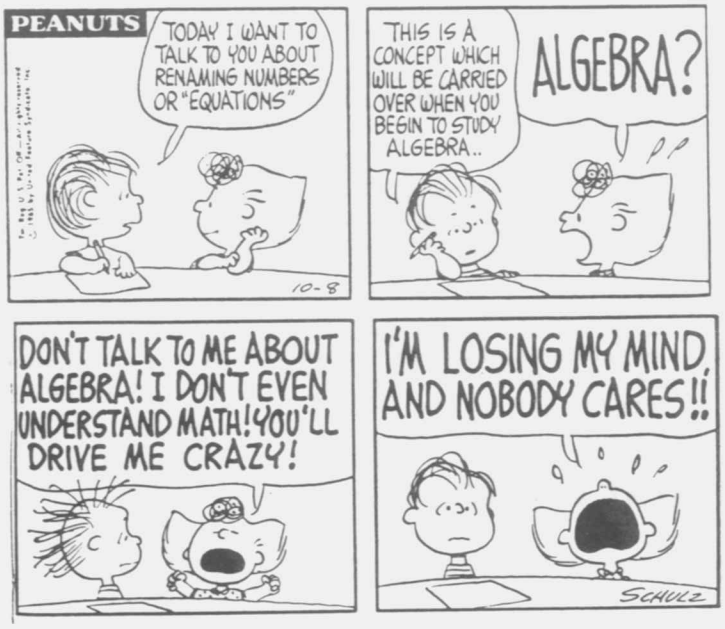
THE NEW ZEALAND MATHEMATICAL SOCIETY

NEWSLETTER



BASIC SKILLS

CENTREFOLD

DR JOHN DARWIN

CONTENTS

Number 31 August 1984 ISSN 0110-0025

Editorial

This issue contains an invited address from Dr J.R. Philip, head of the CSIRO Division of Environmental Mechanics, delivered at the Nineteenth Mathematics Colloquium held at Victoria University in May. Also featured are two talks on Basic Skills given at the Colloquium on the Mathematics Education Day by Megan Clark and Sharleen Forbes, both of Victoria University. Coverage of invited addresses at the Colloquium will continue in the next issue of the Newsletter.

Without exception University Professors have been the focus of previous centrefold articles. So it is particularly pleasing this time to honour an applied practitioner of mathematics from beyond the University circle, Dr John Darwin, the recently retired Government Statistician and formerly of the DSIR, Applied Mathematics Division.

News items, notices, articles of general interest, letters to the editor on current issues and suggestions for centrefolds are always welcome and may be sent to the editor or one of the honorary correspondents. Copy date for the next issue is 15 November, 1984.

John Curran
Editor

OFFICERS OF THE SOCIETY, JUNE 1984 - MAY 1985

President:	Dr M.R. Carter, Massey
Incoming Vice-President:	Professor I.L. Reilly, Auckland
Immediate Past President:	Professor W. Davidson, Otago
Secretary:	Dr C.H.C. Little, Massey
Treasurer:	Dr J.A. Shanks, Otago
Councillors:	Dr P.D. Hill, Waikato (to 1985)
	Dr J.F. Harper, Victoria (to 1987)
	Dr M.A. Jorgensen, Ministry of Agriculture & Fisheries (to 1987)
	Dr E.G. Kalnins, Waikato (to 1987)
Editor:	Dr M.J. Curran, Otago

News and Notices

SECOND INTERNATIONAL CONFERENCE ON TEACHING STATISTICS (ICOTS 2)

The conference will be held in Victoria, British Columbia, Canada, from 11-16 August, 1986. Its objective is to improve the quality of statistics teaching on a world-wide basis. Sessions will take place on teaching statistics at all levels, from school to university and in government, business and industry. Opportunities will be provided to see and experiment with the latest in computer hardware and software for statistical work.

For a copy of the ICOTS 2 announcements write to: Professor T. Lietaer, University Extension Conference Office, University of Victoria, P.O. Box 1700, Victoria, British Columbia, CANADA V8W 2Y2.

The New Zealand coordinator is: John C. Turner, Department of Mathematics, University of Waikato, Private Bag, HAMILTON, N.Z.

MATHEMATICS-IN-INDUSTRY STUDY GROUP

The CSIRO Division of Mathematics and Statistics plans to hold a Mathematics-in-Industry Study Group from November 19-23, 1984 in Melbourne. The Division has invited Drs John and Hilary Ockendon, who organise the Oxford (Mathematics) Study Groups with Industry, to assist and participate. In addition, the Division plans to seek the assistance of appropriate CSIRO staff and interested academics in the work of the Study Group. One of the aims is to stimulate greater awareness in Australian industry of the need for and role of mathematics, not only in industrial research but also in the workplace.

Anyone interested should contact Dr Graeme Wake, Mathematics Department, Victoria University, or write directly to: Mathematics-in-Industry Study Group, CSIRO Division of Mathematics and Statistics, GPO Box 1965, CANBERRA A.C.T. 2601.

NZMS POSTGRADUATE STUDENT TRAVEL FUND

The NZMS has set up a fund to assist selected postgraduate students in the mathematical sciences to attend conferences in 1985. We are especially hoping to encourage attendance at the Australasian Mathematics Convention to be held in Sydney (May 13-17, 1985), but the fund may be used to assist travel to any conference. The amount available per student will depend on the number and quality of applicants, but is likely to be about $200.

If you are yourself eligible and interested, you are invited to apply on the standard form, a copy of which accompanies this Newsletter. If you know of any eligible students who do not receive the Newsletter, please mention the existence of the fund to them and encourage them to apply. They need not be NZMS members.

25TH SUMMER RESEARCH INSTITUTE

The 25th Summer Research Institute of the Australian Mathematical Society will be held at the University of Auckland during the three week period from Monday, 14 January to Friday, 1 February 1985.

The Institute, being held in New Zealand for the first time, combines an opportunity for mathematicians to work quietly on research problems of their own with an opportunity to meet other workers and to participate in seminars on a range of topics. The principal subjects are Analysis, Fluid Dynamics, Numerical Analysis, Stochastic Processes, Universal Algebras and Combinatorics.

Each week two of these subjects will be emphasised with daily lectures in both subjects. The rest of the time will be available for formal or informal splinter groups which will be organised and announced after the commencement of the SRI and will not be confined to the principal subjects.

The timetable is:

First week: 14-18 January: Stochastic Processes with principal speakers Professors D.R. Brinllinger (University of California, Berkeley), P.A.W. Lewis (Naval Postgraduate School, Monterey) and D. Vere-Jones (Victoria University, Wellington). Combinatorics with principal speaker Dr R.L. Graham (Bell Telephone Laboratories in Murray Hill, New Jersey)

Second week: 21-25 January: Universal Algebras with principal speaker Professor G. Grätzer (University of Manitoba)

Numerical Analysis with principal speaker Professor C.W. Gear (University of Illinois)

Third week: 28 January to 1 February: Analysis/Topology with principal speaker Professor F. Gehring (University of Michigan).

Fluid Mechanics with principal speaker Professor P. Saffman (California Institute of Technology).

Enquiries and registrations to: Dr D.J. Smith, New Zealand Secretary, 25th Summer Research Institute, Department of Mathematics and Statistics, University of Auckland, Private Bag, Auckland, NEW ZEALAND.

MATHEMATICS LECTURER

There is a vacancy for a mathematics lecturer at Atenisi University, Tonga. Please write to: The Director, Box 90, Nukualofa; or make enquiries to: Kit Withers, DSIR, Wellington, (ph 727-855).

CORRECTION TO LIST OF FOUNDATION MEMBERS

In a supplement to Newsletter No. 14 (April 1979), a list of NZMS members was published in which those who had joined the Society at its inception were noted as being foundation members. Because of an oversight, the name of Associate Professor D.A. Nield, a foundation member, was not so recorded. We apologise to Professor Nield for this error.

DEMING INSTITUTE

In May, Dr W. Edwards Deming visited NZ at the invitation of Professor Ivor S. Francis. Dr Deming has been a consultant in statistics and a Professor of Statistics for many years. He has written several books on Sampling. Internationally he is best known for his efforts, beginning in 1950, in teaching statistical methods of quality improvement to the leaders of Japanese industry. He has been widely recognized as a principal contributor to the resurgence of Japanese industry, and the Emperor of Japan has decorated him for this work.

During his visit to NZ Dr Deming spoke to university and professional groups at Otago and Victoria Universities and spoke to management groups throughout the country. The main meeting was a 4-day seminar in Auckland for top management where he expounded his philosophy and techniques of management which have a unique statistical foundation. This seminar, attended by over 300 top managers and government officials, was so successful that efforts are underway to assist organisations to adopt quality improvement programmes advocated by Deming.

A Deming Institute for Quality Improvement, with members drawn from some of the biggest companies in the country, is in the process of being established. It will be headed by Professor Ivor Francis and Mr Ken Fink-Jensen of the University of Otago and Mr Tim Ball, Department of Scientific and Industrial Research.

Head office of the institute will be in Auckland. The institute will be independent and self-supporting, being funded by members' contributions and fees earned from services and training.

The institute will take at least a year to get working properly but before this Professor Francis and Mr Ball will travel to Japan and the United States to learn more about their task.

A TRIBUTE TO RICHARD E. BELLMAN

Richard Bellman passed away earlier this year. Many Colloquium participants will remember his visit to New Zealand in 1971 as a Fullbright distinguished visitor and guest speaker at the colloquium in Wellington.

Bellman's fundamental contributions to science and engineering won him many honours and worldwide recognition. Among these: First Norbert Weiner Prize in Applied Mathematics, awarded in 1970 jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics; First Dickson Prize, Carnegie-Mellon University, 1970; John von Neumann Theory Award, awarded in 1976 jointly by the Institute of Management Sciences and the Operations Research Society of America; 1978 IEEE Medal of Honor in recognition of the invention of dynamic programming; Doctor of Science, University of Aberdeen, Scotland, 1973; Doctor of Laws, University of Southern California, 1974; Doctor of Mathematics, University of Waterloo, Canada, 1975; Fellow, American Academy of Arts and Sciences, 1975; and member, National Academy of Engineering, 1977.

Bellman was a towering figure among the contributors to modern control theory and systems analysis. His invention of dynamic programming marked the beginning of a new era in the analysis and optimization of large-scale systems, and opened a way for the application of sophisticated computer-oriented techniques in a wide variety of problem-areas ranging from the design of guidance systems for space vehicles to pest control, network routing, and speech recognition. In addition he made a number of important contributions to both pure and applied mathematics. Of particular note is his work on invariant imbedding, a technique whereby two-point and more complex linear boundary value problems are replaced by equivalent initial value problems, making the calculation of the solution more direct as well as much more efficient. His work on quasi-linearisation and its applications to system identification has led to many results of a practical nature in the study of non-linear systems.

In recent years Bellman's research activity focussed increasingly on the application of mathematics to medicine and biological sciences. His interest in these and related areas reflected his strong conviction that mathematics should not be content with being a beautiful castle with no bridges to the real world. There was a time when Bellman's outspoken criticisms of the elitist attitudes of the mathematical establishment were greeted with hostility and derision. Today, when pure mathematicians are experiencing difficulties in finding suitable jobs, many of those who disagreed with Bellman will concede that he was right.

He is survived by his wife, Nina, his son, Eric, and his daughter, Kirstie.

PRESIDENT'S ANNUAL REPORT 1983/84

On behalf of the Council of the New Zealand Mathematical Society, I have the honour to present the tenth Annual Report of the Society.

The circulated amendments to the Constitution specifying a two year term for Presidents were approved through postal vote, the voting being 34 for and 1 against the proposal. The amendments will be legally registered and the new Constitution published in the Newsletter. The new Constitution will operate from the Annual General Meeeting, 1985.

The Publications Committee (Convener, Dr Ivan Reilly) has now produced the book Calculus for first year university students. It is selling well and the project is already in profit. Work is proceeding on a sixth form textbook designed to cover the new U.E. prescription. This is a joint effort with the New Zealand Association of Mathematics Teachers. On behalf of the Council the Publications Committee is investigating the possibility of the Society collaborating with commercial publishers in Australia, so that a future edition of Calculus might meet a wider market. New contract conditions for authors have been instituted by Council, and copyright of all textbooks produced solely by the NZMS will be vested in the Society.

In the hands of its new Editor, Dr John Curran, the Newsletter continues to provide a valuable information service to mathematicians. Useful expertise is also being built up by successive editors in presenting articles having mathematical content. This will be important if we aim at a future mathematical journal produced in New Zealand.

A delegation of New Zealand mathematicians has been invited, through the Society, by the People to People International organisation to visit the United States in 1984. A delegate leader has now been chosen from a short list of candidates provided by our Council. The delegation leader will be instrumental in the selection of the team and in defining areas of potential professional interest for discussion between delegation members and their American counterparts. Further news of this important development will be published in the Newletter.

Within New Zealand the Society has continued to support projects potentially beneficial to mathematicians.

A sum of $300 was contributed to the Prince and Princess of Wales Science Awards Scheme for the year 1983/84. Annual contributions will continue to be made by the Society on a basis to be established.

The Project Competition for Teachers was conducted by the Society in collaboration with NZAMT and drew eleven entries. Monetary awards were made and Certificates of Merit issued to the authors of the best three entries, which were of high standard. The judges, Associate Professor Peter Lorimer, Dr David Robinson and Mr Bruce Sutton deserve our sincere thanks. This competition and the Predoctoral Thesis competition will be run in alternate years by the Society.

A sum of $200 was sent to the American Mathematical Society to support the production of Mathematical Reviews.

Council has completed the setting up of a fund to assist mathematics students from the University of the South Pacific to undertake graduate studies in New Zealand.

A further fund to assist approved New Zealand postgraduate students to attend conferences related to their studies is being considered by Council.

Dr Charles Little was coopted to Council at its December meeting to act in the role of incoming Secretary until the 1984 AGM. The 1983 NZMS Visiting Lecturer was Trevor Boyle, Principal of St Peter's College, Palmerston North.

The Council met three times during the year: at Massey University on 24 May 1983, at the Science Centre, Wellington on 6 December 1983 and at Victoria University on 6 May 1984.

The Society will wish me to record appreciation of the work of the Publications Committee in the last year. Thanks are due also to Dr Dean Halford for his valuable service as Coordinator for Mathematical Visitors. On behalf of the Society I wish to thanks all members of Council for their work during the year. Particularly, I thank the Secretary, Dr John Shanks, and the Treasurer, Dr Joel Schiff. I thank all the retiring members, Dr Jim Ansell, Dr Alex McNabb, Dr Joel Schiff and Dr David Smith for their stint of service to the Society over the last three years.

W. Davidson
President

Local News

AUCKLAND UNIVERSITY

DEPARTMENT OF MATHEMATICS & STATISTICS

Dr Michael Thornett of the University of Western Australia arrived on a visit to New Zealand in April and was with us until the end of June.

April and May were busy months for the Stork. In April Dr Rob and Helen Goldblatt added another son to their family and Dr Nick and Anne Wormald did likewise in May.

On Monday, 16 April, Dr Bruce Calvert held a video session in the Department on *'The Point of doing Maths and Science'*.

On 11 May, the New Zealand Statistics Association held an Experimental Design Day in the Conference Room of the DSIR, Mt Albert. The conference was organised by Dr Chris Triggs.

Congratulations to Professor Ivan Reilly on being elected Incoming Vice-President of the New Zealand Mathematical Society. Ivan will be President for the two years 1985-87.

Seminars

Dr Wiremu Solomon (Auckland University), *'Limit Theorems for Population Processes using Poisson Random Measures'*.
Professor L. Bruce Richmond (University of Waterloo), *'Central and Local Theorems for Matric Recursions'*.
Dr Michael Thornett (University of Western Australia), *'Randomization'*.
Dr Lee Peng Yee (National University of Singapore), *'Mathematics Education in South East Asia'*.
Professor K. Varadarajan (University of Calgary), *'Wall's Finiteness Obstruction for Nilpotent Spaces'*.
Dr J.J. Hunter (Auckland University), *'Birth-Death Queues with Feedback'*.
Dr Nick Wormald (Auckland University), *'Random Regular Graphs'*.
Professor Gunter F. Pilz (University of Southwestern Louisiana), *'Near-Rings and Geometry'*.

E.D.

DEPARTMENT OF COMPUTER SCIENCE

Dr Alan Creak and Dr Peter Fenwick, who had been consultants in the Computer Centre, have now been appointed as Senior Lecturers in the Department of Computer Science. Dr Philip Rabinowitz, of the Weizmann Institute at Tel Aviv, is now in the Department as a University of Auckland Foundation Fellow. He will give a series of seminars on numerical solution of integral equations, and he will teach part of the Stage 3 course on Numerical Analysis.

The departmental computing laboratory has now acquired a Macintosh computer, which has powerful graphical facilities. Construction of the Science Library extension is progressing rapidly, and it is expected that the Computer Science Department will be installed there before the 1985 academic year.

Seminars

Professor Frank Stenger (University of Utah), *'The role of rational functions in numerical analysis'*.
Professor W.B. Gragg (University of Kentucky), *'The numerically stable reconstruction of Jacobi matrices from spectral data'*.
Professor Mike Osborne (ANU), *'Polyhedral convex functions as models for statistical estimation based on counting and rank'*.

G.J.T.

WAIKATO UNIVERSITY

Tony Grant recently completed a masterate on *'Symbolic Integration'*, and gave us a seminar on it. He then turned actuary.

Bill Dowsland (on our Management Studies staff) gave a pair of seminars on *'The Micro-Computer Laboratory - what it can do for you'*, and *'The Use of Operational Research in Physical Distribution Management'*; I mention this partly because Martin Dew (another Manager) announced it thus: "Bill will explain how Computer AIDS can be developed from simple VDU and the anti-biotics taken to cure it".

Last year, Kevin Broughan's working party brought forward a proposal for a professional School of Informatics (for want of a better name). This went forward quiquennially (along with Bruce Liley's idea of a Graduate School of Technology). This year, detail planning has gone more slowly, because those outside the working party still have to be convinced and indoctrinated.

Both Greg Reid and John Turner completed their D.Phil. theses, working frantically against time at the TROFF to get them word-processed. Both have to "defend" shortly. After many applications, and several toll calls, Greg obtained a job at South Dakota State, and several other offers too.

Besides TROFF and NROFF, the computer centre also offers another Knuth-ful high-TEX mathematics wordprocessor.

Finally, Susan Byrne and Dough Stirling (Massey) paid us a visit, to see how we use (micro)-computers and packages, especially in teaching. We showed them NAG and MACSYMA and also facilities such as REMATH, STATUS and MINITAB, unaccountably available to all users (even the merest fresher). We also tried to show them hospitality.

M.S.

MASSEY UNIVERSITY

Hugh Morton has recently been involved in feverish activity making statistical and computer preparations for the snap election. Hugh's MSc thesis on the opinion polls prior to the 1970 UK election, and his early involvement in a prediction system for the Australian elections, landed him a consulting contract with TV New Zealand. He devised a prediction system for the outcome of a NZ election, based on early returns of vote counts. The system is statistically based, involving cross-stratified sampling of electorates at the first stage, and weighted sampling of booths at the second stage. Probability of booth selection is heavily weighted towards smaller booths, which report their counts soon, and towards booths which have been historically stable with respect to the party percentages in the electorate to which they belonged. The crux of the system is the objective removal of the bias which early returns normally show. To most of the TVNZ personnel Hugh meets, and even to some of the Burroughs personnel who are handling the software aspects of the system, it is all mumbo-jumbo. By the time you read this, you'll know if the mumbo-jumbo worked or not. Depending on this outcome, Hugh intends retiring, either into obscurity, or on the proceeds!

Seminars

Hugh Morton, *'An interesting time series:human oxygen consumption during exercise'.*
Gordon Knight, *'Note-taking in 200-level mathematics classes'.*
Professor J. Aitchison (Hong Kong), *'Triangular thinking in statistics'.*
Charles Little, *'Gems'.*

M.R.C.

VICTORIA UNIVERSITY

We have recovered fairly well from helping to organize two conferences at VUW since the last Newsletter: the N.Z. Mathematics Colloquium in May and the N.Z. Statistics Association conference in June.

Dr Kathleen and Dr Brian Trustrum of the Mathematics Department, University of Sussex, where they work in fluid mechanics and statistics/operations research, have been persuaded to interrupt their N.Z. holiday to give seminars at VUW on 24 July.

During the last nine months Dr Fabio Musmeci has been visiting the VUW Institutes of Geophysics and Statistics and O.R., on study leave from the Italian Commission for Nuclear & Alternative Energy Resources. He has been working with David Vere-Jones on methods for estimating seismicity and seismic risk.

Chris Atkin has gone on a year's leave to Warsaw and Warwick, and Peter Thomson to ANU, Canberra, the Institute of Statistical Mathematics, Tokyo, and LSE, London.

Peter Thomson, Shirley Pledger and Ken Russell will form the VUW contingent at the Australian Statistical Association's annual conference in Brisbane at the end of August.

All will be giving papers. Lindsay Johnston will be doing the same at the ICME (Maths Education) conference in Adelaide. David Vere-Jones will also be there, chairing the session on projects and practical experiments in statistics in upper secondary schools, then going on to Tokyo to give an invited address on space-time models for point processes at the Biometrics Conference. Later in the year he will be spending two and a half months on leave writing a book in Canberra.

Graeme Wake will be visiting the USA in the August vacation, to speak at the biennial Combustion Symposium in Michigan, and then to visit the University of Delaware to renew contact and complete some research with Professor Ivar Stakgold, whom members will remember as the NZMS Visiting Lecturer 1981.

Basic Skills are alive and well at Victoria! Over 140 of our students and 100 of Auckland's have purchased the 11-module set on algebraic manipulation. Sharleen Forbes, who runs the programme, and Bruce Payne of our Computing Services Centre, are currently adapting the modules into a self-teaching computer package on our VAX 11/780.

J.F.H.

DSIR

APPLIED MATHEMATICS DIVISION

A joint CSIRO/DSIR Conference on Convective Flows in Porous Media was held in Wairakei on May 3 and 4. Forty people attended the conference, the proceedings of which are being prepared for publication by Robin Wooding.

Tim Ball and Ivor Francis assisted with the visit to New Zealand by Dr Edwards Deming, culminating in a 4-day seminar on Quality, Productivity and Competitive Position for Top Management in Auckland.

Tim Ball is overseas for 3 months, attending the Quality Assurance Congress in UK, the ASA meeting in Philadelphia , visiting Professor B.L. Joiner in Wisconsin, and JUSE in Japan.

Hugh Barr is overseas for 10 weeks, visiting Australia, London and Tel Aviv. He will attend the International Conference on Forecasting in London, the International Federation of Operational Research in Washington, and the Flexible Manufacturing Systems Conference in Michigan.

John Maindonald is spending 3 weeks in the Pacific, studying the statistical computing requirements for the Pacific Islands for the South Pacific Commission.

Rick Beatson has left AMD to take up a NSF grant in the USA.

Gary Thomas has visited Hawaii, to attend a conference on Soil Erosion, and visited Australia.

Malcolm Grant has been appointed Geothermal Reservoir Engineering Coordinator for DSIR.

G.W.

CANTERBURY UNIVERSITY

Professor Roy Kerr, currently Head of the Department, has been awarded the Hughes Medal of the Royal Society, London. This prestigious award for Mathematical physics is in recognition of Professor Kerr's exact solution of the equations of general relativity, this solution representing the gravitational field of a rotating spherical body. From this arises the possibility of the existence of massive black holes, the now famous "sinks" of the universe. Professor Kerr is the first New Zealand-born recipient of the award. Previous recipients include Maus Geiger, Neils Bohr, Enrico Fermi, Sir John Cockcroft and Martin Ryle. The presentation of the medal will be made in London in November.

The Department as a whole will receive very tangible benefit from this award, in the form of two NCR Decision Mate personal computers, donated by NCR to mark the occasion. The Department intends to purchase three further identical machines, and these together with equipment in place or on order, will enable almost every staff office to be equipped with either a personal computer or a terminal to the NCR Tower minicomputer.

Alan Thompson, a post-graduate student, was awarded second prize in the New Zealand Mathematical Society's pre-doctoral thesis competition, for his M.Sc. thesis entitled *'Reducible 2-(11,5,4) and 3-(12,6,4) Design'*.

Newly arrived visitors are Dr Bill Dowsland and his wife Kathryn, who will be staying until November. They are from the Department of Management Science at the University of Swansea, with interests in management information systems, and in packing problems.

Another visitor due to arrive very soon is Dr D.H. Armitage (University of Belfast), as an Erskine Fellow. He will be staying until mid-September, and his main interest is in classical potential theory.

Seminars

Professor John Aitchison (Hong Kong University), *'A statistical sense of proportions'.*
Dr M.R. Osborne (Department of Statistics, ANU, Canberra), *'Polyhedral convex functions as models for statistical estimators based on counting and rank.'*
Professor Lee Peng Yee (National University of Singapore), *'Orthogonally additive functionals'.*
Dr S.L. Loi (National University of Singapore), *'Quadratic approximation'.*
Dr Rod Ball (Purdue University), *'(n - 1)-Axial Actions on Homotopy Spheres.'*

R.S.L.

OTAGO UNIVERSITY

Professor W.B. Bonnor of Queen Elizabeth College, London (our William Evans Visiting Professor) stimulated various types of mathematical activity during his 3 month stay. For Example, he worked with Professor W. Davidson on research problems in General Relativity and Cosmology, consulted with various members of the Mathematics and Physics Departments, gave a Faculty of Science Open Lecture on *'The Future of Applied Mathematics'*, a lecture on *'The Present State of General Relativity'* at a joint meeting of the Otago branches of Royal Society and the Institute of Physics, and presented seminars in both the Mathematics and Physics Departments.

Dr John Clark attended the 28th Annual Meeting of the Australian Mathematical Society at Monash University as well as the 2nd Annual Algebra Conference of Victoria in May - - and presented papers at both meetings.

Three of our 1983 honours graduates have received Graduate Appointments in both mathematics and computer science at universities in the United States. They are Paul van Mulbregt who has been awarded a 4 year Teaching Assistantship in the Mathematics Department at M.I.T. - - as well as a UGC Postgraduate Scholarship; Ewan Tempero who has been awarded a Graduate Assistantship in the Department of Computer Science at the University of Washington (Seattle) - - as well as a Fulbright-Hays Travel Grant, and Eric Jones who has received a Yale University Fellowship for the study of Artificial Intelligence in the Department of Computer Science - - as well as a UGC Postgraduate Scholarship.

M.Sc. degrees have recently been awarded to Stephen McPhail (*'Algorithms for Least Squares Minimisation not Requiring Derivatives'*) Petronella de Roos (*'Stochastic Population Growth Models'*) and J. Lewis Weatherall (*'Some Sufficiency conditions for Hamiltonian Cycles'*). The supervisors were John Shanks, Bryan Manly, and John Clark, respectively.

Seminars

Dr Iain Duff (A.E.R.E., Harwell), *'The impact of high speed computers on scientific computation'.*
J. Lewis Weatherall (Otago University), *'Hamiltonian graph theory'.*
Dr Roselyne Joyeux (Economics Department, Otago University), *'The use of principal components as an exploratory method of data analysis for economic time series'.*
Professor J. Aitchison (University of Hong Kong), *'Variation and Related Matrices: A Tribute to A.C. Aitken'.*
Professor W. Edwards Deming (Graduate School of Business Administration, New York University), *'The statistician's and manager's role in industrial quality programmes'.*
Professor W.B. Bonnor (Queen Elizabeth College, London), *'Mathematical chaos'.*
Assoc. Professor Bryan Manly, *'Point estimates of function means, variances and covariances'.*
M.A. Nasir (Otago University), *'The multi-level-adoptive-technique'* and *'The problem of transonic flows'.*

Otago Mathematics Association

Activities have included the following talks:

Mr Tor Klevstul (Chief Executive of the Otago Development Corporation) on *'The future of Otago: What are we educating our pupils for?'.*

Dr Dennis McCaughan (Otago University), *'Keeping a secret: the mathematics of codes and cryptography'* to both senior mathematics students from local high schools and their teachers.
Mr David Nightingale (Principal of Buller High School), on *'The S.C. mathematics exam: setting, marking and scaling. Ideas of mastery learning as a possible alternative'.*

Mr Henry Stoddart, H.O.D. of mathematics at Otago Boys High School has received a Wolfe Fisher Award for attendance at ICME V to be held in Adelaide in August.

G.O.

UNIVERSITY OF PAPUA NEW GUINEA

Donald Joyce arrived in February to take up the chair of Mathematics, having spent the previous six months on a study tour of the United Kingdom, India, Malaysia and Singapore, investigating computer education under the sponsorship of the Commonwealth Foundation and the Commonwealth Fund for Technical Cooperation. His previous position was as Reader and Head of Mathematics at the University of the South Pacific.

John Renaud having completed his PhD during his two-year term as Chairman of Mathematics, is going to Sydney for six months research leave from July.

Bernard Duszczyk will be Chairman for the rest of 1984.

Om Ahuja, formerly of the University of Khartoum, is expected to take up a Senior Lecturership in July and Raka Taviri is due back (from study leave at the University of New England) in August.

Billy Kaleva is completing his programme of courses for MSc (Qualifying) and Vincent Malaibe has begun his preparation for PhD studies.

Seven students are enrolled for honours courses in the department, covering topics in applied mathematics, computer science, numerical analysis, operation research and statistics.

The department has completed a review of the undergraduate mathematics courses, following the consultancy visit of Professor Loynes from Sheffield, and has strengthened the sequence of statistics courses.

The microcomputer teaching laboratory has been expanded in readiness for an elementary computing course which has attracted over 200 applicants.

Four staff from UPNG, John Gough (Mathematics/Education), Donald Joyce (Mathematics), Gurcharn Kaeley (Extension Studies), and Dennis Moore (Education Research Unit), participated in the Fourth National Mathematics Education Conference held at the Papua New Guinea University of Technology in Lae, May 24th to 25th. Participants from outside Papua New Guinea included Fred Dewa and Len Raj from the University of the South Pacific, Ginny Fenemigog from the Federated States of Micronesia and Claude Gaulin from Laval University, Quebec, Canada.

D.C.J.

Letters to the Editor

[Editorial note:: This letter was written before the July 14 elections!]

Dear Editor:

I would like to endorse the seventh form curriculum plan proposed by Dr Michael Carter in "Letters to the Editor" (April, 1984).

I believe that a system based on his plan could help to promote more enthusiasm for both the teaching and learning of mathematics- - since more emphasis could then be placed on discovery and less on the passing of exams.

However, the present brigade of teachers has been programmed to follow a prescribed syllabus and to prepare students for exams. Therefore, it seems to me that Dr Carter's proposed plan could be implemented only after we had an effective "IN-SERVICE TRAINING PROGRAM". If the "right" university mathematicians were to play a substantial role in this "retraining", there could be many benefits - - including improved communication between university and high school teachers.

Recently, the Minister of Science and Technology, Dr Ian Shearer, criticized the deficiency of creative ideas in NZ for promoting overseas trade. Perhaps the "proper" re-training of mathematics teachers would lead to a more creative emphasis in the teaching of mathematics and hence to some creative exports.

Gloria Olive

Books

SPRINGER-VERLAG PUBLICATIONS

The following Springer-Verlag publications are available for review. Interested members should contact Dr John Clark, Mathematics Department, University of Otago.

Ergebnisse der Mathematik und ihrer Grenzgebiete, 3. Folge

Compact Complex Surfaces by W. Barth, C. Peters and A. van de Ven, 304 pages.

Quadratic Differentials by K. Strebel, 184 pages.

Lecture Notes in Mathematics

Lie Group Representations II, Proceedings of the Special Year held at the University of Maryland, College Park 1982-1983, 340 pages.

Fluid Dynamics, Lectures given at the 3rd 1982 Session of the Centro Internazionale Matematico Estivo (C.I.M.E.), 193 pages.

Kinetic Theories and the Boltzmann Equation, Lectures given at the 1st 1981 Session of the Centro Internazionale Matematico Estivo (C.I.M.E.), 243 pages.

Cônes Autopolaires et Algèbres de Jordan by B. Iochum, 247 pages.

Algebraic Topology, Proceedings of a conference held in Aarhus, Denmark, August 1-7, 1982, 665 pages.

Number Theory, A Seminar held at the Graduate School and University Center of the City University of New York 1982, 309 pages.

Nilpotente Gruppen und nilpotente Räume by P.J. Hilton, 221 pages.

Galerkin Finite Element Methods for Parabolic Problems by V. Thomée, 237 pages.

Quantum Probability and Applications to the Quantum Theory of Irreversible Processes, Proceedings of the International Workshop held at Villa Mondragone, Italy, September 6-11, 1982, 411 pages.

Algebraic Geometry, Proceedings of the International Conference held in Bucharest, Romania, August 2-7, 1982, 380 pages.

Bifurcation Theory and Applications, Lectures given at the 2nd 1983 Session of the Centro Internationale Matematico Estivo (C.I.M.E.), 223 pages.

Continuous and Discrete Dynamics near Manifolds of Equilibria by B. Aulbach, 142 pages.

Graduate Texts in Mathematics

Harmonic Analysis on Semigroups by C. Berg, J.P.R. Christensen and P. Ressel, 289 pages.

Undergraduate Texts in Mathematics

Mathematical Logic by H.-D. Ebbinghaus, J. Flum and W. Thomas, 216 pages.

Topology by K. Jänich, 192 pages.

A First Course in the Mathematical Foundations of Thermodynamics by D.R. Owen, 134 pages.

Grundlehren der mathematischen Wissenschaften

Elliptic Partial Differential Equations of Second Order by D. Gilbarg and N.S. Trudinger, 513 pages.

Non-Archimedean Analysis by S. Bosch, U. Güntzer and R. Remmert, 436 pages.

Classical Potential Theory and Its Probalistic Counterpart by J.L. Doob, 846 pages.

Problem Books in Mathematics

Demography Through Problems by N. Keyfitz and J.A. Beekman, 141 pages.

Tata Institute Lectures on Mathematics

Lectures on Three-Dimensional Elasticity by P.G. Ciarlet, 149 pages.

Feature Articles

BASIC SKILLS - WHO'S GUILTY?

MEGAN J. CLARK

VICTORIA UNIVERSITY

Paper presented to Nineteenth N.Z. Mathematics Colloquium May 1984

Most New Zealand universities now offer, or are considering offering, some Basic Skills courses or remedial work to help offset the widening gap between school and university mathematics requirements. Some of the factors contributing to this situation are of great interest.

THE POPULATION EXPLOSION

The first factor is the rise in popularity of mathematics as a School Certificate subject.

Number* of School Certificate candidates taking English and Mathematics as a % of total number of candidates [1] :

	1970	1971	1972†	1973	1974	1975	1976	1977	1978	1979	1980	1981	9182
English	91.2	90.4	89.7	89.8	89.4	90.8	92.0	93.6	93.6	93.7	93.6	92.7	93.4
Maths	58.4	59.3	60.9	63.0	64.9	68.1	68.8	73.6	74.6	77.3	77.7	78.2	79.4

* N.Z. candidates only, i.e. minus Pacific Island and Extramural candidates.

† Maths replaces Geography as No. 2 subject - Geography is currently No. 4

What does this percentage increase mean in terms of absolute numbers? Do falling rolls mean that there isn't really a big increase? No.

Year	Total Number Of N.Z. Candidates	Number Taking Mathematics
1970	49639	28989
1971	52750	31281
1972	55339	33701
1973	54805	34527
1974	57165	37090
1975	59983	40853
1976	63237	43515
1977	62615	46080
1978	65712	48995
1979	62031	47971
1980	60475	47015
1981	59703	46712
1982	58732	46620

As the rolls start to fall after 1978, School Certificate Mathematics numbers decline, but much less rapidly. The years 1975 and 1981 have comparable total entries but the mathematics entries have increased by about 6000 candidates or approximately 200-240 classes. In the same period geography entries have dropped by more than 7000 !

In the senior forms we have a similar dramatic increase. In 1956 approximately 10% of the age cohort studied mathematics to 6th form level and 2½% to upper 6th (7th) form level [2] . In 1977 roughly 40% of the age cohort took mathematics to the 6th form and 10% to the 7th form. Thus the proportion of pupils studying mathematics to senior levels has increased four-fold in twenty years.

In Bevan Werry's 1977 survey [3] of mathematics in secondary schools, covering approximately 20% of the pupil population, he found that 89% of pupils in the surveyed schools were studying mathematics: 94% of the boys and 83% of the girls.

Such a dramatic rise in numbers typically stresses an education system [4]. One way to evaluate how well the system is coping is to examine how well-equipped the teachers are.

TEACHERS QUALIFICATIONS

There are two main sources of data on teachers' formal qualifications: Werry's 1977 survey [3] of 458 teachers from 72 schools and the 1979 NZAMT census of 1328 teachers from all 397 state and independent secondary schools in the country. The 1981 I.E.A. survey is not useful in this respect as it asked for the number of semesters (and not the level) of mathematics that were included in the teacher's post-secondary training.

In response to the NZAMT survey question:

"What is your highest qualification in Mathematics?"

	Number	%		1977 Survey %
Masters	64	4.8	8.1	9.7
Honours	44	3.3		
Stage 3	396	29.8		27.2
Stage 2	246	18.5		20.4
Stage 1	243	18.3		21.75
Dip Tchng et al	23	1.7		
HSC & A Levels	23	1.7	7.3	17.1
UE & 6th Form Cert	51	3.9		
SC & O Levels	27	2.0		2.9
NZCE (4, 3, 2)	4	0.3		
Others	7	0.5		
Nil	25	1.9		0.9
No Information	170	12.8		
	1328			

Or

	1977	1979 (underestimates)
No university qualifications	21%	14%
Stage 1 or less	43%	35%

The most worrying aspect about the level of qualifications is that there appears to have been little change in 20 years!

	1956	1977	1979*
No university mathematics	28%	20%	12-25%
Stage 1	18%	24%	18-31%
≥ Stage 2	54%	56%	57-69%

* range due to the 170 teachers who gave no information; it seems reasonable to assume that most of these non-respondents have little or no university qualifications.

i.e., approximately 1 in 5 mathematics classes leading to School Certificate have a teacher with no university qualification in mathematics.

The NZAMT survey reveals more interesting data; of the 1328 teachers surveyed:

A	"Is mathematics your major subject qualification?" :	YES :	533	40%
		NO :	752	57%
		- :	43	3%

but

B	"Is mathematics your major teaching subject?" :	YES :	755	57%
		NO :	530	40%

and the NO's in A range from a reasonable 20% in science through all other imaginable subjects from clothing to physical education.

It has been argued that the highest qualifications in a school have a considerable influence on its work (Bull [2] p.22). Once again, the picture is far from cheerful.

Highest Mathematics Qualification in School (Werry 1977)

	%	
No University	4	24%
1 Year University	7	
2 Years University	13	
3 Years University	33	
≥ 4 Years University	43	

When one considers teachers with responsibility in mathematics (P.R.s and H.O.D.s - those who set the tone for a school, choose the texts and advise the teacher), of these only 58% had their major qualifications in mathematics (Werry [3] p.38) i.e., 42% had a higher qualification in a subject other than mathematics. Specifically, in the Werry survey of 76 PRs and HODs we find:

1 with School Certificate mathematics only
2 with U.E. mathematics only
2 with 7th Form mathematics only
14 with 1 year of university mathematics
13 with 2 years of university mathematics
30 with 3 years of university mathematics
14 with > 3 years of university mathematics

i.e., 25% have Stage I or less.

Of 458 teachers of mathematics surveyed, 42 (i.e., 9%) had PRs in other subjects and presumably a major commitment to those other subjects (Werry [3] , p.12). Similarly, the NZAMT census gave 8.5% of mathematics teachers with PRs in other subjects. That is the state of the formal qualifications.

ADEQUACY OF TEACHERS

In the NZAMT survey, HOD's were asked for the number of classes taught by teachers 'insufficiently equipped' in either mathematics or teaching techniques.

	Form 3	Form 4	Form 5	Form 6	Form 7	Total
Number of classes poorly taught	130	124	80	24	10	368
Total number of classes	1021	1042	1141	624	241	4069
% poorly taught	13	12	7	4	4	9

i.e., an average of 9% of classes are being taught by teachers 'insufficiently equipped' and 13% of the critical 3rd forms. Werry ([3] p.80) estimates the figure as a staggering 25% of the teachers of mathematics in the schools in his sample! It is therefore hardly a surprise that large numbers of students are arriving at universities and polytechnics poorly equipped mathematically. One might reasonably ask what the Department of Education is doing about this situation.

THE DEPARTMENT OF EDUCATION

The Department of Education assesses staff shortages on March 1st each year. In 1978 the shortage was 57 [3] comprised of: 18 actual vacancies
39 equivalent full-time positions.

In 1982 there were 3.2 actual vacancies and in 1983 there were 5.8 actual vacancies.

The department no longer collects the figures for equivalent full-time teaching positions.

Note: These refer to classes without a teacher in front of them and do not take into account classes having a teacher with few or no mathematics qualifications nor classes with a teacher who is a superannuitant. Add this to the between 9% and 25% ill-equipped teachers and we have nothing short of a scandal!

What is happening to Teachers College intakes to alleviate this situation?

Well, in 1981 an overall secondary teacher training quota was set for 1982. Within this quota, subquotas for each teaching subject were set, as a result of an oversupply of geography, history and P.E. teachers and a shortage of mathematics, physics and chemistry teachers.

Prior to 1981 there were no formal subquotas

1981 was the first year that Division C statistics by major teaching subject were even collected.

Total Division C students by First Major Subject [5]

	1981	1983
Mathematics	66	49
Ag/Hort. Science	91	4
Biology		20
Physics	23	11
Chemistry	36	34
Commerce/Typing	6	1
Accountancy	12	8
Economics	29	21
Techn. Drawing	2	5
Metalwork	5	1
Woodwork	9	1
*English	124	67
*Geography	80	28
History	60	24
Languages	48	7
Art	36	19
Music	43	18
Home Economics	23	12
P.E.	53	22
Maori	1	4
Total	747	356

So we see that due to reduced total intake, whilst the proportion of mathematics majors is up 5% of the total, it is down 25% in numbers, whereas the shortage of mathematics teachers has increased over this period.

* Note the large intake of geography majors as late as 1981 and that English numbers are up 2.2% of the total from 1981 to 1983!

So we have:

- an increase in the numbers of students taking mathematics,
- large numbers of poorly qualified or ill-equipped teachers (including PRs and HODs),
- no substantial increase in the sub-quota of mathematics majors into Teachers Colleges,

these coupled with:

- almost total axing of in-service training

adding up to a disaster!

WHAT CAN WE DO?

The NZAMT survey revealed that only 27% of the teachers were members of a local Mathematics Association. I think we must consider changing the nature and role of the local associations to attract the more hesitant teachers by, for example, offering evenings on ' 10 Tips for Teaching S.C. Transformations Geometry' and so on.

Secondly I think we need more input into the system from mathematicians and mathematics teachers and less from educational technologists. This might rid us of such monstrosities as the current School Certificate examination in mathematics which I'm sure is a model of objective testing with all those multiple choice questions but which has trivialised the content beyond belief. We also need to have more input in the light of statements like this:

> "Many teachers assert an intuitive feeling that it takes time to digest mathematical ideas ... this is debatable ..." Werry ([3], p.110)

I don't think this is debatable. Why is it that if a carpenter says "I wouldn't do it that way, they usually fall apart" - its EXPERIENCE: but if a Mathematics teacher says "You need to do lots of similar examples before you'll understand" - its INTUITION ? (Women readers will be familiar with this type of semantic delicacy!) We must express our opinion forcefully, particularly on the virtues of practice.

Finally I think there needs to be an examination of the selection procedure to Teachers College which appears to select in favour of "renaissance men". I fail to see that belonging to a choir or playing a team sport enhances ones ability to teach mathematics. The selection seems to take no cognisance of the fact that the psychological profile of mathematics teachers is more introverted than the population at large [6] . I am sure the profession has sufficient gregarious "all-rounders" to withstand the effect of a few solitary or eccentric but well-qualified mathematics teachers.

REFERENCES

[1] School Certificate Examination Statistics 1974-1982, Department of Education, Wellington.

[2] Bull, M.A. The Qualifications and Supply of Mathematics Teachers, N.Z.C.E.R., 1960.

[3] Werry, B. Mathematics in New Zealand Secondary Schools, Studies in Education #2, N.Z.C.E.R., 1980.

[4] Griffiths, H.B. & Howson, A.G. Mathematics: Society and Curricula, Cambridge University Press, 1974, p.53.

[5] New Zealand Teachers Colleges Summary Statistics, Department of Education, Wellington, 1983.

[6] Kuder, G. Frederic Kuder Preference Record Examiner Manual, Vocational Form-C, pp.15-17, Science Research Associates, Illinois, 1956.

19TH NEW ZEALAND MATHEMATICS COLLOQUIUM

The nineteenth Mathematics Colloquium was held at Victoria University from the 6th to the 8th of May inclusive, in conjunction with a day organised by the New Zealand Statistics Association, on Thursday the 9th.

Several overseas guest speakers gave invited addresses. These were Professor Lee Peng Yee from the University of Singapore, speaking on *'Cesaro Sequence Spaces'*, Professor W.B. Bonnor from Queen Elizabeth College, London on *'The present state of Relativity Theory'*, Dr J.R. Philip from CSIRO, Canberra, on *'Mathematics, Soil and Water'*, Professor J. Aitchison from the University of Hong Kong, on *'Distributions on the Simplex'*, Dr M.R. Osborne from the Australian National University, on *'Aspects of l_1 fitting'*, Dr R.L. Adler from IBM at Yorktown Heights on *'Dynamical Systems and Information Theory*, Dr L.C. Johnston, from Victoria University, on *'Mathematics as the "Latin" of this generation'*, and on the Statistics Day, Professor E.J. Hannan, from the Australian National University on *'Autoregressive Approximation'*.

More than 120 participants were involved in the Colloquium, which besides the invited addresses, involved some 60 presented papers on all aspects of mathematics, pure, applied and statistical. An effort was made by the organisers to involve more secondary school teachers and much of the Wednesday was devoted to papers with a particular relevance to teachers. This wasn't as successful in attracting teachers as might have been wished, but was nevertheless considered to be a worthwhile direction for the Colloquium to have taken.

The Statistics day on the Thursday was largely slanted towards Time Series, and attracted a good attendance, involving speakers and participants from the Statistics Department and the Universities.

The Business meeting discussed the naming and timing conventions for the Colloquia and recommended that the cycle be revised, and that the naming be done by year. In 1985, the Colloquium will be in abeyance since there is to be a joint meeting in Australia of the New Zealand and Australian Mathematical Societies.

There was also some discussion of the pricing of tickets for Colloquium dinners, and it was decided to recommend to the next Colloquium committee that a two price system be considered to allow for those who did not wish to consume alcoholic beverages.

The next Colloquium is due to be held in Christchurch in May 1986 under the auspices of the Canterbury University Mathematics Department.

WHO NEEDS BASIC SKILLS?

SHARLEEN D. FORBES

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Paper presented to Nineteenth N.Z. Mathematics Colloquium May 1984

Background

My personal involvement with remedial mathematics (or basic skills) arose because I had a particular empathy with the problems of returning adult students having had both the experience of a young family when a student and also a complete four-year break away from my mathematics career.

Initially, in 1980, two day-long workshops in Basic Skills were held; one in the May vacation, the other in the August vacation. Entry was voluntary but restricted to students with at most a sixth form mathematics background who were currently enrolled in our service mathematics course (MATH 192) or our service statistics course (MATH 193).

Sixteen students attended the first workshop, 6 subsequently withdrew from their course(s) and the remaining 10 sat a total of 14 finals papers from the two courses.

GRADES OBTAINED BY 'BASIC SKILLS' STUDENTS

GRADE:	E:	D:	C:	B2:	B1:	A:
NUMBER OF STUDENTS:	1	0	7	1	4	1

(a student with no sixth form)

Only one paper was failed and I was so encouraged by the result that the program was extended substantially to include; in 1981:

a. A DIAGNOSTIC TEST (APPENDIX III) which was adapted from overseas examples (see Reference I). This was given to all MATH 192 and MATH 193 students in the first week of term.

b. Weekly 2-hour SEMINAR WORKSHOPS.

c. CONSULTING HOURS when a member of staff was available to answer any basic skills questions on a one-to-one basis.

d. A LIBRARY FACILITY (APPENDIX I:) consisting of a list of mathematical topics and references in which each could be found.

Of these, only the LIBRARY FACILITY was not well-used. In 1982, formal MODULES (see APPENDIX I:) consisting of a PRE-TEST, a small amount of THEORY, WORKED EXAMPLES and lots of EXERCISES with detailed WORKED-SOLUTIONS were created. Basic ALGEBRA was the area most obviously lacking and the 11 topics

1. Fractions, Ratios, Proportions and Percentages
2. Algebra I : Removal of Brackets
3. Solving Equations of One Variable
4. Powers (Indices or Exponents)
5. Algebra II : Factorization
6. Simultaneous Equations
7. Algebra III : Polynomials, Remainder Theorem, Completing the Square
8. Inequalities
9. Absolute Value
10. Matrices
11. Graph Sketching

were selected from discussions with interested colleagues and reference to the paper presented by MILTON FULLER to the 1981 'REMEDIAL MATHEMATICS IN TERTIARY INSTITUTIONS' seminar held at the Queensland Institute of Technology. (REFERENCE II.)

That interest in the area of basic skills from both staff and students has risen phenomenally over the past few years is reflected in the following figures of first-year mathematics students who either purchased the set of modules or attended the course of weekly workshops.

BASIC SKILLS ENROLMENTS:

Year	From Service Courses MATH 192 or MATH 193	From Mainstream Courses MATH 113 or MATH 114	From KELLER PLAN Stream MATH 115 or MATH116	From Other Courses	Total
1980	16	-	-	-	16
1981	38	2	-	-	40
1982	52	16	-	4	72
1983	39	65	7	5	116

For 1984, figures are only available for those purchasing the sets of MODULES: 137 students of whom approximately two-thirds were MATH 113/114 students.

Today in 1984, most of the New Zealand Universities offer some basic skills help.

(i) VICTORIA has the following 'package':

FIRST-YEAR MATHEMATICS STUDENTS - BASIC SKILLS FACILITY

1984.

The majority of first-year mathematics students will sit a diagnostic test on basic algebra skills in the first fortnight of the academic year.

If your performance in this indicates a need or even if you just feel apprehensive about your mathematics background you can make use of some or all of the following BASIC SKILLS services.

I. ESSENTIAL ALGEBRA SKILLS:

A package of 'self-teach' modules (complete with detailed worked solutions) will be available throughout the first-term at an OVERALL cost of $7.50.

The topics covered are:

1. Fractions, Ratios, Proportions and Percentages.
2. Algebra I: Removal of brackets.
3. Solving Equations of One Variable.
4. Powers (Indices or Exponents).
5. Algebra II: Factorization.
6. Simultaneous Equations.
7. Algebra III: Polynomials, Remainder Theorem, Completing the Square.
8. Inequalities.
9. Absolute Value.
10. Matrices.
11. Graph Sketching.

Students wishing to purchase these should get a $7.50 ticket from the Cashier, Mezzanine Floor - Maclaurin Lecture Block in the first week of term and thereafter from the Cashier, Robert Stout Building, and present it to either: Sharleen Forbes (Supervisor, Basic Skills) RB711 or Janice Haworth (Secretary) RB703, as soon as possible.

II. CONSULTING:

A list of staff members who are willing to be approached with BASIC SKILLS queries (NOT weekly assignment problems) will be displayed on the BASIC SKILLS Notice-board outside RB711.

III. SUPPLEMENTARY WORK-SHOPS:

These will be held on WEDNESDAYS 12-2 p.m. in RB822 on selected topics as they arise: in either Math 192/193 or Math 113/114. The topic for each week will be PUBLICIZED on the BASIC SKILLS notice-board outside RB711 on MONDAY of each week and announced in the relevant lecture course(s).
The first workshop is

WEDNESDAY MARCH 7 - 12 noon - RB822
on SIGMA NOTATION.

This applies particularly to M193 students.

Sharleen Forbes
SUPERVISOR - BASIC SKILLS
RB 711 Extension 504.

(ii) AUCKLAND uses the same package and set of modules as Victoria.

(iii) WAIKATO has a system of diagnostic tests, mastery tests and a self-teaching computer package (REMATH) available to all first-year mathematics students.

(iv) MASSEY uses modules and tapes (primarily for extra-mural students).

(v) CANTERBURY has a Bibliography (similar to Victoria's Library Facility).

The results, in terms of student achievement levels, of the Victoria basic skills program were never as spectacular as in the first year. For example in 1982 I compared the following groups of students:

a. Students enrolled in Basic Skills who sat at least one finals paper in either MATH 192 or MATH 193:

   37 students with average diagnostic test mark = 20.6 [out of possible 40]
   (Average diagnostic test mark for those with < 25 = 18.8 .)

b. Students who obtained less than 25 in the diagnostic test and subsequently sat at least one finals paper in either MATH 192 or MATH 193 :

   30 students with average diagnostic test mark 20.4 .

While acknowledging that these groups are too dissimilar for any detailed statistical analysis the following table of final grades suggests no overall significant difference between the two groups with a possible improvement in the number of higher grades obtained by the basic skills students:

GRADE:	E	D	C	B2	B1	A	PASS-RATE	% As	% ≥ B2
GROUP I :	8	11	19	10	13	7	71%	10.1%	43%
GROUP II:	2	11	17	10	8	2	74%	4 %	40%

This provided some substance to my own feeling that as total numbers increased and, in particular, as numbers of 'ordinary' students enrolled in basic skills increased the appropriateness of some of the teaching methods became questionable. Even in overseas programs research into the evaluation of these types of programs is still in its infancy and mainly at the qualitative stage. There seems to be agreement only on the complexity of the reasons why the need for basic skills has arisen. (REFERENCE III)

To add further to the discussion I suggest, from my own experience, that here in New Zealand we have two quite diverse and distinct groups of students who are in need of basic skills help and that their response to different teaching methods is quite different.

The first group are the returning adults with a limited mathematics background and possibly a gap of several (or many) years in their mathematics education. These students respond best to individualised and self-pacing programs and seem to gain an enormous amount of confidence from the small workshop situation where they have social interaction with students of similar backgrounds. In general, self-teaching programs for this group need to be 'take-aways' as many are part-time students. Many requests for help are received early in the summer vacation from students in this category. Computer packages do not appear to be useful for the same reason that the Library Facility was unsuccessful when given to this group. They require too many new skills to be learnt simultaneously.

An entire workshop is devoted just to learning how to use a calculator.

MOST APPROPRIATE TEACHING METHODS: Workshops
Self-teaching modules (or tapes)
Consulting hours

The second group in need are those students who come directly from sixth or seventh form mathematics but who have 'gaps' in their knowledge. In general, they are not as well-motivated as the first group to learn material which is 'old-hat'. Although keen to purchase modules, etc. as reference material unless they are pressured by making a level of achievement in basic skills a terms requirement (currently done in some first year courses) they respond best to new methods of presentation, either by computer or through audio-visual techniques.

MOST APPROPRIATE TEACHING METHODS: Self-teaching computer packages
Audio-visual packages
Library facility
Modules (for reference)

I would contend that there is also a third group who benefit from the teaching of basic skills in our Universities; the academea! There are two main reasons for this:

a. Politically: more and more University departments are requiring some minimum level in either Mathematics or Statistics and it should be possible for all but a very few students to attain that level within the University structure, preferably within the Mathematics department itself.

Although the following table only refers to the past three years the number of enrolments with a limited background does appear to be increasing. The following table is of students enrolled in the first-year statistics service courses, MATH 193.

YEAR	NUMBER SITTING DIAGNOSTIC TEST	HIGHEST PREVIOUS LEVEL OF MATHEMATICS			TOTAL WITH U.E. OR LESS
		≤ SCHOOL C.	6TH FORM CERT.	U.E.	
1982	183	5 (2.7%)	9 (4.9%)	42 (22.95%)	56 (30.6%)
1983	141	8 (5.7%)	14 (9.9%)	29 (20.6%)	51 (36.2%)
1984	118	9 (7.6%)	11 (9.3%)	34 (28.8%)	54 (45.8%)

Ultimately we may have to consider the introduction of elementary (or Level '0') Mathematics courses which count for credit in a manner similar to those currently available in Latin and Greek.

b. As a teaching device. DIAGNOSTIC TESTS in particular provide us with our only real means of knowing what areas the majority of our incoming students have covered. Secondary school teachers agree that they teach to the external examinations rather than to the syllabus and there is not even any standardisation of text-books between schools. This situation is not likely to improve until, at a minimum, University Entrance is moved into the Seventh Form. On occasions the diagnostic test highlights particular (and sometimes surprising) gaps in knowledge.

For example, the following 4 questions on Sigma Notation were part of a diagnostic test given to MATH 193 students.

SECTION 6

Find the following sums:

31. $\sum_{I=1}^{3} I$ ____

If $x_1 = 0$, $x_2 = 1$, $x_3 = 3$, $x_4 = 2$ find:

32. $\sum_{i=1}^{4} x_i$ ____

33. $\sum_{i=1}^{4} (x_i - 2)$ ____

34. $\sum_{i=1}^{4} x_i^2$ ____

It was expected that students who had completed a Seventh Form - year in either Pure or Applied Mathematics would find these relatively easy but approximately one-third of these students performed inadequately getting only one or none correct. Many claimed that they had not met this notation before.

The diagnostic test also provides us with a simple method of determining what the characteristics (sociological or educational) of our student population are.

In conclusion: I believe that the New Zealand Universities are only just beginning to take the teaching of Basic Skills seriously and not only do the topics covered need to be extended to include, for example: Sigma Notation, Trigonometry Functions, Sequences and Series, Logarithms, Basic Differentiation, etc. but also more commitment is required from University Staff in terms of time and effort. To quote from Bill Atweh's paper (REFERENCE II (ii)): 'a remedial programme is only as strong as its administrators and instructors'. A first attempt has just been made (through the New Zealand Mathematics Society) to set up a national co-ordinating body for Basic Skills but we have a long way to go before we match the efforts made overseas in this field, particularly by the United States (REFERENCE IV).

REFERENCES

I: (i) MAA PLACEMENT TESTS:
- published by MATHEMATICAL ASSOC. OF AMERICA (incorporated): 1979 - 80

(ii) John H. Henshaw: DIAGNOSTIC TEST IN BASIC ALGEBRA
- published by AUSTRALIAN COUNCIL FOR EDUCATIONAL RESEARCH

(iii) Joseph B. Orleans and Gerald S. Hanna: ORLEANS-HANNA ALGEBRA PROGNOSIS TEST: 1968
- supplied by NEW ZEALAND COUNCIL FOR EDUCATIONAL RESEARCH

(iv) Robert Lankton: LANKTON FIRST-YEAR ALGEBRA TEST: 1951
supplied by NEW ZEALAND COUNCIL FOR EDUCATIONAL RESEARCH

II: Milton Fuller: REMEDIAL MATHEMATICS AT CAPRICORNIA INSTITUTE OF ADVANCED EDUCATION: 1981

III: (i) William Atweh: REMEDIAL MATHEMATICS AT TERTIARY INSTITUTIONS: AN OVERVIEW: 1981

(ii) William Atweh: RESEARCH AND EVALUATIONS IN REMEDIAL PROGRAMS: 1981

Papers II and III are published in REMEDIAL MATHEMATICS IN TERTIARY INSTITUTIONS: Proceedings of a Seminar held at Queensland Institute of Technology: 24 April 1981.

IV: REPORT OF THE COMMITTEE ON IMPROVING REMEDIATION EFFORTS IN THE COLLEGES: Amercian Mathematical Monthly: Vol. 88, No. 3, March 1981, pp 230-233.

APPENDIX I: LIBRARY FACILITY FOR FIRST-YEAR MATHEMATICS STUDENTS

BASIC SKILLS LIBRARY FACILITY

MATHEMATICS TOPICS:

Absolute value	A1, A3, A9
Acceleration	C1
Antiderivative (Indefinite Integral)	C1
Area	C1, G1, G2
Asymptote	G1, G3
Arithmetic Series (Progression)	A1, A9, M1
Arrangements (Permutations)	P1
Solution of Equations	A5, A7, A8, A1
Binomial Distribution	P1
Binomial theorem	M1
Algebraic manipulation	A5, A7, A8, A1
Argand diagram	A7
Cartesian coordinates	M1
Circle	G2
Circular (Trigonometric) functions	T1, T2, T3
Combinations (selections)	M1, P1
Composite number	A4
Composition of functions	A9
Complex numbers	A7
Congruence	G1
Coordinate systems	A1
Conic sections	G3
Continuity	A9
Cosine	T1, T2, T3
Curve sketching	G3, M1
Cubic equation	G3
Decimals	A1, A2
Derivative	C1
Definite integral	M1
Determinant	A1
Differentiation rules	C1
Distribution	P1
Domain of a function	A1
Ellipse	G1, G3

FIRST-YEAR MATHEMATICS:

BASIC SKILLS FACILITY:

TEXT-BOOKS

Library Facility Code	Title	Author(s)	Catalogue No.
A1	Algebra for College Students: An Intermediate Approach	Max A. Sobel/ Norbert Lerner	QA 154.2 56
A2	College Algebra	Walter Fleming, Dale Varberg	QA 154.2 F53
A3	College Algebra	Steven Bryant/ Daniel Saltz	QA 154.2 B78
A4	New School Arithmetics	Charles Pendlebury	QA 103 P398
A5	A treatise on Algebra	C. Smith	QA 154 S645
A6	Algebra	J.W. Archbold	QA 154 A669
A7	Textbook of Algebra, Part I	Chrystal	QA 152 C558
A8	Elementary Algebra	Hall & Knight	QA 154 H18
A9	Advanced Mathematics	J.R. Sealy & A.E. Agnew	
T1	Essentials of Trigonometry	Curtiss & Moulton	QA 531 C9599
T2	Elementary Trigonometry	J.B. Lock	QA 535 L63
T3	Elementary Trigonometry	Hall & Knight	QA 535 H18
G1	Geometry for Sixth Formers	Tuckey & Swan	QA 453 T898G
G2	A School Geometry	Hall & Stevens	QA 453 H18
G3	Treatise on Graphs	Gibson	
M1	Pure Mathematics: A First Course	Backhouse & Houldsworth	
P1	Probability	T.V.M. McKirgan	
C1	Elementary Calculus: Vol I	Durell & Robson	

Please ask for books from CLOSED RESERVE by BASIC SKILLS MATHS BOOK code .....

(Library Facility Code: e.g. A8, etc.)

APPENDIX II: SAMPLE PAGES FROM A BASIC SKILLS MODULE

BASIC SKILLS FACILITY :

MODULE 1

FRACTIONS : RATIOS, PROPORTIONS AND PERCENTAGES

DEFINITION :

FRACTION = $\frac{\text{NUMERATOR}}{\text{DENOMINATOR}}$

SECTION 1 - RATIO & PROPORTION

We compare the sizes of 2 quantities (written in the same units) by considering what fraction the first quantity is of the second. This is called the RATIO between them and the fraction obtained gives what PROPORTION of the second the first is.

EXAMPLES :

1. The Ratio of 4c to 8c is written as 4 : 8 or $\frac{4}{8}$

   It is usually reduced to its simplest terms i.e., 1 : 2 or $\frac{1}{2}$

2. What Proportion of 8c is 4c?

   4c is $\frac{1}{2}$ of 8c.

NOTE : The quantities compared must be of the same units. We cannot express a ratio between kilograms and centimetres.

A proportion is a statement that 2 ratios are equal.

e.g. $\frac{a}{b} = \frac{c}{d}$.

This is often read as 'a is to b as c is to d' and may be written in the form:

a : b = c : d.

EXAMPLES :

1. $\frac{5}{7} = \frac{15}{21}$ or 5 : 7 = 15 : 21.

2. We can express the question 'if 8 pints cost $5 how much will 12 quarts cost?' by using the symbol x for the unknown quantity:

EXERCISES :

Write each of the following percentages as a fraction (in its simplest form) :

1. 70%
2. 35%
3. 12½%
4. 5¼%

What percentages are equivalent to the following fractions?

5. $\frac{1}{5}$.
6. $\frac{17}{25}$.
7. $\frac{17}{200}$.
8. $\frac{1}{3}$.

In the following examples, what percentage is the first quantity of the second?

9. $15 of $75.
10. ¼ of 2½.
11. 346 of 800.
12. Find 75% of 48.
13. A traveller receives commission at the rate of 15%. What commission will he receive on sales amounting to $125?
14. If 16% of a box of bricks weighs 256kg what does the whole box weigh?
15. If I lose 25% of my money I shall have $750 left. What sum have I?

NOTE: Do not go on until you know how to do all these problems.

TEST FOR MODULE 1 :

FRACTIONS : RATIOS, PROPORTIONS AND PERCENTAGES :

NOTE : Time Limit: Do not spend longer than 12 minutes on this test.

SECTION 1

1. What is the ratio of $\frac{1}{3}$ to $\frac{1}{6}$?
2. 18 out of 540 fish caught by a fisherman are undersize and have to be thrown back. What proportion of the day's catch is this?
3. If 3 men take 80 hours to finish a piece of work, how long will 5 men take?

SECTION 2

4. Write $\frac{3}{5}$ as a percentage, and 45% as a fraction.
5. What percentage of 176 is 22?
6. A boat cost $8,500 and is sold so as to gain 20%. What is the selling price?

SECTION 3

Simplify the following fractions:

7. $\frac{-42}{105}$
8. $\frac{6xy}{3xyz}$
9. $\frac{7ab + 14ac}{49a}$

Simplify the expressions in the remaining sections;

SECTION 4

10. $\frac{7}{8} \times \frac{8}{14}$
11. $\frac{2}{3} \div \left(\frac{-4}{3}\right)$
12. $\frac{x + y}{x} \div \frac{x - y}{x}$

WORKED SOLUTIONS

TEST FOR MODULE 1 :

FRACTIONS : RATIOS, PROPORTIONS AND PERCENTAGES :

NOTE : Some of the following concepts may be unfamiliar to you. These will all be covered fully in the MODULE :

SECTION 1

1. Ratio is $\frac{1}{3} : \frac{1}{6} = \frac{2}{6} : \frac{1}{6} = \underline{2:1}$

2. Proportion is $\frac{18}{540} = \frac{2 \times 9}{6 \times 9 \times 10} = \frac{1}{3 \times 10} = \underline{\frac{1}{30}}$ of the day's catch.

3. Number of men and number of hours taken are inversely porportional.
   e.g. 5 is to 3 as 80 is to x (where x is the unknown number of hours 5 men take).

   $\Rightarrow \frac{5}{3} = \frac{80}{x}$

   $\Rightarrow 5x = 3 \times 80 = 240$

   $x = \frac{240}{5} = \underline{48}$ hours

SECTION 2

4. $\frac{3}{5} = \frac{3}{5} \times 100\%$ $\qquad$ $45\% = \frac{45}{100} = \underline{\frac{9}{20}}$

   $= \frac{300}{5}\%$

   $= \underline{60\%}$

5. $\frac{22}{176} \times 100\% = \frac{2 \times \cancel{22} \times 100}{16 \times \cancel{11}}\% = \underline{12\frac{1}{2}\%}$

6. Selling Price = 20% more than Cost Price

   $= \$(8{,}500 + \frac{20}{100} \times 8500)$

   $= \$(8{,}500 + 1700)$

   $= \underline{\$10{,}200}$

APPENDIX III: DIAGNOSTIC TEST FOR FIRST-YEAR STATISTICS SERVICE COURSE STUDENTS

MATH 193

DIAGNOSTIC TEST

PERSONAL INFORMATION:

NAME

AGE (in years)

NO. YEARS SECONDARY SCHOOLING

SECONDARY SCHOOL LAST ATTENDED

PREVIOUS MATHS MARKS:		Mark(s)	Year
SCHOOL CERTIFICATE		.....	.....
6TH FORM CERTIFICATE		.....	.....
U.E.		.....	.....
BURSARY/SCHOLARSHIP	PURE	...../.....	.....
	APPLIED	...../.....	.....

If none of the above apply state previous highest level of Mathematics taken

.....

where? ..... Year .....

* * *

TEST:

Try to attempt all questions. If you cannot solve one quickly, move on to the next.

Where necessary, show working, but make sure the ANSWERS ARE WRITTEN IN THE BOX provided.

SECTION 1:

1. $\frac{1}{2} = \frac{24}{\square}$

2. $b \times 2a = a \times \square$

3. $x + y = 2x + \square$

Express as simply as possible without brackets:

16. $x + (x + y)$

17. $a - (a - b)$

18. $x(y + z)$

SECTION 4:

For what value of x, will the following statements be true?

19. $x + 2 = 7$

20. $5x - 6 = 2x$

21. $\frac{x}{2} = 4$

22. $\frac{x}{3} = x - 2$

23. $10x + 4 - 8x - 3 = 2$

24. $3(x + 2(x - 2)) = 6$

SECTION 5:

Factorize the following [e.g., $ab + ac = a(b + c)$]:

25. $5xy - 10xz$

26. $a^3 + a^2$

27. $2x + ax + 6 + 3a$

28. $x^2 - x - 12$

Write the following statements as EQUATIONS. DO NOT WORK out the answer.

4. If 5 is subtracted from x the answer is 8

5. 4 more than $3b$ is the same as 1 less than $4b$

6. The sum of 2 consecutive numbers is 25. Let the smaller number be x.

SECTION 2:

If $a = 1$, $b = 2$, $c = 4$, $d = 3$ find the value of:

7. $a + b + c + d$

8. $d + a - b$

9. $ab - cd$

10. bd^2

11. $\sqrt{ac}$

12. $\frac{a}{b} + \frac{d}{c}$

SECTION 3:

Rewrite the following expressions in their simplest form:
i.e., SIMPLIFY:

13. $7a - 6a - 3a$

14. $3x^2 \times x^4$

15. $\frac{6a^3}{2a^2}$

Expand and simplify:

29. $(x + 1)(x - 3)$

30. $(3a + b)(a - 2b)$

SECTION 6

Find the following sums:

31. $\sum_{i=1}^{3} I$

If $x_1 = 0$, $x_2 = 1$, $x_3 = 3$, $x_4 = 2$ find:

32. $\sum_{i=1}^{3} x_i$

33. $\sum_{i=1}^{3} (x_i - 2)$

34. $\sum_{i=1}^{3} x_i^2$

SECTION 7:

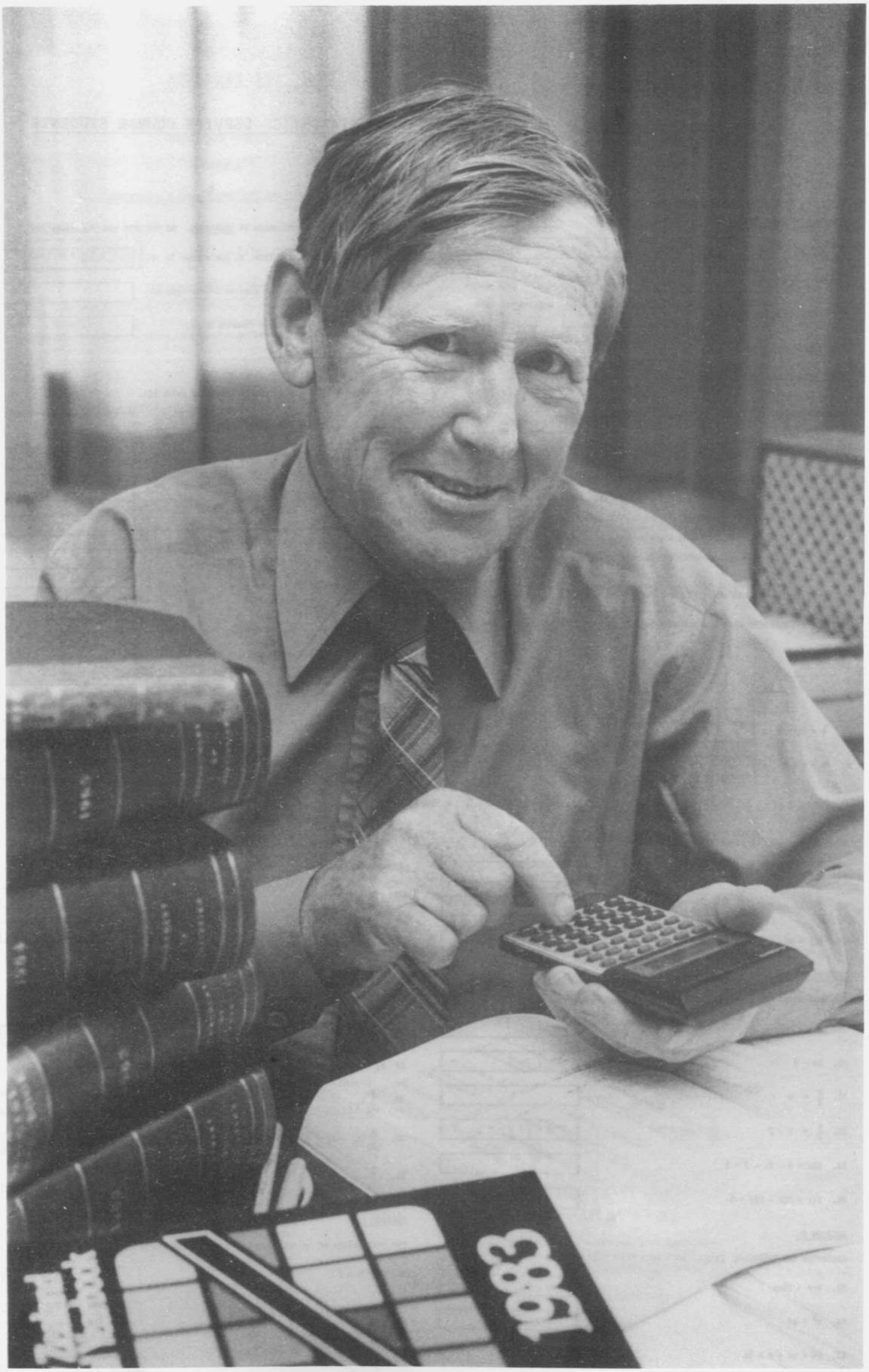
For what values of x will the following statements be true?

35. $x + 5 < 7$

36. $2x - 3 > 9$

37. $(x + 2)(x - 3) > 0$

38. $x^2 > 4$



Photograph by courtesy of the Evening Post

Centrefold

JOHN DARWIN

"I want your advice; I am thinking of joining the Department of Statistics". That is how, John Darwin, told me of his proposed move to the Statistics Department. John had been the leader of the Statistics Section of the Applied Mathematics Division of DSIR and was my immediate supervisor. He set what I saw as the style and image of AMD: friendliness, informality, not too much concern with the rules, combined with competence, innovativeness, mathematical rigour, doing his best for his clients. Perhaps the atmosphere of AMD's earlier headquarters helped this friendly informality - other AMD people will remember happenings which took place on the verandahs of Courtenay Place one of which earned AMD a visit from the law.

John has numerous interests beyond mathematics: he sang with the AMD madrigal group and also with the Orpheus Choir; he very much enjoyed a friendly game of bridge, chess, tennis (he and his wife, Helen, were mixed doubles champions at the Wadestown Club) or table tennis. He was also a very competent home handyman and frequently the blackboard would be covered in engineering calculations during morning tea. For several years he was chairman of his local school committee.

He has had a distinguished academic career. He was a Junior University Scholar, a University Senior Scholar in Pure Mathematics and Cook Prizeman, graduating with an MSc with first class honours. In 1944, he joined the Radar Development Laboratory of DSIR as a physicist, later being reclassified as a Biometrician. He went to Cambridge in 1947 as a Shirtclife Fellow, and obtained a BA, taking a first in Part II of the Maths Tripos. He was also a Trinity College Scholar. Following his degree at Cambridge he was granted two years leave on full pay to study for a PhD at the University of Manchester where he studied under Professor Bartlett. His thesis, titled *'Population differences between species growing according to simple birth and death processes'*, looks at probability models which might explain the observed population sizes of the different species of animals or plants present in a given sampling region.

His publications represent the wide variety of work he encountered on his return to Applied Maths Division. Some of his papers reflect his studies under Professor Bartlett, such as *'Note on the comparison of several realizations of a Markoff chain'*. Then there were papers with a strong biological or ecological bias, written in conjunction with his biologist clients, for example *'Observations on the reproduction of the wild rabbit at varying latitudes and altitudes in New Zealand'* and *'Estimation of opossum populations and results of poison trials from trapping data'*. Other papers reflect the wide range of interests of AMD's clientele; papers such as *'The prediction of floods'*, *'The uses of sampling techniques in auditing'*, *'Species clustering and New Zealand quaternary climate'*, *'Estimation of alcohol for non-respondents in roadside breath surveys'* and *'Dental caries prevalence in several soil areas of New Zealand'*. John always placed a strong emphasis in careful analysis. Frequently, his work required the use of statistical techniques currently under development, or the development of new ones. In this way during his time at AMD, as leader of the Statistics section, he lead and strongly encouraged research into statistical methods.

However, more and more of his work became to have a sociological bias. Some of this was published, for example, *'The changing rate of delinquency in New Zealand'* but most was confidential to the Government department that he was doing the research for. Increasingly, he became to feel that the data was not being collected in the best way to answer the questions he was being asked, that Government was placing insufficient emphasis on scientifically evaluating its policies, that the need for careful statistical analysis was still not properly appreciated by senior Government officials. The idea of starting a social science group within AMD was nibbled at from time to time but not proceeded with.

In 1978 the position of Deputy Government Statistician became vacant. John's former director at AMD, Bob Williams, then head of State Services Commission, encouraged John to apply. Of course, a position with the Statistics Department offered obvious possibilities for improving the way the Government handled its Statistics. John had considerable misgivings about how much he could accomplish in the 5 years before he retired and about shifting from a job in a very small DSIR division to that of a senior administrator in an influential Government Department. Nevertheless, there were precedents, former AMD staff had very successfully moved to senior Government positions. So by the time John came to see me, his mind was more or less made up. He applied and was appointed. In 1980 he was appointed Government Statistician, head of the Department of Statistics. He retired at the beginning of this year, 1984.

So what did he accomplish in the Statistics Department? It's too early to say. But there is increased emphasis on the rigorous interpretation of the data, not just its collection. He has enthusiastically continued the policy of re-examining what is collected with a strong emphasis on user requirements. Communication and understanding within the department has improved. And we hope, through their discussions with John, heads of other Government Departments, have come to appreciate rather more the problems in collection and interpretation of data.

We wish John and Helen the best for their retirement. But we hope it won't be a real retirement. There is lots of statistical work to be done and we hope some of it will find its way to Anne Street in Wadestown, Wellington.

Robert Davies

Problems

Sub-edited by A. Zulauf, University of Waikato

PROPOSALS of problems should be sent to the sub-editor and should be accompanied by solutions and/or relevant references, comments, etc.

SOLUTIONS should be sent to the sub-editor within three months from the publication of each problem. If you discover that a problem has already been mentioned or solved in the literature, please send full details to the sub-editor.

****

Problem 14 *(A question of bounds)*

(a) Prove that there is an absolute constant K with the following property:
For every sequence $(Z_1,Z_2,\ldots)$ of complex numbers in the unit disk $\{Z : |Z| \le 1\}$ there exists a sequence $(\varepsilon_1,\varepsilon_2,\ldots)$ of coefficients in the set $\{-1,+1\}$ such that for all positive integers n
$$\left| \sum_{m=1}^{n} \varepsilon_m Z_m \right| \le K .$$

(b) Find the best possible constant K with the property stated in (a).

B. Aubertin, Massey University

The answer to problem 14(b) is not known yet. Any improvement on $\inf K \le 2$ would be welcome. The following related problem may also be of interest.

(c) Find the best possible absolute constant C with the following property:
For every finite sequence $(Z_1,Z_2,\ldots,Z_n)$ of complex numbers in the unit disk there exists a sequence $(\varepsilon_1,\varepsilon_2,\ldots,\varepsilon_n)$ of coefficients in the set $\{-1,+1\}$ such that
$$\left| \sum_{m=1}^{n} \varepsilon_m Z_m \right| \le C$$

Sub-editor

Mini-problem:

An easier question of bounds

Prove that there exists an absolute constant C with the property stated in problem 14(c) above.

Solution of Problem 10 *(Flight time along closed path)*

The following is an edited version of the solution received from the proposer, A. Mackie of Edinburgh: At the instance when the aircraft has travelled the distance s along C,

let ψ be the angle between the wind direction and the direction of travel, $0 \le \psi \le \pi$. Then

$$\frac{1}{V}\frac{ds}{dt} = m\cos\psi + \sqrt{\{1 - (m\sin\psi)^2\}} = \frac{1 - m^2}{-m\cos\psi + \sqrt{\{1 - (m\sin\psi)^2\}}}$$

Since C is closed, so that $\int_C \cos\psi ds = 0$, the total travel time is therefore given by

$$T(m) = \int_C \frac{ds}{ds/dt} = \frac{1}{V}\int_C \frac{\sqrt{\{1 - (m\sin\psi)^2\}}}{1 - m^2}\, ds$$

It follows that $T(m)$ strictly increases with m, $0 \le m < 1$, since for such values of m

$$\frac{\partial}{\partial m}\frac{\sqrt{\{1 - (m\sin\psi)^2\}}}{1 - m^2} = \frac{m(2 - \sin^2\psi - (m\sin\psi)^2)}{(1 - m^2)^2\sqrt{\{1 - (m\sin\psi)^2\}}} > 0 .$$

Solution of Problem 11 *(A diabolic square)*

(Note: The condition $w < x$ which ensures uniqueness was unfortunately omitted. There are other conditions that would ensure uniqueness, but the one mentioned in Newsletter No. 30 is not one of them. In any case, solvers would not be in any doubt which of the two solutions to prefer!)

B.R. Stokes of Auckland T.C. sent a solution based on Latin squares. Another method is as follows: Let the required progression be $a + kd$ $(k = 0,1,\ldots,15)$ with $d > 0$. Since 69 and 24 are in 'opposite' squares, their sum must equal half the row-sum, so that $93 = 2a + 15d$. Since we also require $0 < a \le 24$, there are two possible cases: (i) $a = 9$, $d = 5$ and (ii) $a = 24$ and $d = 3$. The mapping $a + kd \to k$ reduces the problem to finding a suitable diabolic square formed with $0,1,\ldots,15$. We note that the map of 69 is 12 in case (i) [15 in case (ii)]. All S can be obtained from any given S by a group of 384 transformations which preserve 'oppositeness' and 'adjacency'. The numbers which must be adjacent to 12 [to 15] are 1, 2, 7 and 12 [1, 2, 4 and 8]. Of the 384 possible S, 24 will have 12 [15] in the proper position, and exactly one will have the adjacent numbers in the x, y, z and t positions so that $x < y < z < t$. The required S is now easily completed in both cases.

Case (i)

9	2	15	4
7	12	1	10
0	11	6	13
14	5	8	3

Case (ii)

9	2	12	7
4	15	1	10
3	8	6	13
14	5	11	0

SOLUTION

54	19	84	29
44	69	14	59
9	64	39	74
79	34	49	24

Since $w > x$ in case (ii), the solution is obtained from case (i), by the inverse mapping $k \to 9 + 5k$.

Solution of Problem 12 *(A sequence of near integers)*

The following is an edited version of the solution received from G.J. Tee of Auckland: For part (a), the Gelfond-Schneider Theorem shows that $e^{\pi\sqrt{n}}$ (which equals $i^{-2\sqrt{(-n)}}$) is not merely non-integral but also transcendental. For part (b), a detailed study was published by R.F. Churchhouse and S.T.E. Muir, "Continued fractions, algebraic numbers and modular invariants", Journal of the Institute of Mathematics and its Applications, v.5 (1969), 319-328. That is a fascinating paper, in which the authors treat number theory as though it were an experimental science, with some unexpected oddities being found in some experimental data, subsequently being explained as a very unlikely special case.

Churchhouse & Muir "explain" why $e^{\pi\sqrt{43}} = 884736743.99977$, $e^{\pi\sqrt{67}} = 147194952743.9999986$, and $e^{\pi\sqrt{163}} = 262537412640768743.999999999999250$.

(They do not comment on the last 3 digits 743 in their decimal representations.) They also "explain" why the first 7 powers of the last number are close to integers, with the 7th power having fractional part 0.9988 .

Feature Article

MATHEMATICS, SOIL, AND WATER

J.R. PHILIP

CSIRO DIVISION OF ENVIRONMENTAL MECHANICS, CANBERRA

An invited lecture at the 19th N.Z. Mathematics Colloquium, Wellington, May 1984.

1. Introduction

I am not a mathematician and it is a measure of the generosity and broadmindedness of you New Zealanders that you invite someone from outside the magic circle of mathematicians to talk to you.

There is a story concerning physicists and mathematicians which is so very ancient that the younger of you may not have heard it. It concerns a test put to a physicist and a mathematician, consisting of two problems. The first problem was this: You have an empty kettle, a tap, a gas ring, and a box of matches. How would you boil water? And, of course, both the physicist and the mathematician answered quickly and correctly: Fill the kettle at the tap; light the gas ring; put the kettle on the gas ring; and boil the water.

But now we come to the second problem: You have a kettle full of cold water, and you have a gas ring burning. How would you boil water? The physicist said: That's easy: you just put the kettle on the gas ring; and boil the water; and the mathematician too said: That's easy; but the rest of his answer was: Empty the kettle, turn off the gas ring, and so reduce problem 2 to problem 1.

Physicists tend to find more amusement in that little story than do mathematicians.

After I'd accepted the kind invitation to give this talk, I remembered that, about 30 years ago, I had, with all the brash confidence of youth, presumed to address the Australian Soil Science Conference on "The Role of Mathematics in Soil Physics". In many ways that occasion was the complete converse of the present one. Almost everyone in that audience viewed the use of mathematics with dark suspicion. I told them about that Chinese emperor who could not be convinced by mathematical reasoning that the volume of a sphere varies as the cube of its radius. He agreed reluctantly to this doctrine only after he had various size spheres made filled with water and weighed. It was quite clear that the sympathy of my audience of 30 years ago was all with the Chinese emperor.

On that occasion I was naive enough and idealistic enough to go on and sermonize my audience on how effective use of mathematics in natural science depends on the need for us to make efficient abstractions from the real world; and on how central mathematics is to the processes of prediction and generalization which lie at the very heart of natural science. I fear that my sermon left my audience of soil scientists pretty much unmoved, though one or two people later seemed to like the reprint.

30 years ago I wouldn't have thought it necessary to serve up a sermon of that type to an audience of mathematicians: I would then have thought that would be teaching my grandmother to suck eggs. However, I am now of the opinion that , back in Australia, it wouldn't really be at all out of place to deliver such a sermon to mathematicians. Over those 30 years the nexus between mathematics and the natural sciences has grown progressively weaker, in my opinion to the loss of both. The reasons for this deterioration in the mathematics-natural science symbiosis are no doubt very complicated; but I can't help but feel that the way mathematics is taught has something to do with it.

The pure mathematician has a very proper concern to teach his subject as a linearly developed logical system, in the beauty and power of its utmost generality. The trouble is that, although this may be just right for the small fraction of the student population who are going to end up as 1st Class Honours graduates in Pure Mathematics, it is not well fitted to that body of students, maybe 10 or 20 times larger, from whom is drawn the cream of our research people in the natural sciences. These people are not idiots and, indeed, they may well be the brightest, most creative, and most valuable products of the education system. But the mind best fitted to research in the natural sciences is primarily motivated by a curiosity about real-world phenomena; and minds of this type very often learn best by starting from the particular and progressing to the more general, by building up from the concrete to

the abstract. It is a great pity that, all too often, such people are discouraged and turned off by the kind of mathematics taught them. They abandon their mathematical studies far too early in their training, and live out their research careers deprived of their most powerful research tool, the confidence and ability to use mathematics creatively in their researches.

I have been thinking out loud about my worries relating to mathematics in Australia. Forgive me. I'm sure that you sensible people here in New Zealand don't have the same troubles.

2. Water Movement in Unsaturated Soil

So much for the commercial. Now let's get on with the action. I propose to tell you something of the story of the application of mathematics to problems of water movement in unsaturated soil.

Let me explain straight away that the formulations we shall be considering are closely connected with those for the two-phase flows of petroleum engineering and, I guess, a number of other chemical engineering applications. In our case, however, the non-wetting phase is air: the capillary pressure (to use petroleum engineering jargon) is never negligible; the density excess of the wetting phase over the non-wetting one has a major influence on the phenomenon; and, in most circumstances, the pressure gradient in the air is negligibly small.

We begin, then, with an overall look at this process of water movement in unsaturated soil; and I want, at the outset, to stress that this is no recherché and unsual process: it's happening all over.

I must emphasize that, in its natural state, the soil is normally unsaturated: that is - it contains both water and air. Most of the water involved in the hydrologic cycle is located in unsaturated soil between the time of its arrival as rain at the soil surface and that of its return to the atmosphere. A small fraction of precipitation does not enter the soil, but moves overland directly into streams or lakes; and a second small fraction percolates downward through the unsaturated 'zone of aeration' and joins the groundwater, i.e. the water in the deep, habitually-saturated strata of soil, alluvia, or rocks. In a dry country such as Australia as much as 93% of the precipitation enters the soil; and, of this 92% returns directly to the atmosphere, only about 1% reaching the groundwater. No doubt the figures are rather different for these well-watered islands.

The processes of water movement in unsaturated soil thus play a central part in the scientific study of the terrestrial sector of the hydrologic cycle and in the related problems of irrigated and dry-land agriculture, of plant ecology, and of the biology of soil flora and fauna. They are, in addition, of great significance in connection with the transport through the soil of materials in solution, such as natural salts, fertilizers, and urban and industrial wastes and pollutants.

The unsaturated water movement phenomena of scientific and technological interest include not only infiltration, but also such important processes as: the drainage and retention of water in the soil profile; the extraction of soil-water by plant roots; and evaporation from the soil. Today I'll be talking primarily about infiltration, so I conclude this Section 2 with a definition of infiltration:

> Infiltration is the process whereby water made available at the soil surface enters, and moves downward into, the soil. It is simply hydrologist's jargon for the soakage of water into soil.

My plan is as follows: firstly to give you a very brief review of the mathematical-physical approach to the analysis of water movement in unsaturated soils which has been developed over the past 3 decades, principally in the US and in Australia. Then I shall go on to discuss what we call the quasilinear analysis - a rather fruitful means of studying unsaturated flows in 2 and 3 dimensions. Finally, then, I shall talk briefly of very recent new results on infiltration in 2 and 3 dimensions, found with the aid of the quasilinear analysis.

3. Unsteady Flow in Unsaturated Soil: The Full Nonlinear Equation

3.1 Darcy's Law for Flow in Saturated Soil

We may write Darcy's Law for saturated media, specialized to water flow, as

$$V = -K\nabla\Phi \, . \qquad (1)$$

V is the vector flow velocity, Φ is the total potential, and K is the hydraulic conductivity. The engineering device of expressing potentials per unit weight simplifies our equations and units: K then has the dimensions $[\text{length}][\text{time}]^{-1}$. V and Φ are averages over regions with dimensions large compared with those of the individual pore.

K is a scalar for isotropic soils and a symmetrical second-order tensor for anisotropic soils. We limit the discussion specifically to isotropic soils, but extension to anisotropic soils is straightforward.

3.2 Darcy's Law for Flow in Unsaturated Soils

The basic concepts of flow in unsaturated soils are due primarily to Buckingham. Buckingham is best known to physicists in general as the author of the Π-theorem of dimensional analysis. In 1907 Buckingham suggested that Darcy's law should hold in unsaturated soils in a modified form with K a function of θ, the volumetric moisture content. Richards (1931) and many others subsequently provided experimental confirmation and established the general character of $K(\theta)$. For obvious physical reasons K decreases rapidly, through as much as six or more decades, as θ decreases from its saturation value through the range of interest. Figure 1 shows a typical $K(\theta)$ relationship. We therefore rewrite (1) in the form appropriate to unsaturated nonswelling soils:

$$V = -K(\theta)\nabla\Phi \ . \tag{2}$$

3.3 Total Potential and Moisture Potential of Soil-Water

In unsaturated soils the water is not free in the thermodynamic sense because of capillarity, adsorption, and electrical double layers. Capillarity is dominant in wet, coarse-textured media, and adsorption assumes its greatest importance in dry media. Double-layer effects may be significant in fine-textured media exhibiting colloidal properties. Buckingham was the first to appreciate that the conservative forces governing the equilibrium and movement of soil-water are amenable to treatment through their associated scalar potentials.

We define such potentials relative to the reference state of water (of composition identical to the soil solution) at atmospheric pressure and datum elevation $z = 0$. We then have

$$\Phi = \Psi - z \ . \tag{3}$$

Note that the vertical coordinate z is taken positive downward. Ψ, the moisture potential is the potential of the forces arising from local interactions between soil and water. It is not essential either to know or to specify these forces in detail: it suffices that Ψ, and in particular $\Psi(\theta)$, can be measured by well-established techniques. In water-wet nonswelling soils $\Psi = 0$ at saturation and decreases with θ to very large negative values (typically -10^4 m) at the dry end of the moisture range of interest. Figure 2 depicts the $\Psi(\theta)$ relation for the soil for which $K(\theta)$ is given in Fig. 1.

3.4 General Flow Equation

Combining (2) and (3) with the continuity requirement yields

$$\partial\theta/\partial t = \nabla\cdot(K\nabla\Psi) - \partial K/\partial z \ , \tag{4}$$

where t is time. When the relations between K, Ψ, and θ are single-valued, (4) may be rewritten in terms of a single dependent variable. In terms of θ, the equation is

$$\frac{\partial\theta}{\partial t} = \nabla\cdot(D\nabla\theta) - \frac{dK}{d\theta}\cdot\frac{\partial\theta}{\partial z} \ . \tag{5}$$

Both the moisture diffusivity D, defined by

$$D = K\,d\Psi/d\theta \ ,$$

and the coefficient $dK/d\theta$ are, in general, strongly-varying functions of θ. $D(\theta)$ for the soil of Figs. 1 and 2 is shown in Figure 3.

Typically D may vary through 4 decades in the θ-range of interest and the second "coefficient" in (5) $dK/d\theta$ may vary even more violently. The strong nonlinearity of the Fokker-Planck equation (5) cannot be ignored, and progress in unsaturated flow studies has depended centrally on solving the equation with the nonlinearity preserved.

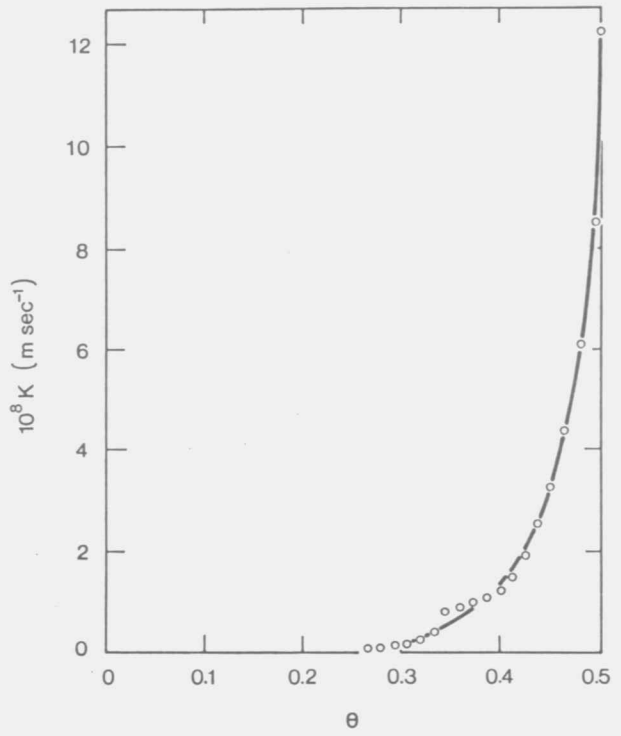


Fig. 1 K(θ) for Yolo light clay

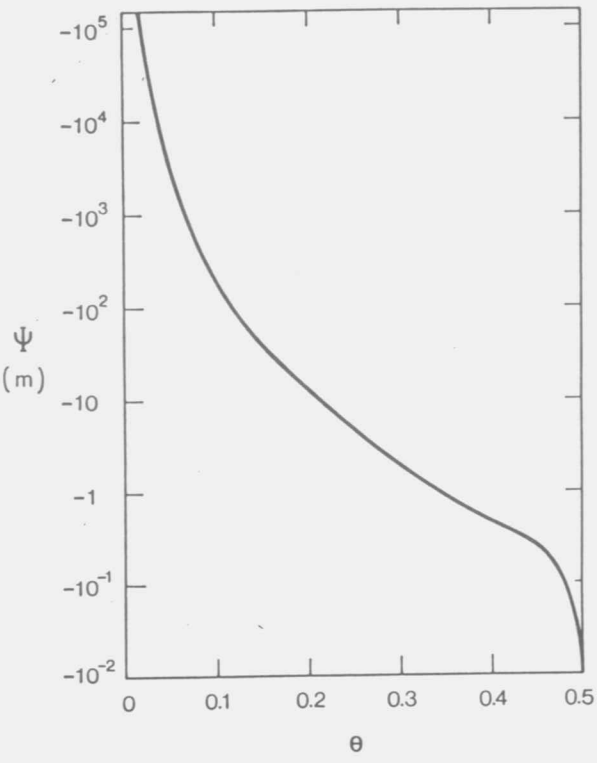


Fig. 2 Ψ(θ) for soil of Fig. 1

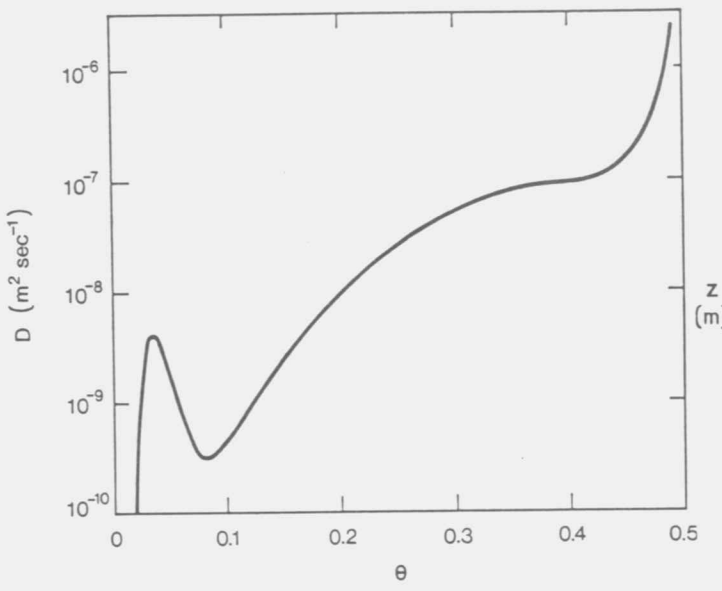


Fig. 3 D(θ) for soil of Figs 1 and 2

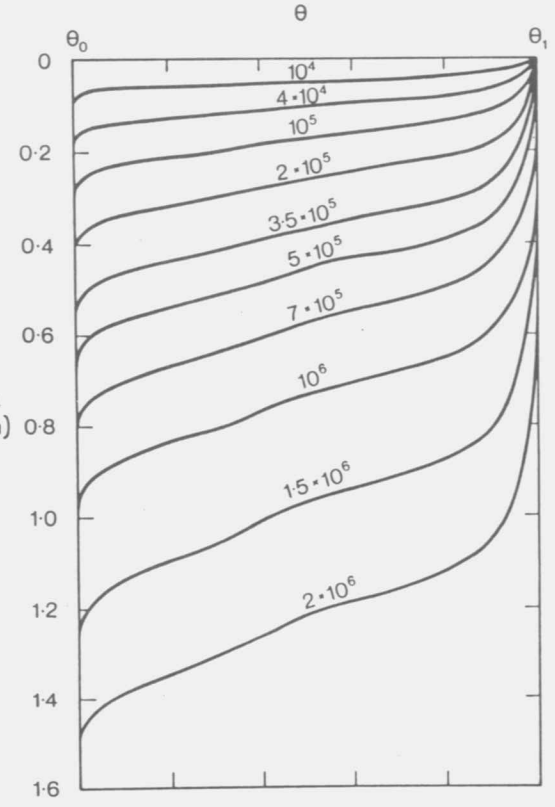


Fig. 4 Moisture profiles for infiltration into soil of Figs 1-3. Numerals on curves are values of t (sec).

Equation (4) appeared in 1931 in a paper by Richards. By the early 1950's, however, the significance neither of Buckingham's pioneering work, nor of the equation Richards derived from it, was generally understood. Each of the various soil-water processes such as infiltration, capillary use, redistribution and retention of water in soil profiles, the evaporation of water from soil, and the extraction of water by plant roots, received its own empirical explanation, pretty much at the level of folkore. Of course, each process was in reality describable by a solution of equation (4) subject to the appropriate initial and boundary conditions.

During the 1950's a few people began to understand this, and to seek solutions of equation (4). To the astonishment of many, it was found that these solutions actually explained and even predicted the experimental observations. It was in this way, through the relevant application of mathematics, that the physics of soil water ceased to be a disjointed collection of myths and fairy tales and has become a fairly respectable quantitative field of physical science.

A consequence has been that, since the early 60's, there has been among soil physicists, hydrologists, and physical agronomists in the US, Australia, and Europe a vast cottage industry devoted to cranking out solutions of equation (5). Most work has used brute-force computer methods and work of this type has produced many PhD's, but little extra general understanding. My own work in this field, off and on since the early 50's, has concentrated on quasi-analytical and analytical solutions - from the viewpoint that they tell us more about the fundamental structure of the solutions and, hence, about the general character of the phenomena they describe. By "quasi-analytical" I mean solutions that depend on the methods of analysis, even though some "coefficients" need to be determined numerically.

Back in 1953 I had the good luck to find the quasi-analytical solution of equation (5) which described the dynamics of one-dimensional infiltration when water is suddenly supplied in excess at the surface of a homogeneous soil with uniform initial moisture content. The solution takes the form

$$z(\theta,t) = \phi_1(\theta)t^{\frac{1}{2}} + \phi_2(\theta)t + \phi_3(\theta)t^{3/2} + \ldots \qquad (6)$$

Here ϕ_1 is the easily-obtained solution of a nonlinear ordinary differential equation, and ϕ_2 , ϕ_3 etc. are the even-more-easily-obtained solutions of a set of linear ordinary differential equations. For the example depicted in Figure 4, the first four terms suffice to yield an accurate solution (error $\leq 0.5\%$) for t as large as 10^6 sec. The solution (6) is supplemented by a very simple travelling wave solution, asymptotically valid for large t . The moisture profiles for $t > 10^6$ sec on Figure 4 were based on the travelling wave solution. Note that the leading term in (6), $\phi_1(\theta)t^{\frac{1}{2}}$ is a fundamental solution of (5), being the exact solution for one-dimensional horizontal absorption; and it serves also as the leading term of expansions describing infiltration in two- and three-dimensional geometries.

4. The Quasilinear Analysis

The great preponderance of work on the nonlinear Fokker-Planck equation has dealt with one-dimensional problems; but many natural situations, and, more particularly, a great number of man-made ones, involve two- and three-dimensional flows.

In 1966 it occurred to me that, with relatively little effort, considerable progress could be made with the investigation of steady flows in two and three dimensions - if we used the following little trick.

Let's look back at equation (4). Here we limit ourselves to steady flows, so we discard the left side of (4) and get

$$\nabla\cdot(K\nabla\Psi) = \partial K/\partial z \ . \qquad (7)$$

[Actually the matter is a little more complicated than that. For 2- and 3-dimensional flows which are "one-dimensional in the large" in a certain sense, the flow is not strictly steady. We have, essentially, steady flow in the upper regions of the soil, joined to a travelling wave flow in the lower regions. But this need not detain us here.] We now introduce the new variable

$$\Theta = \int_{-\infty}^{\Psi} K\,d\Psi \ . \qquad (8)$$

The lower limit of the integral is arbitrary, but it is convenient to take it as $-\infty$. Note that the conductivity K decreases so rapidly with moisture potential Ψ that the integral in (8) exists; and that the transformation (8) goes back to Kirchhoff in the 1880's.

Equation (7) then becomes

$$\nabla^2\Theta = \frac{1}{K}\frac{dK}{d\Psi}\frac{\partial\Theta}{\partial z} \ . \qquad (9)$$

If now we replace $\frac{1}{K}\frac{dK}{d\Psi}$ by the constant α, we have reduced the flow equation to the linear equation

$$\nabla^2\Theta = \alpha \frac{\partial\Theta}{\partial z} \quad . \tag{10}$$

You will all appreciate that making (9) linear will lead to an enormous gain of simplicity and saving of labour and effort - if only we can get away with it. We note that replacing $\frac{1}{K}\frac{dK}{d\Psi}$ by α requires that

$$K = K(0)\, e^{\alpha\Psi} \quad . \tag{11}$$

Now it so happens that, as Ψ decreases from its value 0 in a saturated soil at atmospheric pressure to very large negative values in very dry soils, K decreases rapidly and, indeed, $K(\Psi)$ can be represented reasonably well by the exponential approximation (11).

But a word of warning is needed. The exponential representation of K fails miserably for saturated regions of the soil with water under positive hydrostatic pressure. See Figure 5. The validity of the quasilinear analysis is thus limited to regions of the soil where $\Psi \leq 0$. Unfortunately some authors have not understood this restriction.

Note that when (11) is exact,

$$\alpha^{-1} = \frac{1}{K(0)} \int_{-\infty}^{0} K\, d\Psi \quad . \tag{12}$$

We see that (12) makes α^{-1} a K-weighted mean value of Ψ. Adopting (12) generally ensures a $K(\Psi)$ representation that is at least correct in an integral sense. At the very worst, (12) should ensure that quasilinear solutions yield good estimates of the integral properties of flows.

You will see that α has the dimensions $[\text{length}]^{-1}$. Without going into further detail, we can say that α^{-1} represents a characteristic capillary length of the soil. Fine-textured soils give small values of α and coarse-textured soils give large ones. Originally I estimated the practical range of α as from 0.2 to 5 m^{-1}. Subsequent studies generally confirm these values. Finally, we note that, in the limit as $\alpha \to 0$, capillarity dominates the flow process; and that, in the limit as $\alpha \to \infty$ gravity is dominant.

I stress this because, over the period 1978 to 1980 there were published three very confused papers which were based on the maximally wrong supposition that putting $\alpha = 0$ gives a gravity-driven flow. The matter is put right (and the subject restored to where it was before 1978 !) in a paper to appear shortly.

5. Quasilinear Solutions

I gave the first quasilinear solutions in the late 60's. With my usual laziness, I worked out the easiest solutions, those for a line source (a 2-simensional flow) and a point source (a 3-dimensional flow); and I used the point source to get a first estimate of steady infiltration from a spherical cavity with water made available at its surface at constant moisture potential Ψ_0.

The other early solution was found by Robin Wooding, who was working with us in Canberra at the time. It was for steady infiltration from a shallow circular pond at the soil surface. This quasilinear problem involving mixed boundary conditions remains the mathematically most difficult tackled to date; and Robin's solution represents an heroic piece of mathematics.

During the 1970's many people cranked out quasilinear solutions. These people apparently took fright at the heaviness of Robin Wooding's mathematics and they tend to follow my example of picking away at the easy problems. This limited them to fairly simple problems involving flux boundary conditions: that is the flow rate at some water supply surface was taken as given, and their solutions simply mapped the steady state consequences. Very frequently, however, the practical problem involves the supply of water at some given value of the moisture potential $\Psi = \Psi_0$, and we wish to know the resulting flow rate and moisture distribution.

Recently I have been working on two classes of problem involving fixed potential boundary conditions. The first class involve infiltration from fractionally wetted surfaces, and the second involve infiltration from buried cavities of various shapes. I'll say no more about the first class; but my work on the second class of problem has led on to what seems to be a new interesting development in the mathematics of soil-water studies.

It is useful in these various studies to use dimensionless space coordinates which are $\frac{1}{2}\alpha$ times the physical space coordinates and to use the normalized variable $\upsilon = \Theta/\Theta_0$ where

Θ_0 is the value of Θ corresponding to the fixed potential at the supply surface. The dimensionless form of (10) is then

$$\nabla^2 \upsilon = 2\,\partial\upsilon/\partial Z \ . \qquad (13)$$

∇^2 is now the Laplacian in dimensionless coordinates and we use capitals for such coordinates Thus $Z = \frac{1}{2}\alpha z$. We use the substitution

$$\upsilon = H e^{Z} \qquad (14)$$

to reduce (13) to the Helmholtz equation

$$\nabla^2 H = H \ . \qquad (15)$$

It is then a straightforward matter to use separation of variable methods to solve (15) subject to the transformed boundary conditions in H .

The detailed work on infiltration from cavities has been done for circular cylindrical and spherical cavities. One important motivation for looking at these problems of infiltration from cylindrical and spherical cavities was that they represented paradigms of two- and three-dimensional infiltration. I have always been fascinated by the effects of the dimensionality of flow systems on their general character; and it seemed to me that their exact solutions would throw useful light on the three-way interactions between gravity, capillarity, and geometry which produce the various flows.

It turns out that the solution for the cylindrical cavity is in terms of modified Bessel functions of integral order; and that for the sphere is in terms of functions of half-order. [Elliptical cavities would involve modified Mathieu functions, and spheroidal ones would lead us into the mysteries of spheroidal wave functions.]

The solutions for the cylinder and the sphere worked out very nicely, but one difficulty emerged. As we have noted, the solutions took the form of series involving Bessel functions. The convergence of these series was rapid for R_0 (dimensionless radius) less than 2 . It was still practical to sum them for $R_0 = 5$, but by $R_0 = 10$, one was in real difficulties. Typically, a summation for the total flow rate from the cylinder involved terms of magnitude up to 15 million to yield a final sum of 0.77 . 10-figure accuracy in the Bessel functions was needed to give 2-figure accuracy in the sum.

So what I found was that, although the exact solutions covered a useful practical range of R_0 , there seemed to be no way of analyzing the physically interesting question as to how a flow strongly dominated by gravity is modified by the existence of capillary effects, no matter how weak.

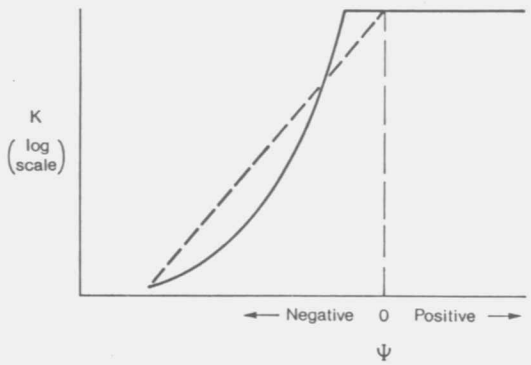


Fig. 5 $K(\Psi)$ (schematic). Full curve: Typical behaviour. Broken curve: exponential representation.

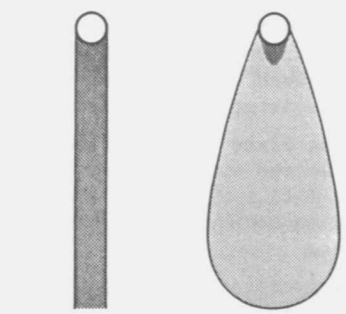


Fig. 7 Don't discard capillarity.

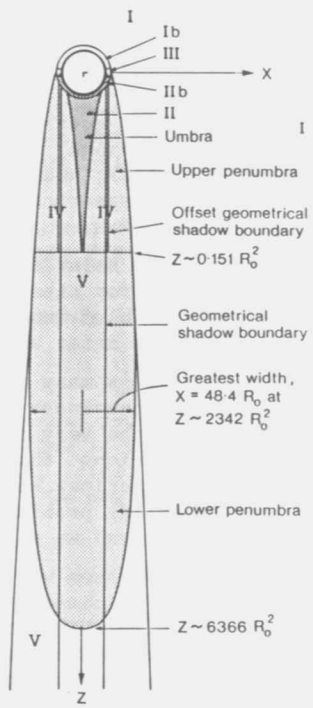


Fig. 6 Geometrical optics analogue to steady infiltration from a cylindrical cavity. Asymptotics of wetted region for large R_0 .

6. The Scattering Analogue

It was my good fortune, however, to stumble on some analogous work in magnetohydrodymanics where equations of the form (15) arise. That work was done by Trevor Waechter, a mathematician at Melbourne University. He solved the problem of the asymptotics (for large R_0 in our case) by recognizing an exact analogue of the problem with that of scattering of plane pulses by an acoustically soft body in the same geometry. It turns out that there is also (and this is potentially more powerful) an exact analogue with the problems of the scattering of plane waves. As many of you will know, there is a vast armory of established results and of very sophisticated and powerful asymptotic methods for solving scattering problems. These have been established in the contexts of acoustics, optics, electromagnetic theory, and quantum mechanics. By recognizing the analogue between unsaturated water movement and scattering, we have opened up the possibilities for establishing many new solutions of soil-water problems.

Figure 6 is, I think, rather fun. We use here the terminology and concepts of present-day geometrical diffraction theory (as practised, for example, by Joe Keller). The analogue shown is that between an opaque cylinder illuminated from above by plane waves, and steady infiltration from a cylindrical cavity.

You will see that the illuminated region is the analogue of that which remains dry; the shadow, corresponds to the essentially saturated region of the soil; and the penumbra corresponds to the region of the soil where infiltration from the cylinder has a significant effect on the moisture content. In detailed calculations of some other figures, I defined the umbra (or deep shadow) as the region where υ is greater than 0.99 and the penumbra as the region where υ lies between 0.99 and 0.01 .

Before I stop, I must emphasize a few points: For a start this work vividly illustrates the strong influence of geometry on infiltration flows. The penumbra for the cylindrical cavity is 128 times as deep as that for the spherical cavity.

Secondly, I note that the asymptotic expression for the steady infiltration rate consists of terms in successive powers of $R_0^{-2/3}$. For the sphere the second coefficient is just twice that for the cylinder; and the third coefficient for the sphere is just 32 times that for the cylinder. In carrying these calculations to many terms, with great accuracy in the coefficients, I was able to plunder the work of T.T. Wu of Harvard, who carried out very sophisticated and excruciatingly detailed scattering calculations in the late 1950's.

Note that scattering results are available for all sorts of shapes and these become available for use in the soil-water context. Note also that, since (13) takes the form of the general linear convection-diffusion equations, the results carry over into many other applications.

One final remark. This concern with the asymptotics of this group of problems is no mere academic exercise. We have a singular perturbation situation here, in the sense that it is wrong to suppose (as many engineers have done) that we can forget about capillarity in large scale systems.

It is never correct, in estimating the wetted region beneath a surface or buried source, to neglect capillarity just because it seems to be relatively small. See Figure 7.

7. Some References

Buckingham, E. (1907). Studies on the movement of soil water. U.S. Dept. Agr. Bull. 38.

Keller, J.B. (1979). Progress and prospects in the theory of linear wave propagation. SIAM Rev. 21, 229-245.

Philip, J.R. (1957). The role of mathematics in soil physics. J.Aust. Inst. Agr. Sci. 23, 293-301.

Philip, J.R. (1968). Steady infiltration from buried point sources and spherical cavities. Water Resour. Res. 4, 1039-1047.

Philip, J.R. (1969). Theory of infiltration. Adv. Hydroscience 5, 215-296.

Philip, J.R. (1984). Aspects of quasilinear infiltration from surface sources, especially the case $\alpha = 0$. Water Resour. Res. 20, 633-635.

Richards, L.A. (1931). Capillary conduction of liquids through porous mediums. Physics 1, 318-333.

Waechter, R.T. (1968). Steady longitudinal motion of an insulating cylinder in a conducting fluid. Proc. Camb. Phil. Soc. 64, 1165-1201.

Wooding, R.A. (1968). Steady infiltration from a shallow circular pond. Water Resour. Res. 4, 1259-1273.

Conferences

Compiled by Dr M.R. Carter, Massey University

1984

September 3-7 (Udine, Italy)
Mathematics of Multicriteria Optimisation
Details from P. Serafini, Centre International des Sciences Mecaniques, Piazza Garibaldi 18, 33100 Udine, Italy.

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Secretarial

MINUTES OF THE FIFTEENTH COUNCIL MEETING

Held at Victoria University on 6th May 1984

PRESENT: W. Davidson (President; in the Chair), M.R. Carter, P.D. Hill, A. McNabb, J.L. Schiff, D.J. Smith, J.A. Shanks.
In attendance: I.L. Reilly (convenor, Publications Committee), C.H.C. Little (by invitation).

1. APOLOGIES: J.H. Ansell

Moved from the Chair that the apology be accepted. CARRIED

2. MINUTES OF THE 14th COUNCIL MEETING:

Moved from the Chair that the Minutes be taken as read. CARRIED

Moved from the Chair that the Minutes be adopted as a true record of the proceedings of the 14th Council Meeting. CARRIED

3. MATTERS ARISING FROM THE MINUTES:

(a) Council discussed the continued support of the Prince and Princess of Wales Science Award Scheme. From awards already made it appeared that research in technological areas was being supported and there must be some doubt as to whether mathematicians would ever benefit. AMcN reported that discussions at the recent Royal Society Member Bodies Representatives meeting had stressed the importance of contributions from member bodies in order to secure support from industry.

Moved (MRC/JLS) that $300 be contributed to the Prince and Princess of Wales Science Award Scheme for 1984, but that we express our reservations to the Royal Society. CARRIED

(b) JAS reported that no response had been received from the Editor of the NZ Mathematics Magazine in reply to the Council's decisions regarding the publication of prize-winning projects from the Teachers' Competition in the magazine. It was decided to write again.

(c) JAS reported that $400 had been made available to cover the expenses of the 1984 Visiting Lecturer.

(d) JAS reported that the Council of NZAMT was due to meet on 10th May 1984 and no doubt some response would be forthcoming regarding the Society's new conditions of contract for authors of publications.

(e) WD described progress on arranging the delegation of mathematicians to visit the United States through the Citizens' Ambassador Program organisation. From 5 suggested candidates, CAP had chosen Professor J.C. Butcher as delegation leader. It seemed that a larger delegation (of the order of 20, plus spouses) was being expected than that originally envisaged by Council. Discussion followed on possible sources of funding. While delegates would be expected to seek their own financial support, the Society could provide some assistance with applications, one already having been made to the PPW Science Award Scheme. There was also the NZUSA Science Co-operation Scheme. AMcN suggested that the Minister of Science and Technology be approached, while PDH mentioned the NZUSA Educational Foundation.

(f) Supporting evidence and biographical details were tabled for the Society's nomination to the Royal Society for an Honours Award. PDH and DJS raised the question of the importance of community work. While it was recognised that the nomination was being made purely on the grounds of outstanding service to mathematics, the meeting felt that no harm would come of stressing those areas of the nominee's work which were of most general application.

Moved from the Chair that the present Chairman and Incoming President determine the most appropriate wording of the grounds for making the nomination. CARRIED

(g) JAS reported that $200 had been sent to the American Mathematical Society to support the production of Mathematical Reviews. An accompanying note about the use of modern technology had produced an explanation from the Editor about their methods.

(h) JLS reported that C.J. Atkin had paid membership arrears and was now recorded as a full member.

(i) Other business:

MRC raised the matter of the Society's policy on such issues as University Entrance and computing in education. On the former topic discussion centred around the advisability of conducting a poll of members' views through the Newsletter. It was agreed that the members should be consulted at the AGM.

Moved (MRC/DJS) that the AGM be recommended to give the Incoming Council authority to take steps to sound out, via the Newsletter, opinions on the University Entrance issue with a view to forming an NZMS policy. CARRIED

On the matter of computing, the possibility of forming a National Committee was considered, but no decisions were reached.

DJS reported from his discussions with the Editor of the Chronicle on the need for a NZ research publication. The Editor was disinclined to have the Society take over the Chronicle and that, should it feel the need for such a publication, then one should be established in its own right. The costs involved in producing a Society Journal were unknown and it was thus

Moved (MRC/PDH) that the Publications Committee be asked to investigate the financial aspects of producing a Journal. CARRIED

WD noted that, following precedent, consultation was needed with the Chronicle over publication of talks of the Invited Speakers at the Colloquium; DJS and M.J. Curran would act on this matter.

4. MEMBERSHIP OF 1984-85 COUNCIL:

JAS reported that 5 members of Council would be retiring and nominations had been sought, through the Newsletter, to fill the vacant positions. Two nominations had been received for one position of Incoming Vice-President (thus necessitating an election at the AGM) and four nominations (the number of positions) had been received for Council. It was noted that in particular JLS, presently the Treasurer, would be retiring.

5. FINANCIAL REPORT:

JLS presented the Treasurer's report, pointing out the healthy assests which had accrued since the end of the reporting period due to heavy sales of the new "Calculus" text. He suggested that the interest earned on the Society's investments could be over $2000 per year and that this could be used to finance a research fund. Discussion followed on how this might be established. WD thought that there may be difficulties in finding a suitable arrangement fitting in with University funding boards.

Moved from the Chair that the Incoming Council consider the establishment of a fund to aid research and to support visits by overseas mathematicians. CARRIED

JLS questioned the Society's rules on the transfer of funds between different accounts. Two motions from the Eighth AGM

[That $2000 of the publication profits may be used for special projects.

That publication funds be taken account of separately and that transfer of these funds to the general account normally be approved only by a resolution of a general meeting.]

were especially restrictive in view of the large amount held in the publication fund at present. If this money was to be used for other than the self-replicating function of producing more and more publications, then it had to be transferred to the general account. It could then be used to fund a variety of schemes. After discussion it was

Moved (JLS/MRC) that the matter of transfer of funds be put to the AGM. CARRIED

Moved (JLS/DJS) that the subscriptions be held at present rates. CARRIED

Moved (AMcN/JAS) that the Financial Report be received and approved. CARRIED

(The meeting adjourned for lunch 12.45 to 1.45.)

6. PRE-DOCTORAL THESIS COMPETITION:

Council considered a report from I.D. Coope (convenor) and in particular the matter of for whom the competition was intended. There were advantages both for maintaining the competition for M.Sc. theses as well as for changing its status to cover Honours projects. In fact this year entries from both camps had been received. No decision was reached but it was evident that some clear policy should be finalised before the next competition is run.

Moved (PDH/MRC) that the Society add $50 to the $250 donated by Burroughs Ltd for prize-money. CARRIED

Moved from the Chair that the report on the pre-doctoral thesis competition be received. CARRIED

Moved (MRC/JAS) that the judges (D. Vere-Jones, I.L. Reilly, D.A. Nield) and convenor (I.D. Coope) be thanked. CARRIED

At this point Dr I.L. Reilly joined the meeting so that the next item was brought forward in the agenda:

16. PUBLICATIONS:

ILR presented the Publications Report and described the success of the "Calculus" text. As requested by Council at its previous meeting, he had written to both the Harcourt-Brace-Jovanovich Group and the Australian Mathematical Society about co-operation in publishing this text in Australia. Response from both groups suggested that such co-operation was unlikely and that if it did go ahead, the selling price would be in the region of NZ$40, thus defeating one of the principal aims of the Society's publications. ILR noted that a revision of the text so that it be suitable for Massey was being considered.

Moved (JLS/MRC) that the Publications Report be received. CARRIED

Moved (MRC/JAS) that publication of the "Calculus" text be continued for 1985. CARRIED

DJS asked about the Society's legal standing in relation to its acting as book distributor and seller. This being unknown to the meeting, it was

Moved (DJS/JAS) that the Publications Committee investigate the proprieties of publication and distribution of books. CARRIED

PDH enquired about the quality of some of the 7th form Applied Mathematics Syllabus Series. ILR replied that this series is due to be phased out shortly with the introduction of the new syllabus in 1986, otherwise new versions would have been produced by now.

ILR was thanked for his attendance and left the meeting.

7. CORRESPONDENCE:

Moved (DJS/MRC) that the inwards correspondence be received and that the outwards correspondence be noted. CARRIED

8. MATTERS ARISING FROM THE CORRESPONDENCE:

The meeting discussed a letter from D.A. Nield requesting that he be recorded as a Foundation Member since he was present at the inaugural meeting although on leave at the time that invitations to join were distributed. From the Treasurer's records it was revealed that Dr Nield had in fact paid a subscription in the first year in which it was collected and that, although not listed as attending, he was indeed present at the inaugural meeting. It was decided to inform him of this and to point out that in fact the Society did not record Foundation Members so that the meaning of this title could only be taken as being present at the inaugural meeting.

9. HONORARY MEMBERSHIP:

Moved from the Chair that Professor G.M. Petersen be declared an Honorary Member of the Society. CARRIED

10. HUMAN RIGHTS:

Moved (JAS/MRC) that the Human Rights Report be received. CARRIED

In response to the request from the Human Rights representative (B. Calvert) it was

Moved (DJS/MRC) that the NZMS authorizes the Bulletin of the International Campaign for Orlov and Scharansky to list it as supporting the campaign. CARRIED

It was agreed to ask the AGM for endorsement.

11. SUMMER RESEARCH INSTITUTE:

Moved (PDH/JAS) that a report on the forthcoming Summer Research Institute from D.B. Gauld be received. CARRIED

12. VISITING LECTURER AND VISITOR INFORMATION:

The report from W.D. Halford held over from the previous Council Meeting was reconsidered. MRC presented an update from WDH and stressed that more and prompt information from departments was needed to make the Visitor Information Scheme work properly.

Moved from the Chair that the reports be received and that WDH be thanked for his services. CARRIED

13. FUND FOR STUDENTS TO ATTEND CONFERENCES:

WD described a scheme with details as follows:

(a) Up to $1000 could be disbursed annually to assist postgraduate students from New Zealand University Mathematics Departments to attend conferences, colloquia or symposia related to their field of specialisation.

(b) Students would apply to the NZMS Secretary giving their biographical details, academic record and an account of their postgraduate research and enclosing a recommendation from their research supervisor.

(c) Normally the conference would be one held in New Zealand.

(d) It is envisaged that about five students would be helped in this way annually.

(e) A subcommittee of Council would be responsible for recommending to Council which, if any, students should be assisted, in order of priority, and the value of monetary assistance. Their report would be submitted to Council at the December meeting.

DJS suggested the addition of the words "and declaring any other source of financial assistance" to item (b).

Moved from the Chair that the fund as described with modification be established. CARRIED

It was noted that the fund would be advertised through the Newsletter and that Mathematics Departments would be informed.

14. UNIVERSITY OF THE SOUTH PACIFIC FUND:

DJS gave a verbal report on progress and communication with USP concerning this fund. No award was made in 1983 but there were at least two possible applicants for this year. Council recommended that the fund be made known to all Heads of Mathematics Departments in New Zealand and that the fund could be readvertised later in the year.

Moved from the Chair that the report be received. CARRIED

15. POSTGRADUATE TOPICS BOOKLET:

JAS informed the meeting that he had taken over the preparation and publication of this annual list of research interests. He advised that future copies would be produced about August/September in order to have the most current information available to postgraduate students. He was thanked for the 1983 booklet.

(At this point PDH had to leave the meeting to catch a flight to Waikato.)

17. ANNUAL GENERAL MEETING:

Council discussed the agenda for the AGM. On the matter of the availability of the membership list to outside bodies, in accordance with the decision at the previous Council meeting, it was

Moved (MRC/AMcN) that Council ask the AGM to endorse the recommendation:

That the Society authorise Council to supply the membership list to outside bodies where this will further the mathematical interests of members.

CARRIED

18. GENERAL BUSINESS:

(a) MRC mentioned the publication of supplements to the Newsletter which had detailed theses and research bulletins produced in New Zealand. The advisability of continuing such supplements was left to the Incoming Council.

(b) AMcN gave a short verbal report of the Royal Society Member Bodies Representatives meeting. He mentioned in particular a discussion centring on the payoffs from Science to the country's industry and technology.

(c) JAS remarked that the Secretary had a large amount of archive material and that there would be a great advantage in having this kept at a central site instead of being passed on each time this office changed. It was suggested that the Society had, by right, storage space for precisely this type of material at the Royal Society. JAS agreed to confirm this and act on it.

The Chairman thanked all members for attending and expressed the Society's gratitude to those retiring from Council. MRC thanked the Chairman for his work during the year.

There being no other business the meeting was declared closed at 5.15 p.m.

J.A. Shanks
Secretary

PUBLICATIONS COMMITTEE REPORT 1983/84

1. 7th form Applied Mathematics Syllabus Series:

Sales of the Booklets 1st May 1983 to 20 April 1984 are: Prob/Statistics 1147 ; Computing & Numerical 882 ; Mechanics 308 ; Teachers Booklet 79 . Reprintings have been ordered as requested. We have refrained from revisions or new editions because of the forthcoming change of 7th form syllabus in 1986. (See item 5).

2. G.E. Andrews "Partitions, Yesterday and Today":

About 20 copies were sold during the year, mainly on commission through the Australian agents (ANU Press). This venture, dating from 1979, is already in profit.

3. Calculus Project:

As convenor of the writing team I would like to thank all members of the Society who made comments on the first draft. Of the suggestions which came to hand in time for the editing process, 497 were adopted and 157 were not.

The book was adopted as textbook for two courses at Auckland and one at Waikato. We produced 1097 copies of which 1010 were sold at $18 each. The other 87 copies were authors copies, library donations and promotion copies. In Auckland the Mathematics Department enrollment procedures allowed direct sales to students at $18, while at Waikato the University Bookshop retailed the book at $22.50. 800 copies were sold at Auckland and 210 at Waikato. Profit on this project should be about $7000 .

4. New 6th form book:

In co-operation with NZAMT, the Society has set up a Wellington based writing team convened by Dr L.C. Johnston. We hope to have promotion copies of this book available to high schools at the beginning of the third term. The new 6th form (U.E.) syllabus comes into operation in 1985.

5. New 7th form books:

Again in co-operation with NZAMT, we are having discussions with prospective convenors of two writing teams for the two new (not yet promulgated) 7th form Mathematics syllabi to come into effect in 1986.

I.L. Reilly
Publications Convenor

MINUTES OF THE TENTH ANNUAL GENERAL MEETING

Held at Victoria University on 7th May 1984

PRESENT: W. Davidson (President; in the Chair), K. Ashton, P.J. Bryant, J.C. Butcher, M.R. Carter M.J. Curran, S.D. Forbes, D.B. Gauld, W.D. Halford, J.F. Harper, M.A. Jorgensen, Lee Peng Yee, C.H.C. Little, W.G. Malcolm, A.W. McInnes, G. Olive, I.L. Reilly, K.G. Russell, J.L. Schiff, J.A. Shanks, D.J. Smith, G.J. Tee, G. Thornley, G.C. Wake.

The meeting was declared open at 7.10 p.m.

1. APOLOGIES: P.D. Hill, B.J. Hayman, K.A. Broughan, M. Schroder, J.C. Turner, J.H. Maindonald, D.C. Harvie.

Moved (Harper/Shanks) that the apologies be accepted. CARRIED

2. MINUTES OF THE NINTH A.G.M. (Previously printed in the Society's Newsletter):

Moved from the Chair that the Minutes be taken as read. CARRIED

Moved (Russell/Wake) that the Minutes be adopted as a true and correct record of the proceedings of the Ninth A.G.M. CARRIED

3. MATTERS ARISING FROM THE MINUTES: None.

4. ANNUAL REPORT:

The President presented the Annual Report, copies of which had been previously distributed, and made a few additional comments.

The Prince and Princess of Wales Science Awards Scheme was to be supported by the Society again this year with a donation of $300. Council felt that the Society should continue its interest in this scheme on a year to year basis with a watchful eye on whether these awards are ever likely to benefit mathematicians; it was evident that so far the awards had been granted for research in more technological areas.

Council had agreed to set up a fund to support the expenses of post-graduate students in attending conferences, usually in New Zealand. The total fund would be $1000 each year which would normally be shared by about five students, although exceptions could be expected.

The president mentioned efforts being made to obtain funds to support the delegation of New Zealand mathematicians to visit the United States through the People to People International organisation. Discussion followed on possible sources of funding. The leader, Professor J.C. Butcher, would be responsible for organisation of the delegation, but the Society would be willing to provide help in any way it could. Professor Butcher said that any mathematicians wishing to join the delegation should contact him; anyone visiting the United States on other business at the time of the delegation would obviously be a strong candidate.

Dr Olive initiated discussion about the fund to assist mathematics students from the University of the South Pacific to undertake graduate studies in New Zealand. Dr Halford had recently spoken with Dr Joyce (no longer at USP) who felt that it was important to continue the scheme. Concern was raised that the $500 fund may be insufficient incentive.

In discussing the Society's publications, the President mentioned that the Publications Committee was to be asked to investigate the financial aspects of producing a Society Journal.

Moved (Shanks/Russell) that the Annual Report be adopted. CARRIED

Moved (Harper/Russell) that the standing President be recommended to include names of prizewinners of the Society's competitions in future Annual Reports. CARRIED

5. FINANCIAL REPORT:

Dr Schiff commented on several aspects of the Financial Report, copies of which had been previously circulated. He stated that the Society was in a very healthy financial position with a substantial profit from the Society's publication activities and in particular from recent sales of the "Calculus" text.

Dr McInnes enquired about the stock on hand at 31.12.83 which accounted for about $7500. Dr Schiff advised that the 7th form Syllabus Series made up most of this stock and these had been printed only weeks before the end of the reporting period; consequently they had yet to be distributed to the schools. Dr Wake reported that in fact about half of that stock had since been sold.

Moved (Schiff/Wake) that the Financial Report be adopted. CARRIED

Dr Schiff raised the matter of transfer of funds from the Publications account to the general account and reminded members of two motions passed at the Eighth AGM, namely:

That $2000 of the publication profits may be used for special projects.

That publication funds be taken account of separately, and that transfer of those funds to the general account normally be approved only by a resolution of a general meeting.

He said that the former was both restrictive and ambiguous and he called on the meeting to discuss its original intention. Drs Halford, Thornley and Wake recalled that the motions were passed at a time when the Society's funds were still meagre and that they were meant to safeguard the Society from the large investments needed for future publications. Dr Harper stated that the Council would be in a better position to decide on expenditure and noted that a decision of the present meeting would be in agreement with the second motion.

Moved (Harper/Wake) that notwithstanding the two motions of the Eighth AGM, the Council be empowered to spend the Society's funds as it sees fit. CARRIED

Dr Schiff advised the meeting that, along with himself, the Auditor (D.M. Emanuel) would be retiring.

Moved from the Chair that the Auditor be thanked. CARRIED BY ACCLAMATION

6. PUBLICATIONS REPORT:

Dr Reilly spoke to his report, previously circulated. He thanked all those involved in the "Calculus" text project and commented on the success of this publication and on plans for producing copies for 1985. Dr Harper enquired about the price of $18 and a possible reduction in view of the profits made by the Society. Drs Reilly and Wake described the way in which the final price had been set; the response from students had been an unknown quantity and so a safeguard was needed against the possibility of having, say, 200 copies left unsold. As it was, all copies had been sold (besides those sent to Universities, writers and so on).

Dr Reilly also outlined approaches to Australian publishers regarding co-operation in overseas publication of the "Calculus" text; the outcome was that the final price would be excessive and thus against the main purpose of producing the book. Direct marketing in Australia by the Society was being considered.

Moved (Reilly/Russell) that the Publications Report be adopted. CARRIED

Moved (Olive/Shanks) that the work of the Publications Committee was appreciated and that its members be congratulated. CARRIED BY ACCLAMATION

7. HUMAN RIGHTS:

The meeting discussed a report from the Human Rights Representative (Dr B. Calvert). The Chairman reported that Council had passed the motion:

That the NZMS authorizes the Bulletin of the International Campaign for Orlov and Scharansky to list it as supporting the campaign.

and was asking the AGM for its endorsement. Dr Reilly stated his misgivings about the Society giving support to such political matters and Dr McInnes strongly objected to the Society's intervention and said that such matters as these should be left to individual members. Professor Malcolm spoke in support of the Council's move and thought that it could do no harm. Dr Ashton said that a national society would have much more weight than support from a number of individuals; Dr Olive added that it was "better to err on the side of mercy".

Moved (Malcolm/Olive) that the meeting endorse the Council's motion. CARRIED

(Dr McInnes asked for his dissenting vote to be recorded.)

Discussion centred on the merits of distributing the Human Rights report well before the meeting. Dr McInnes thought that the wording of any motion concerning Human Rights should be published in the previous Newsletter. The Chairman spoke against such an idea since the exact motion had first to come before Council, which met almost immediately before the AGM. Dr Shanks read from the Constitution that the Secretary has to receive notice of matters for discussion at the AGM at least six weeks before the meeting but is required only to give notice of the meeting (and not its agenda) to the members four weeks in advance. After further discussion concerning the precise presentation of the Report, it was

Moved from the Chair that the function of the Human Rights Representative and the procedure followed by him be referred to Council. CARRIED

Moved (Olive/Wake) that the Human Rights Report be received and Dr Calvert be thanked. CARRIED

8. PUBLICATION OF MEMBERSHIP LISTS:

The Chairman said that the Society had previously been asked to provide a membership list by a publishing house and that the list had been offered for a sum of $100. It was the feeling of Council that the Society should have some definite policy and it was therefore asking the meeting for an endorsement of the recommendation:

That the Society authorise Council to supply the membership list to outside bodies where this will further the mathematical interests of members.

Moved (Malcolm/Gauld) that the meeting endorse that recommendation. CARRIED

9. ELECTION OF OFFICERS:

After an election, Assoc. Professor I.L. Reilly was declared elected to the position of Incoming Vice-President, 1984-85. There were four vacancies on Council and the four nominees, Dr M.A. Jorgensen, Dr J.F. Harper, Dr E.G. Kalnins and Dr C.H.C. Little were declared elected for the period 1984-87.

Moved (Wake/Halford) that the Auditor be appointed by the Incoming Council. CARRIED

10. GENERAL BUSINESS:

(a) The Chairman announced that Professor Gordon Petersen had been made an Honorary Member of the Society. Members applauded this honour.

(b) There was discussion about whether the Society should become involved in the University Entrance issue. Dr McInnes thought that this was clearly political and therefore the Society should take no part. Dr Halford said that if the Society did have a unified opinion then this should be voiced.

Moved from the Chair that the Incoming Council take steps to sound out, via the Newsletter, opinions of the University Entrance issue with a view to forming an NZMS policy. CARRIED

(Dr McInnes asked for his dissenting vote to be recorded.)

(c) Ms Forbes spoke about a scheme to co-ordinate ideas on the development of teaching basic skills. She said that University Mathematics Department had given general support.

Moved (Malcolm/Russell) that Council be recommended to give consideration to establishing a national committee to co-ordinate development in basic skills programmes. CARRIED

(d) Dr Tee announced details of a symposium "Transmission of Mathematical Science" organised by the International Commission on the History of Mathematics to be held at Berkeley, 31 July to 8 August 1985.

(e) Dr Wake reminded the meeting of the Australasian Mathematics Convention to be held in May 1985 and asked whether further communication with the organisers had raised the important matter of the Convention covering a broad spectrum of mathematics. Dr Russell replied that this point had been made in 1983.

(f) Dr Carter expressed the Society's gratitude to the outgoing President and its best wishes for his forthcoming retirement. The members applauded in agreement.

There being no other business, the meeting closed at 9.40 p.m.

J.A. Shanks
Secretary

MINUTES OF BRIEF COUNCIL MEETING

Held at Victoria University, May 7, 1984

The meeting was declared open at 9.45 p.m.

PRESENT: M. Carter (Chair), I. Reilly, W. Davidson, J. Schiff, J. Shanks, J. Harper, D. Smith, J. Curran, M. Jorgensen, C. Little.

1. APOLOGY: P. Hill — SUSTAINED

2. APPOINTMENTS:

Secretary: Moved from the Chair that Dr C. Little be appointed. — CARRIED

Treasurer: In view of the resignation of Dr J. Schiff as Treasurer, it was decided that Dr E. Kalnins should be asked if he would be willing to assume this office.

Newsletter Editor: Moved from the Chair that Dr J. Curran be re-appointed. — CARRIED

Publication Committee: Moved from the Chair that no change in membership be made. — CARRIED

Visiting Lecturer Selector: Moved from the Chair that Dr M. Jorgensen be appointed. — CARRIED

RSNZ Member Bodies Representative: Moved from the Chair that Dr M. Jorgensen be appointed. — CARRIED

Teachers Project Competition Organiser: Moved from the Chair that Dr P. Lorimer and Dr D. Robinson be approached. — CARRIED

Human Rights Representative: Moved from the Chair that Dr B. Calvert be asked to continue in this position. — CARRIED

Co-ordinator of Visitors: Moved from the Chair that Dr D. Halford be asked to continue in this position. — CARRIED

Graduate Information Co-ordinator: Moved from the Chair that Dr M. Carter be re-appointed. — CARRIED

University of the South Pacific: Moved from the Chair that Dr E. Kalnins be asked to assess applications from students for financial support. — CARRIED

Post-Graduate Topics Booklet: Moved from the Chair that Dr J. Shanks prepare a booklet containing information on the fields of study available to prospective post-graduate students in New Zealand. — CARRIED

Remedial Mathematics: Moved from the Chair that Dr J. Harper be appointed to maintain liaison with Ms S. Forbes regarding her efforts to ensure the co-ordination of remedial mathematics programmes in New Zealand universities. — CARRIED

(At 10.10 p.m. the meeting adjourned until 10.15 a.m. the following day. Present at the resumption of the meeting were: M. Carter, C. Little, J. Harper, J. Schiff, J. Shanks, J. Curran, I. Reilly, M. Jorgensen. An apology was received from W. Davidson.)

Treasurer: It was noted that efforts to contact Dr Kalnins had been unsuccessful. It was moved from the Chair that Dr J. Shanks be appointed Treasurer and authorised to negotiate with a suitable accountant to be appointed Auditor. — CARRIED

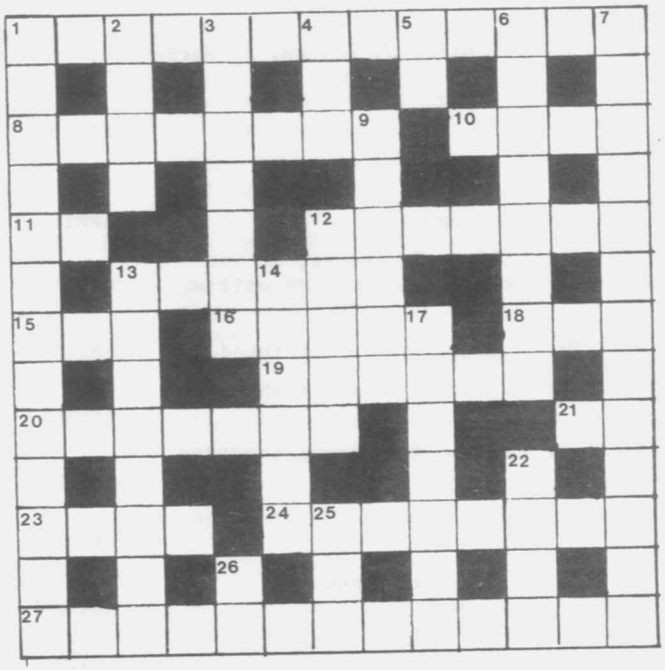
It was noted that Dr B. Clavert had agreed to remain in his position as Human Rights Representative.

The meeting closed at 10.20 a.m.

C.H.C. Little
Secretary

Crossword

No. 14 XOX by Matt Varnish



Across:

1. Composer's message gives title. (4,3,6)
8. Lacking legality as is zero. (8)
10. Gave a heavenly body. (4)
11. A measure of two points. (2)
12. Dust net learner. (7)
13. Top verb. (6)
15. To nothing also. (3)
16. Got up = got up = got up (after stein?). (5)
18. Have from now. (3)
19. Obtained in US had X in UK. (6)
20. Force applied as diverted gives Div? (7)
21. Ascending preposition. (2)
23. No first class around and back for the holy place. (4)
24. The points end coast. (8)
27. The least bent gave later insights. (8,5)

Down:

1. Use near results i.e. for poles. (7,6)
2. V = a document. (4)
3. Rag bale of symbols. (7)
4. Semi-circular doctor. (3)
5. Poem title. (2)
6. The support of all else knot will be. (8)
7. First appointments in the rat race? (8,5)
9. To hate poor exam grades. (6)
12. Double duck in standard was on feet. (5)
13. Feedback controller. (8)
14. Hear gently the metal container. (6)
17. Type of triangle. (7)
22. Port home of pride? (4)
26. The number almost gives the pip. (2)

CROSSWORD No. 13 SOLUTION

Across:

1. Trouble With Harry,
10. llama, 11. easel,
12. irons, 13. triskaidekaphobia,
16. elfin, 18. bergs, 21. eject,
23. due, 24. out, 25. straw,
26. inter, 27. Ixion, 28. hun,
29. roc, 30. Delhi, 31. gassy,
34. aleph, 36. The fear of thirteen,
42. rouse, 43. calyx, 44. lined,
45. least distressing.

Down:

1. Tell the, 2. okapi,
3. black and white sets, 4. elemi,
5. issue, 6. halma,
7. arithmetical rules, 8. rhomb,
9. a spartan, 14. die, 15. keg,
17. feral, 18. being, 19. rites,
20. sorry, 21. exile, 25. sad story,
32. ago, 33. set, 35. hangdog,
37. elude, 38. raced, 39. folds,
40. hexer, 41. ennui.

The Newsletter is the official organ of the New Zealand Mathematical Society. It is produced in the Mathematics Department of the University of Otago and printed at the University Printery. The official address of the Society is:

New Zealand Mathematical Society (Inc.)
C/- The Royal Society of New Zealand
Private Bag
WELLINGTON

However correspondence should normally be sent direct to the Secretary, Dr C.H.C. Little, Department of Mathematics and Statistics, Massey University, Palmerston North.