Spacing of Resonances.
(A.J. Gilks - enrolled 1966)

Resonance Overlap - Effect of Neighbouring Resonances.
(D.J. McKeegan - enrolled 1965, conferred 5.4.68)

The Problem of Unknown Parameters in Neutron Resonance Theory.
(A.R. Musgrove - enrolled 1966)

Formulation and Calculation of Resonance Overlap Effects.
(P.J. O'Halloran - enrolled 1965, conferred 5.4.68)

The Diffusion Theory of Neutron Thermalization Experiment.
(K.J. Maher - enrolled 1965, conferred 5.4.68)

An Analytical and Statistical Treatment of the Infinitely Dilute Resonance Integral.
(D.G. Thompson - enrolled 1965)

Master of Arts

Mathematical Models for the Wollongong Urban Area.
(Miss J. Shaw - enrolled 1967, registration suspended until 1969)

Department of Physics

Doctor of Philosophy

(A.I.M. Ritchie - enrolled 1968)

Fission Physics.
(J.W. Boldeman - enrolled 1968)
Master of Science

The Detection and Measurement of Infra-Red Radiation in Astronomy.
(H. Fraser - enrolled 1967)

Application of the Mossbauer Effect to the Study of Solid Solutions.
(J. Lising - enrolled 1966)

Studies of the Information Content of Photographic Emulsions.
(J.M. Robinson - enrolled 1968)

STAFF RESEARCH ACTIVITIES

Department of Geology

1. Coal Carbonization: A study of relation between the properties of coals and the properties of their cokes, with particular emphasis on petrographic aspects of both the coals and cokes. Two aspects which have received particular attention are coking properties of low vitrinite coals and the effects of blending high rank low vitrinite coal with low rank high vitrinite coal. In part this is a collaborative project with the Australian Iron & Steel Coal Geology and Coke Research Sections.

2. The Variation of Coal Properties in the Southern Coalfield, N.S.W.: One aspect of this study concerns the collection of data, a second the development of methods of analysing the data and a third the relation of the variation to structure and sedimentation conditions. It has been demonstrated that a significant relationship exists between the thickness of the Bulli Seam and some of the structures which affect the seam.

3. Myrmekites: Myrmekites are quartz-plagioclase intergrowths found on the rims of some plagioclase crystals. The ratio of quartz to felspar and the composition of the felspar are being determined for a number of myrmekites to help resolve the question of their origin.

4. Intrusive Complexes of Northern New England: Research is being continued on the petrography of these mainly granitic bodies.
5. Magnetic Properties of Rocks: The magnetic properties of rocks are currently being investigated. At present these investigations are not concentrated on local rocks, although preliminary studies are presently being commenced on rocks from the Illawarra region. Palaeomagnetic aspects and the relation of magnetic properties to the petrology and mineralogy of the rocks are considered. The Illawarra region offers scope for the application of rock magnetic studies to structural geology and mining geology.

6. The Diameter of Lightning: The diameter of lightning has been determined in the U.S.A. by measuring the size of holes, fused by the return stroke, in specially constructed fibre-glass "boots". These boots are placed over lightning conductors. This method, which appears not to have previously been used in Australia, gives results which agree well with theoretical considerations, whereas photographic methods give overestimation of diameters.

Department of Mathematics

1. Nuclear Reactor Theory: Previous investigations of resonance absorption have been continued. These include the development of and a study of the spacing of resonances in the statistical region. A new Doppler broadened cross section allowing for crystal binding in a solid moderator has been derived and appears to offer computational advantages over the usual free gas model.

2. Oceanography: The work on seiches in irregularly shaped basins is continuing. To assist this study a number of long wave recorders have been obtained and one installed at Jervis Bay obtained a record of very large waves of 3 min. period during a storm in June. It is felt that these waves come from the ocean and may be responsible for the violent conditions in Port Kembla harbour which could be made to resonate by waves of such a period.

3. Operations Research: The study of urban population models has continued, and the results applied to various servicing problems. The application of various Operations Research techniques to problems of Farm Management has also been under consideration.
4. **Algebra:** Research on the theory of groups has lead to some new results on Maximal abelian p-subgroups of the general linear group.

**Department of Physics**

1. **Infra-red Astronomy:** An 18-inch Cassegrain infra-red solar telescope is nearing completion. Whilst primarily intended for narrow band filter studies of the solar chromosphere in the infra-red, it will also be used for stellar and planetary studies.

2. **Infra-red Imaging Systems:** The relative merits of I.R. photographic plates, I.R. vidicons and I.R. image converters for astronomical applications are being investigated.

**PUBLICATIONS**

**Department of Geology**

1. "Mafic hybrid rocks from the New England Batholith, New South Wales".

   E.R. Phillips


   Intrusion of an adamellite with K-feldspar megacrysts into metadolerite wall-rock has produced a hybrid rock with K-feldspar prophyroblasts and quartz "ocelli" rimmed by hornblende. This indicates a high-level development of the feldspar and suggests that mafic contamination is an important factor in the genesis of the xenolith-rich porphyritic adamellite.

2. "Some Results of a Reconnaissance Magnetic Investigation of Ordovician Rocks from Central Western New South Wales".

   R.A. Facer


   Previous field and laboratory investigations having indicated potential suitability, reconnaissance magnetic studies were carried out on samples of volcanic rocks of Ordovician age from the Orange-Molong area of Central Western New South Wales. The Ordovician in the region consists largely of massive volcanic horizons, and their structure is little known in detail. Petrologic methods were also used in t...
study, the rocks being mainly andestic in composition. The results of the laboratory magnetic study, which included alternating field demagnetization, showed these Ordovician rocks to be apparently unsuitable for palaeomagnetic investigations. This result was in good agreement with previous results from Ordovician rocks elsewhere in the world, and supplemented thermal studies on these N.S.W. rocks.

3. "The Relationship between Seam structure and Seam thickness for the Bulli Seam in the Permian of the Sydney Basin, New South Wales".
A.C. Cook. 

4. "Coal Reserves in the Southern Coalfield, New South Wales".
A.C. Cook. 

5. "The Petrography of a Coal Seam from the Clyde River Coal Measures, Clyde River Gorge, New South Wales".
A.C. Cook and H.W. Read. 
The coal is of low bituminous rank. It is rich in vitrinite but contains significant amounts of exinite. In type it is very similar to a number of coals previously described from the Greta Coal Measures. The rank of the coal is much lower than that of the Bulli Seam coal in the Illawarra Coal Measures near Wollongong, though it would appear that the maximum depth of cover is similar for the Clyde River Coal Measures and for the Bulli Seam in the Wollongong area.

6. "Application of Coal Petrography at the Port Kembla Works".
R.G. Wilson and A.C. Cook. 
The B.H.P. Technical Bulletin
The application of coal petrography to the problems associated with coke manufacture is discussed and relations between the petrographic characteristics of a coal and coke strength are presented. From these relationships and maps showing the
distribution of rank and type it is clear that the main problems associated with the production of high strength coke at Port Kembla relate to vitrinite poor Bulli Seam coal.

7. "An Application of Trend Surface Analysis to the Preparation of Cover Isopach Maps for Coal Seams".

A.C. Cook and O.J. Shiels.
Proc. Australas. Inst. Min. & Metall., 228,
Conventional hand drawn isopach maps of the cover of the Bulli Seam are too complex for use in the delineation of large domains of similar cover. Isopach maps prepared from trend surfaces fitted to the cover data are much simpler in form and can provide a convenient method of delineating broad domains of similar cover. Additionally the trend surfaces may simulate at the coal seam horizon the smoothing effects of thick cover on the differential loads associated with topographic relief.

8. "The Proportionality of Quartz in Myrmekite."

Measured quartz volumes in certain myrmekites from Broken Hill are close to the amount predicted from theoretical considerations, suggesting that the myrmekite may have formed by exsolution.


E.R. Phillips,
Publication of the Department of Geology and Mineralogy, The University of Queensland, 1968, 50 pages.
Igneous rocks from the Undercliffe Falls - Liston - Maryland area of northern New South Wales vary from metadolerites to granites. The main plutonic rock is the Undercliffe Falls porphyritic adamellite and this intrudes Permian "Boorook" strata which, away from contacts, are little-altered sediments and volcanics. The rhyolitic adamellite is intruded by the Stanthorpe adamellite which is displaced by the more acidic Ruby Creek granite. These masses are described by means of
new chemical, mineralogical and petrographic data, resulting in the division of the Undercliffe Falls and Stanthorpe masses into a number of varieties.

Much of the Undercliffe Falls mass (the normal type) is a porphyritic rock with basic xenoliths which have a preferred orientation developed by a primary platy flow imposed when the intrusion was magmatically emplaced. Contacts are discordant in detail. Large pink K-feldspars, some of which are mantled by plagioclase, are found in the normal type, in its contained xenoliths and in metadolerite country rock. Other varieties of the Undercliffe Falls mass include an even-grained marginal type and a relatively basic phase with white K-feldspar phenocrysts. The younger intrusions are even-grained rocks which were probably emplaced as magmas. Compositionally the Ruby Creek granite falls in the low melting portion of the NaAlSi$_3$O$_8$ - KAlSi$_3$O$_8$ - SiO$_2$ - H$_2$O - (CaAl$_2$Si$_2$O$_8$) system.

The Undercliffe Falls porphyritic adamellite probably formed by chemical hybridization involving gabbroic rock (similar to the Wall-rock metadolerite found in the area) and acidic magma. Calculations indicate that the Stanthorpe adamellite is a suitable acid parent and it, together with the Ruby Creek mass, may have been derived by crustal melting.

10. "Magnetic studies of the Canobolas Mountains, Central Western New South Wales".

R.A. Facer

Field and laboratory magnetic investigations have been carried out on rocks of the Mt. Canobolas volcanic complex near Orange, Central Western New South Wales. The complex consists of acid to basic lavas and pyroclastics, with some intrusives, built up on Palaeozoic rocks. The field magnetic results correlate in style and trend with the anomalies shown in existing aeromagnetic maps of the surrounding region of Palaeozoic rocks, suggesting that they largely delineate the structure of these rocks beneath the volcanic pile. Detailed laboratory investigations of the petrology, mineralogy and magnetic properties of the basalts from near Orange indicated a definite
correlation between these properties. The basalts could be divided into two rock-types (titanaugite olivine basalt and olivine basalt), the first Group having a stable magnetization, the second Group unstable magnetization. This study has shown the need for complementary petrological studies in rock magnetic investigations.

Department of Mathematics

1. "Seiche Motions for one-dimensional flow".
   D.J. Clarke.
   The linearized equations of motion for the case of one-dimensional flow are solved as a sequence of approximations for the modes of oscillation of a fluid in an enclosed basin by using Galerkin's method from the calculus of variations.

2. "A Marine Physics Project".
   D.J. Clarke, A. Keane, P.J. O'Halloran
   Wollongong University College Bulletin No. 17 (Oct. 1968)
   "Modern Techniques for Farm Management".
   A. Keane

3. "On the Evaluation of Integrals Related to the Error Function".
   C. Chiarella, A. Reichel.
   Mathematics of Computation (Jan.1968)22. No.101 p.137

4. "Synthetic Kernels and the Infinitely Dilute Resonance Integral".
   C.A. Wilkins, C. Chiarella, A.J. Gilks and A. Reichel.
   The infinitely dilute resonance integral is usually calculated on the assumption that resonances are randomly distributed. A more accurate approximation is obtained by a method shown to be equivalent to the use of the Goertzel-Greuling synthetic kernel.

5. "Some Points in the Methodology of Urban Population Distributions".
   C.A. Wilkins
   Operations Research, 16, 1 (1968)
For some operational problems concerned with urban populations, the actual location of population within each city is not of primary importance. For such problems, it may be best to proceed in terms of the function $A(D)$ defined as being the city area over which the population density $\pi D$. Knowledge of this function enables a suitable symmetric representation of a city of fairly arbitrary form to be determined, and Weiss' problem of maximizing the population in a given total area chosen from the regions of a sequence of cities to be tackled in reasonably general terms. General equations are given for this problem. Simple cities of nonstandard form may satisfy a generalization of Sherratt's form, to which a number of Sherratt's results are easily extended. When distance from the (unique) city centre is important - such as in a single-bomb centrally-directed nuclear attack - Clark's type of representation is appropriate. Equations for the expected number of casualties in such an attack are given for Sherratt's (asymmetric) and Clark's type of city.
DIVISION OF SOCIAL SCIENCE

Head of Division: R. Duncan, M.A.(Adel.)

ACADEMIC STAFF

Department of Education

Senior Lecturer


Lecturer

Vacancy

Department of Geography

Senior Lecturer

Vacancy

Lecturer

Vacancy

Vacancy

Tutor

A.R. Dell, B.A.(Tas.)(Resigned 31.12.68)

Department of History

Professor

R. Duncan, M.A.(Adel.)

Senior Lecturer

A.M. Healy, B.A.(Syd.), Ph.D.(A.N.U.)

Lecturers


C.P. Kiernan, M.A.(Cantab.) and (Melb.)

Vacancy

Tutor

Vacancy

Department of History and Philosophy of Science

Lecturer

R.D. Francis, M.A.(N.Z.), and (Melb.) ABPsS.

Tutor

Mrs. E. Robinson, (appointed April, 1966, transferred to Kensington).

Department of Psychology

Lecturer

J.L. Morris, (Dr.Morris to take up appointment in 1969).

Vacancy

Senior Tutor

N.L. Adams, B.Sc.(N.S.W.)

Tutor

C.G. Cupit, B.A.(Syd.)
HIGHER DEGREE TOPICS

Department of Psychology

Doctor of Philosophy

Scholastic Achievement, Anxiety and Family Value - Discrepancy in Senior School Pupils.
(N.L. Adams - transferred from Kensington, 1968)

STAFF RESEARCH ACTIVITIES

Department of Education

1. Curriculum Research Library: Steps are being taken to establish a curriculum research library in the teaching of social studies in the schools.

2. Philosophical Dimensions of Moral Education: An enquiry is being conducted into the philosophical dimensions of moral education.

Department of Geography

This department, having no staff other than a tutor responsible for all teaching and some administration, had no opportunity to engage in research.

Department of History

1. Immigration into New South Wales, 1860-1940: Research continues into the social mobility of immigrants who arrived from the U.K. during the period 1860-1940. The occupations of immigrants and their places of residence are used to determine the degree of social mobility. The geographic mobility of immigrants is also being investigated.

2. Australian Social History: Further research is being undertaken into Australian social history, and in the collection and study of primary source material, particularly the collection of documents on the origins of welfare policies in Australia circa 1880-1910. Work has also begun on a preliminary assessment of educational opportunity in this period.
3. Pacific Colonial History, with particular reference to Papua-New Guinea: Investigation continues into the comparative aspects of colonial administration. A second research visit was made to Papua-New Guinea and the British Solomons in January-February 1968 with the aid of funds from the Australian Research Grants Committee. Material is being prepared for publication on the last elections in the British Solomons and on native administration and political development in Papua-New Guinea.

4. Science and the Enlightenment in Eighteenth-Century France: The aim of this research was to examine the importance of science in the French Enlightenment. It was discovered that science was employed not only to solve problems posed by scientists, but also to attempt to resolve dilemmas in ethics, politics and religion. A re-interpretation of the thought of the French Enlightenment was then developed.

5. The Illawarra Social Survey: Dr. Hagan is Joint Director of a social survey of the Illawarra District to determine the socio-economic structure of the region, and to attempt to establish trends that will assist in predicting changes in that structure. The Illawarra Regional Development Committee has voted $8,500 to finance the first year of operation of this project.

6. Archives: The collection of local archival material has commenced in an effort to build up a stock of primary source material for use by honours students and staff.

Department of History and Philosophy of Science

1. Extraversion and Anxiety: Work continues on the two personality variables of extraversion and anxiety, the former investigated by sensory isolation, the latter by attitude and optical pupil size. An ancillary study on extraversion and anxiety was also conducted. This involved the collection of data from the State Penitentiary.

Department of Psychology

1. Scholastic Achievement, Anxiety and Family Value-Discrepancy in Senior School Pupils: Research continues into the relationships between academic achievement, anxiety, and
parent-student value discrepancies. In the course of this investigation fifty pupils and their parents were interviewed and tested in the Gerrigong-Kiama-Shellharbour area. These results of these tests are at present being processed by the computer.

PUBLICATIONS

Department of Education

1. "A Review of Recent Reports on Tertiary Education" in Report of the Committee Appointed by the Premier on Tertiary Education in Western Australia, University of Western Australia Press, Perth, 1967. pp.60-71
In the capacity of professional secretary to the Premier's Committee on Tertiary Education, the author prepared by request a review of such reports as the Robbins, in Britain, the Murray, Martin and Wark reports in Australia, and sundry State reports, making some comparative evaluations.
B.V. Hill.

This article attempts to project forward some present tendencies in the area of Christian Education, as the term is understood by various groups. It is less an attempt at historical prediction than a means of exhibiting the logical implications of certain present positions.
B.V. Hill.

The development of what is now called in Australia 'tertiary education' is traced through from the nineteenth century to the present time, with special reference to the changing relation of the university to other forms of tertiary education. Two general questions are then discussed, namely, the emergence of a binary system of tertiary education, and the importance of research to the idea of the university.
B.V. Hill.

B.V. Hill.

Department of History


C.P. Kiernan.


J. Hagan.

These articles discuss the broad political attitudes of unions of highly-paid printing craftsmen over the period circa 1850-1925 in Australia. Their conclusion is that not so much the 'Great Strikes' of 1890-94, but the period of chronic unemployment circa 1890-1905, and its attendant social legislation, marked a turning point in their industrial relations.


J. Hagan.

This article attempts to isolate some of the major omissions and weaknesses of Australian trade union historiography, and suggest research tasks which seem important.


A.M. Healy.

This article traces the history of labour disputes and resulting attempts at industrial combination on the New Guinea goldfields between the two World Wars. It emphasizes the effects of the unusual nature of the social and industrial environment on disputes between labour and management.
notably, the division between European and native workers. This division, *inter alia*, inhibited European unionisation through fear of similar moves amongst natives.


C.P. Kiernan.
Helvétius worked to establish ethics as a science. He employed the Newtonian synthesis as his model. This article discusses his achievement. In the process major ethical issues are examined.


C.P. Kiernan.
This is an integration of Lalor's participation in the Eureka Stockade with his subsequent career in the Victorian State Parliament. The importance of ethical considerations in Lalor's career is examined.


C.P. Kiernan.
The usual interpretation of Victorian State politics in terms of 'party' is here subjected to criticism. An interpretation in terms of splinter groups is proposed instead. This involves a reassessment of the politics of Australian federation which, in Victoria, is seen as representing an attempt to reform state politics.


J. Hagan.
   A.M. Healy.

    A.M. Healy.

    C.P. Kiernan.

    C.P. Kiernan.

Department of History and Philosophy of Science

   R.D. Francis. (with M.R. Kelly of Macquarie University).
   Recently there has been a spate of work on teaching machines. Almost all of this work ignores individual modes of learning. The proposal and details are offered which show how computers can be used, both as teaching aids and, simultaneously, as a means of assessing different modes of learning.

   R.D. Francis.
   This is an account of how one might explain differential to sensory deprivation. The range of individual responses can be partially accounted for in terms of perturbations of space and time co-ordinates. This article suggests a means of discriminating the relative potency of these two parameters.
Doctor of Philosophy

P. Van der Werf (Mechanical Engineering, 1966)
P.C. Arnold (Mechanical Engineering, 1968)
R.T. Wheway (Mechanical Engineering, 1968)
N.F. Kennon (Metallurgy, 1968)

Master of Science

R. Rudzats (Chemistry, 1963)
M.W. Dyos (Mathematics, 1966)
T.W. Barnes (Metallurgy, 1966)
J.P. Pollard (Mathematics, 1967)
D.J. McKeegan (Mathematics, 1968)
P.J. O'Halloran (Mathematics, 1968)
K.J. Maher (Mathematics, 1968)
J.R. Snedden (Chemistry, 1968)

Master of Engineering

P. Van der Werf (Mechanical Engineering, 1964)
M.J. Lowrey (Mechanical Engineering, 1968)

Master of Engineering Science

S.R. Webb (Mechanical Engineering, 1968)