THE NEW ZEALAND MATHEMATICAL SOCIETY

NEWSLETTER

SCOOP: EDITOR FLEES POST

MATH WITH GARY

CENTREFOLD

EGYPTIAN FRACTIONS or, Pyramid Parties : are they proper?

CROSSWORD

CONTENTS

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Editorial

In elevating Dean Halford to the Presidency of our Society, members have shown recognition of dedicated service to the Society and expectation of further contributions. However, they have shown scant regard for the welfare of the Newsletter, the Editorship of which now falls from Dean's capable hands into my lap. So members may count on my faithfully reflecting this cavalier attitude of theirs in their own publication.

I find I have inherited a remarkably smooth operation, but with a zero-order perturbation upon it; namely the plan to run to 4 editions per year. The intention is to succeed this August edition by a bumper Xmas special in December-January and thereafter to produce a Newsletter every 3 months. To achieve this and to maintain some standards I have elicited the help of three Assistant Editors:

Michael Carter , Massey
Graham Wood , Canterbury
Ian Coope , Canterbury.

This transition issue is printed and distributed from Massey. It also has the distinction of being produced by Graham and Ian in the absence of the Editor! In compliance with the rôle of "all responsibility, no care" justified above, I shall be in the antipodes for the completion of this edition.

We trust then, that readers will forgive us for taking liberties with the normal lay-out and for instituting some innovations rather half-cocked. We are grateful to Matt Varnish for responding to a request for crosswords, which will become a regular feature, and we thank Maurice Askew of the Fine Arts Department for filling out a cartoon idea at a few hours notice.

W. Brent Wilson, Canterbury.

SUB-EDITORIAL

The editors are grateful to our typists, Mrs. Ann Tindall and Mrs. Beverley Haberfield for typing this Newsletter, and to those who contributed articles. Contributions to future Newsletters are invited from anyone with items of interest to the New Zealand mathematics community, and may be sent to the editor or one of the Honorary correspondents listed on p.51.

ANOTHER NEW ZEALAND MATHEMATICAL PUBLICATION

Mathematical Chronicle is published by the Mathematical Chronicle Committee, Department of Mathematics, University of Auckland, Private Bag, Auckland. The editors are Professor J.A. Kalman, Dr. D.B. Gauld, Dr. G.R. Baird and Dr. B.D. Calvert. The subscription is $12.00 per volume of three issues, with a reduced rate of $6.00 for individual subscribers and a further reduction to $5.00 for members of the New Zealand Mathematical Society. The Chronicle welcomes contributions of short research articles and mathematical notes by New Zealand mathematicians.

D.B.G.

PRESIDENT'S ANNUAL REPORT 1979/80

On behalf of the Council, I am pleased to present the sixth annual report of the New Zealand Mathematical Society.

The work of the Society throughout the year was carried out enthusiastically and well by its officers. I begin by thanking them all for their efforts and the support they have given me.

The full Council met immediately after last year's Annual General Meeting, and again just before this one. A postal meeting was held in August 1979, and regional meetings took place at Massey University and Canterbury University in November 1979. Dr. M.Schroder, our Secretary, is to be congratulated for keeping Council Members fully informed on all Society matters by sending out a number of well-timed abbreviated summaries of the more important correspondence of the Society. The brevity, and wit, of these documents have been of great help to us in digesting the said correspondence and bearing the burdens of dealing with it.

I am pleased to note that membership increased by 11%, to a total of 193; New Zealand Forest Products and Digital Equipment Corporation are new institutional members.

Three issues of the Society's Newsletter appeared, in August 1979, December 1979 and April 1980, all maintaining an extremely high standard of presentation under the Editorship of Dr. D. Halford. In addition to these, two invited Colloquium addresses, and three Colloquium papers, were published as supplements. A special supplement was produced in April, being a collection of submissions on topics in mathematics education; the purpose of this was to stimulate discussion and prepare readers for the Mathematics Subject Conference being held in Auckland in May. The volume of material now being processed for newsletters and supplements is such that the Editor has suggested increasing the number of issues per year to four.

Several new publishing ventures have been undertaken, each with its own good measure of success. A booklet by Prof. G.E. Andrews, the 1979 Visiting Lecturer, entitled "Partitions : Yesterday and Today" has already sold nearly 400 copies at home and abroad. The users manual for the statistical computing language STATUS was published in February, and was financially profitable before the bill for printing was received! The booklet on Post-Graduate Topics was up-dated; similar work in the Employment Brochure has just been completed.

The Society has set up a "Thesis Prize" to be awarded each year to the author of "the best masters thesis on a mathematical topic". I thank Dr. G. Wake for carrying this project through, to I.B.M. for supporting it financially, and the three adjudicators, Professors Vere-Jones, Woods and Zulauf, for the hard work they put in trying to separate the submitted theses.

I will finish my report by giving brief summaries of a number of activities or actions taken by the Society during the year.

1. The Society gave moral support to the organizers of the XIV Mathematics Colloquium at Waikato University in May, which was held in conjunction with the N.Z. Philosophy Conference, and sponsored the Colloquium Lecturer, Dr. Wojtyński.

2. During April and May Prof. G.E. Andrews, of the Pennsylvania State University, spent several weeks touring New Zealand as the Society's Visiting Lecturer.

3. The Society sponsored two workshops, one on analysis at Victoria University in June 1979, the other on topology at Auckland in August.

4. The Society has applied for incorporation. Certain constitutional amendments have been required, and these are to be put to the forthcoming Annual General Meeting. It is hoped that incorporation will be completed shortly afterwards.

5. The Society sent a letter of protest to the Minister of Foreign Affairs of Uruguay, about the imprisonment of Dr. J.L. Massera, and is looking for support in this from the New Zealand Government.

6. The Society has yet to decide whether to support the International Mathematical Union Commission on Development and Exchange with more than sympathy.

7. The Second Australasian Mathematical Convention in Sydney, in May 1981, is being organised - mainly by the Australian Mathematical Society - with the Society's support.

Assistance and recognition of the Convention may also proceed in due course from the South East Asian Society and the International Mathematical Union.

8. A reciprocity agreement with the Mathematical Society of Japan is likely to be concluded shortly. However, the one with the Chinese Mathematical Society foreshadowed in the last report seems unlikely to be completed. Negotiations have opened with the Mathematical Association of America.

9. The Society asked the Royal Society of New Zealand to apply to the International Mathematical Union for level II status for New Zealand. Although Dr. Wake prepared a substantial case for this, the Royal Society did not accede to this request.

Finally, I offer my thanks to the many people, on Council and off, who have given service and advice beneficial to the Society and helpful to me. Particular thanks are due to Drs. Joyce, Schroder and especially Wake, who are now leaving the Council.

John C. Turner, May 1980.

MEDITATION

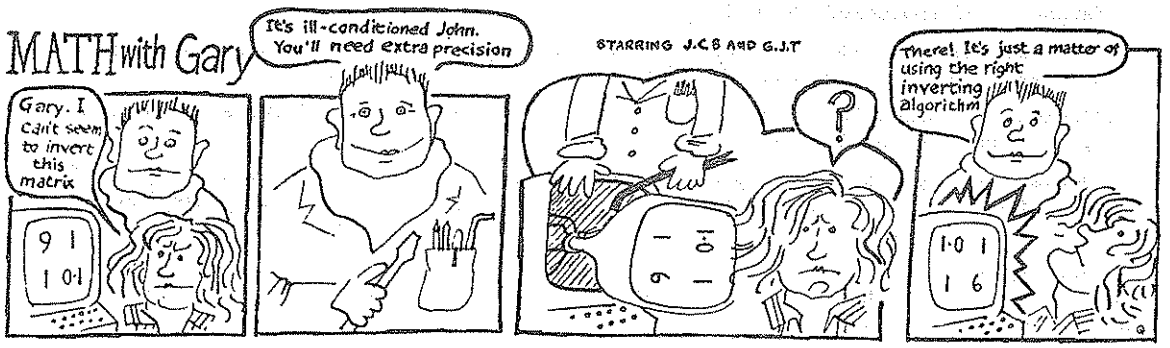
"Let us sit on this log at the roadside," says I, "and forget the inhumanity and ribaldry of the poets. It is in the glorious columns of ascertained facts and legalised measures that beauty is to be found. In this very log we sti upon, Mrs. Sampson," says I, "is statistics more wonderful than any poem. The rings show it was sixty years old. At the depth of two thousand feet it would become coal in three thousand years. The deepest coalmine in the world is at Killingworth, near Newcastle. A box four feet long, three feet wide, and two feet eight inches deep will hold one ton of coal. If an artery is cut, compress it above the wound. A man's leg contains thirty bones. The Tower of London was burned in 1841."

"Go on, Mr. Pratt," says Mrs. Sampson. "Them ideas is so original and soothing. I think statistics are just as lovely as they can be."

(O. Henry)

DIGESTING PI

The Mathematics Department at the University of Waikato has had a query from a man wanting to get his name in the Guinness Book of Records, by memorising as many places of π as possible. However, he first needs some information! If you have access to a table listing the first 5000 places of π, or know of a likely source, please let them know.



News and Notices

A CALL TO AUTHORS

The publications committee of the Society wishes to bring to the attention of N.Z. mathematicians the resources of the Society and invites them to consider the Society as a vehicle for publication of their mathematical works. The Society is prepared to consider a wide variety of mathematical publications, within the constraints of finance and profitability. In the last year the Society has produced the following publications (in addition to the Newsletter and its supplements).

PARTITIONS : YESTERDAY AND TODAY, by G.E. Andrews, Pennsylvania University. A collection of three essays on number theory, given in N.Z. during the author's tenure as N.Z.M.S. Visiting Lecturer, 1979.

STATUS : A STATISTICAL COMPUTING MANUAL, by J.C. Turner and W.J. Rogers, Waikato University. Written for use in University courses.

COLLECTED PAPERS OF THE SYMPOSIUM ON ANALYSIS, (Wellington, June 1979), edited by C.J. Grigson and G.C. Wake, Victoria University.

EMPLOYMENT OPPORTUNITIES IN MATHEMATICS, edited by R. Littler, Waikato University. A guide for students of mathematics to the jobs available.

The one job in hand is the production of three problem oriented booklets for students of (NZ) seventh form applied mathematics - one on each of the three areas of mechanics, statistics, numerical mathematics and computing. Further, it is anticipated that the Society will be associated with the production of the collected works of A.C. Aitken which is being edited by Garry Tee of Auckland University.

Intending authors are invited to contact one of the members of the publications committee to discuss matters further, no matter how tentative their plans happen to be. The members of the committee for 1980-81 are -

Graeme Wake,	Victoria University, Convener.
David Gauld,	Auckland University
Garry Tee,	Auckland University
David Vere-Jones,	Victoria University
Brent Wilson,	Canterbury University, Editor of Newsletter

G.C. Wake

PROFESSOR A. KAUFMANN IN AUSTRALIA

Professor Arnold Kaufmann, author of the multi-volume work "Theory of Fuzzy Sets", will be visiting Australia during August 1980. Professor Kaufmann is a former professor at Institut Polytechnique de Grenoble, Ecole Superieure des Mines de Paris and Université de Louvain. He has written more than 60 books and 300 papers and has been a consultant to Bull General Electric, U.N.E.S.C.O. and the O.E.C.D. While in Australia, Professor Kaufmann will be giving two seminars. The first, on "Fuzzy Sets and Systems: Theory and Applications" will be a two-day seminar, and will be held on 7 and 8 August (fee $75). The second, on "The Science of Decision Making" will be held on 14 August (fee $50). Both will be held at the University of Sydney, and all enquiries should be addressed to Associate Professor John Gero, Department of Architectural Science, University of Sydney, Sydney, New South Wales, Australia 2006.

INTERNATIONAL UNION OF THEORETICAL AND APPLIED MECHANICS

The General Assembly of IUTAM in a unanimous vote has approved New Zealand membership of IUTAM. The current membership of the National Committee is Dr. I.G. Donaldson (Convener), Mr. A.L. Andrews, Dr. P.J. Bryant, Mr. R.E. Chilcott, Professor C.M. Segedin, Mr. P.C. Spearman. We will be represented at the IUTAM General Assembly in Toronto this August by Dr. W.B. Wilson. Members of the committee have information about the Toronto Congress and about forthcoming specialist symposia.

OF NEWSLETTERS

The Waikato Mathematical Association is now producing a Newsletter, the first issue having appeared in May this year.

SUBJECT CONFERENCE

The complete proceedings of the May conference at Auckland, edited by Graeme Wake, are published as a supplement to this Newsletter.

SYMPOSIUM IN ANALYSIS, WELLINGTON, 1979.

Copies of the collected papers of the symposium held at Victoria University of Wellington last year are available from Graeme Wake - NZMS members $3 a copy, others $4.

EMPLOYMENT BROCHURE 1980.

A new edition is available now from Ray Littler, Waikato.

WANTED - BOOKS

The I.M.U. Commission on Development and Exchange have embarked on a project to help developing countries to build up their mathematical libraries. NZMS is collecting textbooks, journals and varied mathematical publications to contribute to this project. If you have books or journals to donate please send them (or a list of titles and authors) to Gillian Thornley, Dept. of Mathematics and Statistics, Massey University, Palmerston North, by October 1980.

SOCIAL RESPONSIBILITY IN SCIENCE

Papers presented on this topic at the January 1979 ANZAAS meeting in Auckland have been assembled in a book entitled "Focus on Social Responsibility in Science". In SEARCH, Vol. 11, No. 5 May 1980, p.159 the book received a favourable review. Copies can be obtained by sending a cheque for $4.50 to 'Focus Publications', N.Z. Association of Scientists, P.O. Box 1874, Wellington.

YOUNG SCIENTISTS' FUND

The Royal Society of New Zealand has funds available to assist young scientists to travel to overseas meetings. Here are the relevant details:

Scientist eligibility: Open to all professionally qualified junior scientists who are under 35 at 1st June of the year of the award, and who are using their

scientific training in their work or study.

Travel eligibility: Money will be allocated to help the recipient attend a predominantly scientific conference outside N.Z., sponsored by either an ISU or non-ISU organisation.

Application: Applications to be lodged with Executive Officer, R.S.N.Z. between 1st October and 1st December for distribution in the year commencing the following 1st April. (Box 12249, W'ton). Applicants should supply details of -

(a) Birthdate, qualifications, current position, research activity, publication list and a supporting statement.
(b) Conference name, organising organisation, place.
(c) Potential benefit to the attender, and whether or not a paper is being offered.
(d) Total costs involved, and amount requested in the application.
(e) What other support has been or will be applied for.

SECOND AUSTRALASIAN MATHEMATICS CONVENTION

The Twenty-fifth Annual Meeting of the Australian Mathematical Society,
The Sixteenth New Zealand Mathematics Colloquium,
and
The Annual Meeting of the New Zealand Mathematical Society
to be held at
The University of Sydney 11-15 May, 1981.

The convention will follow the standard format of invited addresses covering various areas interleaved with more specialized contributed papers.

The following people will be presenting addresses (the list is not yet complete):

Professor C.W. Curtis, University of Oregon,
Professor S. Eilenberg, Columbia University,
Professor E. Hewitt, University of Washington,
Professor J.T. Stuart, Imperial College,
Professor C.T.C. Wall, University of Liverpool.

The specialist sections will be divided as follows:

1. Foundations, History,
2. Number Theory,
3. Algebra (including combinatorial theory),
4. Analysis (including functional analysis, differential equations),
5. Harmonic Analysis,
6. Geometry, Topology,
7. Applied Mathematics,
8. Probability and Statistics,
9. Computer Science, Numerical Analysis,
10. Computer-based teaching,
11. Mathematics Education.

TRAVEL

Travel concessions for domestic travel (TAA) and group fares are available.

Further details may be obtained from the convention secretary -
Dr. T.M. Gagen,
Department of Pure Mathematics, F07,
The University of Sydney,
Sydney, N.S.W. 2006.

APPLICATIONS FOR TRAVEL ASSISTANCE TO 2ND AUSTRALASIAN MATHEMATICS CONVENTION

The New Zealand Mathematical Society has a fund of about $2000 which is to be used to assist New Zealand speakers to travel to the 2nd Australasian Mathematics Convention, to be held in Sydney May 11-15, 1981.

Applications, on the special form enclosed with this Newsletter, are now invited from those intending to present papers, who may or may not be members of the New Zealand Mathematical Society. It is likely that most grants-in-aid will not exceed $150.

Applicants will be notified of the outcome as soon as possible after the *closing date*, which is *30 January, 1981*.

Please send applications to the Secretary, New Zealand Mathematical Society, Department of Mathematics & Statistics, Massey University, Palmerston North. Additional application forms are available from the Secretary.

TRAVEL FUNDS

It was resolved at the May Colloquium Business Meeting that profits from the Colloquium will be donated to the N.Z. Mathematical Society to augment the fund to assist mathematicians to attend the Second Australasian Mathematics Convention. It is expected that around $700 will be available from this source.

VACANCIES

THE VICTORIA UNIVERSITY OF WELLINGTON
LECTURESHIP and SENIOR LECTURESHIP in MATHEMATICS (STATISTICS)

The Council of the Victoria University of Wellington invites applications for a Lectureship and for a Senior Lectureship in the Department of Mathematics from men and women with research and teaching experience in mathematical statistics and/or probability theory. Both appointments are available from 1 February 1981.

SENIOR LECTURESHIP: Applicants for the Senior Lectureship should have a special interest in the area of time series analysis and its applications. The person appointed will be expected to take an important role in developing the Department's teaching and research programmes in probability and statistics and its contacts with statistical groups outside the University. For these reasons preference will be given to applicants with teaching experience in New Zealand or Australian Universities. The closing date for applications for the Senior Lectureship is 1 August 1980.

LECTURESHIP: The successful applicant will be expected to teach within the range of statistics and probability courses offered by the department, to undertake research and to assist in consulting duties. The closing date for applications for the Lectureship is 31 August 1980.

The department offers a wide range of undergraduate courses leading to the general BA and BSc degrees, as well as a variety of more specialised courses for fourth year students proceeding to a Bachelors degree with honours in mathematics. Students are also accepted for Masters degrees (two papers and a thesis) and for PHD (thesis). In addition, a one year postgraduate course, leading to the Diploma in Operations Research and Statistics, and consisting of four papers and a project, is offered by the Mathematics Department in conjunction with the Departments of Information Science and Economics, and provides a more practical training in statistics and related areas.

The Professor responsible for statistics and probability in the department is Professor D. Vere-Jones. Current areas of research interests include experimental design, population models, stochastic point processes, applications of stochastic processes in geophysics, and topics arising from consulting work. The department maintains contact with statisticians in other university departments. There are also close links with statisticians and probabilists in the Applied Mathematics Division of the DSIR which is located on the university campus. The university has a Burroughs B6700 computer.

The department contains groups working on various topics in pure and applied mathematics and encourages staff to share their research interests and to teach from time to time outside their main discipline. Persons wishing for further details are welcome to write to either Professor D. Vere-Jones or to the Chairman of the Department, Professor W.G. Malcolm, Victoria University of Wellington, Private Bag, Wellington, New Zealand.

THE CLOSING DATES FOR APPLICATIONS ARE:

SENIOR LECTURESHIP - 1 August 1980
LECTURESHIP - 31 August 1980

THE UNIVERSITY OF THE SOUTH PACIFIC
LECTURER/SENIOR LECTURER IN STATISTICS

Applications are invited for the above post in Mathematics. Applicants should have postgraduate qualifications in statistics or operations research with a good record of University teaching, research and consultancy. The University is seeking a person who is able to teach statistics and related subject areas at all undergraduate levels to internal students and to develop courses for extension (external) students. The successful applicant will be expected to assume duties no later than January 1981. Salary in accordance with qualifications and experience in one of the following scales:

Lecturer - $F 8490 - 11878
Senior Lecturer - $F12275 - 14450

($F1 = $NZ 1.25). In addition the University provides gratuity amounting to 15% of basic salary, superannuation contribution, appointment allowance, partly furnished accommodation at a maximum rental at present of 12½% of salary: this is under review. Appointments will be for a contract period of three years and will be renewable by mutual agreement. Candidates should send THREE COPIES of their curriculum vitae quoting the relevant post reference indicated above with full personal particulars, names and addresses of three referees and date of availability to the Registrar, the University of the South Pacific, P.O. Box 1168, Suva, Fiji, to reach him no later than 31 August 1980. Further details may be obtained from Donald Joyce, Head of Mathematics, at the same address.

UNIVERSITY OF CANTERBURY
LECTURER IN MATHEMATICS

Applications are invited for the above position in the Department of Mathematics.

Applicants from any field will be considered, but weight will be given to qualifications and experience in teaching Engineering Mathematics and/or Statistics.

Applications close on 15 October 1980.

The salary for Lecturers is on a scale from $NZ15,149 to $NZ18,615 per annum.

Further particulars and conditions of appointment may be obtained from Mr. W. Hansen, Registrar, University of Canterbury, Private Bag, Christchurch, or from registrars of all other universities in New Zealand.

REPORT FROM THE NEW ZEALAND ASSOCIATION OF MATHEMATICS TEACHERS

The Council of the NZAMT held its 1980 meeting on 14 June at Christchurch. One of the underlying questions that surfaced during the day was the question of how best should NZAMT operate, even, should it operate, and is such an organisation going to fulfil a worthwhile objective? As a result of discussions I am quite convinced that there is a strong desire to make NZAMT exist and function as an organisation to the benefit of the New Zealand Mathematics Educational scene. To this end there has been terrific encouragement and support from the New Zealand Mathematics Society. This is very much appreciated. This positive attitude towards NZAMT is very reassuring especially since I was having doubts as to whether such a body would be able to produce benefits that member Associations could see to be worthwhile. However, to be effective with just one, one-day meeting per year has proved to be rather difficult and for 1981 it is intended to hold a two-day meeting in Wellington at a time when it may be possible to join with some other function and reduce costs. I hope that all member Associations will be able to attend.

Some of the decisions made at this year's Council meeting follow but I emphasize that these are my notes and full minutes will be with council members as soon as possible.

Council Meetings: Agreed in principle that NZAMT Council Meetings should be held at same time and place as Colloquium (except in 1981 New Zealand Colloquium will be held in Sydney, hence the decision mentioned earlier).

Constitutional Amendment: Passed - this gives the Secretary the right to vote but he shall not represent any member association.

Australian Mathematics Competition: General acceptance even though members thought that NZAMT should not openly foster the competition. (155,313 entries for 1981 from Australia, New Zealand, Pacific Islands and Singapore. 5,700 New Zealand entries from 110 schools).

N.Z. Senior Mathematics Competition: was spoken of with encouraging comments even though some areas still felt it conflicted with their own local competitions. Negotiations are proceeding with Air N.Z. to reintroduce the 50% subsidy on fares for this year.

"Why Study Maths" Brochure: Further investigations to be made on the actual style and scope of such a brochure. It was agreed that a brochure giving leads on "How to Study Maths" and "Maths for Parents" could be useful.

General Mathematics: Conflicting views here on whether some degree of "nationalisation" of the various local certificates should take place. It was agreed that all Associations should write to the Department of Education recommending a residential course to study the whole area of local Certificates.

Professional Status: Interesting discussions took place, and varied between NZAMT being not accepted enough yet to make any Honorary Fellow membership mean much to the complete reverse - if NZAMT conferred such important recognition on suitable members, that this would promote it to a higher status. Generally agreed that idea had merit but too early yet. Decided to have discussions with NZMS and make approaches to Royal Society to have NZAMT admitted as a member.

Survey of Mathematics Teachers and Departments: The statistics of this survey were presented by Mr. George Kay. Mr. Kay has agreed to write a report to summarize the findings.

I.C.M.E. 1980: After some discussion it was agreed that the President should attend this Conference if possible even though the Department of Education has not offered support. The Royal Society and NZMS have made grants and have asked that the President be their official representative. NZAMT also made a grant of $600 towards costs. (Note: the $1,800 in Government Stock is tagged to assist teachers to attend the Second Australasian

Mathematics Convention to be held in Sydney in May 1981 and the $600 would have to be replaced in some way).

Conclusion: Time prevented us discussing other matters, which was most unfortunate. However, I would like to thank Council members for their time and effort. I will continue to keep you in touch with any matters that come to my attention. I would also appreciate any information of general interest from member Associations being passed on to me for wider circulation.

N.J. Gale
President, N.Z.A.M.T.

APPLIED MATHEMATICS SYMPOSIUM

Guest of honour: Professor Cecil Segedin

Dates: Friday and Saturday - 26th and 27th September 1980.

Venue: Applied Mathematics Division D.S.I.R.
Room 701 (7th floor) Rankine Brown Building,
Victoria University, Wellington.

Professor Segedin retires at the end of this year, and this is being held in recognition of his contributions to Applied Mathematics in New Zealand.

It is a special symposium of the joint A.M.D. - Victoria University Mathematics Department series to which Professor Segedin has made an almost annual contribution from its beginning in the early sixties.

The programme will be a series of twenty minute talks followed by a short discussion period. It is hoped that a dinner can be arranged for Thursday evening and that a bound copy of the talks might be produced at the end.

Persons wishing to participate are asked to contact Dr. A. McNabb at A.M.D. (Box 1335, Wellington) as soon as possible. Please send titles of talks as soon as possible and tell others who might be interested.

INTERNATIONAL CONGRESS OF MATHEMATICIANS, 1982

PRELIMINARY ANNOUNCEMENT

The Organizing Committee is pleased to announce that the next International Congress of Mathematicians will be held in Warsaw, August 11-19, 1982.

The Chairman of the Organizing Committee is Professor Czesław Olech.

The First Announcement containing more detailed information will appear in summer 1981.

* * * * *

The way of an eagle in the air; the way of a serpent on a rock; the way of a ship in the midst of the sea and the way of a man with a maid are difficult to predict analytically. One does sometimes wonder how mathematicians ever manage to get married. (J.E. Gordon)

Local News

AUCKLAND UNIVERSITY

Department of Mathematics

Professor S. Chatterjee (of NYU) is here as a Visiting Professor.
Dr. Alan J. Lee has returned from leave at Chapel Hill.
Dr. Joel Schiff is on leave, at the University of Liverpool.
Dr. Stuart Scott attended a conference at Oberwolfach in April, and visited several universities in the U.K.
Mr. William F. Hawkins toured Scotland and England in June and July, lecturing on John Napier and demonstrating Napier's Promptuary at many universities and museums.

Seminars

Mr. John H. Maindonald (AMD, DSIR) on:
"GENSTAT as a statistical language".
Dr. J. Gani (CSIRO) on:
"Mathematical Models in Biology".
Dr. Craig Ainslie (University of Chicago), on:
"Nonlinear regression, viewed as a problem in signal detection", and
"Small sample properties of estimators for ARMA time series models".

Department of Computer Science

Professor J.C. Butcher has been elected a Fellow of the Royal Society of New Zealand.

Dr. Peter Gibbons (from Massey University) has been appointed as a Senior Lecturer, commencing in August 1980. Conversely, Paul Lyons has departed to Massey University.

John Whale has returned from leave in London, and Dr. R.G. Crawford has returned to Queen's University (in Kingston, Ontario) after spending a sabbatical year with us.

Two new positions are being advertised, for an Associate Professor and a Lecturer.

At the latest count, 538 students are enrolled for Computer Science courses, with most of them taking both of the Stage 1 courses. The courses to be offered in 1981 include a restructuring of the Stage 1 courses, with an introductory course in the first half of the year and a more advanced course in the second half. Courses for an M.Sc. in Computer Science will be offered in 1981.

G.J.T.

Department of Community Health: Biostatistics Unit

Staff: This unit is staffed by a Lecturer, Peter Mullins, a Research Officer, Alistair Stewart, who joined the Unit on March 31, a Training Fellow in Biostatistics, Linda Nicholls, and a computer programmer/systems manager, Chris Lovell, who is unfortunately leaving us for Great Britain on July 23rd.

Seminars

The following seminars were presented to the Medical School Biometrics Group, and were well attended:

Peter Davis (Dept. of Community Health)
"Some Excursions in Multivariate Analysis of Social Data".
Chris Lovell (Dept. of Community Health)
"The CHIPS in my life".

P.R.M.

WAIKATO UNIVERSITY

Research seminars have not been frequent so far this year.

Dr. B. Weglorz (Wroclaw) spoke on Large Invariant Sigma-fields on $\mathbb{R}$ and also on Some Problems and Theorems on Filters, before returning to Poland in April.

Prof. A. Gelfand (a statistician from Connecticut) gave a seminar, arranged by the Physics Department, on Switching Nets: Representations and Behaviour.

The N.Z.M.S. Visiting Lecturer, Dr. J.M. Gani, gave a public talk on The Early History of Gambling and Probability to a mixed audience of about fifty, and then discussed The Spread of Epidemics.

Home-grown seminars were given by Dr. Sneyd, on Alternating and Rotating Magnetic Fields Applied to Liquid Metals, and by Dr. Craig, on Solar and Stellar Atmospheres: Coronal Loops.

The Department has another distinguished visitor, Prof. Willard Miller, who arrived in early July for a two month stay. On leave from the University of Minnesota, his areas of interest include special functions, separation of variables and related Lie theory, all of which he is actively pursuing with his local collaborator, Dr. Kalnins.

M.S.

MASSEY UNIVERSITY

Staff: Susan Byrne has now joined us and is taking over the optimisation and operations research teaching formerly done by Les Foulds.
Dr. K. Palmer will be taking up a three-year contract appointment in August. His research interests lie in the area of bifurcation theory and differential equations.

Courses: Student numbers in mathematics and statistics courses continue to rise quite sharply. The number of equivalent full-time students in the department in 1980 is 13% higher than in 1979; the 1979 figure was in turn 11% higher than the 1978 figure. The most spectacular rise has been in the main statistics service course, which this year almost became our first paper to achieve a four-figure enrolment (it missed by 7). Teaching staff, while aware that they should be cheered and encouraged by all this evidence of continued interest in their subject, cannot help feeling a little hard-pressed at times!

Seminars

Recent departmental seminars have been as follows:

Dr. R.J. Brook, on "Some Random Thoughts on Sample Surveys".
Dr. H.P. Edwards, on "Ranking and Selection Problems : What to do if your ANOVA rejects the Null Hypothesis".
Dr. M.D. Hendy, on "Factoring Large Integers".
Dr. S. Byrne, on "A Quadratic Programming Method".
Dr. G. Thornley, on "Hypersurfaces in a Finsler Space".

In addition, Dr. P. Diggle (University of Newcastle upon Tyne) paid us a short visit and gave a talk on "Spatial Point Patterns and the Modelling of Plant Competition". Dr.J.M. Gani (CSIRO), the 1980 NZMS visiting lecturer, spent two days with us, and his talks on "The Spread of Epidemics" and "The Early History of Gambling and Probability" proved highly entertaining as well as illuminating.

M.R.C.

VICTORIA UNIVERSITY

Shirley Pledger has joined us as our first half-time lecturer with permanent tenure; we are glad to welcome her back to the Mathematics Department after several months in Poland and England.

Sharleen Forbes has been appointed to a temporary full-time lectureship until the end of this year; we are happy that she too can rejoin us.

Andrew Lacey is to be our next postdoctoral fellow; from Oxford, his field is the theory of differential equations, especially those of heat transfer in chemically reacting systems.

An advertisement appears elsewhere in this issue for a Senior Lectureship and a Lectureship in Statistics, with closing dates 1 August and 31 August respectively.

Jock Hoe has resigned to return permanently to China. He was appointed to a Lectureship in Statistics here in 1963 and has since risen to Reader, while his research interests have shifted to mediaeval Chinese mathematical history. His departure in the long vacation will leave an unfillable gap in the Department. We wish him well for the future.

David Vere-Jones has just become the President of the N.Z. Statistical Association.

Ken Pledger has returned from sabbatical leave in Poland and England.

Terence Nonweiler should by the time this is published have taken over as Chairman of the Mathematics Department from Wilf Malcolm, having been given only three weeks' grace after his return from sabbatical in England.

G.C.W.

DSIR

Tony Cooper who recently joined our staff is completing an M.Sc. at Massey this year.

Gary Dickinson has left to become an Assistant Government Statistician.

Kelly Mara has taken a year's leave to take up a position of Assistant Professor at the School of Statistics at the University of Minnesota.

H.S.R.

CANTERBURY UNIVERSITY

Neil Watson has returned from leave spent in Queensland and the U.K.

Brent Wilson is away on special leave. His main purpose is to attend the General Relativity and Gravitation Conference held in Jena in the Peoples Democratic Republic of Germany.

Seminars

Speakers have included:

Dr. Francis J. Wall (Albuquerque) on "What's involved to obtain a government licence for a new pharmaceutical".
Dr. Bogden Weglorz (Wroclaw) on "Some problems and theorems on filters".
Dr. J.M. Gani (CSIRO) on "Yeast cells and random graphs".
Dr. Craig Ansley (Chicago) on "Monte Carlo Studies in time series".
Mr. Gregg Kelly (Canterbury) on "Minimum variance estimators and sufficient statistics".

P.F.R.

OTAGO UNIVERSITY

Mr. M.D.E. Conder, a graduate of the University of Waikato, has been appointed to a postdoctoral fellowship for 1981. At present, he is completing his doctorate in Group Theory at Brasenose College, Oxford.

Mr. John Rayner has returned from his sabbatical leave in Australia. Most of his time was spent with John Best (CSIRO Division of Mathematics and Statistics) at the Food Research Laboratory, North Ryde, Sydney. He also spent short periods at the University of New England and Flinders University.

Visitors included Mr. Garry Tee of Auckland University and the 1980 NZMS Visiting Lecturer, Dr. Joe Gani of DMS, CSIRO. Mr. Tee have a Seminar on "Linear Programming : Khachian's Algorithm." Dr. Gani gave a Science Faculty Open Lecture (that was jointly sponsored by the Otago Mathematics Association) on "The early history of gambling and probability" as well as a seminar on "Mathematical models in biology".

There has been a change in plans by the "Study Group Seminar". Instead of investigating Simple Groups and Graph Theory, they have been exploring Banach algebras and p-groups. Also, Dr. Chris Meaney (our Postdoctoral Fellow) has been giving a series of lectures on "Fourier Analysis on Compact Groups".

The "Weekly" seminars have included -

Dr. Chris Meaney: "Uniqueness of Spherical Harmonic Series"
Dr. Ray Enlow: "Some interesting geometry in transonic flow".
Mr. Bryan Manly: "Detecting and measuring the effects of natural selection on a multivariate distribution, including some Egyptology".
Dr. Peter Fenton: "A problem involving the largest value of a set of integrals".
Professor J.R. Flynn (of the Political Studies Department): "Black and white IQ: Military testing and the myth of the widening gap".
Dr. Gerrard Liddell: "Formulas for integrals and solutions of differential equations".
Dr.G.H. Jowett (former Professor of Statistics and Chairman of Mathematics Department at Otago University - who is now Biometrician with MAF, Invermay): "The piecemeal assembly of unorthodox ANOVAS".
Dr. Stuart Crosbie (Former student who is now a Biometrician with MAF, Invermay): "Capture-recapture modelling".
Professor William Davidson: "Hyperbolic motion in gravitational theories".
Mr. John Rayner: "The choice of class probabilities and number of classes for the simple X^2 goodness of fit test".
Dr. Dennis McCaughan: "Normal products of groups".

G.O.

UNIVERSITY OF THE SOUTH PACIFIC

Hasmukh Morarji and Len Raj participated in the Colloquium and Subject Conference in Auckland. Frank Avenoso, Senior Lecturer in Statistics, has returned to New York after a year at USP during which he introduced several innovations including a 300-level Special Topic covering Logic, Number Theory, Graph Theory, and Geometry and a 200-level Applied Statistics course with a heavy emphasis on practical project work. Three new preliminary lecturers arrived in February - Fred Dewa from a computer company in Fiji, Geoff Whittle from the Tasmanian CAE and Robert Wojcik from a high school in Fiji. Parul Deoki has gone on study leave to India for a one-year M.Sc. in Statistics and Val Elley has taken up a temporary one-year preliminary lectureship. New developments for the second semester include the use of micro-computers in teaching at all levels and the preparation of the first degree-level extension (extramural) courses.

D.C.J.

EGYPTIAN FRACTIONS

Charles S. Rees
University of Auckland
and
University of New Orleans

This paper was presented in May 1980 as an invited address at the New Zealand Mathematics Colloquium.

The ancient Egyptians used the following symbols for numbers:

1	|	6	||| |||	9	||||| ||||
2	||				
3	|||	7	|||| |||	10	∩
4	||||				
5	|||||	8	|||| ||||	100	9

The number 1000 was a lotus, 10 000 was a worm or periscope, 100 000 was a tadpole, and 1000 000 was a man sitting with arms raised. They wrote right to left, so 467 was
\|\|\|\|∩∩∩
\|\|\| ∩∩∩9999 .

The reciprocal of a positive integer was denoted by a ⬭ above the integer, so 1/12 = ⬭12.

The ancient Egyptians used only the fractions 1/n and 2/3, but were very proficient in using these to add and multiply. No one today seems to know why they did not use other fractions, and what little we do know is due to the Rhind Papyrus and the Moscow Mathematical Papyrus. The first of these was found in Thebes, bought in Luxor in 1858 by the Scot Rhind, and given to the British Museum. It was written about 1650 B.C. by the scribe A'HMOSE. There were three sections: arithmetical problems, geometrical problems concerning mensuration, and practical arithmetic problems dealing with accounting, taxes, division of wages, beer, etc. The Moscow Papyrus was bought in 1893 by a Russian, who gave it to the Moscow Museum in exchange for a life annuity (which was not paid after 1917).

We shall now give some brief examples of how they used repeated doubling (based on the binary system) to multiply and divide. To find 6×13, they write 1 and 6 at the head of two columns, then double repeatedly until some of the numbers in the first column add up to 13.

* 1	6 *
2	12
* 4	24 *
* 8	48 *
13	78

Now the numbers on the left with * add up to 13, and the corresponding ones on the right with * add up to 78, which is the required product. This same format allows us to find $6 \times K$, for $K = 1, 2, 3, \ldots, 15$.

To divide 84 by 7, they say "what times 7 is 84?" Thus they write

	1	7
	2	14
*	4	28 *
*	8	56 *
	12	84

and conclude that 84 divided by 7 is 12.

To find 1/5 of 11, using their method and our notation gives

*	1	1/5	*
*	2	2/5	*
	4	4/5	
*	8	8/5	*
	11		11/5

But using their method and their fractions requires

*	1	1/5	*
*	2	2/5 = 1/3 + 1/15	*
	4	2/3 + 2/15 = 2/3 + 1/10 + 1/30	
*	8	4/3 + 2/10 + 2/30 = 1 + 1/3 + 1/5 + 1/15	*
	11		product

and so the product = 1/5 + (1/3 + 1/15) + (1 + 1/3 + 1/5 + 1/15)

= 1 + 1/3 + 1/3 + (1/5 + 1/15 + 1/15) + 1/5

= 1 + 2/3 + (1/15 + 1/15 + 1/15 + 1/15 + 1/15) + 1/5

= 1 + 2/3 + 1/3 + 1/5 = 2 + 1/5 = $2\frac{1}{5}$.

The exact steps above are speculative, but we know they used the doubling method. This required extensive tables of 2/n as a sum of Egyptian fractions. We will exclude 2/3, and call only fractions of the form 1/n Egyptian fractions.

The Rhind Papyrus had such tables for 2/n with n = 5, 7, 11, 13, 17, 19, 23, 25, ..., 101. For instance 2/5 = 1/3 + 1/15, and 2/7 = 1/4 + 1/28, and 2/17 = 1/12 + 1/51 + 1/68, and 2/61 = 1/40 + 1/244 + 1/488 + 1/610. They did not need n = 2k since 2/n = 2/2k = 1/k, and n = 3k was not needed since they knew $2/3k = \left(\frac{2}{3}\right)\left(\frac{1}{k}\right) = \frac{1}{2k} + \frac{1}{6k}$.

The table showed a preference for even denominators and small denominators. Even ones are clearly an advantage in a doubling method, while small ones mean smaller tables. For these reasons, and maybe others, they preferred to write 2/61 = 1/40 + 1/244 + 1/488 + 1/610 as above instead of 2/61 = 1/31 + 1/1891 for instance.

The Egyptians also knew many rules which helped their calculations greatly, rules which we now write as $\frac{1}{k} = \frac{1}{k+1} + \frac{1}{k(k+1)}$ and 2/n = 1/n + 1/2n + 1/3n + 1/6n for example.

Remember, from now on we call numbers of the form 1/n *Egyptian fractions*, where n = 1, 2, 3,... .

In 1880, J.J. Sylvester proved that any positive rational can be written as a sum of a finite number of distinct Egyptian fractions. In fact this had been proved earlier (about 1200) by Fibonacci, and it was used by the ancient Egyptians. We give here a quick outline

of the "finite" part. Choose $1/n$ maximal so that $1/n < a/b$. Thus $1/n < a/b < 1/(n-1)$, which gives $na - b < a$. But $a/b - 1/n = (na-b)/nb$, so the numerators decrease and the process terminates after a steps, at most.

Here is a proof of the whole thing by induction on a = numerator. Take $0 < a/b < 1$, $(a,b) = 1$, and suppose that all fractions with numerator $\leq a - 1$ can be written as a finite sum of distinct Egyptian fractions. Then $\frac{b+a}{a} = q + \frac{r}{a}$ by the division algorithm with $r \neq 0$, hence $0 < r < a$. Then $b + a = aq + r$ gives $\frac{b+a}{bq} = \frac{a}{b} + \frac{r}{bq}$, and so $\frac{a}{b} = \frac{1}{q} + \frac{a-r}{bq}$ where the numerator $a - r < a$. By the induction hypothesis, $\frac{a-r}{bq}$ is a finite sum of distinct Egyptian fractions. Further, none of the denominators can be q since $\frac{a-r}{bq} < \frac{1}{q}$ iff $a < b + r$, which is true.

If $a/b > 1$, choose n so that $1 + 1/2 + \ldots + 1/n < a/b < 1 + 1/2 + \ldots + 1/n + 1/(n+1)$, and apply the above paragraph to $a/b - 1 - 1/2 - \ldots - 1/n$.

This method gives $9/13 = 1/2 + 1/6 + 1/39$.

Some random examples are

$5/18 = 1/6 + 1/9$

$11/14 = 1/2 + 1/4 + 1/28$

$3/17 = \frac{18}{17(6)} = \frac{17+1}{17(6)} = \frac{1}{6} + \frac{1}{102}$

$\frac{13}{32} = \frac{8+4+1}{32} = \frac{1}{4} + \frac{1}{8} + \frac{1}{32}$

$9/13 = 1/3 + 1/4 + 1/12 + 1/39 = 1/2 + 1/8 + 1/26 + 1/52 + 1/104$

$= 1/5 + 1/6 + 1/7 + 1/13 + 1/30 + 1/31 + 1/42 + 1/65 + 1/930$

Clearly any a/b has infinitely many representations as a finite sum of distinct Egyptian fractions - just use $\frac{1}{n} = \frac{1}{n+1} + \frac{1}{n(n+1)}$ repeatedly. Also we may include any $1/n$ (provided $1/n < a/b$) since the harmonic series diverges.

So far we have seen the Fibonacci-Sylvester (max $1/n$) algorithm. There is also one based on continued fractions. We shall now present one based on Farey Series.

The Farey Series F_n consists of all distinct fractions a/b written in increasing order, where $0 < a/b < 1$ and $1 \leq b \leq n$. The first few Farey Series are $F_1(1/1)$, $F_2(1/2,1/1)$, $F_3(1/3,1/2,2/3,1/1)$, $F_4(1/4,1/3,1/2,2/3,3/4,1/1)$, and $F_5(1/5,1/4,1/3,2/5,1/2,3/5,2/3,3/4,4/5,1/1)$. Two nice properties of Farey Series are (i) if a/b and c/d are adjacent in some F_n with $a/b < c/d$, then $\frac{c}{d} - \frac{a}{b} = \frac{bc-ad}{bd} = \frac{1}{bd}$, and (ii) if a/b and c/d are adjacent in some F_n with $a/b < c/d$, then the next entry between a/b and c/d for some F_k, $k > n$, will be $\frac{a+c}{b+d}$. Your students will love property (ii) - in fact, some of them probably already use it.

Part of F_{10} is 1/3, 3/8, 2/5, 3/7, 4/9. Using property (i) alone, along with only those fractions to the left of 4/9 with successively smaller denominators, gives

$4/9 = 3/7 + (4/9 - 3/7) = 3/7 + 1/63$

$= 2/5 + 1/35 + 1/63 = 1/3 + 1/15 + 1/35 + 1/63.$

For 13/22, which is about .59, we don't need any part of F_{22} larger than 3/5 = .60 nor any smaller than 4/7, which is about .57. Using property (ii) above repeatedly gives (4/7,3/5), then (4/7,7/12,3/5), then (4/7,11/19,7/12,10/17,3/5), then (4/7,11/19,7/12,10/17, 13/22,3/5) which is the part of F_{22} we need. Then by (i)

$13/22 = 10/17 + 1/374 = 7/12 + 1/204 + 1/374$

$= 4/7 + 1/84 + 1/204 + 1/374$

$= 1/2 + 1/14 + 1/84 + 1/204 + 1/374.$

We now give a comparison of several algorithms for

$a/b = 1/n_1 + 1/n_2 + \ldots + 1/n_k$, n_i increasing where k = number of terms

n_k = maximum denominator

(1) Fibonacci-Sylvester (max 1/n)

$k \leqslant a$ and n_i grows exponentially

(2) Erdos (1950)

$$k \leqslant \frac{8 \log b}{\log \log b} \quad \text{and} \quad n_k \leqslant \frac{4b^2 \log b}{\log \log b}$$

(3) Golomb (1962)

$k \leqslant a$ and $n_k \leqslant b(b-1)$

(4) Farey Series (Bleicher, 1968)

$k \leqslant a$ and $n_k \leqslant b(b-1)$

(5) Continued fractions (Bleicher, 1972)

$$k \leqslant \min\left\{a, \frac{2(\log b)^2}{\log \log b}\right\} \quad \text{and} \quad n_k \leqslant b(b-1)$$

We now write 5/121 by several methods.

(a) $1/25 + 1/757 + 1/763309 + 1/873960180913 + 1/1527612795642093418846225$ by (1) above.

(b) $1/48 + 1/72 + 1/180 + 1/1452 + 1/4356 + 1/8712 + 1/87120$ by (2) above.

(c) $1/25 + 1/1225 + 1/3577 + 1/7081 + 1/11737$ by (5) above.

(d) $1/30 + 1/242 + 1/363 + 1/1210 + 1/3630$ by Bleicher and Erdos in 1976.

Other expansions of 5/121 are

(e) $1/42 + 1/70 + 1/330 + 1/5082$

(f) $1/42 + 1/70 + 1/726 + 1/770 + 1/1815$

Clearly (e) is shorter than any of the first 4, and (f) has the smallest last denominator. Furthermore the bounds on k in (1) to (5) depend variously upon a and b. To sum it all up, WE NEED BETTER ALGORITHMS.

In writing the Farey Series F_1, F_2, F_3, ... the fraction 21/23 is the first one which needs more than 4 Egyptian fractions. We give below four ways of writing 21/23 using standard algorithms.

Fibonacci-Sylvester

$21/23 = 1/2 + 1/3 + 1/13 + 1/359 + 1/644046$

Erdos

$1/2 + 1/3 + 1/24 + 1/46 + 1/69 + 1/552$

Continued Fractions

$1/2 + 1/4 + 1/8 + 1/40 + 1/110 + 1/253$

Farey Series

$1/2 + 1/6 + 1/12 + 1/20 + 1/30 + 1/42 + 1/56 + 1/72 + 1/90 + 1/110 + 1/253$

Consider the equation $\frac{1}{x^n} + \frac{1}{y^n} = \frac{1}{z^n}$, n fixed. If we multiply by $(xyz)^n$, we get $(yz)^n + (xz)^n = (zy)^n$, so the first equation has positive integer solutions if and only if $a^n + b^n = c^n$ does. In light of Fermat's "Last Theorem", it is prudent to consider only $n = 1$ and $n = 2$.

It may be shown that if x, y, and z have no common factors, then all solutions of $1/x + 1/y = 1/z$ are $z = ab$, $y = ab + a^2$, $x = ab + b^2$, where $(a,b) = 1$.

Using the above it may be shown that all solutions of $1/x^2 + 1/y^2 = 1/z^2$ with y even and $(x,y,z) = 1$ are $x = r^4 - s^4$, $y = 2rs(r^2 + s^2)$, $z = 2rs(r^2 - s^2)$ where $r > s > 0$, $(r,s) = 1$, $r + s \equiv 1 \pmod 2$.

For example, in the case $n = 1$, the values $a = 3$ and $b = 4$ give $1/28 + 1/21 = 1/12$. In the case $n = 2$, the values $r = 3$ and $s = 2$ give $1/65^2 + 1/156^2 = 1/60^2$.

The equation $a/b = 1/x + 1/y$ with $(a,b) = 1$ has distinct solutions x and y if and only if there are integers P and Q with $(P,Q) = 1$ such that P divides b, Q divides b, and $P + Q \equiv 0 \pmod a$. For example if $a/b = 19/280$, we may take $P = 56$, $Q = 1$ and get

$$\frac{19}{280} = \frac{56+1}{3(280)} = \frac{1}{15} + \frac{1}{840}$$

Does $a/b = 1/x + 1/y + 1/z$ have integer solutions? This can be decided in a finite number of steps since $1 \leqslant x < y < z$ implies $b/a < x < 3b/a$. For each such x, try by the previous paragraph to solve $\frac{a}{b} - \frac{1}{x} = \frac{1}{y} + \frac{1}{z}$. For 8/17, this procedure will show there are no solutions in 3 terms.

Similarly, for k fixed, $\frac{m}{n} = \sum_1^k \frac{1}{x_i}$ has distinct solutions x_i if and only if there exist M and N with $M/N = m/n$, and k divisors $N_1, N_2, \ldots, N_k$ of N (relatively prime) with $N_1 + N_2 + \ldots + N_k \equiv 0 \pmod M$.

Erdos and Strauss conjecture that $4/n$, for any n, can always be written as a sum of three or less Egyptian fractions. By the Fibonacci-Sylvester algorithm, there are always solutions with four or less terms.

Sierpinski has conjectured that $5/n$ can also be expressed with three or less Egyptian fractions.

For example $4/17 = 1/5 + 1/30 + 1/510$ and $5/17 = 1/4 + 1/34 + 1/68$.

Professor J.C. Butcher and I have done some work on $4/n = 1/x + 1/y + 1/z$, and by computer search or formulas have verified it for (a) all numbers n up to 8017 (b) all numbers n except primes of the form $120k + 1$ and $120k + 49$. Some of the printouts are

$$\frac{4}{1009} = \frac{1}{253} + \frac{1}{(4)(253)(1009)} + \frac{1}{(4)(23)(1009)}$$

$$\frac{4}{2089} = \frac{1}{532} + \frac{1}{(532)(2089)} + \frac{1}{(2089)(14)}$$

$$\frac{4}{6121} = \frac{1}{1545} + \frac{1}{(2)(103)(6121)} + \frac{1}{(2)(15)(6121)}$$

$$\frac{4}{6121} = \frac{1}{1574} + \frac{1}{(9)(6121)(1574)} + \frac{1}{(9)(6121)}$$

and some of the formulas are

$$\frac{4}{8k+5} = \frac{1}{2k+2} + \frac{1}{(k+1)(8k+5)} + \frac{1}{(2k+2)(8k+5)}$$

$$\frac{4}{120k+73} = \frac{1}{30k+20} + \frac{1}{(6k+4)(120k+73)} + \frac{1}{(15k+10)(120k+73)}$$

Erdos wrote in July 1980 that the problem is still open.

In the American Mathematical Monthly in 1974, Erdos has considered

$$1 = \frac{1}{x_1} + \frac{1}{x_2} + \ldots + \frac{1}{x_n}$$

with n fixed and $x_1 \leqslant x_2 \leqslant \ldots \leqslant x_n$. Let $y_n = \max x_n$ and $z_n = \min x_n$. Then the following results are shown.

(1) $y_n = y_{n-1}(1 + y_{n-1})$. This was shown in 1922 by Kellogg. A "plausibility proof" follows by maximizing x_n one at a time after the first n - 1 have been maximized and fixed (rather that look at all x_i, $1 \leqslant i \leqslant n$), using $1/n = \frac{1}{n+1} + \frac{1}{n(n+1)}$.

(2) The inequalities $y_5 = y_4(1+y_4) > y_4^2 > (y_3^2)^2 = y_3^4 > (y_2^2)^4 = y_2^8 = 2^8 = 2^{(2^3)}$, and related ones, show that $y_n > 2^{(2^{n-2})}$.

(3) For work on z_n, assume $x_1 < x_2 < \ldots < x_n$ for otherwise $x_1 = x_2 = \ldots = x_n$ gives a trivial solution. Now

$$\begin{aligned} 1 &= \frac{1}{x_n} + \frac{1}{x_{n-1}} + \ldots + \frac{1}{x_1} \\ &\geqslant \frac{1}{x_n} + \frac{1}{x_n - 1} + \frac{1}{x_n - 2} + \ldots + \frac{1}{x_n - n + 1} \\ &= \left(\frac{1}{x_n} + \frac{1}{x_n - 1} + \ldots + \frac{1}{1}\right) - \left(\frac{1}{x_n - n} + \ldots + \frac{1}{1}\right) \\ &\geqslant \log x_n - \log(x_n - n) - \frac{K}{n} \end{aligned}$$

implies $1 \geqslant \log \frac{x_n}{x_n - n}$, hence $x_n \geqslant \frac{n}{1 - \frac{1}{e}}$, and thus

$$z_n \geqslant \frac{n}{1 - \frac{1}{e}} \geqslant 1.58n.$$

(4) Erdos conjectured that for sufficiently large n

$$z_n < (1 + \varepsilon)\frac{n}{1 - \frac{1}{e}}$$

In 1963 in the Proceedings A.M.S. Erdos and Stein proved several interesting theorems including one I call the polygamy theorem. It states that the set of Egyptian fractions can be partitioned into disjoint finite subsets S_1, S_2, ... such that each positive rational is the sum of the elements of precisely one S_i. This is easy to remember by considering a polygamous society and identifying the positive rationals with the men and the Egyptian fractions with the women.

In 1976 Bleicher and Erdos made the following conjecture concerning lacunary sequences

$n_i : n_{i+1} > n_i$ and $\frac{n_{i+1}}{n_i} > c > 1$. Can the set of rationals a/b such that

$$\frac{a}{b} = \frac{1}{n_{i_1}} + \frac{1}{n_{i_2}} + \ldots + \frac{1}{n_{i_t}}$$

is soluble for some t contain all rationals in some interval? They conjecture no.

Stewart has shown that if b is odd, then a/b can be written as $\sum_1^k 1/n_i$ with each n_i odd. His proof uses the identity

$$\frac{1}{B} = \frac{1}{2B+1} + \frac{1}{3B+2} + \frac{1}{3(2B+1)} + \frac{1}{B(2B+1)} + \frac{1}{3(2B+1)(3B+2)}$$

In 1963 in Proceedings L.M.S., Graham proved several intriguing theorems.

(a) Let a and b be positive integers and (p,q) = 1. Then

$$\frac{p}{q} = \sum_1^n \frac{1}{ak_i + b}$$

for some positive integers n and $k_1 < k_2 < \ldots < k_n$ if and only if $\left(\frac{q}{(q,(a,b))}, \frac{a}{(a,b)}\right) = 1$.

For (a,b) = 1, the condition is (q,a) = 1. If a = 7 and b = 4, we need (q,7) = 1. Thus $\frac{5}{9} = \sum_1^n \frac{1}{7k_i + 4}$ for some k_i, but $\frac{5}{14} \neq \sum_1^n \frac{1}{7k_i + 4}$.

(b) $\frac{p}{q} = \sum_1^n \frac{1}{k_i^2}$, k_i distinct if and only if $\frac{p}{q}$ is in $[0, \frac{\pi^2}{6} - 1) \cup [1, \frac{\pi^2}{6}) \approx [0, .645) \cup [1, 1.645)$.

For instance

$$\frac{1}{3} = \frac{1}{2^2} + \frac{1}{4^2} + \frac{1}{10^2} + \frac{1}{12^2} + \frac{1}{20^2} + \frac{1}{30^2} + \frac{1}{60^2}$$
$$= \frac{1}{4} + \frac{1}{12} = \frac{1}{4} + \frac{1}{4}\left(\frac{1}{2^2} + \frac{1}{4^2} + \ldots + \frac{1}{60^2}\right)$$

and so such representations are not unique.

(c) p/q is a finite sum of reciprocals of distinct odd squares if and only if q is odd and p/q is in $[0, \frac{\pi^2}{8} - 1) \cup [1, \frac{\pi^2}{8}) \approx [0, .23) \cup [1, 1.23)$.

(d) $\frac{p}{q} = \sum_1^n \frac{1}{k_i^3}$, k_i distinct, if and only if p/q is in $[0, z - \frac{9}{8}) \cup [\frac{1}{8}, z - 1) \cup [1, z - \frac{1}{8}) \cup [\frac{9}{8}, z)$ where $z = \zeta(3) = \sum_1^\infty \frac{1}{k^3} \approx 1.202$.

(e) For any positive integer n, every sufficiently small rational can be expressed as the finite sum of reciprocals of distinct n^{th} powers of integers.

(f) A positive rational p/q with (p,q) = 1 can be expressed as the finite sum of reciprocals of distinct square-free integers if and only if q is square-free.

(g) Let T be a set of integers which contains all sufficiently large prime numbers and all sufficiently large squares. Then every positive rational can be expressed as a finite sum of reciprocals of distinct integers taken from T.

If problems such as those in this paper interest you, perhaps the following reformulations will help.

First, $\frac{a}{b} = \frac{1}{x_1} + \frac{1}{x_2} + \ldots + \frac{1}{x_n}$

is "just" a Diophantine equation.

Second, $\frac{1}{x_1} = \frac{1}{x_2} + \frac{1}{x_3} + \ldots + \frac{1}{x_n}$

is equivalent to

$$0 = \begin{vmatrix} x_2 & x_3 & 0 & 0 & \ldots & 0 \\ x_2 & 0 & x_4 & 0 & \ldots & 0 \\ x_2 & 0 & 0 & x_5 & \ldots & 0 \\ \vdots & & & & & \vdots \\ x_2 & 0 & 0 & 0 & \ldots & x_n \\ x_2 - x_1 & x_1 & x_1 & x_1 & \ldots & x_1 \end{vmatrix}$$

Finally, I want to take this last chance to publicly thank the Mathematics Department of the University of Auckland, and the people of New Zealand, for a year without parallel for me and my family.

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THE DEATH OF GALOIS

The Myth, the Facts and some Queries

Persecuted by his teachers, denied his rightful place in the Ecole Polytechnique, expelled from the Ecole Normale, imprisoned as a republican, released, challenged to a duel; Galois spent the night before the duel (which he expected to be fatal) hurriedly writing his mathematical testament, breaking off his account of one research with a scribbled "I have no time; I have no time" to begin an outline of yet another. The next morning: the duel with pistols, the fatal shot, Galois left mortally wounded on the "field of honour", picked up by a stranger four or five hours later, taken to hospital, where he died the next morning. Thus the myth, told by Bell (1), Infield (2), Sarton (3) and others. Thus *almost* the facts.

Those who stop to reconsider Bell's narrative (perhaps years after a first reading) may wonder whether he had exaggerated. A glance at the article in the Dictionary of Scientific Biography (4), shows that in broad outline he is correct. But a more careful reading of Bell shows some errors: some of the dates don't quite make sense and he speaks of Galois being buried in a common ditch which looks like a mistranslation of *une fosse commune* (a pauper's grave).

The text of the letter that Galois wrote that night, to Auguste Chevalier, is printed in full in the collected works of Galois (5) and this gives a sufficiently dramatic picture, but something a little less highly coloured than Bell's. The testament that Galois actually left (or sent) to Chevalier was a longish letter and two or three papers, or fragments of papers.

The letter refers to three papers that "could be written" from his researches. The first had already been written and was substantially one which Poisson had rejected but which Galois (rightly) stood by, subject to some corrections. The other two, presumably still in his head, are represented by longish summaries in the letter and by partially completed drafts found by Chevalier. After these summaries the letter continues with a brief paragraph outlining other ideas, but giving no details, and ends with the sentence: 'Mais je n'ai pas le temps, et mes idées ne sont pas encore bien développées sur ce terrain, qui est immense' (5.p32). Then follows the request, that Bell quotes, to have the letter published and the theorems submitted to Gauss and Jacobi for appraisal.

The sentence ' Je n'ai pas le temps ' occurs in fact only *twice*; once, as quoted above, near the end of the letter to Chevalier, and again in the first paper (Oeuvres, p.40). In the latter Chevalier's note explains that in the MS the enunciation and proof, of Proposition II contain corrections, and that there was a marginal note: 'Il y a quelque chose à compléter dans cette démonstration. Je n'ai pas le temps'. Chevalier further says that the writing of this note appears hurried. There is another correction in Proposition III (p.41) where the enunciation and proof are crossed out and a new enunciation supplied in the margin. This is followed by the words 'On trouvera la démonstration'. ("The proof will be found" or "someone will find the proof"). Again Chevalier reports the hasty writing. Galois' death is tragic, Bell made it melodramatic. There remain however several question marks over the story.

This "duel" seems very odd - *two opponents* are mentioned but no *seconds*, no surgeon; was this the honourable (or even usual) way to conduct an "affair of honour"? Why did Galois accept an assignation under these circumstances? Why did he write an open letter "To all republicans" in which he apologizes for not dying for his country? Why in that same letter did he write 'Pardon pour ceux qui m'ont tué, ils sont de bonne foi'? Both good faith and common decency seem strangely lacking.

J.C.W.D. 14 July 1980

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Centrefold

PROFESSOR JOHN BUTCHER

Elected Fellow of the Royal Society of N.Z.

On the 22nd May 1980 the Royal Society announced the election of one of our members, Professor John Butcher (Auckland) to a Fellowship of the Royal Society of N.Z. This brings to six the number of mathematicians within the Fellowship (the others are, Professors Davidson (Otago), Forder (Auckland), Kerr (Canterbury), Lawden (Birmingham - previously Canterbury), and Petersen (Canterbury).

The Royal Society released the following statement on Professor Butcher.

> "Professor John Charles Butcher, Professor of Mathematics at the University of Auckland, is one of the leading mathematicians in the world working on the theory of the numerical integration of ordinary differential equations. His work in this field has resulted in the development of new mathematical techniques that have found widespread practical application in the efficient use of computers, in solving problems that arise in modern technology and in scientific research."

Within the Society we can add that Professor Butcher served as the second President of the N.Z. Mathematical Society (1975-76) and has continued to support the Society since its inception.

Professor Butcher's career is summarised below. He is 47 years old ("but looks 37" according to a recent Auckland newspaper article), married with three children, and is currently head of Auckland University's new Department of Computer Science. Professor Butcher was born in Auckland, and his early education was in Dargaville, Taumarunui, and Hamilton. He graduated from Auckland University with an M.Sc. (in Physics) in 1955. He then proceeded to complete his doctorate in Physics at Sydney University "working on computers". To quote from the Auckland papers he says -

> "In those days I was a physicist, and that was in the early days of computers. More or less as a hobby, I started working on these differential equation questions."

He returned to New Zealand in 1961 as a Senior Lecturer in Mathematics at Canterbury University after a two year spell as a Lecturer in Applied Mathematics at Sydney University. After a brief period as a Computer Mathematician at Stanford (USA) he became a Professor of Mathematics at Auckland University in 1966. In 1970 he was awarded a D.Sc. by the University of Sydney and he became the first Head of the new Department of Computer Science at Auckland early this year. Since 1955, Professor Butcher has written some 40 papers, predominantly in the area of numerical solution of differential equations. Papers of particular interest include:

Coefficients for the Study of Runge-Kutta Integration Processes, J. Austral. Math. Soc. 3(1963), 185-201.

Implicit Runge-Kutta Processes, Math. Comp. 18(1964), 50-64.

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An Algebraic Theory of Integration Methods, Math. Comp. 26(1972), 79-106.

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The Mathematical Society congratulates Professor Butcher on his achievements. (Well done John!)

G.C. Wake

CUCKOOS IN THE MATHEMATICS NEST

Address by our President, John Turner, to Fellows of the Royal Society of New Zealand

I thank you, Sir, for your introductory remarks; and I thank all of you for inviting me to address you on behalf of the Mathematicians of New Zealand - an awesome task indeed! I have not had the time to consult them (other than my Council members) as to what I should say to you, so you must judge for yourself how truly the remarks I make this afternoon represent the views of my profession generally.

My theme today, I title "Cuckoos in the Mathematics Nest". The term 'cuckoo' is not to refer to some kind of foolish mathematician; rather it is meant to conjure visions of large eggs of new kinds of Applied Mathematics, and of new methods of doing all kinds of mathematics, being spawned, or laid if you prefer, in the warm and comfortable nests of existing research areas and teaching syllabuses of my subject Mathematics. And you all know what cuckoo eggs do, shortly after being laid! They hatch out, and rapidly become thoroughly objectionable, rapacious and pushy little creatures.

Before I tell you which strange bird is laying the new eggs, objectionable or golden, according to your personal point of view, and launch into my theme, let me briefly say who I represent. - Who are the persons most likely to be affected in New Zealand by these new species of mathematics.

First there are the 193 members of the Mathematical Society. Of these, over a hundred will be mathematicians in the Departments of Mathematics of the seven New Zealand Universities. The remainder will be mathematicians in Government and other research institutes, members of Statistics and Operational Research teams in private companies, or teachers of mathematics in Polytechnics and High Schools throughout the country. There are very many more mathematics teachers of course, than are members of my Society. They have their own Association, namely the New Zealand Association of Mathematics Teachers, which currently has approximately 650 members; we maintain close links with this Association. There may well be another 3 - 4,000 teachers who are not members of the Association. Perhaps I should mention finally, the very large body of young men and women who are currently studying Mathematics at one level or another. All of these people are touched strongly by the subject Mathematics; - they study it, use it, research it, love or hate it, wrestle with its mysteries, enjoy its power, are wrapt by its beauties. This, then, is my population of New Zealand Mathematicians; the universe of my discourse today.

Now I can introduce my strange bird, my layer of new topics and methods for Mathematics. I offer no prize for your guesses to its identity - it is of course the device known as the electronic computer. You will have seen T.V. films such as 'The Chips are Down', read Toffler's 'Future Shock', have read about and discussed the changes that computers are going to bring about in Society. Today I want to describe some of the changes that they have already brought about in the subject matter and practice of Mathematics; and I will at the end do a little crystal-ball gazing, to see if I can predict further changes.

I began preparation for my talk by drawing a small sample of New Zealand Mathematicians, setting their histories against the time-scale of computing developments, and finding out how computing had affected them so far. It was not a random sample - rather a convenience sample; it was in fact three members of staff of my own Mathematics Department! A microcosm of mathematicians. I asked each of them to tell me the year when he took his first degree, when was his first contact with computers, how he had come to use them (or not, as the case may be), and whether he now used them for research and teaching.

I later added myself to the sample, thereby introducing bias and one more degree of freedom!

I will now describe some of my findings, and comment upon them.

To begin with myself, whom I know best, I give the following details. I took my first degree in Mathematics, specializing in Statistics, in Britain

in 1954. Computers had only just arrived on the scene, but no University had one other than Manchester and Cambridge where the first ones were developed. I did my practical work in Numerical Analysis by winding the handle of an entirely mechanical Facit. I recall that one student almost fainted during his finals, overcome by the tenseness of the situation and the sheer physical exertion of carrying out quadratures, inverting matrices and so on by setting levers and spinning a handle. After completing the degree I became a Scientific Officer, doing mathematical studies for the Armaments Research and Development Establishment in Kent, England. Our numerical work was done by us, or by junior technicians on mechanico-electrical machines. How amazing I then thought those devices to be. Now, of course, every University student has a hand-held calculator which is vastly more powerful and costs less than one-tenth the price of those old machines.

In 1955 there was great excitement in our Establishment, when the Atomic Energy Division installed the first Government computer in Britain (if my memory serves well), a machine called ACE. It filled a space the size of three lecture rooms, was programmed with great difficulty and controlled by three resident engineers who seated themselves in front of a battery of VDU screens. If one's eyes were sharp enough, one could follow the progress of one's program evaluation by checking the changes in binary patterns on the screens.

After a ten-day course in programming ACE, I believe I succeeded in evaluating e^x and $\sin x$ by computing the first dozen or so terms of their series! However, I had sensed the power of the machine; and I and my superior officer decided to begin using it by causing it to simulate tank battles. I set about finding out how to model different contours of terrain over which tanks might besport themselves, making use of random sampling techniques which ACE could be made to understand.

I pause here to make two observations:

(i) the introduction of the large computer changed my life as a working mathematician. Computers do not always take such immediate effect on mathematicians. Indeed, as we shall see, many mathematicians make little or no use of them even today. It is my belief however, that cuckoos will reduce these hardy species of 'no-computer' mathematicians drastically in the next 20 - 50 years.

(ii) One new type of mathematics I had to become familiar with was that of simulation. Simulation, where large random samples of variates have to be drawn and the sample values put together to model a physical situation, is a technique which computers carry out with ease. We use it often now at Waikato University. We use it widely as a teaching tool; for students can grasp, through simulation projects, many concepts about statistical tests and methods for which they would otherwise develop little feeling or knowledge. We also use it in Statistics research; and it is an invaluable tool of Operational Research, when studying, for example, queue networks and stochastic inventory systems. May I add to this last observation that the mathematics of Operational Research - that which was first invented to study and make efficient wartime operations, came in the 50's to be used for designing and improving Social Welfare systems, and then into industry for giving management advice on all manner of problems such as improving production, investigating new products, siting a warehouse, designing airports and so on.

The growth of Operational Research mathematics since 1950 has been another great force for changing the face and fashions of modern mathematics. Many of its techniques however, cannot be carried out without the aid of a powerful computer, and so there is much justification for saying that the growth of Operational Research and the effect of computers on mathematics are part and parcel of the same thing.

My life story continues with my leaving armaments research (and the computer) for teaching in Kenya in 1956. I did not meet up with the machines again (apart from passing glances or brief encounters) until late 1965, when I joined the Department of Mathematics and Computer Science at Huddersfield Polytechnic. We purchased a small computer, an Elliot 803, which I learned to program with ALGOL; but I made little use of it. From 1968 to 1970 I was

at Leeds Polytechnic, where we installed a much larger ICI computer; there I helped introduce computing on a much wider scale to our teaching programmes. Students were taught to use it for many of their projects in Statistics and Operation Research and Numerical Analysis, and we introduced a 3-year degree course entitled 'B.Sc. in Operational Research with Computing Science', the first one of its kind in any of the Polytechnics in Britain.

I came to New Zealand in 1970, and in the last decade my acquaintance with computers has deepened dramatically. On my arrival at Waikato University, I found there was an IBM 1130 machine, with 8K of memory, installed in a room with no staff to run it. Anyone wishing to use it had to learn how to operate it, and run it himself! Surprisingly little use was made of the machine by mathematicians or physical scientists: its main user was a Social Scientist with large amounts of survey data which he wished to analyse statistically. In 1972 the New Zealand Universities bought a $5m network of Burroughs' computers and Waikato acquired a terminal and a line to a powerful B6700 machine at Auckland University. Many more staff from a variety of subjects now began to use our computers for research, and to experiment with their use for teaching purposes. Then in 1977, Waikato University purchased a PDP 11/70, a computer operating on a time-share basis and servicing some 25 Visual Display Units; that is 25 terminals which could be distributed around the Campus. Ten terminals were placed in a lecture room, which could be booked by any subject wishing to use them for teaching, seminars etc. One was placed in the Library, and the others shared amongst the Science, Social Science and Management Studies departments. Now, in 1980, we have over sixty terminals, including VDU's, Graphic devices, and lineprinters driven by two PDP computers; and we still have the line to the big computer at Auckland. The Computer Science Department has a laboratory with 20 terminals for use by its own students. The Mathematics Department has set up its own laboratory room with a terminal at the front of the class and two overhead TV screens so that a lecturer can talk to his students and simultaneously have the computer illustrate his talk by doing calculations, producing tables and plotting graphs 'before their very eyes'. Our staff are slowly beginning to make use of this facility : in a few years time they will regularly do so. I ask you this: 'When they do, will they teach the same kind of Mathematics as now; how will such a presentation affect the ways in which students ingest Mathematics - how will it affect students attitudes and subsequent modes of use of the methods they learn?'

Now for my convenience sample of mathematicians. You have heard the history of my flirtation and engagement with computers (I will not go so far as to say marriage!). In order to tell you how other mathematicians, in different research areas and different age groups, have been affected by computing, I grabbed several of my unsuspecting colleagues when they chanced by my office, and asked them for a few details of their careers. The following picture tells the story I want to convey!

A CONVENIENCE SAMPLE OF MATHEMATICIANS

	Self	Colleague A	Colleague B	Colleague C
Mathematics Specialties	Statistics/O.R., Graph theory, Knots	Topology	Numerical Analysis, Math. Physics, Solar flares	Statistics/ Probability, Genetic models
Age group	50 - 55	35 - 40	30 - 35	35 - 40
First Degree	1954	1963	1971	1964
Computing - first contact	1955	1968	1971	1969
how learned	short course	short course	short course	short course
first use	1965	1978	1972	1974
use in research	1971-80 statistical analyses; study of knot classes	Nil	extensive solution of p.d.e.s; graphics (79)	none in Ph.D. minor later. Graphic study of genetic process

Use in teaching	extensive, statistics projects	Nil	extensive, numerical analysis, demos and projects	extensive, statistics demos and projects

What are the main points to bring out from this table?

First, it describes the experience of two statisticians, a pure mathematician and a mathematical physicist; ages range from just over 30 to over 50. They span the whole period since the advent of computers.

Second, even though computers have been with us for thirty years, none of these mathematicians used one during his first degree studies, all learned to use one via a short course, possibly on FORTRAN programming - in other words they have had no formal training in theory and practice of Computer Science.

Third, now that it is considerably easier to use computers, in particular by means of V.D.U. terminals (Visual Display Units), mathematicians are becoming more acquainted with them, beginning to use them in their research and working out ways of using them to help with teaching their subjects.

I hope that some of this information has surprised, rather than bored, many of you. I am sure that non-mathematicians associate all mathematicians with the computer, believing that they use the machine comfortably, easily and regularly. This is certainly not the case, in many Universities and in many areas of mathematics. As recently as 1975 I did study leave in the Mathematics Department at a Midlands University in England. There out of about 15 mathematicians, only one claimed to use the computer at all; none even thought of using it in teaching; the senior statistician even argued against its use in teaching Statistics! And this was in 1975, but five years ago.

The fourth point from my sample is that the applied mathematicians in it are now beginning to use it extensively in their research and teaching. I claim that this is not only helping them with these tasks but also it is gradually, inevitably, changing their attitudes towards their subjects. And as their attitudes change, so will the material they study, the material they select to teach, the faces of mathematics they elect to gaze upon and show to their students.

To move on quickly with my tale, I must now leave behind my convenience sample of only four mathematicians, set fast in their slots against the backdrop of computing history.

In a rather short time a new generation of mathematicians/computer scientists will be filling the University posts of our Mathematics Departments. This new breed will be very familiar with the principles and practice of computing. How soon will this happen? It is just beginning in my own University, with several of that ilk stepping forward since 1975; one I have in mind has had to take a Junior Lectureship in Computer Science, as no place was open to him in Mathematics. Certainly within fifteen years, when personnel in my age group begin shuffling from the coil of what is a very static staff situation, there will be plenty of the new kind waiting to move in.

I am not arguing that the whole of mathematics will change; or that parts of it will suddenly disappear; these propositions would be patently absurd! What I am saying is that within fifteen years these new men, and women, will see the field of mathematics differently from the way we do. Their ideas of what it is important to do will not be the same. The kinds of problem they tackle will be new; the kinds of solution they will find acceptable and worthwhile will change; the kinds of models and methods they develop to study them will become more complex and more suited to computer study; the areas of mathematics which will be invaded, explored, and extended to support these new activities will differ from the usual fields such as partial differential equations, which rely heavily on methods of calculus and so-called hard analysis, giving way to soft functional analysis, study of complex models, more use of methods of discrete mathematics and so on. And all of this process will accelerate as we move into the 21st century.

Can we look briefly, by way of summarizing my talk, at some of the evidence I have noted concerning changes that have taken place in mathematicians and their subject which are in some way related to the computer.

THE MATHEMATICIANS

THE OLD. Those over 30 years old have taught themselves to use computers, if they have seen the need for them. Most of these users still have limited experience, but many, particularly applied mathematicians, now use the machines extensively to help with their research and teaching. Much depends on the availability of suitable computing machinery; in particular, where VDUs and graphics terminals are in easy reach, more mathematicians are investing time in learning how to use them.

THE YOUNG. Those under 30 years old, especially those now taking a first degree, are likely to be trained in computing as well as in mathematics. They will look at mathematics with new eyes, do it in new ways; and they will lay the cuckoo eggs of my title.

SUBJECT AREAS

PURE MATHEMATICS. Fewer pure mathematicians than other kinds have yet been seduced by the power of computers. But many have been. The four colour map problem has finally been settled by long hours of computer processing dictated by ingenious mathematical ideas. The proceedings of a Conference held at Oxford was published in 1970. Its title: Computational Problems in Abstract Algebra. Many discrete systems, such as groups, lattices, classes of graphs, knots etc. produce important problems which can only be solved by combinatoric methods - and direct enumerations by computers either effect, or go a long way towards, their solutions.

MATHEMATICAL PHYSICS. Even 25-30 years ago hardly any mathematical techniques other than those provided by 19th century analysis and geometry were used in the solution of technical problems. Nowadays (and this is not solely due to developments in electronic computing, of course) ideas and methods are drawn from the fields of logic, abstract algebra, and functional analysis. This last is particularly evident in modern developments of distribution theory, integral transformations and so forth.

STATISTICS. The advances in methods for dealing with multivariate statistics have been particularly rapid since the advent of computers. In the 40's an M.Sc. student might take a year to carry out one factor analysis. Now a statistician can seat himself at a VDU terminal, be in touch through the keyboard with several large statistical software packages, and carry out a dozen different factor analyses before breakfast. He can study the printed output before lunch, then in the afternoon return to the fray to transform his variables, select new ones, rotate his axes, and carry out a dozen more. This is the kind of thing that is possible, is now done, and is of course leading gradually to new philosophies of how to analyse data.

OPERATIONAL RESEARCH. As mentioned above, the development of Operational Research methods has taken place in parallel with that of computing. Many new branches of mathematics have flourished, including theories of queues, inventories, reliability, and network process.

MATHEMATICS FOR COMPUTER SCIENCE. This is a direct link between the two subjects (indeed it is often hard to separate them). The theoretical areas of Computer Science, for studying operator systems, data structures, systems design, and so on, rely heavily on a number of branches of mathematics. These are, for example, logic, discrete number systems, combinatorics, linear algebra, groups and rings, recursive function theory. Thus Computer Science feeds and grows on mathematics; in return it presents new ideas and problems for mathematicians to study.

EDUCATIONAL CHANGES. Finally I will tell you how the mathematics taught in High Schools is going to change; or rather, I will give you my opinion on the matter.

The belief that numeracy was as important as literacy for the youth of today led in the 50's and 60's to a number of revisions of school mathematics

curricula; the term 'New Mathematics' was born. Today most schools, perhaps all, teach the new syllabuses; and steady pressure on them to raise the level of numeracy has resulted in more students carrying on with mathematics until School Certificate and beyond.

Today there is a new pressure, building relentlessly, to include computer topics in schools programmes. In my view this pressure cannot, and indeed should not, be resisted. Already it has had a number of effects. In 1974 the Bursary Applied Mathematics syllabus was changed to include three topics, namely Mechanics, Statistics, and Numerical Analysis with Computing. Students must tackle at least two of the three. Many schools now teach only the last two named: Mechanics, the traditional applied mathematics, is being squeezed out. Enter the new applied mathematics, heralded by a fanfare of electronic computer music!

The pressure for more changes in this direction continues. Shortly a new Mathematics syllabus will start for many VIth forms. Certain of the students will be able to choose to study less of traditional Algebra and Calculus, and do instead projects involving topics such as Critical Path Methods and Graph Theory: a further move towards Computer Science Mathematics. The computing cuckoos are vigorously working!

I am not too dismayed by all this. If children acquire their numeracy through Computer Science studies, so be it. Their pleasure, however, will not be my pleasures, their modes of mathematical thought not mine. They will all still, of course, have to do a certain amount of mathematics as is currently taught. But in the 21st century even that will be taught differently. For every school, down to primary level, will have microprocessors with colour graphics in every classroom; and parents and their children will have hand-held computers in their homes. Who will need to know about logarithms then?

I close with two quotations:

Karl Friedrich Gauss, the truly great mathematician of the early 19th century, once said that: *GOD DOES ARITHMETIC.*

Another truly great mathematician, Albert Einstein, who died in 1955, exactly one hundred years after Gauss, said:

GOD DOES NOT CARE ABOUT OUR MATHEMATICAL DIFFICULTIES. HE INTEGRATES EMPIRICALLY.

You will see that Einstein knew better than Gauss. His quote, in modern idiom, is: *GOD USES A COMPUTER!*

This explains my lack of dismay over my Cuckoos in the Mathematics Nest.

Address delivered 30 April 1980.

* * * * *

"Anyone can prove true theorems." W. Feller

* * * * *

"For the averagely mathematical man, spinor calculus is not easy to learn" P. Rastall, 'A new spinor calculus', *General Relativity and Gravitation* **3** (72), 287-304.

Problems

Readers are invited to send problems for this section. Some indication should be given of how a problem has arisen and whether a complete solution is known and attribution of sources should be provided for problems that are not original. Attempts at solutions should be sent to the setter or to the Editor.

FIRING SQUAD (Problem 1). Solution

(A finite automata problem, described in Newsletter 15, August 1979).

Easy Problem

To solve the "easy" problem may be quite hard. Many, even of those familiar with such automata problems, initially conjecture that the problem is unsolvable as stated, when presented with the question in an "is it possible?" form. So knowing that a solution exists may be half the battle.

The basic idea is that a signal proceeds along the line from the general at maximum speed, (1 soldier per unit time); when this reaches the end soldier, he reflects it back still at speed 1. Meanwhile the general has also initiated a slow signal, speed 1/3. This meets the returning main signal halfway along the line, and the (one or) two central soldiers then both regard themselves as generals, and begin anew on the half-size lines, propagating in their respective directions. When a soldier notes that he and both his neighbours are end soldiers (or generals), he fires. To account for lines of odd or even length is a simple detail. The time till this first meeting is approximately 3n/2. Thus the total time taken is approximately

$$\frac{3}{2}(n) + \frac{3}{2}\left(\frac{n}{2}\right) + \frac{3}{2}\left(\frac{n}{4}\right) + \ldots = 3n.$$

Two examples; n = 7,8; are shown. (12 states used).

State	Description
.	quiet
G	general, ordering "begin"
E	quiet end point (or general)
>	fast signal
<	" "
$)_1$ $)_2$ $)_3$ $(_1$ $(_2$ $(_3$	slow signal components
F	fire.

n = 7

t = 0	G	.	.	.	.	.	.
t = 1	G	>	.	.	.	.	.
t = 2	E	$)_1$	>	.	.	.	.
etc.	E	$)_2$	.	>	.	.	.
	E	$)_3$	.	.	>	.	.
	E	.	$)_1$	.	.	>	.
	E	.	$)_2$	.	.	.	<
	E	.	$)_3$	.	.	<	E
	E	.	.	$)_1$	<	.	E
	E	.	.	G	.	.	E
	E	.	<	G	>	.	E
	E	<	$(_1$	E	$)_1$	>	E
	)	.	$(_2$	E	$)_2$	.	<
	E	>	$(_3$	E	$)_3$	<	E
	E	G	G	E	G	G	E
t = 15	F	F	F	F	F	F	F
t = 17							

n = 8

G	.	.	.	.	.	.	.
G	>	.	.	.	.	.	.
E	$)_1$	>	.	.	.	.	.
E	$)_2$	.	>	.	.	.	.
E	$)_3$	.	.	>	.	.	.
E	.	$)_1$	.	.	>	.	.
E	.	$)_2$	.	.	.	>	.
E	.	)	.	.	.	.	<
E	.	.	$)_1$	.	.	<	E
E	.	.	$)_2$	.	<	.	E
E	.	.	$)_3$	<	.	.	E
E	.	.	G	G	.	.	E
E	.	<	G	G	>	.	E
E	<	$(_1$	E	E	$)_1$	>	E
)	.	$(_2$	E	E	$)_2$	.	(
E	>	$(_3$	E	E	$)_3$	<	E
E	G	G	E	E	G	G	E
F	F	F	F	F	F	F	F

Although we do not give the transition function explicitly, hopefully the above examples give enough information to construct it. It is a simple

though messy calculation to show that the fast and slow signals always meet in the centre(s), as shown. The general and corporal always behave as if they were interior soldiers, pretending that their missing neighbour is in the same state as their real neighbour.

More Difficult Problem

We give a solution involving 6 states. We have not been able to give a proof that 6 is minimal, nor construct a lesser example.

The above solution has an essentially asymmetrical transition function
e.g. f(> . .) = >
but f(. . >) = .
The number of states can be reduced by making the transition function symmetrical. It can be further reduced by eliminating the diadic skeleton of quiet pseudo-endpoints, E. A soldier will know he "really is" an end, in the present example, whenever two main signals converge on him.

The states are

.	quiet
A	main signal body
B	main signal leader = "begin"
C,D	slow signal components
F	fire.

The full transition function is as follows.
(Values are not given for argument combinations that never occur.)

a	b	c	f(a,b,c)
.	.	.	.
.	.	A	.
.	.	B	B
.	.	C	.
.	.	D	.
.	A	A	.
.	A	B	A
.	A	C	D
.	A	D	C
.	B	.	D
.	B	A	A
.	B	B	D
.	B	D	A
.	D	C	B

a	b	c	f
.	C	A	C
.	C	B	C
.	C	C	B
.	C	D	.
A	.	A	.
A	A	A	A
A	A	B	A
A	A	C	B
A	A	D	A
A	B	A	.
A	B	B	.
A	B	C	D
A	C	A	C
A	C	C	C
A	D	A	C

a	b	c	f
A	D	C	C
A	D	D	C
B	.	B	B
B	A	D	A
B	B	D	D
B	C	B	C
B	C	C	C
B	D	B	D
B	D	D	D
C	.	C	.
C	C	D	.
D	.	D	.
D	B	D	D
D	C	D	.
D	D	D	F

Recall the table is to be completed by (i) symmetry, (ii) a null argument (for the two end soldiers) behaves as the opposite neighbour.

An example; n = 11; is given which illustrates most of the transitions. We recommend that those with the time and facilities do a computer simulation with a good range of n, as a check, and to get a good "feel" for the solution.

```
t = 0     B . . . . . . . . . .
t = 1     D B . . . . . . . . .
t = 2     D A B . . . . . . . .
t = 3     C A A B . . . . . . .
 etc.     C B A A B . . . . . .
          C D A A A B . . . . .
          . C A A A A B . . . .
          . C B A A A A B . . .
          . C D A A A A A B . .
          . . C A A A A A A B .
          . . C B A A A A A A B
          . . C D A A A A A A .
          . . . C A A A A A . .
          . . . C B A A A . . .
          . . . C D A A . . . .
          . . . . C A . . . . .
```

```
                  .  .  .  .  C  D  .  .  .  .  .
                  .  .  .  .  .  B  .  .  .  .  .
                  .  .  .  .  B  D  B  .  .  .  .
                  .  .  .  B  A  D  A  B  .  .  .
                  .  .  B  A  A  C  A  A  B  .  .
                  .  B  A  A  B  C  B  A  A  B  .
                  B  A  A  A  D  C  D  A  A  A  B
                  .  A  A  A  C  .  C  A  A  A  .
                  .  .  A  B  C  .  C  B  A  .  .
                  .  .  A  D  C  .  C  D  A  .  .
                  .  .  C  C  .  .  .  C  C  .  .
                  .  .  B  B  .  .  .  B  B  .  .
                  .  B  D  D  B  .  B  D  D  B  .
                  B  A  D  D  A  B  A  D  D  A  B
                  .  A  C  C  A  .  A  C  C  A  .
               .  .  D  C  C  D  .  D  C  C  D  .
               .  .  B  .  .  B  .  B  .  .  B  .
               .  B  D  B  B  D  B  D  B  B  D  B
t = 34         D  D  D  D  D  D  D  D  D  D  D  D
t = 35         F  F  F  F  F  F  F  F  F  F  F  F
```

Readers are invited to prove, that for $n > 2$, the exact time till firing is

$$3n + 2[\log_2(n-1)] - \#_2(n-1) - 2$$

where $\#_2(k)$ = number of "1"'s in binary expansion of k.

Extremely Hard Problem

The basic idea is that the general sends out signals of speeds 1, 1/3, 1/7, 1/15, etc. An indefinite supply can be managed with only a finite number of states. As soon as the main signal reaches the far end, the end soldier behaves like a general and does the same. The returning main signal will meet the slow signals 1/2 way, 1/4 way, 1/8 way, etc. along; at each meeting point the soldier(s) also start to behave like generals, and so on. By the time the first main returning signal has reached the starting end, the whole line has been successively halved, quartered, etc., and again all fire when all have both themselves and their neighbours as end points.

Clearly there are a great many details to complete. Space does not permit a full description here, but if he cannot construct it for himself, the dedicated student is referred to:-

"The Firing Squad Problem" by BALZER, Information and Control (10) pp22-41.

Bill Taylor, Mathematics Department, Canterbury.

DISTINCT QUADRUPLES (Problem 2). Comments.

(Newsletter 16, December 1979. From n distinct objects, N(n) is the number of quadruples, no two of which have more than one object in common.)

This has recently been solved completely by A.E. Brouwer in his paper 'Optimal packings of K_4's into a K_n'. (Math. Centre Report No. ZW 92/77, Math. Centre Amsterdam, 1977). This is to appear in the Journal of Combinatorial Theory (A). The same author also has a paper giving information on this and similar problems in 'Packing and Covering in Combinatorics' (A. Schrijver, ed., Mathematisch Centrum, Amsterdam, 1979) pp89-97 entitled 'Packing and Covering of (k/t) - sets.'

As special cases we have

$N(8) = 2$, $N(9) = 3$, $N(10) = 5$, $N(11) = 6$, $N(17) = 20$ and $N(19) = 25$.

All other cases are covered by

$$N(n) = \left[\frac{V}{4}\left[\frac{V-1}{3}\right]\right] - \varepsilon$$

where $\varepsilon = 1$ if $n \equiv 7$ or $10 \pmod{12}$ and $\varepsilon = 0$ otherwise. Here the square brackets indicate that integer parts should be taken.
Thus $N(68) = 374$ and $N(70) = 401$.

D.R. Breach, Mathematics Department, University of Canterbury.

Problem 4 (*Four cubes*)

Four unit cubes are used to make a compound solid which has four three-fold axes of symmetry each of which coincides with a threefold axis of symmetry of a constituent cube (see figure 1). The lines of intersection on one face of a cube generated by the other three cubes are shown in figure 2. If O is the origin for Cartesian co-ordinates with axes as shown then show that G,H,I,J are the points $\left(\frac{3}{11}, \frac{3}{11}\right)$, $\left(\frac{3}{5}, \frac{3}{5}\right)$, $\left(\frac{9}{11}, \frac{6}{11}\right)$, $\left(\frac{6}{7} \frac{6}{7}\right)$ respectively.

D.R. Breach, Mathematics Department, University of Canterbury.

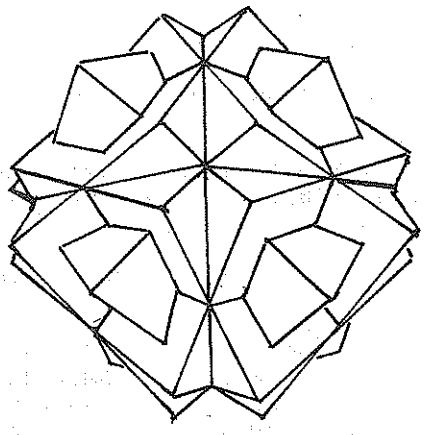

Figure 1

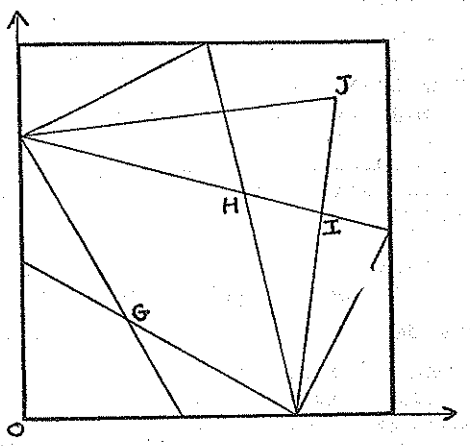

Figure 2

* * * * *

APPLIED MATHEMATICS BURSARY EXAM 1979

- a selection of answers

Newton Raphson is a quick method for finding an accruate answer.

Newton Raphson uses the graduate of a point on the curve.

This method (NR) is based up gradental intersectal lines with the x-axis, which works in most cases.

Newton Raphson's method is only an approximation and therefore it doesn't reach a conclusion.

The bisection method bisects each consecutive space along the curve and decides if the gradient of the curve can be considered positive or even. If so, one takes a wild guess at the answer and writes down some ambiguous constant, in lieu of an informed, well-defined answer.

... convergence of the illiterations.....to the imagery root...

Bisection method: An approx. value of the root is found, x_0. A line is drawn between the f(x) value for this x_0 value and the actual root. x_1 is found by drawing a line to the x-axis halfway along this first line.

Mery Christmas.

NZMS/IBM PREDOCTORAL THESIS COMPETITION 1980

At a prize giving ceremony at Auckland University on 19th May the President of the N.Z. Mathematical Society, Mr John Turner of Waikato University announced the winners of the 1980 IBM - NZ Mathematical Society thesis competition. This competition is organised by the New Zealand Mathematical Society in association with IBM (NZ) Ltd., is open to any masters student in a N.Z. University, and is designed to encourage mathematical research in N.Z. universities. The winners are determined from evaluation of the theses which these students have submitted for their masters degrees.

The winners received their prizes and certificates from the Auckland branch manager of IBM, Mr Des Morrison and are:

Mr Neville Stuart Jeans of Massey University, Palmerston North, first prize ($70), "*Units in some Algebraic Number Fields*";
Miss Pamela M. Moss (now Pamela Burrage) previously of Auckland University and now in England, second prize equal ($40), "*Stability and Implementation Problems for Computational Differential Equations*";
Mr B.S. Mudford, previously of Waikato University, Hamilton, and now studying at Oxford University, England, second prize equal ($40), "*Dissipative Plasma Stability*".

The following are the remarks made by Prof. A. Zulauf, on behalf of the panel of judges, during the prize-giving ceremony.

Mr President, Mr Morrison, esteemed colleagues and fellow members of the NZMS,

When the Society invited me to be one of the judges in the NZMS/IBM Predoctoral Thesis Competition, I accepted with much delight but also with considerable apprehension: delight at the prospect of getting to know the work of New Zealand's most promising master's students during the last two years, apprehension because the task of ranking and selecting winners was surely not going to be an easy one. Events have proved me right on both counts, as my fellow judges, Professors David Vere-Jones and Brian Woods, will readily agree.

Eleven entries were received from five universities. Their topics covered a wide spectrum of mathematics, from the very pure to the very applied. The judges were impressed by the very high level of competence of the individual entrants, and also by the remarkable uniformity of standards across the universities. All theses entered are commendable pieces of work; all show evidence of originality by way of new results, or by way of critical analysis, or simply by way of scholarly selection and arrangement of material. Each thesis has something interesting to say, and does so in a well-produced and well-presented manner.

From these remarks it should be clear that the very time-consuming task of reading all the eleven theses was also a very enjoyable one. It should be equally clear that if candidates are as close as they have been in this competition, then the judges have a real problem on their hands. Let me mention some of the difficulties.

To begin with, comparison between widely different mathematical topics is not easy, particularly if one is better informed about some topics than about others. There is a danger that one may be prejudiced in favour of topics that one personally likes the best, and an even greater danger that one might overcompensate by judging the favoured topics too harshly. Comparison is further complicated by the fact that different universities attach different weights to a thesis in the overall assessment for the degree. These differences are far from trivial. Another imponderable is the extent to which the supervisor has contributed to the success of the thesis either directly or indirectly. The very choice of the topic plays a big part here: one topic may lead quickly to a fruitful line of research, whilst another may require painstaking assimilation and laborious sifting of a vast amount of prerequisite material.

How then is one to say which of eleven very talented candidates is, or is going to be, the best mathematician? Fortunately, that was not our task. Our brief was, after all, just to find the best thesis. My fellow judges and I chose to interpret this as meaning that the theses should be judged not only by the quality of the mathematics contained therein, but also by the impact they make as pieces of mathematical writing. Now it became actually an advantage that of the three judges who read each thesis at least two could not profess special expertise in the particular field of mathematics with which the thesis dealt. This then was the real test: How well does the author get the main points of the thesis across to the reader, how well does the expository style suit the topic, how well does the thesis hold the reader's attention? Some theses make compelling reading, unfolding their story beautifully and with ease. Others are more humdrum, requiring rather much effort from the reader to uncover the mathematical gems hidden in them.

To describe the qualities the judges were looking for, I can perhaps do no better than to repeat my comments on the thesis that proved to be the eventual winner. Here is what I said: This thesis is an excellent piece of writing which enables a reader with no previous specialized knowledge to follow the topic from its beginnings right through to an area of active research, including original work of the author. I give it full marks on selection and organization of material, economy and fluency of style, perspicuity and consistency of notation, clarity of expression and presentation generally. The summary of basic theory given at the beginning is concise and authoritative, yet comprehensive and highly readable. Recent developments in the field are then explained, and the work of various researchers is critically analysed and compared. The author's own contribution consists of both theoretical work and practical computation. There are no wasted steps in this thesis; all steps are fully motivated and follow each other in logical sequence. Well chosen examples illustrate the main points and problems. There is a comprehensive bibliography, and all sources are meticulously quoted. Altogether a scholarly piece of writing.

As I said, these were my own comments, but I hasten to add that all three judges were unanimous in their choice of the winner by a clear margin. You will have to wait a little longer before you learn who the winner is. There are some final comments which I feel I must make. The primary object of a thesis is to demonstrate to the examiners how good a mathematician the candidate is. It is not to produce a literary masterpiece. In view of this, is it perhaps unfair in a competition such as this to give much weight to the literary qualities of a thesis? I think not! The competence of each candidate as a mathematician has already been recognized by the award of a degree, presumably with distinction or first class honours. I believe it is right and proper that, in looking for that something extra, which lifts some theses above others, we should pay attention to how well a thesis communicates. A good and pleasing expository style is something that should be encouraged in our young mathematicians. For that, if no other reason I think that a thesis competition can fulfil a useful role.

My fellow judges join me in congratulating the NZMS and IBM, the sponsors, for their initiative, and in expressing the hope that the competition may become a regular event.

* * * * *

God made integers, all else is the work of man

L. Kronecker

Conferences

*** 1980 ***

August 4 - 8 (Rio de Janeiro)
International Seminar on Functional Analysis, Holomorphy and Approximation Theory
Details from J.A. Barroso, Instituto de Matematica, Universidade Federal do Rio de Janeiro, Caixa Postal 1835, 21910 Rio de Janeiro, RJ, Brasil.

August 4 - 8 (Puebla, Mexico)
Workshop on the Present Trends of Representation Theory
Details from R. Martinez, III ICRA, Apdo. Postal 70-450, Mexico 20, D.F., Mexico.

August 4 - 15 (Medford, Massachusetts)
Third International Conference on Probability in Banach Spaces
Details from Marjorie Hahn, Department of Mathematics, Tufts University, Medford, Massachusetts 02155, U.S.A.

August 4 - 15 (Vancouver)
NATO Advanced Study Institute on Generalised Concavity in Optimization and Economics
Details from Siegfried Schaible, Faculty of Business Administration, University of Alberta, Edmonton, Alberta, Canada T6G 2G1.

August 4 - 22 (Montréal)
Seminar on Complex Manifolds: Applications to Algebraic Geometry and Mathematical Physics
Details from Ghislaine David, Département de Mathématiques et de Statistique, Université de Montréal, C.P. 6128, Montréal H3C 3J7, Canada.

August 4 - 22 (Montréal)
Canadian Mathematical Society Summer Seminar in Harmonic Analysis
Details from Carl Herz, Department of Mathematics, McGill University, 805 Sherbrooke St. West, Montréal, P.Q., Canada H3A 2K6.

August 8 - 16 (Puebla, Mexico)
Third International Conference on Representations of Algebras
Details from R. Martinez, III ICRA, Apdo. Postal 70-450, Mexico 20, D.F., Mexico.

August 10 - 16 (Berkeley)
Fourth International Congress on Mathematics Education
Details from ICME IV, Mathematics Department, University of California, Berkeley, CA 94720, U.S.A.

August 11 - 15 (Ottawa)
International Conference on Categorical Aspects of Topology and Analysis
Details from Louis D Nel, Department of Mathematics, Carleton University, Ottawa, K1S 5B6, Canada.

August 11 - 15 (Bethlehem) Pennsylvania)
IUTAM Symposium on Finite Elasticity Theory
Details from Lehigh University, Center for the Application of Mathematics 203 E. Packer Ave., Bethlehem, PA 18015, U.S.A.

August 11 - 15 (Las Cruces, New Mexico)
Conference on Constructive Mathematics
Details from W. Julian, Department of Mathematical Sciences, New Mexico State University, Las Cruces, New Mexico 88003, U.S.A.

August 14 - 28 (Lubbock, Texas)
Workshop on Topology and Linear Orderings
Details from H. Bennett, Mathematics Department, Texas Tech University, Lubbock, Texas 79409, U.S.A.

August 17 - 23 (Toronto)
Fifteenth International Congress of Theoretical and Applied Mechanics
Details from Ken Charbonneau, Executive Secretary, ICTAM Toronto, National Research Council, Ottawa, Ontario K1A 0R6, Canada.

August 18 - 22 (Patras, Greece)
Summer Meeting in Logic
Details from Logic Symposium I, Chair of Logic and Set Theory, University of Patras, Patras, Greece.

August 18 - 22 (Edinburgh)
Compstat 80: Fourth Symposium on Computational Statistics
Details from Compstat 1980, C/- Director, Program Library Unit, Edinburgh University, 18 Buccleugh Place, Edinburgh EH8 9LN, Scotland.

August 18 - 22 (Brisbane)
Seventh Australasian Hydraulics and Fluid Mechanics Conference
Details from Conference Manager, 7th Australasian Hydraulics and Fluid Mechanics Conference, The Institute of Engineers, Australia, 11 National Circuit, Barton ACT 2600, Australia.

August 18 - 23 (Aarhus, Denmark)	*18th Scandinavian Congress of Mathematicians* Details from Organizational Committee, 18th Scandinavian Congress of Mathematicians, Mathematisk Institut, Aarhus Universitat, 8000 Aarhus C, Denmark.
August 18 - September 20 (Beijing, People's Republic of China)	*International Symposium on Partial Differential Equations and Differential Geometry* Details from S.S. Chern, Department of Mathematics, University of California, Berkeley, California 94720, U.S.A.
August 24 - 30 (Prague)	*Logic Colloquium 80 and European Summer Meeting of the Association for Symbolic Logic* Details from Logic Colloquium 80, Mathematical Institute of the Czechoslovakian Academy of Sciences, 25 Zitna, 115 67 Prague 1, Czechoslovakia.
August 25 - 29 (Geelong)	*Eigth Australian Conference on Combinatorial Mathematics* Details from K.L. McAvaney, Division of Computing and Mathematics, Deakin University, Victoria 3217, Australia.
August 25 - 29 (Szeged, Hungary)	*Colloquium on Lattice Theory* Details from Gábor Czedli, Bolyai Institute, Szeged, Aradi vértanúk tere 1, H-6720, Hungary.
August 25 - September 7 (Scarborough, Ontario)	*18th International Symposium on Functional Equations* Details from J. Aczél, Pure Mathematics Department, University of Waterloo, Waterloo, Ontario N2L 3G1, Canada.
August 27 - 29 (Utrecht)	*Geometry Symposium* Details from D. Siersma, Mathematisch Institut, Rijksuniversiteit Utrecht, Budapestlaan 6, 3508 TA Utrecht, The Netherlands.
August 27 - September 3 (Torun, Poland)	*International Conference on Young Tableaux and Schur Functions in Algebra and Geometry* Details from Tadeusz Józefiak, Mathematical Institute, Polish Academy of Sciences, Chopina 12, 87100 Torun, Poland.
August 28 - 30 (Bonn)	*IV Bonn Workshop on Combinatorial Optimization* Details from Institut für Ökonometrie und Operations Research, Rheinische Friedrich-Wilhelms-Universität Bonn, Nassestrasse 2, D-5300 Bonn 1, Federal Republic of Germany.
September 1 - 13 (Black Sea Coast, Romania)	*International Conference on Operator Algebras and Group Representations* Details from OAGR Conference, Department of Mathematics, INCREST, Bd. Pacii 220, 77538 Bucharest, Romania.
September 8 - 12 (Leicester, UK)	*Third IUTAM Symposium on Creep in Structures* Details from Professor A.R.S. Ponter, Department of Engineering, The University, Leicester LE1 7RH, UK.
September 9 - 11 (Sheffield)	*Third IMA Conference on Control Theory* Details from The Secretary and Registrar, The Institute of Mathematics and its Applications, Maitland House, Warrior Square, Southend-on-Sea, Essex, SS1 2JY, England.
September 15 - October 3 (Nancy, France)	*Summer School of the International Centre for Pure and Applied Mathematics: Harmonic Analysis* Details from ICPAM, Villa "La Lézardière", 1 av. Edith Cavell, 06000 Nice, France.
September 22 - October 3 (Maratea, Italy)	*Nato Advanced Study Institute on Singularities in Boundary Value Problems* Details from H.G. Garnir, Department of Mathematics, University of Liège, 15 avenue des Tilleuls, B-4000 Liège, Belgium.
September 29 - December 20 (Strasbourg, France)	*Autumn School of the International Centre for Pure and Applied Mathematics: Ordinary Differential Equations and Control Theory* Details from ICPAM, Villa "La Lézardière", 1 av. Edith Cavell, 06000 Nice, France.
October 1 - 3 (Lake Placid, New York)	*21st Annual Symposium on Foundations of Computer Science* Details from Andrew C. Yao, Program Chairman, Computer Science Department, Stanford University, Stanford, California 94305, U.S.A.

October 1 - 4 (Winnipeg)
10th Manitoba Conference on Numerical Mathematics and Computing
Details from Department of Computer Science, University of Manitoba, Winnipeg, Manitoba R3T 2NL, Canada.

October 2 - 8 (Maryland)
Conference on Applications of Numerical Analysis and Special Functions in Statistics
Details from Frank Olver, Institute for Physical Science and Technology, University of Maryland, College Park, Maryland 20742, U.S.A.

October 6 - 17 (Tokyo & Melbourne)
International Federation for Information Processing Congress
Details from IFIP Congress 80, GPO Box 880 G, Melbourne, Vic. 3001, Australia.

October 13 - 15 (Madison)
Symposium on Transition and Turbulence
Details from Gladys Moran, Mathematics Research Centre, University of Wisconsin, 610 Walnut Street, Madison, Wisconsin 53706, U.S.A.

October 24 - 25 (DeKalb, Illinois)
Conference on Measure Theory
Details from Department of Mathematical Sciences, Northern Illinois University, DeKalb, Illinois 60115, U.S.A.

November 14 - 15 (New York)
Foundations: Logic, Language and Mathematics
Details from E. Mendelson, Department of Mathematics, Queens College, Flushing, New York 11367, U.S.A.

December 1 - 6 (Concepción, Chile)
First Congress of Biomathematics
Details from Sociedod Latinoamericana de Biomatemática, Instituto de Cálculo, Facultad de Ciencias Exactas y Naturales - U.B.A. of 2003, Pabillon No. 1, Ciudad Universitaria, Buenos Aires, Argentina.

December 16 - 19 (Versailles)
4th Conference Internationale sur L'analyse et L'optimisation des Systèmes
Details from I.N.R.I.A. Serv. Rd. ext., Domaine de Voluceau, Rocquencourt, B.P. 105, 78150, Le Chesnay, France.

*** 1981 ***

January 2 - 8 (Banff, Canada)
Winter Research Institute on Geometric Quantization
Details from Mrs. Pat Dalgetty, Secretary, Geometric Quantization Conference, Department of Mathematics and Statistics, The University of Calgary, Calgary, Alberta, Canada T2N 1N4.

January 5 - 8 (Barbados)
Third Caribbean Conference on Combinatorics and Computing
Details from C.C. Cadogan, Department of Mathematics, University of West Indies, P.O. Box 64, Bridgetown, Barbados, West Indies.

January 12 - February 6 (Hobart)
Australian Mathematical Society 21st Summer Research Institute
Details from R. Lidl, Department of Pure Mathematics, University of Tasmania, GPO Box 252C, Hobart, Tasmania 7001, Australia.

July 20 - 24 (Swansea)
Eigth British Combinatorial Conference
Details from A.D. Keedwell, Honorary Secretary, British Combinatorial Committee, Department of Mathematics, University of Surrey, Guildford, Surrey GU2 5XH, England.

not yet decided (Dubrovnik, Yugoslavia)
ICHMT/IUTAM Symposium on Heat and Mass Transfer and the Structure of Turbulence
Details from Professor Z. Zaric, International Centre for Heat and Mass Transfer, P.O. Box 522, 11001 Beograd, Yugoslavia.

June 23 - 26 (Dundee)
Biennial Conference on Numerical Analysis
Details from G.A. Watson, Department of Mathematics, University of Dundee, Dundee DD3 4HN, Scotland.

July 13 - 24 (Cambridge)
NATO Advanced Research Institute on Nonlinear Optimization
Details from M.J.D. Powell, DAMTP, Silver Street, Cambridge, CB3 9EW, England.

Secretarial

EXTRACTS OF THE MINUTES OF THE NINTH COUNCIL MEETING

Held at the University of Auckland, on Sunday, 18 May 1980. Though the agenda heralded this meeting as the tenth, a count-back reveals it to be the ninth. The meeting opened at 10.05 a.m., adjourned for coffee or lunch several times, and closed at 5.30 p.m.

Those present were: J.C. Turner (chair), M. Schroder (pen), W.D. Halford, D.C. Harvie, H.S. Roberts, B.R. Stokes, G.M. Thornley, G.C. Wake and M. Westcott.

JCT welcomed BRS (representing the N.Z.A.M.T.) and MW (representing the Australian Mathematical Society).

I. APOLOGIES

Apologies for absence were given for: G. Gale, D.C. Joyce, R.S. Long and G. Olive.
JCT moved that these be sustained. CARRIED

II. MINUTES OF PREVIOUS MEETINGS

The Minutes of Council Eight and the subsequent Short Council had already been confirmed (Postal Meeting, August 1979).

MS/GCW moved that the minutes of the Northern Regional Meeting of 10 November 1979 be confirmed, subject to the comments noted in the minutes of the Southern Regional Meeting of 17 November 1979. CARRIED

As no-one present had taken part in the latter, MS/GCW moved that its minutes be received. CARRIED

III. MATTERS ARISING THEREFROM

Discussion of the only matters arising from the minutes, the Convention in 1981 and the Employment Brochure, was deferred.

IV. CORRESPONDENCE

Some further items of correspondence were tabled (226-230), summaries or copies of the remainder (1-225) having been circulated.

MS/JCT moved that the inward correspondence be received and the outward approved. CARRIED

V. ACCOUNTS AND BUDGET

JCT moved that the audited annual accounts for the calendar year 1979 be approved, and that they be presented for approval at the AGM. CARRIED

HSR/MS moved that the payments listed on the "Statement of accounts as at the end of April 1980" be ratified, and that the following accounts be approved:

Audit Fee	up to $20	Massey University	$19.14
Colloquium Lecturer	$100	" " (N/L)	$148.48
Visiting Lecturer	$200	University of Waikato	$26.33
IBM Prize	$150	" " " up to	$150
Victoria University Maths. Dept.	$11		

CARRIED

HSR/GMT moved that Council recommend an ordinary subscription of $15 for 1981 to the AGM. CARRIED

During discussion, GCW recalled that the 1979 AGM had accepted the need for a further increase, and that part of the increase should go towards a "publications reserve", WDH noted that Newsletter costs would likely rise sharply, and asked whether the Society could "do its job" on less, and DCH suggested that profits from successful publishing should not be fed into the Society's general coffers, a point which met with unanimous AGREEMENT.

WDH/DCH moved that Council recommend a student subscription of $2 for 1981. CARRIED

JCT/GCW moved that the institutional subscription be not less than $25 for 1981. CARRIED

Note - Council determined the institutional subscription, and reciprocal members pay half the ordinary fee.

VI. SUB-COMMITTEE REPORTS

Education Sub-committee; JCT (convener), DCJ and GMT.
The sub-committee has been active this year in preparing the Supplement to the NZMS Newsletter number 17, entitled: "The Teaching of Mathematics in High School and University". This was published in April, its purpose being to present a collection of submissions from mathematicians throughout the country, airing their views on topics in mathematics education and preparing readers for the forthcoming Mathematics Subject Conference. Invitations to submit short papers were sent to over two hundred people, an attempt being made to include all mathematicians in universities, technical institutes and teachers' colleges. The Secretary of

N.Z.A.M.T. was asked to pass invitations to a large number of teachers in high schools to obtain their views and proposals. Sixteen papers were received (plus one which arrived too late for publication); I supplied an Editorial, and Professor Vere-Jones an introduction to the Subject Conference itself. The material was typed and collated at Waikato University, and forwarded to Massey University for final editing by Drs. Thornley and Halford, before printing. I thank them for their help. Since receiving the supplement, I have had comments from a number of colleagues and others who have read it, and I have a feeling that it has done the intended job. It has stirred thoughts, stimulated discussion, and will bring well-prepared speakers to the Conference. Finally, the publishing of a "Mathematics Syllabus Series" has been mooted.

J.C. Turner, Convener

JCT/MS moved that the report be received. CARRIED

WDH/GCW moved that the sale of the Education Supplement to non-members, at 50c a copy, be authorized. CARRIED

Publication Sub-committee; its draft report was tabled (item 229), along with the report of the editor of the Newsletter (item 227), and a sample of the "Mathematics Syllabus Series".

GCW/MS moved that the Collected Papers on Analysis be sold at $3 to members and $4 to others. CARRIED

GCW/HSR moved that (a) the Society consider setting up a charitable trust fund to which professional societies and organizations could contribute, and (b) the Society continue to search for a publisher with which it could be associated in publishing the Collected Works of A.C. Aitken. CARRIED

JCT/MS moved that the Publications Sub-committee investigate the legal, financial and other aspects of the preceding proposals and report to Council before taking any more substantive action. CARRIED

Publication details of the Employment Brochure were discussed, in particular, points both for and against its printing by IBM (rather than the Society). It was AGREED to carry on the negotiations with IBM. Its editor, R.A. Littler, reported that he could provide for his successor detailed extracts from the annual Vice-Chancellors' Graduate Employment Surveys. GCW observed that the Society did not need to look for the successor until next year.

GCW/WDH moved that C. Atkin be asked to continue compiling the Post-Graduate Topics Brochure. CARRIED

Canterbury's request for a more standardized format will be forwarded, along with an enquiry about listing the graduate courses offered. MS asked whether the Society should continue to distribute its Membership List beyond its membership. It was LEFT to the incoming Council to decide this.

JCT/GCW moved that the Publications Committee prepare a notice to N.Z. mathematicians, indicating the Society's willingness to be involved in publishing, and inviting potential authors to consider the Society as a vehicle for their publications. CARRIED

Displaying this notice in the next Newsletter was RECOMMENDED. JCT amplified the draft report's coverage of STATUS, by giving the up-to-date profit figures (all costs were already amortized), and describing the comedy of errors which led to the pricing policy ($6 for students, $7.50 for institutions). Several noted that the "Mathematics Syllabus Series" could well end up defining the syllabus, in some areas such as statistics. The desirability of their acceptability to (i) teachers, (ii) the Department of Education, (iii) the N.Z. Statistical Association, (iv) the designer of the syllabus, (v) the N.Z.A.M.T., and (vi) the University Entrance Board (to whom drafts should be SENT for comment). Problems of timing were also raised.

WDH/GCW moved that the Publications Sub-committee consider the Series urgently, consult with D. Vere-Jones and JCT, and publicize it during the Colloquium and Subject Conference. CARRIED

HSR/MS moved that Council consider contacts with other tertiary and governmental institutions. CARRIED

JCT/DCH moved that the draft report be received with thanks, subject to its being approved by the Publications Sub-committee. CARRIED

JCT/DCH moved that the editor's report be received, and that the editor be thanked for the efforts he put into making the Newsletter a success. CARRIED

WDH/DCH moved that from 1981, overseas members and institutions be asked to opt for either air mail or surface postage of the Newsletters and Supplements, and that for air mail postage, a surcharge of $3 be added to the annual subscription. CARRIED

WDH/GCW moved that from 1981, the Society increase the frequency of publication of the Newsletter. CARRIED

WDH/MS moved that Council debate the matter of the location of the Editor and production facilities. CARRIED

Centralized publication at Massey was clearly not possible in the reign of WDH, who gave notice of resigning as editor before the August 1980 issue of the Newsletter. GCW in particular agreed to twist a few arms.

Awards and Prizes Sub-committee; GCW.

GCW tabled the press release (item 231) on the IBM Thesis prize, and reported that 11 candidates from 5 universities had entered theses of a very high standard, according to the examining panel. He was THANKED for his efforts.

Human Rights Sub-committee; GO (convener), A. McNabb, B. Calvert.

In GO's absence, MS could only remind all that he had sent a letter of protest about J-L Massera's imprisonment to the Uruguayan government, and one to Mr. Talboys, requesting official N.Z. support, but that no reply to either had come in.

VII. NZAMT MATTERS

BRS raised a number of points of interest both to the Society and to the N.Z.A.M.T.

(i) Should mathematics and computer science be separate school subjects, and who can or should teach the latter?

(ii) Should a survey of maths teachers in schools be conducted, covering qualifications, experience, and so on?

(iii) Is the booklet "Why study maths?" worth polishing for distribution to schools? If so, should N.Z.A.M.T. produce it?

(iv) Are the N.Z. Senior maths competition (run by the Canterbury Mathematical Association), and the Wales competition in Australia worth supporting (secretarial bias visible here)?

(v) Should one look for national recognition, or co-ordination, of the maths certificate programmes for the "lower spectrum" (these are at present run by the local maths associations)?

(vi) The Department of Education can not fund N.J. Gale to ICMI IV. (Several pointed out that the Royal Society had appointed him as official N.Z. representative, with a $500 grant).

(vii) Is the N.Z.A.M.T. viable? Does the mathematics (teaching) profession need a professional body such as an Institute of Mathematics?

JCT/MS moved that the Society investigate the possibility of N.J. Gale being the 1981 Visiting Lecturer. CARRIED

GMT/JCT moved that the Society grant $50 to N.J. Gale, and invite him to contribute an article on ICMI IV for the Jan. 81 Newsletter. CARRIED

The Council Meeting of the N.Z.A.M.T. will take place in Christchurch on June 14; BRS invited the Society to send a representative.

VIII. ROYAL SOCIETY MATTERS

As the Royal Society had changed the dates for applying to the Young Scientists Fund, this should be ADVERTISED in the August Newsletter. JCT reported that the meeting of the Member Bodies' Committee he attended on April 30 was informative to him; but he felt that the breadth of membership interests, and once-a-year attendance, tended to prevent achievement. However his address "Cuckoos in the Mathematics Nest" had been well received, and was to be reprinted (?) by the Royal Society, he said.

WDH/DCH moved that this article be published in the Newsletter. CARRIED

It was agreed that WDH attend the meeting of the National Committee on Mathematics instead of JCT, and that the Society through him ask it to keep open New Zealand's application for Group II status with the I.M.U. On behalf of the Society, JCT and MS had nominated W. Malcolm, D. Gauld and P. Hill to the Royal Society for the National Committee, to replace J.A. Kalman and R.B. Davies (whose terms had expired) and MS (whose patience had). MS said that the Royal Society was not bound by these nominations, and could well appoint others such as Davies. The remaining members of the Committee are G.H. Knight, B.A. Woods, and GMT. BRS inquired about the National Consultative Committee on Mathematics - whether the Society is represented on it, what it does, why, and for whom? DCH and others said it advised the Department of Education. MS was asked to approach the Director General, asking these questions.

IX. FOREIGN AFFAIRS
MS mentioned the stall with the Chinese, the start with the M.A.A. (the ball is in their court now), and the progress with Japan (the ball is in our court), and forgot to mention Iran.

X. AGENDA FOR SIXTH A.G.M.
Convention, 1981. MW advised us that J. McMullen (a member of the organizing committee) had about 400 copies of the first circular: after some discussion, Council agreed to send these to all New Zealanders who attended Convention 78, and to other select groups. Council also agreed to negotiate with the organizers, about the choice of an N.Z.M.S. Lecturer, whose fee of A$100 could be paid out of "A.N.U. Press" earnings (proceeds from the sale of Andrews' monograph). Much emphasis was laid on the "education" side of the Convention, in the hope that MW would convey this feeling to the organizers. P. O'Halloran at the Canberra C.A.E. was suggested as a possible contact for pushing this side of the Convention. MS inquired whether the Society's representatives can - legally - collect convention fees and forward them in bulk, and was directed to find out. (Answer - yes, on making suitably detailed application to the Reserve Bank through the B.N.Z.). WDH recalled the JCT/DCH motion passed at the AGM 1979, "that the bulk of the money be used to assist New Zealand speakers at the 1981 Convention in Australia". The subsequent Short Council authorized JCT and MS to look into the possibilities and report. This led to the agreement mentioned in §13 of the minutes of the Northern Regional Meeting.

JCT/MS moved that the persons administering this fund be the President and Secretary at the time, and that they have power to decide the grants. CARRIED

GCW/JCT moved that the Society augment the fund by $200, and that all interest accruing, be credited to the fund. CARRIED

It was agreed to advertise this at the Colloquium and its Business Meeting, and in the Newletter, with application forms. MS was asked to write to Dr. Gagen, the Convention Secretary, emphasising the New Zealand desire for a significant education-teaching section in the convention, suggesting (if possible) a suitable speaker or focus for this section, asking for provision for a Council meeting, and for a meeting with the Council of the A.M.S., confirming the Convention fees, inquiring about their policy on publishing invited addresses (and mentioning the Society's policy). The question of closer relations with the Australian Mathematical Society could be discussed at the Convention: meanwhile, food for thought.

JCT/GCW moved that the Society send its minutes to the Australian Society. CARRIED

MW conveyed friendly greetings from both Dr. Gani and incoming president Prof. Blakers, and told us that Prof. Hayman had represented the Society at the Council Meeting of the Australian Society.

XI. GENERAL
No general items surfaced.

27 May 1980 M. Schroder, Secretary

MINUTES OF THE SIXTH ANNUAL GENERAL MEETING

Held at the University of Auckland, on Tuesday, 20 May 1980.

I. APOLOGIES
The President, J.C. Turner, opened the meeting at 4.05 p.m., welcomed those present, apologised for failing to mention Massey University and Dr. M. Hendy (the winner's supervisor) at the awarding of the IBM Thesis prize, welcomed Dr. J.R. McMullen (Sydney) and Dr. M. Westcott (C.S.I.R.O.), and called for apologies. 45 members were present.

J.C. Turner/M. Schroder moved that apologies for absence from Prof. G.M. Petersen, Dr. D.C. Joyce and Mr. R.S. Long be sustained. CARRIED

II. MINUTES OF THE FIFTH A.G.M.
These had been published in the Society's Newsletter of August 1979.

J.C. Turner/M. Schroder moved that they be taken as a true and correct record of that meeting CARRIED

III. MATTERS ARISING THEREFROM
The President asked if any matters arose from the minutes. Silence.

IV. THE PRESIDENT'S REPORT
The President read his report, which had also been distributed with the agenda.

M. Schroder/G.M. Thornley moved its adoption. After some discussion of (i) the wording and

meaning of "STATUS... profitable before the bill was received" - which was intended to mean that it had already amortized its costs - and (ii) whether "the Royal Society felt unable ..." or simply "... did not...", the motion was CARRIED

G.C. Wake pointed out that J.C. Turner had waived royalties for the first 2000 copies of "STATUS" sold.

V. THE TREASURER'S REPORT, BUDGET AND SUBSCRIPTIONS

Speaking to the audited accounts attached to the agenda, the Treasurer, H.S. Roberts, said that

(i) the IBM prize of $150 incorporated in the profits was not profit, and had in fact now been paid out, and

(ii) that as the costs of workshops and Regional Council Meetings was likely to rise, it might be worth discussing their value to the Society.

D. Vere-Jones asked why no publishing expenses were shown, except for the Newsletter, and was told that they had not been incurred by balance date.

H.S. Roberts/J.C. Turner moved the adoption of the audited accounts and the Treasurer's statement. CARRIED

D.A. Nield asked if the Society still intended to support a Colloquium Lecturer at the Convention in Australia, and was told that the Council had just agreed to do this.

After speaking to the budget (published in the April 1980 Newsletter), H.S. Roberts/ W.D. Halford moved (i) that the ordinary subscription for the calendar year 1981 be $15 (CARRIED), and (ii) that the student subscription for that year be $2 (CARRIED). The meeting was also reminded that institutional subscriptions were set by the Council, which had just decided on a $25 minimum.

Answering a question on defaulters, H.S. Roberts said that they had two years "grace" and several reminders (sent with the Newsletter), but then they were "out".

VI. CONSTITUTIONAL AMENDMENTS AND INCORPORATION

Constitutional amendments having been duly circulated in due constitutional time, and copies being attached to the agenda, J.C. Turner/D. Vere-Jones moved their adoption. After some discussion of the logic of the "secret ballot" proposal for article VIII, the motion was CARRIED

The following points were made in favour of incorporation, that the Society could legally be the object of bequests, and could legally invest its assets as a body and that its Council would no longer be severally and personally liable for debts contracted by the Society.

VII. SUB-COMMITTEE REPORTS

The convener of the Publications Sub-committee, G.C. Wake, said that the report, endorsed by the Sub-committee, would appear in the Newsletter in full, and summarised its contents.

G.C. Wake/J.C. Turner moved its adoption. CARRIED

D. Vere-Jones stressed the need to keep the general and publication accounts well separate, and asked how to augment the latter. J.C. Turner sketched the activities of the Education Sub-committee, culminating in the Supplement to the April Newsletter, and foreshadowed the possibility of a series of booklets on the school mathematics curriculum. G. Olive, convener of the Human Rights Sub-committee, said that she and her supports, A. McNabb and B. Calvert, tried to publicise cases within New Zealand, keep in touch with agencies such as Amnesty, and organise suitable protest action.

J.C. Turner moved from the chair the adoption of both reports. CARRIED

VIII. RELATIONS WITH OTHER BODIES

The President advised us that D.C. Harvie represented the Society on the Member Bodies' Committee of the Royal Society, a meeting of which he had addressed on 30 April. This address, "Cuckoos in the Mathematics Nest" should appear in the August Newsletter, (JCT) said.

J.A. Kalman, chairman of the National Committee on Mathematics, was then invited to speak. He said that

(i) the N.C.M. was the agent through which the Society's unsuccessful request for Group II status with the International Mathematical Union was forwarded to the Royal Society, but that it had agreed to keep this application on its agenda,

(ii) the N.C.M. had recommended a delegate, N.J. Gale, to ICMI IV at Berkeley, the Royal Society had appointed him with a grant towards his expenses,

(iii) that only one applicant for a grant to the Convention from the Young Scientists

Fund had come forward, and had been turned down, but that application would re-open around October for a short time, with more publicity, perhaps,

(iv) that the N.C.M. would support the Australian National Committee's efforts to get representation on the I.M.U., and - more in the distance - to have the quadrennial conference staged in Australasia, and

(v) that the Society will be asked to send a representative to the next meeting of the N.C.M.

J.C. Turner moved a vote of thanks for Prof. Kalman's work on the N.C.M. CARRIED

D. Vere-Jones asked what its relationship was with other groups of mathematicians affiliated with, or applying for affiliation with the Royal Society, and whether groups such as the statisticians should ask for support from the N.C.M. J.A. Kalman replied that at a higher level, the I.S.I. does not belong to the appropriate International Union, I.C.S.U., but that in general, the N.C.M. "looked after" most areas of mathematics, to some extent.
W.B. Wilson suggested that the Council be asked to put forward nominations for the National Committee on Theoretical and Applied Mechanics, to establish relations with that Committee, and asked if it were an oversight by the Royal Society not to have solicited nominations.
B.R. Stokes spoke briefly on the N.Z. Association of Mathematics Teachers. J.C. Turner said that the Council had just agreed to grant N.J. Gale, President of the N.Z.A.M.T., $50 towards his trip to Berkeley, and would ask him (i) to contribute an article to the Newsletter, and (ii) if he were interested in a speaking tour, perhaps early in 1981.

B. Calvert/M. Schroder moved that the Council set up a fund to support the I.M.U.'s Commission on Development and Exchange, and transfer $300 to this fund.

J.H. Ansell/A. Zulauf amended this, by substituting "." for ", and ... fund." CARRIED
The amended motion was put, and was CARRIED 14-12

Council was asked to bear in mind that many felt that (this) aid should be devoted to the Pacific Basin, as far as possible.

IX THE THESIS COMPETITION
G.C. Wake reported briefly on the difficulties of setting up the Thesis competition, and its eventual success.

X THE SECOND AUSTRALASIAN MATHEMATICS CONVENTION
Members were advised of J. McMullen's talk about the Convention, to be given the next morning. They were also advised of the funds held by the Society and the N.Z.A.M.T., and of the way grants were likely to be made.

XI ELECTION OF OFFICERS
W.D. Halford was elected President, unopposed and with acclamation.
The election for Incoming Vice-President was won by D.B. Gauld.
J.H. Ansell and M.R. Carter, nominated for the two vacancies on the Council, were thus elected unopposed.
Similarly the Auditor, A.R. Clark, was elected unopposed.

XII GENERAL
J.A. Kalman/W.D. Halford moved a vote of thanks to J.C. Turner for his year's Presidency.
CARRIED, with acclamation
W.D. Halford/J.C. Turner moved a vote of thanks to the retiring Councillors, D.C. Joyce, M. Schroder, and especially to G.C. Wake for his long and active service.
CARRIED, with acclamation
M. Schroder, having forgotten to put the due motion, destroyed the voting papers. (They weren't at all palatable).

There being no other items of general business, the meeting closed at 5.39 p.m.

28 May 1980 M. Schroder, Secretary

* * * * *

Plato said "ἀεὶ ὁ θεὸς γεωμέτρει." Jacobi changed this to "ἀεὶ ὁ θεὸς ἀριθμητίζει." Then came Kronecker and created the memorable expression "Die ganzen Zahlen hat Gott gemacht, alles andere ist Menschenwerk." F. KLEIN

REPORT OF THE PUBLICATIONS COMMITTEE 1979-80

1. INTRODUCTION

The committee consists of the following: Graeme Wake (Convener), David Gauld, Dean Halford, Garry Tee and David Vere-Jones.

The year 1979-80 has been a busy one with three NZMS publications appearing in addition to 3 issues of the Newsletter. These are:

Partitions : Yesterday and Today, by G.E. Andrews
Status - A Users Manual by W. Rogers and J. Turner
Collected Papers of the Symposium in Analysis, edited by C.J. Grigson and G.C. Wake
(Published jointly with the Victoria University Mathematics Dept.)

Inevitably the pressure of events meant that some mistakes occurred and consultation was at times inadequate (at least on the part of the convener!). However, I believe it has been a significant year for the society in terms of its publications. The fact that so much was achieved is due mostly to the hard work of members of the Publication Committee in earlier years, especially its previous convener, Kevin Broughan.

2. VENTURES COMPLETED IN 1979-80

(i) *Partitions : Yesterday and Today*
The manuscript was retyped in the Mathematics Department of the University of Canterbury and printed in their printery under the supervision of Brent Wilson, whose assistance is gratefully acknowledged. Five hundred copies were printed at a cost of $612. Notices of this publication have been distributed fairly widely as follows:

NZMS Newsletter (December 1979 issue)
Aust. Math Society Gazette (August 1980 issue)
Sankhya (Indian Math Society)
Notices of the A.M.S. (February 1980 issue - free!)
Chronicle (February 1980 issue)
ANU press catalogue (Commission sales)
Abstract in Historica Mathematica

One review has appeared so far (NZMS Newsletter, April 1980).
The distribution of copies to date (14 May 1980) is:

Distributed	Copies	Costs		
Paid	96	Printing		$612
Yet to pay	184	Postages	CU (estimated)	50
Author	100		GCW	24
Review and library copies	11	Advertisement (Chronicle)		20
	391		Total	$706
Amount received	$381			

Hence we have already recovered over half of our total outlay on this publication.

(ii) *Status* - this was also printed at Canterbury under the supervision of Brent Wilson. Distribution was arranged by John Turner at Waikato. It is understood that this has already returned a profit to the Society.

(iii) *Collected papers of the Symposium on Analysis.* This symposium was held in Wellington in June 1979. All the authors (with one exception) provided written contributions for the collected papers and this was distributed free to any member who requested it. So far about 18 copies have been distributed. The only cost to the Society was a grant of $25 towards the holding of the symposium and this was used to pay for part of the xeroxing. The remaining costs were borne by the Victoria University Mathematics Department.

3. CONTINUING VENTURES

(i) Collected Works of A.C. Aitken
Garry Tee, who is editing Aitken's collected works, is still seeking a publisher with which we could jointly publish this. (So far both Otago and Edinburgh University Presses have not agreed.) Publication costs are estimated to be $160,000 - a figure which we cannot contemplate of course. Clearly the project cannot proceed until adequate financing is found. However Garry has suggested the following:

PROPOSAL:

(a) that the Society consider setting up a charitable trust fund to which professional societies and organisations could contribute.

(b) that we continue to search for a publisher with which the NZMS could be associated in this publication.

(ii) Collected Works of K.E. Bullen
George Eiby of Wellington (Geophysics Division, DSIR, now retired) is willing to edit Bullen's works provided that some sponsor (e.g. RSNZ) can be found. The only NZMS involvement so far is the letter we have written urging RSNZ to give it favourable consideration. RSNZ initially turned it down, but are at present reconsidering it after another approach from Garry Tee.

(iii) Jock Hoe, Vol. 2
The approach we made to the French publishers of Vol. 1 did not persuade them to reconsider their decision to not proceed with Vol. 2. However, Vol. 2 is now to be published by the Science Publishing House of the Chinese Academy of Sciences in Peking. (Jock Hoe is returning to China permanently in 1981.) Also Vol. 1 is to be republished by them in English.

4. REGULAR ACTIVITIES

(i) Newsletter: This is the subject of a separate report from the Editor, Dean Halford.

(ii) Employment Brochure: the next edition has been organised by Ray Littler of Waikato. It is understood to be nearly ready for printing. Graeme Wake discussed the question of financing by Burroughs at a meeting in Wellington on 13 May 1980. It appears likely that they will be able to pay for a run of 2500 and have recommended that it be printed at their printery in Lower Hutt. (Offset printing as before.) They would like to see the manuscript first and I have arranged a meeting with their General Manager to finalise arrangements on 26 May 1980. I believe we should plan on the printing to be finished by 30 June 1980.

(iii) Post-Graduate Topics: It has been recommended by Canterbury that the format be standardised. Chris Atkin of Victoria University is prepared to arrange the 1980 edition of "Postgraduate Topics in Mathematics for 1981".
We need to confirm appointments of people to complete these tasks in 1980-81.

(iv) Relationship with Chronicle: The most significant development is the pre-colloquium meeting to cooperate with the Chronicle and the NZ Mathematics Magazine over publication of talks at the colloquium. Also we have this year fortuitously, one member of the Publications Committee in common with the Mathematical Chronicle Committee. We need to continue to exchange views on matters of common concern.

5. FUTURE VENTURES

Having completed some of the ventures begun by the foundation Publications Committee we are ready for contemplation of further ventures.

It is recommended that: The Incoming Publications Committee prepare a notice to NZ Mathematicians that the Society is prepared to be involved in publishing works, especially those with some NZ content, and that potential authors are invited to consider the Society as a vehicle for such publications.
Note: We have already been involved in discussions with David Vere-Jones, Chairman of the Mathematics Steering Committee of the Entrance Board concerning the lack of student notes and/or texts for the current 7th form applied mathematics syllabus.

It has been tentatively agreed that the Society should investigate the possibility of publishing 3 booklets to cover the present three sections of the syllabus with a view to having these accepted by the Universities' Entrance Board and in the Schools for the 1981 school year. Offers to write these notes have been received as follows:

Mechanics - Jim Ansell, John Harper and Graeme Wake, Victoria University
Probability and Statistics - John Turner and R. Cornwell, Waikato University
Computing and Numerical Mathematics

Graeme Wake,
Convener, Publications Committee, 15 May 1980.

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	Dr. G. Olive	Maths. Dept., Otago University, Box 56, Dunedin.
Editor:	Dr. W.B. Wilson	Maths. Dept., Canterbury University, P.B. Christchurch.
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	Mr. B.R. Stokes	Hamilton Teachers' College, P.B. Hamilton.
Auditor:	Mr. A.R. Clark	Accounting Dept., Victoria University, P.B. Wellington.

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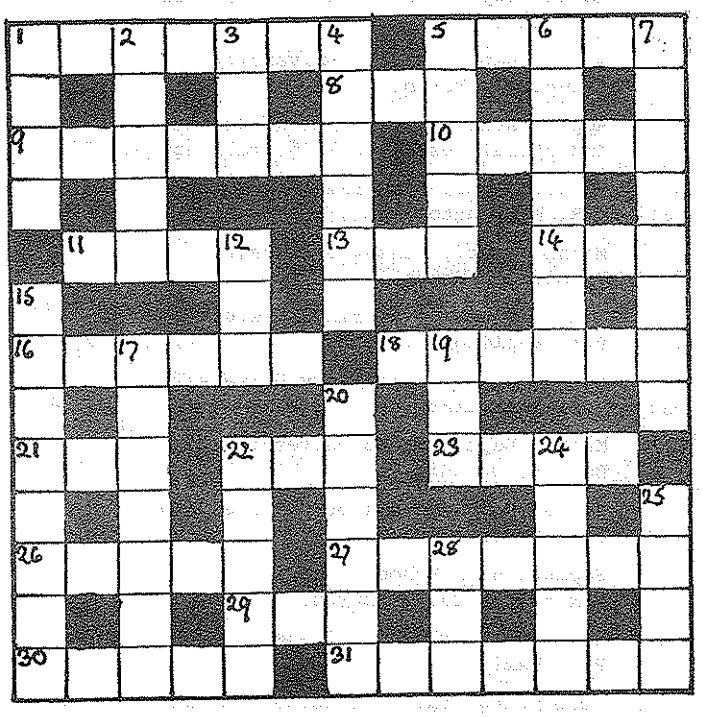
Dr. D.C. Hunt,	School of Maths, Univ. of NSW, Kensington, NSW 2033, Australia.

Crossword

N^{o} 1

by Matt Varnish



ALBERT IN A TWIST

Across:

1. Material determinant. (7)
5. A 21 which is 25. (5)
8. Often has a ring. (3)
9. Do it more than once for 31. (7)
10. A sound of modern communication. (5)
11. Yards on 3. (4)
13. See 14 across.
14. and 13 across. Urn so back to the pavilion. (3,3)
16. Creature characterised by having seven pairs of legs. (6)
18. Of marginal fame. (6)
21. Firm collection. (3)
22. A letter of sadness? (3)
23. The French and very soft northerner. (4)
26. Bow to stroke. (5)
27. Aids to proof. (7)
29. Brick carrier not always a professor. (3)
30. Often cast out. (5)
31. Σ, Σ. (7)

Down:

1. Holy number. (4)
2. Phase out form. (5)
3. One hundred unwell. (3)
4. Went on to be mint master. (6)
5. A consequence of group action. (5)
6. The little one of 18 is true. (7)
7. Full speed ahead? (7)
12. Made by Eve. (3)
15. SteEin. (7)
17. Regular goon act. (7)
19. Five yards on four. (3)
20. Prize mathematical structures. (6)
22. Graphic ways of irish aspirations. (5)
24. Smooth flat. (5)
25. Holy matter. (4)
28. Quiet mother! (3)

CROSSWORD 0. SOLUTION

Across:

1. Gains, 4. Borough, 8. Reading,
9. Thief, 10. Fiend, 11. Apology,
13. Lira, 15. Exceed, 17. Tremor,
20. Lose, 22. Vintner, 24. Trend,
26. Clean, 27. Heathen, 28. Relayed,
29. Terms.

Down:

1. Giraffe, 2. Image, 3. Swindle,
4. Beggar, 5. Ratio, 6. Uniform,
7. Hefty, 12. Pats, 14. Idle,
16. Conceal, 18. Retract,
19. Ridings, 21. Orchid, 22. Vicar,
23. Nancy, 25. Ether.