THE NEW ZEALAND
MATHEMATICAL SOCIETY (INC.)

NEWSLETTER

CONTENTS

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Dr J Rayner	Mathematics and Statistics (University of Otago)
Mr G J Tee	Mathematics and Statistics (University of Auckland)

LOCAL NEWS

DSIR
AMD Wellington

That name, DSIR Applied Mathematics, has been laid to rest. We became part of the much larger DSIR Physical Sciences Division on 1 July 1990, incorporating AMD, INS, DIT, and PEL. We are officially now the Applied Maths Group of the Division of Physical Sciences. What effect this will have on applied mathematics in the DSIR remains to be seen. In the short term, our financial and project accounting system is being changed. Meanwhile we try to get some good mathematics done despite the disruptions and extra administrative loads. There is much ado at our Wellington location lately, organising a big Quality Improvement conference called Improving Quality and Reducing Costs in the Public Sector.

There have been big changes at our Mount Albert location: Chris Triggs has taken up a position in the Department of Mathematics and Statistics at the University of Auckland. David Whitaker has taken up a position in Operations Research at Waikato University. Sue Cammell has gone to New Zealand Insurance. Jocelyn Dale has taken 6 months parental leave. John Maindonald has returned from four months in the UK, and Tony Cooper is due back soon from study leave at Stanford.

At our Wellington site, Polly Buckland and Vicky Mabin are away on maternity leave. Rona Bailey is in Europe conferencing and holidaying for several weeks. Kit Withers is in Africa conferencing and holidaying. Mark McGuinness gets to visit Japan twice this year, on commercial business. Alex Neil is soon to return from parental leave.

Mark McGuinness

DEPARTMENT OF STATISTICS
Mathematical Statistics Division

Vince Galvin has returned from his overseas travel, and Alistair Gray is back after his sabbatical leave at ISOR. Minoo Officer (nee Meimand) and Bruce have a daughter,Tara. Michael Henley has resigned, to continue his overseas travel, Michael Chappell is spending a year with Staff Training Section, and Tracy Moore has moved to Census to implement her work on the Post-enumeration survey. Rosemarie Africa will return to the Phillipines at the end of July.

Gary Houston is on leave travelling overseas. Robert Templeton will take leave for travel shortly, after giving a paper in Macau, and he will then be joined by David Fitzgerald. Claire Cameron and Martin Hamilton have joined the Division in Christchurch, and Roger Macky in Wellington.

Andrew Bruce visited the Australian Bureau of Statistics, and we entertained several visitors from there.

Mike Doherty

UNIVERSITY OF AUCKLAND
Mathematics and Statistics

Dr. Chris Triggs, who graduated from here, has been a statistician in the Mt. Albert branch of AMD/DSIR. He has now been appointed as Senior Lecturer in the Statistics Unit.

Dr. Colin Fox, who graduated from here, has been a Post-Doctoral Fellow at Otago for two years, working with Professor Vernon Squire on studies of Antarctic sea-ice. He has now been appointed as Lecturer in the Computational and Applied Mathematics Unit.

David Gauld has departed on leave, to be spent at London, Helsinki, Dubrovnik, Madison and Ann Arbor, plus the ICM at Kyoto.

Alastair Scott was an invited speaker at the Second Pacific Statistics Congress (and Tenth Australian Statistics Conference), which was held at UNSW in July. Chris Triggs and Alan Lee also attended, and Alan stayed to do some work with Nick Fisher after that Congress.

In May and June, John Butcher presented a paper at a conference at Arizona State University - Tempe, and

gave a seminar at University of California - San Diego. He was invited to Novosibirsk by the Siberian Division of the Academy of Sciences of the USSR to speak about his work on numerical solution of ODE's. He attended a performance at the Novosibirsk Ballet Theatre of a ballet based (loosely) on *Paradise Lost*. The dancers proudly shewed him a display panel of newspaper reviews of their performances, including a review by L.C.M. Saunders in *The New Zealand Herald* of their season at Auckland in *c*1975. In Vienna he gave a paper at a conference celebrating Hans Stetter's 60th birthday, and at Helsinki he gave an invited address at an international conference on Numerical Ordinary Differential Equations.

M.K. Vamanamurthy took short leave from May to July. At the University of Helsinki he gave two lectures and participated in the Rolf Nevanlinna Colloquium, at Dubrovnik he participated in the Fifth International Conference on Topology and at the University of Belgrade he gave a lecture.

Ivan Reilly led the NZ team for the 31st International Mathematical Olympiad, at Beijing in July.

Dr. Russell Blyth, a Massey graduate who is currently based at St. Louis University, is visiting for the second term. He is teaching a post-graduate course on number theory.

Professor Steve Thompson, of the University of Alaska, is a long-term visitor to the Statistics Unit.

Professor Lee Peng Yee, from the National University of Singapore, visited in May and June.

Dr. Günter Steinke, who had been a visitor here, has gone to the University of Canterbury on a Humboldt Fellowship.

The new student computing laboratories for Mathematics and Statistics, and for Computer Science, came into use in July.

The 1990 NZ Mathematics Colloquium was held at this Department in May, with members of this Department presenting the following lectures:

Ken Ashton, "Pattern matching: a general principle and its logical consequences";

John Butcher, "Some orbital test problems";

Bruce Calvert, "Convex bodies invariant under projection";

Robert Chan, "Extrapolation methods for differential equations";

Marston Conder, "Experimental algebra" (invited address);

Marston Conder and Margaret Morton, "Groups associated with 4-arc-transitive cubic graphs";

Brent Everitt, "The quasimetrization problem";

David Gauld, "Non-metric manifolds";

Lawrence Lau and Cecil Smith, "Some recent developments of *STRIDE*";

Peter Lorimer, "The geometry of the pyritohedron";

Alastair McNaughton, "Models for analytic functions";

Keith Miller, "Geometrically-based finite element methods with moving nodes" (invited address);

Ivan Reilly, "On a decomposition of continuity";

George Seber, "Blood, probability and the law";

Garry Tee, "Sir George Grey and mathematics";

W. A. Thompson Jr; "A belief theory of science" (invited address);

M.K. Vamanamurty, "Quasiconformal Schwarz lemma".

The Abstracts for all lectures presented at the 1989 *and* the 1990 NZ Mathematics Colloquia will be published in the *Mathematical Chronicle*, Volume 19.

Seminars:

Dr. David Penny (Massey University), "The Fast Hadamard Transform for Evolutionary Trees".

Dr. Brian McArdle (Zoology, University of Auckland), "The natural history of multivariate linear analysis".

Thomas Yee (University of Auckland), "Generalized additive models".

Professor Mamasichi Takesaki (UCLA), "What is continuous dimension?".

Dr. John Ryan (University of Sydney), "Dirac operators in R and C".

Professor P. M. Cohn (University of London), "Free algebras" (joint seminar with Department of Philosophy), "An Algebraist looks at coding theory; or, How to parse without punctuation".

Dr. J. N. Lyness (Argonne National Laboratory, Illinois), "Lattice rules and their generator matrices".

Dr. Giles Auchmuty (University of Houston), "Unconstrained variational methods for eigenvalue problems ".

The Seminar on Algebra, Combinatorics and Geometry has been meeting weekly, and 3 or 4 lectures each have been given by:

A-Prof. Peter Lorimer on "Manifolds and orbifolds",

Dr. Günter Steinke on "The geometry of the Laguerre planes",

Professor Russell Blyth on "Rewritability in groups", and

Dr. Marston Conder on "Computational methods in group theory".

Post-Graduate Studies:

Seven of our Temporary Tutors departed at the end of the second term, for post-graduate study at various universities in the Northern Hemisphere.

Back: Brent Everitt (Toronto), Andrew Ensor (Berkeley), Paul Turner, (Manchester), Simon Marchant (Berkeley).
Front: Andrew Balemi (Washington), Tava Lennon (Stanford), Timothy Surendonk (Rutgers).

G. J. Tee

UNIVERSITY OF CANTERBURY
Mathematics

We have two long term visitors in the department currently (July). Dr. W.A.C. Lun (Monash University) is with us until September. His research interests are in General Relativity and PDEs. Dr. Gunter Steinke (from Germany) has taken up a research position with us for about a year, and is working with David Glynn. His research interest is topological geometry. His position is mostly funded by the Alexander von Humboldt Foundation.

Graham Wood has just returned from a twelve month circumnavigation of the globe. Three months were spent in Europe working on deterministic and probabilistic approaches to the global optimization problem. This was followed by a nine month statistical gestation period spent at the Statistics Department and Business School of the University of Wisconsin at Madison. A highlight was working with a local computer company to reduce complexity within their organisation - marrying theory and practice to create efficiency.

Kevin O'Meara recently spent six weeks at the universities of Connecticut and Utah on an Erskine fellowship, studying some problems in ring theory. David Wall was also away briefly, studying inverse problems at an AMS meeting and then at a workshop in Ames, Iowa.

Professor Frederic Dias (Worcester Polytechnic Institute, Massachusetts), "Water waves in the 1980's: Recent progress"

Professor Les Woods (Mathematical Institute, Oxford), "The tutorial system in the University of Oxford", and (a Science Faculty Prestige Lecture) "Can Philosophy of Science help research in the Physical Sciences?"

Professor John Ryan (University of Arkansas) , "Dirac operators in real and complex n-space"

Professor Bert Hartnell (St. Mary's University, Halifax, Nova Scotia), "On well-covered graphs"

John Hannah

MASSEY UNIVERSITY
Mathematics and Statistics

The Statistics section have just completed a major reorganisation of their courses at all levels. At 100-level there will now be a separate paper for Business Studies students, as well as a general service paper and a paper for better-prepared students. Another major change is a move to half-papers at 300 and 400 levels, to give students greater flexibility in their choice of topics. The Mathematics section have also made a partial move to this direction, particularly in the Operations Research offerings.

Four members of the Department ("Ganes" Ganesalingam, Jeff Hunter, Charles Lawoko and Hugh Morton) attended the 10th Australian Statistical Conference/2nd Pacific Statistical Congress in Sydney during the first week of July. Jeff Hunter and Charles Lawoko presented papers, and Hugh Morton organized the session on election night forecasting.

On the Mathematics side, Dean Halford left at the beginning of July for a few months leave in the U.K. Mike Hendy has been invited to attend a workshop on Artificial Intelligence, Expert Systems and Modern Computer Methods in Systematic Biology (ARTISYST), to be held in California in September.

We have been given two new lectureships, one in Mathematics and one in Statistics—an advertisement appears on page 9 of this Newsletter.

Seminars

Roger Young (AMD Wellington), "A coupled diffusive/convective system"

Shayle R. Searle (Cornell and Auckland), "An understanding of the EM algorithm for estimating variance components"

David Kelsey (Economic Dept., ANU), "An introduction to chaos".

Hugh Morton (Massey) and Gary Thomas (AMD Palmerston North), "The aeroplane game: statistical and legal".

Dough Stirling (Massey), "Beyond Statlab: the next generation of a program for teaching statistics"

Mike Hendy (Massey), "Computing the Hadamard transformation"

Russell Blyth (St. Louis, Missouri), "Rewritability in groups"

Paul Bonnington (Massey), "Basic 'Freehand' drawing"

M.R. Carter

OTAGO UNIVERSITY
Mathematics and Statistics

It's all happening in Otago, or, if not in Otago, to Otagonians. In the interest of brevity, only the high points will be mentioned in the following report.

Our tireless leader, Professor Derek Holton has been heavily involved in the promotion of mathematics in the wider community. In early June Derek was an invited speaker at the National Mathematics Seminar of the Canadian Mathematics Competition held in Waterloo, Ontario. Without pausing long enough even to get jet lag let alone get over it, he pushed his home laundry facilities to the limit, repacked and headed off to Beijing with the New Zealand Maths Olympiad team.

Professor Vernon Squire has just returned from Cambridge where he attended the U.K./N.Z. 1990 Symposium on Antarctica and Climatic Warming.

Professor Bob Hemminger has been visiting from Vanderbilt University in Nashville, Tennessee. Unfortunately Bob will be returning to America at the end of July. His visit has proved very profitable and enjoyable for the combinatorialists in the department.

Professor Richard Anstee from the University of British Columbia will be visiting from early August for an extended period covering the northern academic year.

Professor Paul Cohn will be visiting our department for three days in mid-July. During that time he will give an address of general interest to the algebraically inclined and one aimed at the more serious ring theorists.

Professor Lyman McDonald from the Department of Statistics, University of Wyoming, will be visiting Bryan manly for three weeks in August to take part in a workshop for biologists on field sampling and resource selection, and attend ICOTS 3.

Professor Roger Mead from the Department of Applied Statistics, University of Reading, will also be arriving at about the same time, but will be staying until April 1991. Roger is the Secretary of the International Biometric Society, and a well-known expert in experimental design. Apart from interacting with University of Otago staff, he is looking forward to working with MAF biometricians at Invermay Research Station and other locations.

Earlier in the year, Gloria Olive spent several months in the U.S.A. revisiting the scenes of past triumphs, renewing old friendships and forging new links with the mathematical world. While in the U.S.A., she gave an invited address at a meeting of the Mathematical Association of America. The address was entitled "Does Rudolf Steiner have the answer?". Since returning to Dunedin, she has resumed her active pursuit of new results.

ICOTS 3 (International Conference on Teaching Statistics) will be held here in August this year. The conference is expecting 550 participants representing 48 countries—a major undertaking that we hope will prove to be very successful.

Looking further ahead, the 25th NZMS Colloquium will be held at the University of Otago from 20-23 May 1991. A hand-picked team of high-powered go-getters has been brought together to organise what is sure to be arguably the finest mathematics colloquium of its type in the world.

Robert Aldred

VICTORIA UNIVERSITY
Mathematics
Institute of Statistics and Operations Research

Terence Nonweiler retires from the Chair of Applied Mathematics at the end of the year. The chair has been discontinued, and the Department will instead be making an appointment at the Lecturer/Senior Lecturer level (see notice on page 9 of this Newsletter).

Ross Renner, University Statistician, has been awarded a PhD for a thesis entitled "On the resolution of compositional data sets into convex combinations of extreme vectors".

Our usual correspondent, John Harper, has taken a year's sabbatical, to be spent at Northwestern University, Cambridge, and Oxford. Stephen Glasby spent three weeks of July in Sydney, working with research colleagues in computational group theory. Thora Blithe and Bill Barton (visiting McCarthy Fellow) attended the Fifth South East Asian Conference on Mathematical Education at Brunei Darussalam in June. The Pacific Statistical Congress in Sydney in July received a large delegation from ISOR: Shirley Pledger, Leigh Roberts, Peter Smith, and Peter Thomson.

Rob Goldblatt

UNIVERSITY OF WAIKATO
Mathematics and Statistics

In spite of an absence from these columns the University of Waikato Department of Mathematics and Statistics is alive and kicking, as this scribe discovered after a period of leave.

Moving into building G was a significant event in the evolution of the Department. This fine permanent building of 5 storeys was one of the last to be built under the UGC Works Committee Program. Its approval was due in no small part to the efforts of our previous Vice-Chancellor Don Llewellyn. The design of most of the mathematics facilities was completed by Professor Emeritus Teddy Zulauf, who performed this herculean feat of design twice during his tenure. He has been permanently immortalised in the "Zulauf-dog-leg," feature of almost every mathematics staff office.

The building houses Computer Services, Mathematics and Statics (which at Waikato includes Operations Research) and Computer Science (including Information Systems) and thus forms an excellent home for the School of Computing and Mathematical Sciences. It was opened on 1 June by the PM who did it in passing as he waxed eloquently cn the Law School and the talents of our current Vice-Chancellor. A fine celebration followed funded by the computer companies (a surrogate donation of equipment) who had installed equipment in the building. Mathematical visitors included Marston Conder, Roger Hosking and Ivan Reilly.

Our congratulations and best wishes go to Mark Schroder, Anika and Ivan who continues to shine and thrive. In happy vein also we are glad to reannounce the engagement of Ingrid Rinsma and Mat Malchertt (Computer Science).

There have been arrivals and departures: Graham Rickard is a Post Doctoral Fellow working with Ian Craig and Alfred Sneyd (who was promoted to Associate Professor). Graham arrived early in the year. David Whitaker has taken up a joint position in the Department and Waikato Centre for Applied Statistics, bringing our number of jointed beings to 5—a record, but also a nightmare for those who count EFTS. We are sorry to be losing Peter Danaher to Auckland, not attracted there they tell me by the bright lights and long commute. As a result we have a vacancy in statistics.

Kevin Broughan arrived back from the UK in May at the end of his first term on leave. John Turner departed for North America and the UK in June. Murray Jorgensen and Ian Craig departed in July, the latter to Hawaii, Glasgow and St Andrews. Both will be presenting papers at Conferences in Australia. Ernie Kalnins will be presenting an invited address to the 34th meeting of the Australian Mathematical Society. Ian Urch arrived back from leave in Adelaide at the beginning of July.

Ian Craig and Alfred Sneyd have obtained a grant for a D.Phil student to work on a project funded by Calmaco. The student has started work and brings the number of D.Phil's working in the Department to 6. The Mathematical Software Project has obtained a grant from the Numerical Algorithms Group for work on the Senac system. A contract has been signed with the University of London for distribution of Senac in the UK and Western Europe and with Mitchell and Gauthier Associates for North America.

The Master of Computing and Mathematical Sciences degree regulations have been approved by the University and await the royal (Goff/NEQA) consent as it "monitors" our activities. We hope for a positive flow of students between institutions at the end of a first degree and would like the new degree to assist this flow.

Seminars and Visitors

Prof G Mehta (Queensland) "Mathematical utility theory and topological preordered spaces".
Dr M D Hendy (Massey) "The Hadamard transformation—A new tool for evolutionary tree analysis".
Assoc Prof A D Sneyd "Parametric resonance in mechanics and fluid mechanics."
Paul Bonnington "Separation in 3-graphs."
Dr Grant Keady "The concavity of positive solutions of some elliptic boundary value problems."
Prof Douglas Bridges "Computability in mathematics and physics—An exposition of recent work by Pour-el and Richards."
Dr Murray Jorgensen "A heroic estimation: 162 nonlinear parameters."
Dr Gerrard Liddell (Otago) "Logical mathematical computing."
Dr Peter Danaher "A generalisation of the duplication of viewing law applied to multivariate magazine exposure distributions."
Dr Graeme Wilson (Waterloo, Canada) "Huygens's principle for spin wave equations on curved space times."
Prof Giles Auchmuty (Houston) "Unconstrained variational principles for linear eigenproblems."
Prof Roger Hosking (James Cook University, North Queensland) "Tropical cyclones."
Lyn Hunt "Finite mixture models in multivariate analysis."
Dr Marston Conder (Auckland) "Cayley workshop."
Dr Russell Blyth (St Louis, Missouri) "Rewriting products of group elements."

<div align="right">K.A. Broughan</div>

NOTICES

NZMS VISITING LECTURESHIP

The Council of the New Zealand Mathematical Society would be very pleased to know about visitors who may be suitable candidates for the annual NZMS Visiting Lectureship. This lectureship usually entails a 3-week tour of the main centres of New Zealand, giving two or three lectures to general and specialist audiences in each place. Suggestions or nominations may be sent either to the NZMS President (Dr. Gillian Thornley, Department of Mathematics & Statistics, Massey University, Palmerston North), or to Marston Conder (Department of Mathematics & Statistics, University of Auckland, Private Bag, Auckland).

SIXTEENTH AUSTRALASIAN CONFERENCE ON COMBINATORIAL MATHEMATICS AND COMBINATORIAL COMPUTING

The 16th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing will be held at Massey University, Palmerston North, New Zealand during December 3-7, 1990. The conference is one of a series of annual conferences run by the Combinatorial Mathematics Society of Australasia, and is being sponsored by the Royal Society of New Zealand.

The following people have agreed to deliver one-hour invited lectures:

> Fan Chung, Bell Communications Research
> Charles Colbourn, Department of Computer Science, University of Waterloo
> Ron Graham, AT&T Bell Laboratories
> Jennifer Seberry, Department of Computer Science, Australian Defence Force Academy
> Ralph Stanton, Department of Computer Science, University of Manitoba
> Doug Stinson, Department of Computer Science, University of Manitoba
> Douglas Woodall, Department of Mathematics, University of Nottingham

There will also be half-hour contributed papers.

It is planned that the proceedings of the conference be published in the Australasian Journal of Combinatorics.

The organisers wish to thank the Royal Society of New Zealand, and Bennett's University book Centre Ltd for financial assistance, and the British Council for a generous contribution towards the airfares for Douglas Woodall.

For further information, please contact: Dr C. Little, Department of Mathematics and Statistics, Massey University, Private Bag, Palmerston North.

NZMS AWARD FOR MATHEMATICAL RESEARCH

As announced at the Annual General Meeting in May, the NZMS Council has decided to instigate an award for mathematical research in New Zealand. Details of the award scheme, which will commence immediately, are given below.

Please note that candidates may either apply for the award themselves, or be nominated (provided they give their consent). **For the inaugural awards, to be made in May 1991, research work published by candidates in the last ten years (that is, since 1980) will be taken into account,** but from 1992 onwards only work published in the last five years will be considered. The form of application is described under the "Procedures" section below.

Purpose of the award

The purpose of this award is to foster mathematical research in New Zealand and to recognise excellence in research carried out by New Zealand mathematicians.

Procedures

Applications are called for now. Nominations may also be accepted but only with the candidate's written consent.

Applicants must have been residents of New Zealand for the previous three years. They should send the following to the Secretary of the NZMS by 1 October:

- Name and affiliation
- Statement of general area of research
- Names of two persons who are willing to act as referees
- A list of research published within the previous five calendar years
- Two copies of each publication listed
- A clear statement of how much of any joint work is due to the applicant.

The award will be based on mathematical research published in books or recognised journals within the previous five calendar years only.

A judging panel shall be chosen by the NZMS Council. The judges may call for reports from the nominated referees and/or obtain whatever additional referees' reports they feel necessary.

The judges shall recommend one person for the award, or a joint award to more than one person, or that no award be made.

No person shall win the award more than once.

The award shall consist of a certificate including an appropriate citation of the awardee's work.

Publicity

Announcements of the award(s) and presentation of certificate(s) for any year shall be made at the Annual General Meeting of the Society (if at all possible). Also an announcement including the appropriate citation(s) shall be made in the NZMS Newsletter, and in a national press release.

MASSEY UNIVERSITY
Lectureships in Mathematics and Statistics

The Department of Mathematics and Statistics has vacancies for lecturers in Mathematics and in Statistics. Applicants should possess a higher degree in Mathematics or Statistics. The Department is particularly interested in seeking candidates with expertise in one or more of the following areas: applied analysis, mathematical programming, mathematics education, applied probability, applied statistics and statistical consulting. However candidates with qualifications in other areas are encouraged to apply. The Department teaches undergraduate, postgraduate and service courses and supervises research degrees to the PhD level. Courses are also taught by correspondence throughout New Zealand. The appointee would be expected to contribute to the research and consultancy activities of the Department, to interact in a substantial way with one or more of the research groups in the Department and to participate fully in its teaching programs.

Further information can be obtained from the Head of Department.

Salary: $36,000 – $47,200.

Applications including a full curriculum vitae and the names and addresses of three referees should be sent to Mrs V B Bretherton, Personnel Section, Massey University, Palmerston North, New Zealand before 31 August 1990.

VICTORIA UNIVERSITY OF WELLINGTON
Lectureship/Senior Lectureship in Mathematics

The Council of Victoria University of Wellington invites applications from suitably qualified women and men for a Lectureship/Senior Lectureship in the Department of Mathematics, tenable from 1 February 1991.

Applications in all areas of mathematics will be considered seriously, and are particularly welcome in

fields relevant to modern applications of mathematics, or computational mathematics. Applicants are expected to show strong potential in both teaching and research.

Enquiries about academic aspects of the position may be directed to Professor Rob Goldblatt, Department of Mathematics, e-mail (Internet): rob@math.vuw.ac.nz.

The salary scale for Lecturers is $36,000 – $NZ43,700 per annum where there is a bar; then $NZ45,000, $NZ46,100, $NZ47,200 per annum;

Applications should be sent to the Appointments Administrator, Victoria University of Wellington, P.O. Box 600, Wellington, New Zealand with whom applications close on 1 October 1990.

The University is an equal opportunity employer.

REPORT ON THE 1990 NZ MATHEMATICS COLLOQUIUM

The 1990 New Zealand Mathematics Colloquium was held in the Department of Mathematics & Statistics at the University of Auckland, from Monday May 14th to Thursday May 17th. The last day was the Mathematics Education Day, which was organised separately from the first 3 days of the Colloquium.

Organising Committee:

John Butcher (programme), Marston Conder (sponsorship), Jill Ellis (Education Day), Simon Fitzpatrick (treasurer), David Gauld (invited speakers), Alan Lee (social), Alastair McNaughton (Education Day), Margaret Morton (Education Day), Ivan Reilly (Education Day), Alastair Scott (chairman), Garry Tee (secretary).

Mathematics Colloquium—First 3 Days:

There were 95 delegates and 43 lectures were delivered. The invited speakers were:

Dr. Gillian Thornley, Massey University, New Zealand Mathematical Society Lecturer, "Differential geometry—connections!".

Professor Jeffrey Hunter, Massey University, "Generalized inverses and their application to problems in applied probability".

Professor Keith Miller, University of California - Berkeley, "Geometrically based finite element methods with moving nodes".

Dr. Brailey Sims, University of Newcastle, Bank of New Zealand Lecturer, "The existence question for fixed points of non-expansive mappings".

Dr. Marston Conder, University of Auckland, Mathematical Chronicle Lecturer, "Experimental algebra".

Professor Jim Ansell, Victoria University, "Mathematical seismology 1890 and 1990".

Professor Bill Thompson, University of Missouri - Columbia. "A belief theory of science".

The Colloquium was supported by the following sponsors:
Air New Zealand,
Bank of New Zealand,
The New Zealand Mathematical Society,
The Mathematical Chronicle Committee, Department of Mathematics & Statistics, University of Auckland.

A booklet of abstracts for all Colloquium lectures was issued to all delegates when they registered. The Business Meeting was held on Monday 14th (with the 1991 Colloquium being allocated to the University of Otago), the annual meeting of heads of mathematical departments and the Annual General Meeting of the NZMS were held on Tuesday 15th, and the National Committee on Mathematics met on Wednesday 16th. A Social Hour, hosted jointly by the Colloquium Organisers and the NZMS Council, was held in the Senior Common Room on Monday 14th. The Colloquium Dinner was a Chinese banquet at the Sun Sun Restaurant on Tuesday 15th, which was attended by 76 people.

Mathematics Education Day:

Over 200 teachers—primary, secondary and tertiary—attended the Mathematics Education Day on Thursday May 17th. The invited speakers were :

Brenda Burns, Glenfield College, "Reality in the secondary mathematics classroom".

Jenny Young-Loveridge, University of Waikato, "The development of number concepts in 5- to 9-year olds".

Trevor Boyle, Ministry of Education, "Hey, Teach! It's up to you".

In the afternoon, 16 workshop sessions were held, followed by an informal gathering with fruit juice, wine and cheese.

The Mathematics Education Day was co-sponsored by the Auckland Mathematics Association, EQUALS Mathematics/Science network, MECA (Mathematics Education Centre Auckland) and the Primary Mathematics Association.

<div align="right">

GJ Tee
Colloquium Secretary

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LETTER TO THE EDITOR
From S. W. Taylor

Dear Sir,

As a medical student in the late 1940's I was impressed by the statement, still valid today, that although the function of every other organ in the body has long since been elucidated, that of the brain, as mind, remains unresolved. Meaning that our knowledge of brain function cannot be extended in a linear or any projective manner into the foundational system of a knowledge of knowledge as a whole. We have in our understanding, no grasp of the integration of brain and mind, equivalent for instance to the integration of form and function which exists in our knowledge of the heart and its circulatory system.

This led me to undertake an extensive reading in the journals of physiology, psychiatry and neurophysiology etc., beginning what was to become a life-long study of this problem; not so much to elucidate mind in terms of brain as to determine the ground upon which it could be approached. As this work progressed I became more and more convinced that mind as such has a mathematical substratum. Ordinarily we study math as a subject upon which our attention is directed, but in my thesis 'math', as a basic and essential pattern, exists in the foundation of mind itself. My study therefore led me to believe that math must be circular through and through. Indeed I could pose it as a Law, that math cannot be other than circular in essence because of this, its relation to mind.

In this view circularity is the first and most fundamental characteristic in all math; and there can be no math escaping this circular nature.

In recent years I have been joined in this work by my son, and we now feel able to defend this thesis (of circularity) in all mathematical branches whatsoever. In various papers (1 2 3), we have been able to show that arithmetic's fundamental rules, and in particular those of positive and negative signed numbers, and the associative, commutative and distributive laws, can be easily demonstrated upon the basis of circular counting lines. We can further show that these circular lines, their algorithms, rules and results encompass the whole of arithmetic and that a total circular framework for arithmetic is valid.

The subject is of wide scope ranging from teaching material for children to higher math; and from psychology to physics. Besides the articles noted we have seven published books. We would be pleased to expound the subject in any way we could which might lead to an interdisciplinary interest and expression of opinion.
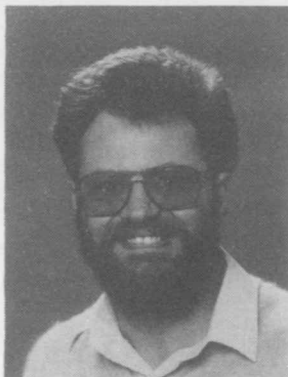
<div align="right">

R.M. Taylor,
S.W. Taylor M.B., Ch.B.
Auckland

</div>

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[2]   The Distributive Laws, R.M. Taylor, The N.Z. Maths. Magazine, Dec. 1984, Vo. 21, no. 4, 126-132.

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NEW COLLEAGUES

CHRIS TRIGGS

Dr Chris Triggs has recently joined the Statistics Unit within the Department of Mathematics and Statistics at Auckland University as a senior lecturer. Chris is a graduate of that department receiving his B.Sc. and M.Sc., and subsequently Ph.D. after being supervised by George Seber, (and encouraged by Alastair Scott).

After teaching in England at the University of Nottingham for six years he returned to New Zealand to join what was then the Applied Mathematics Division of the DSIR, being based at the Mt Albert Research Centre. Chris's research interests are in analysis of variance and experimental design, and in the problems arising from statistical consulting in the fields of biometrics and market research.

COLIN FOX

Dr Colin Fox was recently appointed to a lectureship in the Applied and Computational Mathematics Unit within the Department of Mathematics and Statistics at Auckland University. Colin was born in Kawakawa on the austral summer solstice in the year of the Earth-Boar but spent most of his early life in Northcote. He received his undergraduate and masters education at the University of Auckland in the years 1978 to 1983. For some of this period he and a partner operated a business selling single board computers of their design and supplying custom made audio equipment to disco operators. His MSc thesis (in Physics) was entitled 'An Acoustic Direction Finder'.

His PhD was completed in 1988 within the Cavendish Laboratories at Cambridge University with thesis title 'Conductance Imaging'. Since completing his doctorate, Colin took up a post-doctoral fellowship at the University of Otago where he worked with Prof. Vernon Squire on the study of ocean wave propagation through ice infested waters. In spring 1989 they teamed up with colleagues from Victoria University and the DSIR to measure physical properties of sea ice in Antarctica. Colin's current research interests include wave-ice interaction, inverse problems, measurement of acoustical parameters and numerical solution of boundary value problems.

BOOK REVIEWS

*Lectures on Numerical Methods in Bifurcation Problems,*by H.B.Keller.   Tata
Institute Lectures in Mathematics, Bombay; Springer-Verlag, Berlin, 1987, iv+155pp, DM 20.
ISBN 0-387-28367-1.

Another review of this book appears in Rheinboldt [1988]. (Both Keller and Rheinboldt are leading
contributors to the area: also both have computer packages for problems in it. See also Rheinboldt [1986] for
the code for one of the packages.)

Keller's book is based on transcriptions of his lectures presented at the Tata Institute. This set of lectures
was held in December 1985 and January 1986. (Some readers of this newsletter have heard similar lectures
given by Keller on his visit to Massey University around the time of the May Colloquium there in 1989.) The
course materials included Keller's computer package in the area and anyone considering offering a course in this
area using the book under review should also use this software and its user manual. (The version of the manual
which I've studied is Doedel [1986].) The book and the manual are complementary: the book under review
covers the theoretical aspects only.

The problem treated is as follows. Let X be a Banach space, which when applied to numerical
computations is usually R^N, ordinary Euclidean N-space. Let I be an interval of reals. Let f map the
Cartesian product $X \times I$ into X (and suppose that f is appropriately smooth). The problems treated are of the
form: find, as λ varies over the interval I, the families of solutions (λ, x), with x in X, solving

$$f(x,\lambda) = 0.$$

A favorite technique of solving nonlinear problems, for which one has a good approximation to the solution, is
Newton iteration:

$$x_{n+1} = x_n - (Df(x_n,\lambda))^{-1} f(x_n,\lambda).$$

Here $Df(x_n,\lambda)$ is the derivative (regarding λ as fixed), in finite dimensions sometimes called the Jacobian
derivative. In "branch-following" or "continuation" techniques, one uses knowledge of a solution on the branch
to move along the branch to a new solution. Such problems appear in many different forms: my own interests
having primarily been in differential equations applications.

In the differential equations applications the special form

$$f(x,\lambda) = Ax - \lambda g(x),$$

where A is an operator related to a linear boundary-value problem, occurs quite frequently. It occurs sufficiently
frequently that problems

$$Ax = \lambda g(x),$$

have their own special name: *nonlinear eigenvalue problems*. A favorite easy example concerns $N=1$,
$X=R^1$, say $A=1$, and $g(x)=x(1-x^2)$. The solutions come in two sorts. First there is the *line of trivial
solutions* $(\lambda,0)$. Something special happens as λ increases past 1. For $\lambda > 1$ there are other solutions
$(\lambda,X(\lambda))$ and $(\lambda,-X(\lambda))$ with

$$X(\lambda) = (1- (1/\lambda))^{1/2} .$$

The point $(1,0)$ is an example of a bifurcation point. The diagram in the (λ,x)-plane representing the solutions
is an illustration of a *pitchfork bifurcation*.

Besides bifurcations occurring starting with small solutions, they can start from large solutions:
bifurcation from infinity. This reviewer's first own efforts with computational "branch-following" involved
problems with bifurcation from infinity and are described in Keady and Norbury [1980]. I also share with Keller
an interest in the "nonlinear functional analysis" which underpins the subject. For many years I have taught
numerical analysis and, associated with this, the first item associated with Keller which I read was the minor
classic of text-book writing, Isaacson and Keller [1966].

I first read of Keller's bifurcation problems package in his 1977 reference. I know one user at University
of N.S.W. Also some applied mathematicians at Massey are considering acquiring the package (but, as usual,
there are complications such as what machine it should be put on, and the usual uncertainty about new machines
about to come, and the fact that tuning up the package to make best use of its graphics on the local hardware

would take time so that it is important to get the decisions right). So far my own problems have been sufficiently simple that my own code has sufficed. Should this change in the future, I would certainly give Keller's package a try.

Typically the N in differential applications is of the order of thousands (and very much more in some partial differential equation problems in more space dimensions). Efficiency really matters. Following the branches around curves, e.g. a local extremum of λ, and locating secondary bifurcation points and moving along them are two problems one wants the computer package to do well. Keller's package does. Keller's book describes some of the mathematics underpinning this: here a theory of continuation and path following.

Chapter I gives some examples. Chapter II collects various basic theorems—Contraction Mapping Theorem, Implicit Function Theorem, Newton-Kantorovich Theorem—and then applies them to a local analysis of continuation methods. Chapter III turns to global continuation results based on degree theory and homotopy invariance. Chapter IV concerns practical aspects of the numerical path-following methods, including techniques pioneered by Keller and central to how his computer package works. Chapter V discusses two computational examples which, I believe, were done (well) by students of the course in India.

I would have preferred a much larger bibliography. I also think that the absence of an index is deplorable in these days of computer typesetting or word-processing. On the positive side, there are relatively few misprints: I have found some on p17, 34, 50, 121,130 and 154. A possible complication in connection with recommendations for library purchase is that, in the preface, Keller states that his notes are being independently prepared for publication in a more extended form than these Tata lectures.

I will conclude with a remark concerning the computational environment, the world, into which Keller's efforts are offered. No remark like this is made in his book, presumably because of its theoretical orientation. I believe that packages like Keller's (and hence also the theory in his lecture notes) will become much more widely used by mathematicians and other scientists when standard symbolic computing packages like REDUCE, Maple, Macsyma, Mathematica, or more specialised environments for interfacing symbolic and numeric computing such as Waikato's SENAC, are used to prepare the code for the subroutines specific to the bifurcation problem being considered. For more on my crusade on automating code production for Newton iteration, see Keady [1990].

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[4]   Keady, G. Equilibrium flows of water in pipe networks: a SENAC case study and a discussion of some other developments at the symbolic-numeric interface. *Research Report, Maths Department, University of Waikato*, 1990.
[5]   Keller, H.B. Numerical solution of bifurcation and nonlinear eigenvalue problems. In P. Rabinowitz (ed.), *Applications of bifurcation theory*, Academic Press, 1977.
[6]   Rheinboldt, W.C. *Numerical solution of parametrized nonlinear equations*, Wiley, 1986.
[7]   Rheinboldt, W.C. *SIAM Review*, 30 (1988), 677.

Grant Keady
University of Waikato

*Conformal Geometry and Quasiregular Mappings,*by M.Vuorinen. Lecture Notes in Mathematics, Volume 1319, Springer-Verlag Berlin-New York, 1988, xix + 209pp, DM 35. ISBN 3-540-19342-1.

This book represents a survey of the properties of quasi-regular and quasi-conformal mapping in euclidean n-space R^n ($n \geq 2$). These mappings generalize analytic functions of the plane to higher dimensional euclidean spaces. The author also introduces the concepts of moduli of path families and conformal capacities of condensers and proves several inequalities for them. He applies these inequalities to prove distortion theorems of quasi-regular mappings.

Chapters I and II introduce conformal geometry; in particular the properties of Möbius Transformations, the hyperbolic and quasi-hyperbolic metrics in R^n, then moduli of path families, capacities of condensers and other useful conformal invariants. In particular the moduli of Teichmuller and Grötzsch extremal condensers get

exhaustive analysis. These are the means by which quasi-regular maps can be studied.

Chapters III and IV deal mainly with the properties of Quasi-regular mappings. For $1 \leq K < \infty$ a map, $f : \Omega \to R^n$, is K-Quasi-regular over a domain $\Omega \subset R^n$ iff

$$|f'(x)| \leq KJ(x, f) \quad \text{a.e. } x \in \Omega, \text{ where } J \text{ is the Jacobian of } f.$$

In the particular case when f is injective one obtains quasi-conformal mappings. These mappings constitute a rather wide class of mappings which are much better known than the class of quasi-regular mappings. The theory of quasi-conformal space mappings is already presented in J. Väisälä's book (1971). The present book is the first book in English about quasi-regular mappings.

In chapter III basic definitions are introduced and theorems are given without proof. The tools developed in the earlier chapters are then used to obtain numerous estimates of the modulus of continuity for mappings of certain domains in R^n. Chapter IV discusses the boundary behaviour of quasi-regular maps and the book ends with an assortment of open problems.

The author presents ideas in a natural and "flowing" manner. Numerous examples are cited and great lengths are gone to extract as much information about a particular function or property. Diagrams are used to great effect to augment intuition and to develop a better understanding of the subject matter. There are nearly a hundred exercises of varying difficulty which complete the text. Finishing the book with a list of open problems challenges the reader to a participatory role and reveals the relatively recent and dynamic nature of this area of mathematics. As such this work represents a comprehensive and invaluable source on the nature, properties and uses of conformal geometry and quasi-regular (conformal) mappings and could be a fine graduate text on this subject.

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Andrew P. Balemi
University of Auckland

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Gauge Field Theory and Complex Geometry, by Y.I.Manin, translated from the Russian by N.Koblitz and J.R.King. Grundlehren der mathematischen Wissenschaften, Bd 289. Springer-Verlag, Berlin- Heidelberg-New York, 1988, x + 297pp, DM 154. ISBN 3-540-18275-6.

In recent years a number of new ideas have entered the arena of theoretical physics and as a consequence have had important implications in mathematics. The book by Manin deals with three such families of ideas—those of non-abelian gauge field theory, of twistor theory and of supersymmetry.

Gauge theory in the present context means the study of the Yang-Mills equations. The Yang-Mills equations thus may be thought of as natural generalisations of both Maxwell's equations and the Hodge equations for a harmonic form. Unlike these equations however the Yang-Mills equations become nonlinear when the fibres of the associated vector bundle have higher dimension. These equations (or more correctly their quantised version) are now widely believed to govern the strong force which binds together the nuclei of atoms and a slight variant is used to account for the weak force which regulates the beta decay of neutrons.

Twistor theory, the second family of geometric ideas, arises out of connections between the conformal geometry of Minkowski space, complex analysis and solutions of certain conformally invariant differential equations such as Maxwell's equations. The set of all light rays in Minkowski space has the structure of a 0.5 dimensional real hypersurface in a complex 3 manifold, viz. it can be identified with a real hyperquadric in a complex projective 2 space minus a projective line. This (projective) twistor space is known as $CP(3)$. The key observation is then that certain holomorphic objects on $CP(3)$ correspond to solutions of conformally invariant partial differential equations via the Radon Penrose transform. In particular holomorphic vector bundles on twistor space give rise to self dual solutions of the Yang-Mills equations in space time. These solutions are not physically admissible classical solutions of the Yang-Mills equations but are considered to have an important influence on the quantum version of the theory where they allegedly give rise to tunnelling behaviour. Solutions to the self dual equations in Euclidean space are the so-called instantons. These have all been classified using the twistor correspondence which reduces the problem to one of classifying algebraic vector bundles on $CP(3)$ subject to extra conditions.

As already mentioned the self dual solutions of the Yang-Mills equations are not the most physically interesting. The interesting solutions are those which have compact holonomy on Minkowski space. Solutions of this form were found where the twistor space $CP(3)$ is replaced by a certain non-reduced complex projective variety in $CP(3) \times CP(3)$. The establishment of these solutions follows most readily from

arguments involving supersymmetry and complex manifolds. Manin devotes half of the book to a systematic development of the theory of complex supermanifolds. In so doing he has provided a valuable contribution to the expository literature as well as an original piece of research. The treatment is not only of the mathematical foundations but also provides insight as to the physical motivation. Interesting treatments of the super-Yang-Mills equations and $N = 1$ supergravity are given. In particular an account is given of the twistor correspondence for the super-Yang-Mills equations.

Many recent developments have not been covered in this text principally because the original Russian version was written some years ago. However the book provides a large amount of background for current research across a spectrum of fields. The book requires effort to read but it is worthwhile and rewarding.

E.G.Kalnins
University of Waikato

Tsirelson's Space, by Peter G.Casazza and T.J.Shura. Lecture Notes in Mathematics, Volume 1363, Springer-Verlag, Berlin-Heidelberg-New York, 1988, viii + 204pp, DM 35. ISBN 3-540-50678-0.

The simplest examples of Banach spaces (over the real scalars) are the sequence spaces

$l_p := \{ (x_n) \mid \sum_{n=1}^{\infty} |x_n| < \infty \}$ with $\|x\|_p := \sum_{n=1}^{\infty} |x_n|$ where $1 \leq p < \infty$ and $c_0 := \{ (x_n) \mid x_n \to 0 \}$

with $\|x\|_\infty := max_n |x_n|$. For many years every new infinite dimensional Banach space discovered happened to contain one of these sequence spaces, where E is said to contain F provided F is linearly topologically isomorphic to a subspace of E. This led to the general feeling that all infinite dimensional Banach spaces should contain one of these sequence spaces.

However, this proved to be far too optimistic a view of the way a structure theory for Banach spaces would develop. Indeed, the Soviet mathematician Boris Tsirelson produced an example of an infinite dimensional Banach space of sequences which does not contain c_0 or l_p for any p, and this book is devoted to discovering the structure and properties of this space, its dual, and the various generalizations of it that have proliferated. The authors take T to be the dual of Tsirelson's original space; since T is reflexive, the original Tsirelson space is recovered as the dual T^* of T. The reason for this choice is that Tsirelson originally defined his space abstractly and an analytical description of the norm of T^* is still not available, while the norm of a finitely nonzero sequence in T can be explicitly defined.

Nevertheless the norm of a finitely nonzero sequence is usually not easy to calculate, and the second appendix to the book gives an algorithm for computing the norm. I tested this Pascal program on a Sun 4 computer and found it to be quick and useful. There is nothing like painlessly calculating the norms of a few dozen short sequences to give one the (possibly misleading) impression that one is starting to get an idea of what is going on.

One reason for studying T and its analogues in great depth is that there are many conjectures about reflexive Banach spaces and several of them are refuted by these counterexamples. Of course the study of T then generated more conjectures. One curious property that Tsirelson's space has which is not even shared by the Hilbert space l_2 is that the space $H(T^*)$ of holomorphic functions on T^* is reflexive. Unfortunately the authors didn't have room to include the proof of this singular case of Tsirelson's space behaving better than l_p.

The first appendix is a discussion of weak Hilbert spaces, which are Banach spaces which have weak type 2 and weak cotype 2 (neither of which can be quickly defined here). The reason this is relevant to this book is that "2-convexifications" of Tsirelson's space are the main examples of weak Hilbert spaces that are not isomorphic to real Hilbert spaces.

In general the proofs given in this book are quite complicated, but they are set out in a way that allows the casual reader a general overview without attempting to digest the details. I recommend this way of reading the book.

The reflexivity of Tsirelson's space led Haskell Rosenthal to state "The Problem": Must every infinite dimensional Banach space contain c_0, l_1 or an infinite dimensional reflexive space? Since there are nice results known about Banach spaces which contain c_0 or l_1, a counterexample to this would be even more interesting than Tsirelson's space.

Simon Fitzpatrick
University of Auckland

SPRINGER-VERLAG PUBLICATIONS

Information has been received about the following publications. Anyone interested in reviewing any of these books should contact

David Alcorn
Department of Mathematics and Statistics
University of Auckland

Applications of Mathematics

21. Protter P   Stochastic Integration and Differential Equations. 302pp.

Ergebnisse der Mathematik und ihre Grenzgebiete.3.Folge

21. Bosch S   Néron Models. 340pp.

Graduate Texts in Mathematics

41. Apostol TM   Modular Functions and Dirichlet Series in Number Theory. 2nd ed. 205pp.
121. Lang S   Cyclotomic Fields I-II. 2nd ed. 440pp.

The IMA Volumes in Mathematics and its Applications

19. Stanton D(ed)   Invariant Theory and Tableaux. 305pp.

Universitext

Emery M   Stochastic Calculus in Manifolds. 168pp
Verhulst F   Nonlinear Differential Equations and Dynamical Systems. 277pp.

Miscellaneous

Zeidler E   Nonlinear Functional Analysis and its Applications. Part II/B: Nonlinear Monotone Operators. 733pp.

MATHEMATICAL VISITORS TO NEW ZEALAND

List No.26 : 1 July 1990

The information for each item is arranged as follows:
Name of visitor; home institution; whether accompanied; principal field of interest; dates of visit; principal host institution; principal contact person; comments.

One of the main purposes of this list is to enable other institutions to invite visitors to spend time with them. Anyone wishing to issue such an invitation should do so through the principal contact person.

Professor Richard Anstee; University of British Columbia, Canada; combinatorics; September 1990 – June 1991; University of Otago; Prof. Derek Holton.

Dr. Russell Blyth; University of St. Louis, Missouri; wife (Peg) & child; group theory; June – August 1990; University of Auckland; Dr. Marston Conder. Dr. Blyth's visit is being partly supported by the University of Auckland Foundation.

Professor G.E.P. Box; University of Wisconsin, Madison, U.S.A.; wife (Claire); statistics & quality improvement; 14–18 July 1990; University of Waikato; Prof. J.A. John.

Professor P.M. Cohn; Bedford College, University of London; algebra; 8–18 July 1990; University of Otago; Prof. Derek Holton.

Ms Kay Gilliland; EQUALS, University of California, Berkeley; mathematics education, equity in mathematics, sciences & technology; 4 June – 5 September 1990; University of Auckland; Dr. Margaret Morton. Kay Gilliland is a Fulbright Scholar.

Professor Chris Godsil; University of Waterloo, Ontario; wife (Gillian Nonay) & daughter; graph theory & algebraic combinatorics; March – April 1991; University of Auckland; Dr. Marston Conder.

Professor R. Hemminger; Vanderbilt University, Tennessee; graph theory; September 1989 – July 1990; University of Otago; Prof. Derek Holton.

Dr. Flavia Jolliffe; Brunel University, U.K.; statistics teaching; August 1990; University of Waikato; Dr. Fay Sharples.

Dr. Grant Keady; University of Western Australia; wife & daughter; symbol manipulative computation, differential equations; 1 July 1989 – 30 June 1991; University of Waikato; Dr. Kevin Broughan.

Professor Toby Lewis; The Open University, U.K.; statistics; 19–31 August 1990; University of Otago; Prof. Brian Manly.

Professor D.V. Lindley; retired (U.K.); Bayesian statistics; 27 August – 5 October 1990; University of Canterbury; Prof. John Deely. Professor Lindley will be an Erskine Fellow.

Dr. Lyman McDonald; University of Wyoming, U.S.A.; wife; statistics; 1–31 August 1990; University of Otago; Prof. Brian Manly.

Professor F.R. McMorris; University of Louisville, Kentucky; combinatorics, mathematical phylogeny; 2–17 December 1990; Massey University; Dr. Mike Hendy.

Professor Roger Mead; University of Reading, U.K.; wife; statistics; August 1990 – April 1991; University of Otago; Prof. Brian Manly.

Professor Marcel Neuts; University of Arizona; wife (Olga); algorithmic probability & queueing theory; 16 July – 10 August 1990; University of Auckland; Prof. George Seber. Professor Neuts is a University of Auckland Foundation Visitor for 1990.

Dr. Gillian Nonay; Wilfrid Laurier University, Ontario; husband (Chris Godsil) & daughter; graph theory, combinatorics; March – April 1991; University of Auckland; Dr. Marston Conder.

Professor Jerome Spanier; Claremont Graduate School, California; wife; numerical analysis, applied mathematical modelling, Monte carlo methods; 1 September – 30 November 1990; Massey University; Profs Jeff Hunter & Graeme Wake. Professor Spanier is a Fulbright Visiting Professor.

In addition to those listed, a number of overseas visitors are expected to attend the **16th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing**, to be held at Massey University, 3–7 December 1990. See the list given in the April 1990 issue of this Newsletter. Further details may be obtained from Dr Charles Little (Department of Mathematics & Statistics, Massey University, Palmerston North).

Please note: Production of these lists is dependent on my receiving information. When you know about a visit (whether it be definite, very likely, or possible), would you please forward the details to me at the earliest convenient time. Thank you.

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Marston Conder
NZ Mathematical Society Visitors' Co-ordinator
Department of Mathematics & Statistics
University of Auckland

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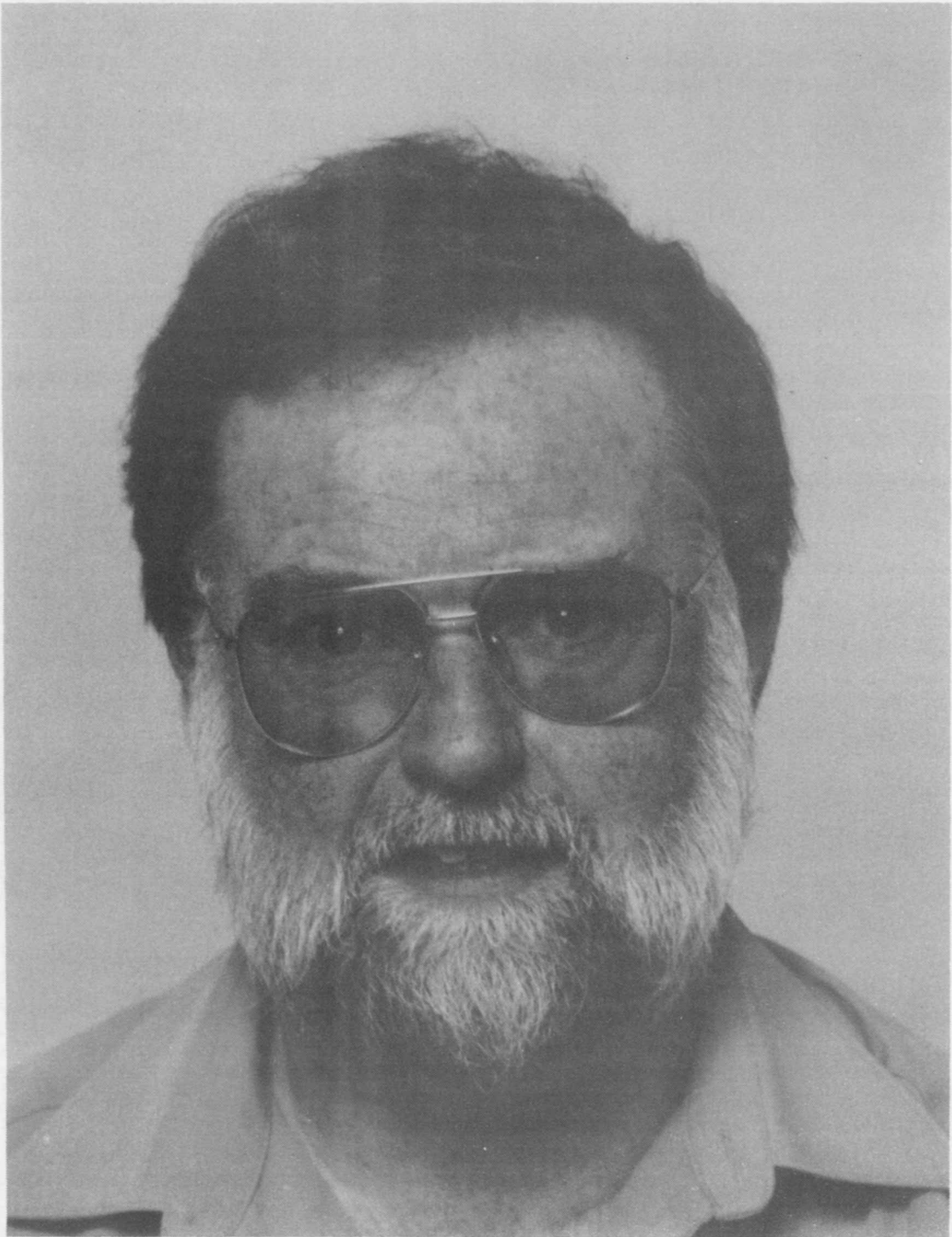
Prof Derek Holton

DEREK ALLAN HOLTON

By John Rayner

Derek Holton is British by birth, mainly Australian by education and family ties, and a New Zealander by recent adoption. Currently he is the genial and energetic Professor of Pure Mathematics, and about to start his second five year term as Chairman of the Department of Mathematics and Statistics at the University of Otago. Since taking on these positions, Derek has impressed both the local and national mathematical communities with the breadth and vigour of his mathematical and administrative achievements.

Derek Allan Holton was born at Chesham Buckinghamshire on January 24, 1941. His family emigrated to Melbourne, Australia in 1957. There Derek completed his B.Sc. in 1961, Dip. Ed. in 1962, and M.A. in 1967. In the midst of this activity, Derek and Marilyn were married in 1965. Sara, their first child, was born in 1967. Timothy arrived in 1969 while the family was in Montreal. There Derek received his Ph. D. from McGill University in 1970. Then it was back to the University of Melbourne as a lecturer. Nicholas and Matthew were born in Melbourne in 1970 and 1971. Apart from visiting appointments, Derek remained there until accepting the chair in Dunedin in 1985.

Derek's research in graph theory and combinatorics has developed from his Ph. D. in group theory at McGill. Groups figured prominently in his early work with graphs, where he used the automorphism group of a graph to study its structure. In later years he has studied the structure of graphs using the machinery of graphs themselves. These investigations have led to results in planarity of graphs, cycles through specified vertices and edges, and related structural characterizations of graphs. Derek has worked with many of the biggest names in graph theory/combinatorics, and is well respected in their ranks. The numbers in these ranks have been swollen by the interest Derek has stimulated. Top class research students have been attracted from around the world to work with Derek. Many have gone on to become leaders in graph theory/combinatorics.

As well, Derek has been involved in Mathematics Education, such as projects assessing the differences in boys and girls mathematical performances. One of the interesting results to come out of these collaborations is that despite girls' superior verbal skills, they do not perform as well as boys on mathematical word problems.

To the detriment of his research, Derek has pursued the popularisation of mathematics and science. To quote him,

> "People need to know that we exist, what it is that we do and where it might all lead. They also need to know that we enjoy doing it."

Most obvious have been his contributions in radio and television. Amongst these, in 1985 and 1986 he appeared on the ABC Science Show; in 1986,1987, 1988 and 1989 he had varying input to University Challenge; in 1987,1988, 1989 and 1990 he was a consultant for the Krypton Factor. There have been several books and articles of general interest, and service on enumerable committees. But of major note has been his work with the more able students. In 1986 Derek launched the National Bank Junior Mathematics Competition, which has run most successfully since then. This year there were over 6000 participants. These competitions have identified New Zealand's most able young mathematicians. From them a select few have participated in training camps, with the elite going on to represent their country in Mathematical Olympiads in Canberra, in Braunschweig (West Germany), and, in 1990, in Beijing. In January of this year Derek helped launch Hands–on Science in Dunedin. This was a science summer camp for 140 school students of exceptional ability. The principal emphasis was on hands–on participatory activities in a wide range of disciplines, including anatomy, food science, marine science, mathematics, human nutrition and psychology.

Since 1989 Derek has been Deputy Chairman for the Division of Sciences at Otago University. He is currently Vice President of the New Zealand Mathematical Society, taking over the presidency from next May. An excellent administrator, Derek has been called upon to do more and more in this area. His workload is huge, but he is never too busy to assist someone, or to exchange pleasantries. We who benefit can only regret that there will be fewer research students supervised, fewer articles written and fewer courses taught. We wish Derek good health and continued vitality.

GRANTEE REPORTS

Marijcke Vlieg

In February (11-15th) I attended the 26th Australian Applied Mathematics Conference at Coolangatta, Queensland where I presented a paper "Dynamical Conservation Laws" reporting some of the work I have been doing under the supervision of Associate Professor Dean Halford in part fulfilment of the requirements for a PhD. It was specially valuable to have discussions with Professor Brian Gray, Dr John Merkin, Dr John Ockenden, Professor Fenton Pillow and Dr Alan Head. As a result of these discussions, Dr Alan Head has kindly sent us a copy of his very useful computer program for finding the Lie Algebra of partial differential equations of interest to us.

I appreciated very much the opportunity to attend this conference and I doubt whether I would have gained the information in any other way. Certainly I would not have made such progress and contacts in such a short time especially as there are only a few people in NZ known to be working in my area of interest. I am therefore very grateful to the New Zealand Mathematical Society for the travel grant of $500 which made this all possible.

Marijcke Vlieg
Massey University

Robert Sisson

The purpose of leave was to attend the 26th Australian Applied Mathematics Conference at the Greenmount Hotel, Coolangatta, Queensland (11-15 February 1990), as part of a contingent of lecturers and research students from New Zealand. I presented a paper "Multiple steady-states and periodic solutions of a self-heating system: a pseudo-arclength approach", based on work carried out at Massey University by myself, under the supervision of Professor Graeme Wake and Mr Adrian Swift. I was able to renew an acquaintance with Professor Brian Gray of Macquarie University, Sydney. We discussed the collaboration between our departments on the formulation of a reaction-diffusion model for self-heating bodies with moisture content (a problem of major concern to Queensland sugar cane companies).

I look forward to next year's conference on "home ground" at Christchurch.

I would like to thank the New Zealand Mathematical Society for a travel grant of $500. Thanks also to the Association of Commonwealth Universities for their scholarship which paid the balance of my expenses.

Robert Sisson
Massey University

Aroon Parshotam

I thank the New Zealand Mathematical Society sincerely for allocating me a grant of $500 for allowing me to attend my first overseas conference in Coolangatta, 11-15 February, 1990 in Australia. I also thank the Royal Society of New Zealand for offering me a 'Young Scientists' award to attend the conference. The experience and feedback I obtained at the conference, the contact and friends I made and the future contacts I made was invaluable. I also met with people working in related areas that significantly changed the direction of my research. This was fortunately as I had anticipated.

I spent most of my days (and evenings) attending as many talks and seminars as possible. Each seminar had something of interest and as most talks were running in parallel in three different rooms, it was often difficult to decide which one to attend. Often I would spend the one and a half hours lunch break allocated to us doing a bit of swimming or relaxing on the beach with colleagues (some of us got circled by what we thought were sharks but which turned out to be dolphins!!). It was a most fabulous venue for a conference. One of the many highlights of my visit to Australia was the trip organised by Dr N. DeMestre to Bond University.

I once again thank the New Zealand Mathematical Society for making my trip possible.

Aroon Parshotam

SECRETARIAL

MINUTES OF THE TWENTY-SEVENTH COUNCIL MEETING
Sunday May 13 1990

The meeting was held in the Seminar Room of the Department of Mathematics and Statistics, University of Auckland and began at 10.30am.

PRESENT: Gillian Thornley (in the Chair), Colin Anderson (for NZAMT), John Butcher, Marston Conder, John Giffin, Rob Goldblatt, Dennis McCaughan, David Smith, Alfred Sneyd, Kee Teo, Chris Triggs, Brian Woods.

1. **APOLOGIES**: There were no apologies.

2. **MINUTES OF THE TWENTY-SIXTH COUNCIL MEETING**:

   The Chair noted the following correction to the minutes whereby, in Section 6(b), *"essentially all of the interest on capital received during the current financial year"* should be amended to read *"essentially all of the interest on capital received during the previous financial year"*.

   With this amendment, it was **moved** from the Chair that, *the minutes of the previous meeting be received and signed as a true and accurate record.*

   The motion was **carried**.

3. **MATTERS ARISING FROM THE MINUTES**:

   (i)   With reference to the 1995 centenary of the birth of A.C. Aitken (Section 3(iii)), G. Thornley reported that no action had yet been taken towards an appropriate commemoration.
   (ii) G. Thornley noted that Gordon Knight (Officer for Mathematics Education) will investigate the School Mathematics competition, including funding aspects.
   (iii) G. Thornley confirmed that the Royal Society of New Zealand will pay for her return airfare to the IMU General Assembly in Japan in August 1990 (Section 10(iv)).

   (a)   Howard Edwards has agreed to organise the tour of Professor Peter Whittle, the 1991 Forder Lecturer, during March 1991.
   (b)   It was noted that the cost of providing free membership of the Society to final year undergraduate students is approximately $18 per student per year. Even if all BSc (Hons) Part 3 and BCMS (Year Four) Mathematics students were included a per member surcharge of only $2-3 would be implied. It was agreed that this was a small cost for the resulting encouragement, publicity and promotion of Mathematics in New Zealand, and that a list of all fourth-year students who wish to become members be compiled annually and forwarded to the Membership Secretary. Updated copies of the NZMS brochure are also available for distribution.

4. **CORRESPONDENCE**:

   The Secretary reported that several grantee reports from the Australian Applied Mathematics Conference, held in Coolangatta in February have been received. (They appear elsewhere in this Newsletter.)

5. **TREASURER'S REPORT**:

   The Treasurer noted that there had been considerable difficulties in balancing the accounts for 1989/90. These were mainly due to transitional changes in GST charging and problems in liaising with the Dunedin-based auditor.

The financial report presented was in draft form. It was noted that interest had declined from $15,000 in 1988/89 to $9,000 in 1989/90.

The subscription to be recommended to the AGM for 1991 was agreed at $32 plus GST, with $30 plus GST for prompt payment.

There was considerable discussion regarding an apparent anomaly over stocks of unsold secondary school textbooks published jointly with NZAMT. At present book stocks are carried by the NZMS only, and fifty percent of trading profits are forwarded to NZAMT. However, these profits have not taken into account the printing costs of books still in stock. An example was given for "Modelling Activities": 300 books remain in stock, and 200 more need to be sold before a profit is made on the current print run. Nevertheless the balance sheet shows a profit to be paid to NZAMT.

C. Anderson suggested that a special policy be considered for NZAMT to reach a fairer agreement. It was decided to contact NZAMT to clarify the (re)calculation of profit in which total printing costs would be deducted first. G. Thornley, K. Teo and J. Giffin will investigate.

6. APPLICATIONS FOR FINANCIAL ASSISTANCE:

The Secretary noted that only $200 of the $1,000 available for student travel to the 1990 Colloquium had been used. Of the grants made at the last Council Meeting, those for Dr Rod Downey and Dr K.K. Sankara (five hundred dollars each) had not been taken up.

Response to applications:

It was **moved** from the Chair that:

> *Dr Rod Downey be given $500 (five hundred dollars) towards the cost of attending and presenting a paper at the Fourth Asian Logic Conference in Tokyo in September 1990.*

> *Ms S. Greenwood be given $500 (five hundred dollars) towards travel costs incurred in visiting the University of Michigan (Ann Arbor) for four months in late 1990.*

> *Dr M. Roberts be given $500 (five hundred dollars) towards the cost of attending and presenting an invited paper at the International Symposium on Echinococcosis in Zurich and attending the International Congress in Parasitology in Paris in August 1990.*

> *Dr J. Turner be given $500 (five hundred dollars) towards the cost of attending and presenting a paper at the Fourth International Conference on Fibonacci Numbers and their Applications in North Carolina in July-August 1990.*

> *The twenty-seventh Applied Mathematics Conference be given $500 (five hundred dollars) towards the cost of providing airfares for visiting speakers in February 1991.*

> *The 1990 Australasian Conference on Combinatorial Mathematics and Combinatorial computing be given $500 (five hundred dollars) towards running expenses incurred in the December 1990 Conference.*

> *The International Conference on the Teaching of Statistics (ICOTS 3) be given a further $1,000 (one thousand dollars) as both a reimbursement of GST from the previous grant and as a general grant towards running expenses incurred in the August 1990 Conference. (The previous grant was to assist NZ teachers to attend the conference.)*

The motion was **carried**.

Other applications were seriously considered and declined..

G. Thornley was thanked for providing an analysis of NZMS fund distribution for the past three years, the results of which give accurate guidelines for future grant spending.

During the consideration of Dr Rod Downey's application, it was noted that he received the prestigious Hamilton Award for 1990. The Secretary will forward the Council's warmest congratulations.

The meeting adjourned for lunch at 12.30pm and resumed at 1.45pm.

7. AFFILIATION OF NZMOC TO NZMS:

There was considerable discussion on the appropriateness of mathematics competitions and the Mathematical Olympiad in particular. It was agreed that one of the many aspects of mathematics involves rather artificial problem-solving puzzles, and any successful means of attracting gifted students should be deemed worthwhile.

It was **moved** by G. Thornley (seconded by C. Anderson) that:

the New Zealand Mathematical Olympiad Committee be affiliated to the NZMS subject to their finances being kept separate and that the NZMS not be responsible for any debts incurred by the NZMOC.

The motion was **carried**.

8. NZMS AWARD FOR MATHEMATICAL RESEARCH:

M. Conder spoke to the document that P. Lorimer and he had drafted. The Council was unanimously in favour of the idea of the award, to be inaugurated in May 1991. It will take the form of an appropriately inscribed citation, with no prize money and no medal. It was suggested that Professor B. Neumann (ANU) be consulted as to the configuration of the first judging panel, and that there be a minimum standard set for the inaugural award(s). G. Thornley and M. Conder offered to deal with initial details, and two volunteers will be called for to organise and decide upon the judging panel.

J. Butcher **moved** (seconded by G. Thornley) that

the document on the NZMS Award for Mathematical Research be approved subject to minor amendments.

The motion was **carried**.

P. Lorimer and M. Conder were thanked for their efforts, with acclamation.

9. REPORT FROM WORKING PARTY ON MATHEMATICAL SCIENCE FUNDING:

M. Conder introduced the draft document which was distributed at the meeting. He drew attention to two suggestions directed to NZMS:

- that we consider appointing a Public Relations officer,
- that we investigate coordination of NZ's mathematical library resources.

R. Goldblatt suggested that the document be circulated throughout the NZ Mathematical community, and undertook to do so. M. Conder was thanked for his efforts.

10. POLICY FOR EXCHANGE JOURNALS:

D. Smith noted that there is no fixed policy for what happens to journals the Society receives in exchange for the Newsletter, for example Acta Mathematica Sinica, Extracta Mathematicae, American Math Society Notices and the ORSNZ Newsletter.

It was decided that Victoria University will act as the depository in the future.

11. OTHER REPORTS:

(a)   Newsletter: D. Smith noted that the Newsletter is now printed in Dunedin, overseen by John Shanks, and with (paid) student compositors. D. Smith was thanked for his excellent work as Editor.

(b)   Publications: A Sneyd presented the attached report. G. Thornley indicated that compensation had finally been received in the case of the incinerated books. Little cooperation had yet been forthcoming from other Societies on the matter of the proposed booklet on career opportunities in the mathematical sciences.

12. NZMS LECTURERS:

(a)   C. Triggs reported that David Moore is scheduled to arrive in NZ on August 1, and his itinerary includes most universities. To reduce immigration difficulties, the Secretary will send him a formal invitation.

(b)   Because the 1991 Forder Lecturer will be here in March 1991, it was suggested that the 1991 NZMS Lecturer be scheduled in Term 2 or Term 3. Suggestions for the speaker are welcome.

(c)   The 1991 Colloquium will be held in Dunedin. Suggestions for an NZMS lecturer for it are needed.

13. AGM:

C. Triggs agreed to act as minute secretary, in the absence of J. Giffin.

14. OTHER BUSINESS:

(i)   In the matter of the pre-doctoral thesis competition, it was reported that D. Breach was encountering funding difficulties. NZMS funds could possibly be used, but sponsoring should not be the most important matter in the reinitiation of the competition.

(ii)   A letter from Graeme Wake brought up the subject of a NZMS Journal of Mathematics. It was decided that G. Wake, R. Goldblatt (convenor), M. Conder and D. Alcorn should investigate the feasibility of NZMS involvement in the publication of a journal of mathematics and report back to NZMS Council.

(iii)   The next Council Meeting is scheduled for 10.00am Friday 23 November in the Royal Society Council Room, Turnbull Street, Wellington.

The meeting closed at 4.46pm.

MINUTES OF THE SIXTEENTH ANNUAL GENERAL MEETING
15 May, 1990

The meeting was held in the Science Lecture Theatre, Mathematics and Physics Building at the University of Auckland and began at 5.05pm.

PRESENT: G. Thornley (in the chair), D.P. Alcorn, J. Ansell, J.C. Butcher, M.R. Carter, R.P.K. Chan, M. Conder, R. Fenton, D. Gauld, R. Goldblatt, D. Halford, J.F. Harper, D. Holton, M. Jorgenson, E. Kalnins,A.W. McInnes, D. McCaughan, K. Pledger, H. Rae, I. Reilly, A. Scott, G.A.F. Seber,C. Smith, D. Smith, G. Tee, K. Teo, J. Thompson, C. Triggs, J.C. Turner, M.J. White, B. Woods.

1. **APOLOGIES:** Apologies were received from J. Giffin, and G. Wake, who noted that this was the first AGM of the New Zealand Mathematical Society from which he had been absent. It was **moved** from the Chair that: *the apologies be accepted.* The motion was **carried.**

2. **MINUTES OF THE FIFTEENTH AGM:** It was **moved** from the Chair that: *the Minutes of the fifteenth AGM be accepted.* The motion was **carried.**

3. **MATTERS ARISING FROM THE MINUTES:** None.

4. **PRESIDENT'S REPORT:**

    (a) The President presented her report to the meeting, [The report is appended to these minutes] making the following points:

    (i): D.S. Moore will be the NZMS Visiting lecturer for 1990, visiting New Zealand in August.

    (ii): The booklet on employment opportunities in mathematics is being revised by Ray Littler. Members were invited to submit case studies and examples.

    (iii): The Royal Society of NZ has increased its levy to $3 per member of constituent societies for 1991, and, coincidentally, had established a separate panel to examine candidates in the mathematical sciences for Fellowships of the RSNZ.

    (iv): The NZMS Award for Mathematical Research was announced, [details follow these minutes.]

    (v): The NZ Mathematical Olympiad Committee has been affiliated to the NZMS under the condition that the finances of the Society and the Committee are to be kept quite separate, and that the Society has no financial liability with respect to the Committee.

    (vi): The Editor, David Smith, authors, and correspondents of the newsletter of the Society were thanked with acclamation by the meeting.

    (b) D. Halford suggested that the Society should increase support for students to attend conferences. It was noted that all students who had applied to the Society had received grants to assist with conference attendance. J. Butcher **moved** (seconded B. Woods) that: *the President's report be accepted.* The motion was **carried with acclamation.**

5. **TREASURER'S REPORT:** As there had not been time for the auditors to complete their report, due to the location of the auditor in Dunedin and the treasurer in Palmerston North, and due to the transfer of the Society's accounts to the method of accrual accounting, an interim financial statement was circulated. It is expected that the final report, signed by the auditors will differ only in minor detail. [This report follows these minutes.] With the transfer of the accounts to accrual accounting there are some difficulties in defining costs and profits in relation to NZAMT of joint publishing ventures. K. Teo **moved** (seconded D. Halford) that: *the Treasurer's report be accepted.* The motion was **carried with acclamation.**

6.   **ANNUAL SUBSCRIPTION:** It was noted that the number of members of the Society had not changed from 1988 to 1989, and that the subscription was expected to cover the costs of the newsletter, administration costs of the Society, and the levy of the Royal Society. It was **moved** by K. Teo (seconded J. Butcher) that: *the subscription be raised to $32 (thirty two dollars) not including GST with an abatement for prompt payment.* The motion was **carried.**

7.   **ELECTION OF COUNCIL MEMBERS:** With the elected terms of B. Woods, R. Goldblatt, A. Sneyd, and C. Triggs coming to an end there were four vacancies to be filled on the council. The following nominations had been received.

Incoming Vice-President:
     D. Holton nominated by G. Thornley (seconded by C. Little)
Members of Council:
     R. Goldblatt nominated by P. Donelan (seconded by C. Bailey)
     I. Rinsma nominated by E. Kalnins (seconded by A. French)
     D. Robinson nominated by D. Breach (seconded by P. Renaud)

There being no further nominations Professors Goldblatt and Holton, and Drs Rinsma and Robinson were **declared elected** to the Council. The President thanked those stepping down from the Council for their efforts on behalf of the Society.

8.   **OTHER BUSINESS:**

(i)   B. Woods notified the meeting that the 1991 Applied Mathematics Conference was being held in Hanmer Springs in February 1991 and gave the list of invited speakers. Members and graduate students were strongly invited to attend.

(ii)   D. Gauld spoke to the draft report of the Working Party on Funding for Mathematical Sciences which had been presented to the Council (13.v.90), the heads of Mathematics departments meeting (15.v.90), and was to be presented to the National Committee on Mathematics meeting on 16.v.90. The final report is due to be presented in September 1990, and drafting is being led by Rob Goldblatt and Marston Conder. Discussion took place as to whom the report should be directed. Members were exhorted to be aware of, and to take an active part in the promotion of, Mathematics Awareness Week.

(iii)   Nominations were requested for the NZMS Lecturer and the Colloquium Lecturer for 1991, and the Forder lecturer for 1993 (who will be chosen in early 1991).

(iv)   M. Jorgensen expressed concern about the position of mathematicians in the Public Service and particularly in DSIR in the light of reorganisations within the State Sector. This concern was echoed by J. Ansell who noted that such people were constrained by their conditions of employment from speaking publicly. It was suggested that Professor Ansell should consult those mathematicians within the State Sector and draft an initial submission expressing the concerns of the society.

(v)   J. Butcher suggested that the New Zealand Mathematics Colloquium carry the additional title "Annual Meeting of the New Zealand Mathematical Society". After considerable discussion supporting the suggestion it was **moved** from the chair that: *the 1991 Colloquium organisers be asked to include "Annual Meeting of the New Zealand Mathematical Society" under the title of the Colloquium.* The motion was **carried** without dissent.

The meeting closed at 6.05pm.

                                                                        C.M. Triggs
                                                                        Meeting Secretary.

FINANCIAL STATEMENTS
for the year ended 31 December 1989

INCOME AND EXPENDITURE ACCOUNT

	1989 $		1988 $
Income			
Subscriptions	3,630		3,588
Interest	9,314		15,719
Donations	500		–
Publications (Note 2)	84,512		100,458
Miscellaneous Receipts	603		–
		98,559	119,765
Expenditure			
Newsletter	1,475		2,066
NZMS Visiting Lecturer	338		700
Forder Lecturer	700		–
Travel/Council Expenses	1,192		2,667
Travel and Research Grants	5,380		3,000
Donations	3,500		4,500
Miscellaneous	2,570		1,782
NZAMT share of Publications Profits	7,453		2,964
Publications (Note 2)	62,209		87,020
		84,817	104, 699
EXCESS INCOME OVER EXPENDITURE		$ 13,742	$ 15,066

BALANCE SHEET

Accumulated Funds	1989 $	1988 $
Balance brought forward	108,899	93,833
Excess of income over expenditure	13,742	15,066
	$122,641	**$108,899**

REPRESENTED BY

Assets

		1989	1988
Bank	- General Account	6,198	16,608
	- Massey	699	9,242
	- Canterbury	–	12,211
	- Auckland	–	94
	- Wellington	5,076	4,804
	- Aitken Memorial Trust	370	354
	- General Autocall Account	78,374	39,770
	- Massey Autocall Account	–	5,100
Petty Cash		70	–
Debtors		10,188	20,093
Book Stock on hand		49,687	25,376
GST		774	–
		151,406	133,652

Less Liabilities

	1989	1988
Owing to NZAMT	7,453	2,964
Creditors	21,312	21,298
Owing for GST	–	491
	28,765	24,753
	$122,641	**$108,899**

NOTES TO THE ACCOUNTS

Note 1   Statement of Accounting Policies

General Accounting Policies: The following general accounting policies have been adopted in the preparation of the financial statements.

(i) The measurement base adopted is that of historical cost.
(ii) The matching of revenue earned and expenses incurred uses accrual accounting concepts, except that interest and subscriptions are accounted for on a cash basis.
(iii) Income and Expenditure are exclusive of GST.

Stock: Stocks of books are valued at the lower of cost or net realisable value.

Note 2   Publications

	Income	Expenditure
Maths/Calc	33,282	22,916
Maths/Stats	14,277	9,929
Calculus	16,980	13,979
Sec School Maths	3,653	2,461
Linear Algebra	11,310	9,307
Modelling Activities	5,010	3,617
	$84,512	**$62,209**

AUDITOR'S STATEMENT
18 June, 1990

We have examined the accompanying Balance Sheet and Income and Expenditure Account of the Society and have obtained all the information and explanations we have required.

Stocks of Books have been accepted as advised by the Treasurer.

Subject to the matter referred to in the above paragraph in our opinion, the Balance Sheet and Income and Expenditure Account respectively give a true and fair view of the financial position of the Society at 31 December 1989 and of the results for the year ended on that date.

KPMG PEAT MARWICK
Chartered Accountants

NZMS PUBLICATIONS REPORT
May, 1990

Modelling Activities

We printed an initial run of 500, of which 150 have been sold and 5 given away (for reviews etc.). The price to schools is $33.75 (including GST) which gives a profit of about $6.65 per book.
Sales are a little slow at present, and about 300 copies remain unsold. We've sent about 24 to Australia, and have had enquiries about distribution in Singapore. McGraw Hill have published two books which reproduce 4 or 5 pages from *Modelling Activities* without clearing copyright.

Calculus

We have received about $750 from Corporate Press in compensation for the books which were wrongly addressed and accidentally incinerated.

Linear Algebra

The first printing of 500 was sold out. A new run of 700 (with minor changes and corrections) has been printed. The wholesale price is $30.00 (excluding GST) - an increase of about $3.00 from last year, mainly because of increased printing costs. The retail price this year is $50.63 (including GST). It is estimated that current stocks should last for about two years.

Employment Opportunities in Mathematics

A new edition is in preparation, with a similar format to the previous one. Ray Littler has kindly agreed to help gather information etc. Progress is rather slow, mainly because I was away for about three months over the summer. We are still gathering background information, and serious writing should begin shortly.

Alfred Sneyd
Publications Convenor

PRESIDENT'S REPORT

It is my pleasure to report on the activities of the New Zealand Mathematical Society for the year 1989-90.

NZMS Visiting Lecturer

Professor Ren Potts of the University of Adelaide toured New Zealand as the 1989 NZMS Visiting Lecturer in August. He also contributed to the annual conference of the NZ Operational Research Society while in Wellington and was an invited speaker at the inaugural conference of the NZ Association of Mathematics Teachers in Hamilton. His participation in these conferences greatly reduced the time he was able to spend with university mathematicians at Waikato and Victoria. We are grateful to the NZ Operational Research Society and the NZ Association of Mathematics Teachers for their assistance in financing Professor Potts' visit.

The 1990 NZMS Visiting Lecturer will be Professor David Moore of Purdue University, who will tour in July/August prior to attending ICOTS 3.

Forder Lecturer

Professor Peter Whittle of Cambridge University has been chosen as the 3rd Forder Lecturer. He will visit in March 1991. Howard Edwards is arranging the itinerary.

Publications

The Newsletter continues to fulfil an important role in the life of the Society under the direction of David Smith as editor.

Work is proceeding on a new upmarket version of the booklet "Employment Opportunities in Mathematics and Statistics". Ray Littler is gathering information for this.

"Calculus" is no longer a prescribed text in any of the universities and is now out of print. This project has contributed a substantial profit to the Society over a period of six years. Thank you to all who were involved in the writing, production and promotion of this book.

NZMS and NZAMT jointly published "Modelling Activities" by Russell Dear in August 1989. This is a resource book at about sixth form level, for teachers and students. Local sales have been disappointing this year but a few have sold in Australia and there is interest in it in Singapore.

"Linear Algebra", "Mathematics with Calculus", "Mathematics with Statistics" and "Secondary School Mathematics" continue to sell.

Grants

The Council made a policy decision to fund grants from interest received in the previous year. The high interest rates and healthy bank balance in 1988 enabled us to make grants to the following:

1990 Colloquium
NZ Mathematics Olympiad Committee
ICOTS 3
RSNZ Prince and Princess of Wales Award Scheme
Mathematics Education Centre Auckland

The Research Fund provided 2 grants to assist with travel overseas and 4 grants to assist overseas mathematicians to come to NZ for collaborative research work with local mathematicians.

The Student Travel Fund provided 3 grants to postgraduate students presenting papers at conferences in Australia and one grant to a postgraduate student to attend the 1990 Colloquium.

Royal Society of NZ

During 1989 the Royal Society established a separate panel for mathematics for the selection of Fellows. Previously we had shared a panel with physics. This gives added prominence to mathematics in the RSNZ and recognises the importance of mathematical research in New Zealand. We hope it will enable mathematicians to play a greater role in the RSNZ in the future.

As a member body of RSNZ we are required to pay an affiliation fee which is related to our membership. Over a period of 3 or 4 years, this fee has been raised from about 29 cents per member to $3 per member this year. This increase will be reflected in our subscriptions.

Funding for the Mathematical Sciences

Following the discussions on funding last May, the Heads of Departments meeting set up a working party under the chairmanship of David Gauld, to gather information on funding for the mathematical sciences. NZMS is represented on that committee by Marston Conder and Kevin Broughan. The National Committee for Mathematics, NZ Statistics Association and the Operational Research Society are also represented.

An interim report has been prepared for discussion among the bodies represented and it is planned to have a final report available in September.

It is still not clear what the situation is, or will be , regarding funding for research or for teaching in the universities. Nor is it clear how we can influence the situation for the better. The Council would appreciate any information or suggestions on this issue. In the meantime we all need to take advantage of any opportunities to raise the profile of the mathematical sciences and to publicise the work we do.

It is with a great sense of loss that we report the untimely death of Brent Wilson in June 1989. Brent was a foundation member of the Society, a councillor for two terms, secretary, newsletter editor, organiser of the pre-doctoral thesis competition, and a stimulating colleague.

I wish to thank the Council for its support during the year, particularly the secretary, John Griffin, and the treasurer, Kee Teo. To those who are retiring from Council, Brian Woods, Chris Triggs, Alfred Sneyd, we thank you for the contributions you have made to the Society. We are also grateful to the many people who continue to work on special projects for the Society.

Gillian Thornley, President
6 May 1990

CONFERENCES

** 1990 **

October 1–5 (Marseille, France)   **Organisations et Theorie des Jeux**
Contact CIRM: see (8) below.

October 5–6 (La Crosse, Wisconsin) **Math-History Conference**
Contact J.D. Wine, Department of Mathematics, University of Wisconsin - La Crosse, La Crosse, WI 54601, U.S.A.

October 14-20 (Oberwolfach, West Germany) **Geometrie**
Contact MFPG: see (1) below.

October 15–19 (Minneapolis, Minnesota) **Shock Induced Transitions and Phase Structures in General Media**
Contact IMA: see (3) below.

October 15–19 (Marseille, France)   **Modeles pour L'Analyse des Donnees Multidimensionnelles**
Contact CIRM: see (8) below.

October 15–19 (San José, Costa Rica) **Tercer Congreso Nacional de Matematicas**
Contact H. Barrantes, Escuela de Matemática, Universidad de Costa Rica, San José, Costa Rica.

October 19–20 (Rolla, Missouri) **Nineteenth Midwest Conference on Differential and Integral Equations**
Conact L.M. Hall, Department of Mathematics and Statistics, University of Missouri-Rolla, Rolla, MO 65401, U.S.A (email c0635 @ umrumb. bitnet).

October 21–27 (Peniscola, Spain) **International Functional Analysis Meeting on the Occasion of the Sixtieth Birthday of Professor M. Valdivia**
Contact J. Bonet, Univ. Politecnica de Valencia, E.T.S. Arquitectura, Dept. Matematica Aplicada, C. de Vera, E–46071 Valencia, Spain.

October 21–27 (Oberwolfach, West Germany) **Arithmetik der Körper**
Contact MFOG : see (1) below.

October 21-27 (Oberwolfach, West Germany) **Mathematische Methoden in der Robotik**
Contact MFOG: see (1) below.

October 22-25 (Jerusalem) **Fifth Jerusalem Conference on Information Technology**
Contact J.M. Adams Jr., Director, Membership/Professional Services, Association for Computing Machinery, 11 West 42nd Street, New York, NY 10036, U.S.A. (email jimadams @ acmvm. bitnet).

Oct. 28-Nov. 3 (Oberwolfach, West Germany) **Mathematical Economics**
Contact MFOG: see (1) below.

October 29–November 2 (Trieste, Italy) **Trieste Conference on Integrable Systems**
Contact ICTP: see (5) below.

October 29–November 2 (Marseille, France) **Algorithme Parallele et Architectures Nouvelles**
Contact CIRM: see (8) below.

October 29–November 2 (Lisbon) **D-Modules and Microlocal Geometry**
Contact T.M. Fernandes, CMAF Complexo II, Av Professor Gana Pinto 2, 1699 Lisboa Codex, Portugal.

October 29–November 16 (Trieste, Italy) **Workshop on Mathematical Ecology**
Contact ICTP: see (5) below.

October 31–November 3 (La Habana, Cuba) **Latin American Seminar on Applications of Mathematics and Computer Science to Biology**
Contact L. Sastre, Departamento de Matematica, Centro Nacional de Investigaciones Cientificas, Apartado 6990, La Habana, Cuba.

November 4–10 (Oberwolfach, West Germany) **Wahrscheinlichkeitsmasse auf Gruppen**
Contact MFOG : see (1) below.

November 5–7 (San Francisco) **Second SIAM Conference on Linear Algebra in Signals, Systems and Controls**
Contact SIAM : see (6) below.

November 12–16 (New York) **Supercomputing '90**
Contact Supercomputing '90, IEEE Computer Society, 1730 Massachusetts Ave, N.W., Washington, DC 20036–1903, U.S.A.

November 12–16 (Minneapolis, Minnesota) **Microstructure and Phase Transitions**
Contact IMA : see (3) below.

November 12–16 (Berkeley, California) **Workshop on Representations of Reductive Groups over Finite Fields**
Contact MSRI: see (2) below.

November 18-24 (Oberwolfach, West Germany) **Komplexitätstheorie**
Contact MFOG: see (1) below.

November 19–22 (The Hague) **International Symposium on Huygens's Principle 1690-1990, Theory and Applications**
Contact Congress Bureau, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands.

November 25–Dec. 1 (Oberwolfach, West Germany) **Lineare Modelle und Multivariate Statistische Verfahren**
Contact MFOG : see (1) below.

November   25-Dec. 1   (Oberwolfach, West Germany)   **Stochastische Approximation und Optimierungsprobleme In Der Statistik**
Contact MFOG: see (1) below.

December 2-8 (Oberwolfach, West Germany) **Multigrid Methods**
Contact MFOG: see (1) below.

December 3–5   (College Park Maryland)   **First International Symposium on Uncertainty and Analysis: Fuzzy Reasoning, Probabilistic Methods and Risk Management**
Contact B.M. Ayyub, Department of Civil Engineering, University of Maryland, College Park, Maryland 20742, U.S.A.

December 3–7   (Palmerston North)   **Sixteenth Australasian Conference on Combinatorial Mathematics and Combinatorial Computing**
Contact Dr C.H.C. Little, Department of Mathematics and Statistics, Massey University, Palmerston North, New Zealand.

December 3–7   (Taipei)   **SINO-JAPANESE Joint Seminar on Nonlinear PDEs with Emphasis on Reaction-Diffusion Aspects**
Contact S.S. Lin, Department of Applied Mathematics, National Chiao-Jung University, Hsinchu, Taiwan.

December 3–7 (Berkeley, California) **Workshop on General Group Representation Theory**
Contact MSRI: see (2) below.

December 9-15 (Oberwolfach, West Germany) **Allgemeine Ungleichungen**
Contact MFOG: see (1) below.

December 13–18 (Osaka, Japan) **Osaka International Conference on Complex Geometry and Related Topics**
Contact Professor S. Murakami, Department of Mathematics, Osaka University, Toyonaka 560, Japan.

December 15–19 (Kent, Ohio) **Curves and Surfaces: An Algorithmic Viewpoint**
Contact A.S. Cavaretta, Dept. of Math. Sciences, Kent State University, Kent, OH 44242, U.S.A (email: Internet cavarett @ cs. kent edu)

December 16-22 (Oberwolfach, West Germany) **Mathematische Logik**
Contact MFOG: see (1) below.

December 17–21 (Orlando, Florida) **Non-linear Dispersive Wave Systems**
Contact L. Debnath, University of Central Florida, Department of Mathematics, Orlando, FL 32816, U.S.A.

Dec. 25-Jan. 1   (Oberwolfach, West Germany)   **Lineare Modelle und Multivariate Statistische Verfahren**
Contact MFOG: see (1) below.

** 1991 **

January 6–12 (Oberwolfach, West Germany) **Automorphe Formen und Anwendungen**
Contact MFOG: see (1) below.

January 7–10   (St Augustine, Trinidad)   **Sixth Caribbean Conference on Combinatorics and Computing**
Contact E.J. Farrell, 6cccc, Department of Mathematics, The University of the West Indies, St. Augustine, Trinidad.

January 13–19 (Oberwolfach, West Germany) **Combinatorial Optimization**
Contact MFOG: see (1) below.

January 16–19 (San Francisco) **Annual Meeting of the American Mathematical Society**
Contact H. Daly, AMS, P.O. Box 6248, Providence, RI 02940, U.S.A.

January 20–26   (Oberwolfach, West Germany)   **Spektraltheorie Singulärer Gewöhnlicher Differentialoperatoren**
Contact MFOG: see (1) below.

January 21–25 (Minneapolis, Minnesota) **Statistical Thermodynamics and Differential Geometry of Microstructured Material**
Contact IMA : see (3) below.

January 27–February 2 (Oberwolfach, West Germany) **Harmonischer Analyse und Darstellungstheorie Topologischer Gruppen**
Contact MFOG: see (1) below.

February 3–7 (Hanmer Springs, New Zealand) **27th Applied Mathematics Conference**
Contact Peter J. Bryant, Mathematics Department, University of Canterbury, Christchurch, New Zealand. (email pjb @ math. canterbury. ac. nz)

February 3–9 (Oberwolfach, West Germany) **Konstruktive Methoden in der Komplexen Analysis**
Contact MFOG: see (1) below.

February 10–16 (Oberwolfach, West Germany) **Endlichdimensionale Lie-Algebren**
Contact MFOG: see (1) below.

February 10–16 (Oberwolfach, West Germany) **Affine Differentialgeometrie**
Contact MFOG: see (1) below.

February 24–March 2 (Oberwolfach, West Germany) **Medical Statistics: Statistical Models for Longitudinal Data**
Contact MFOG: see (1) below.

March 3–9 (Oberwolfach, West Germany) **Partielle Differentialgleichungen**
Contact MFOG: see (1) below.

March 10–16 (Oberwolfach, West Germany) **Mathematische Stochastik**
Contact MFOG: see (1) below.

March 11–15 (Minneapolis, Minnesota) **Free Boundaries in Viscous Flows**
Contact IMA : see (3) below.

March 17–23 (Oberwolfach, West Germany) **Elementare und Analytische Zahlentheorie**
Contact MFOG: see (1) below.

March 17–24 (Haifa, Israel) **Sixth International Conference on Geometry**
Contact Professor J. Zaks, Department of Mathematics, University of Haifa, Haifa 31999, Israel.

March 22–24 (Houston, Texas) **Fifth SIAM Conference on Parallel Processing for Scientific Computing**
Contact SIAM: see (6) below.

March 24–30 (Oberwolfach, West Germany) **Gewöhnliche Differentialgleichungen**
Contact MFOG: see (1) below.

April 7–13 (Oberwolfach, West Germany) **Algebraische Gruppen**
Contact MFOG: see (1) below.

April 8–12 (Kobe, Japan) **Seventh International Conference on Data Engineering**
Contact N.J. Cercone, Center for Systems Science, Simon Fraser University. Burnaby, British Columbia, Canada V5A 156 (email nick @ cs. sfu. ca)

April 14–20 (Oberwolfach, West Germany) **Brauer Groups and Representation Theory of Finite Groups**
Contact MFOG: see (1) below.

April 15–19 (Minneapolis, Minnesota) **Variational Problems**
Contact IMA : see (3) below.

April 28–May 4 (Oberwolfach, West Germany) **Deductive Systems**
Contact MFOG: see (1) below.

May 12–18 (Oberwolfach, West Germany) **Nichtlineare Evolutionsgleichungen**
Contact MFOG: see (1) below.

May 13–17 (Minneapolis, Minnesota) **Degenerate Diffusions**
Contact IMA: see (3) below.

May 19–25 (Oberwolfach, West Germany) **Differentialgeometrie im Grossen**
Contact MFOG: see (1) below.

May 22–24 (Iowa City, Iowa) **Second International Conference on Algebraic Methoddogy and Software Technology**
Contact T. Rus, University of Iowa, Department of Computer Science, Iowa City, IA 52242, U.S.A. (email rus @ herky. cs. uiowa. edu)

May 26–June 1 (Oberwolfach, West Germany) **Optimalsteuerung und Variationsrechnung-Optimal Control**
Contact MFOG: see (1) below.

June 2–8 (Oberwolfach, West Germany **Diskrete Geometrie**
Contact MFOG: see (1) below.

June 9-15 (Oberwolfach, West Germany) **Singuläre Störungsrechnung**
Contact MFOG: see (1) below.

June 10–14 (Nahariya, Israel) **Bernoulli Society Twentieth Conference on Stochastic Processes and their Applications**
Contact R. Adler, Industrial Engineering and Management, Technion, Haifa 32000, Israel.

June 17–21 (Kobe, Japan) **1991 International Symposium on the Mathematical Theory of Networks and Systems**
Contact H. Kimura, Department of Mechanical Engineering for Computer-Controlled Machinery, Faculty of Engineering, Osaka University, Yamada-oka, Suita, Osaka 565, Japan.

June 30–July 6 (Oberwolfach, West Germany) **Elliptische Operatoren auf Singulären und Nichtkompakten Mannigfaltigkeiten**
Contact MFOG: see (1) below.

July 1–5 (Bath, England) **The Mathematics of Nonlinear Systems**
Contact J.F. Toland, School of Mathematical Sciences, University of Bath, Claverton Down, Bath BA2 7AY, England.

July 8-12 (Washington D.C.) **Second International Conference on Industrial and Applied Mathematics**
Contact IMA: see (7) below.

July 8–14 (Szekszárd, Hungary) **ICOR '91 International Conference on Radicals**
Contact L. Márki, Mathematical Institute, Hungarian Academy of Science, PF. 127, H-1364 Budapest, Hungary.

July 14–20 (Oberwolfach, West Gemany) **Dynamische Systeme**
Contact MFOG: see (1) below.

July 22-26 (Dublin) **Thirteenth IMACS World Congress on Computing and Applied Mathematics**
Contact J.H. Miller, University of Dublin, School of Mathematics, 39 Trinity College, Dublin 2, Ireland.

July 28–August 3 (Oberwolfach, West Germany) **Gruppen und Geometrien**
Contact MFOG: see (1) below.

August 3–7 (Coral Gables, Florida) **Interamerican Conference on Mathematics Education**
Contact U. D'Ambrosid, Institute of Mathematics, Univ. Estadual de Campinas, CP6063 (13081), Campinas (SP), Brazil.

August 5–8 (Beijing) **ICMI China Regional Conference on Mathematics Education** Contact Professor Zhong Shanji, Department of Mathematics, Beijing Normal University, Beijing 100875, People's Republic of China.

August 16–23 (Quebec City, Canada) **ICME7 : Seventh International Congress on Mathematics Education**
Contact D. Wheeler, Department of Mathematics, Concordia University, 7141 ouest, rue Sherbrooke, Montréal, Québec H4B 1R6, Canada.

September 9–17 (Cairo, Egypt) **International Statistical Institute: 48th Biennial Session**
Contact ISI Permanent Office, 428 Prinses Beatrixlaan, P.O. Box 950, 2270 A2, Voorburg, The Netherlands.

Special Contact Addresses:

M.R. Carter

PROBLEMS AND QUERIES

The P&Q editors have received solutions to two problems, **P17** and **P18**, but no new problems. There are some further questions to be answered relating to **P18**, so we shall leave this problem open for further solutions. **P4, P10**, and **P16** are also open questions.

P17 Squares in triangles—II (Ted Zulauf, Waikato University). Let T be a triangle containing a unit square, and let Δ be the area of T.
(i)   Prove that $\Delta \geq 2$,
(ii)   Find all triples of interior angles for which $\Delta = 2$.

SOLUTION (submitted by Alistair Hall, Fruit and Trees Section of DSIR, Palmerston North, PhD student in Mathematics at Massey University).

(i)   From Ted Zulauf's solution to problem **P8** , a triangle of minimal area surrounding a unit square must have one edge lying along an edge of the square. Hence we need only consider the two situations below.
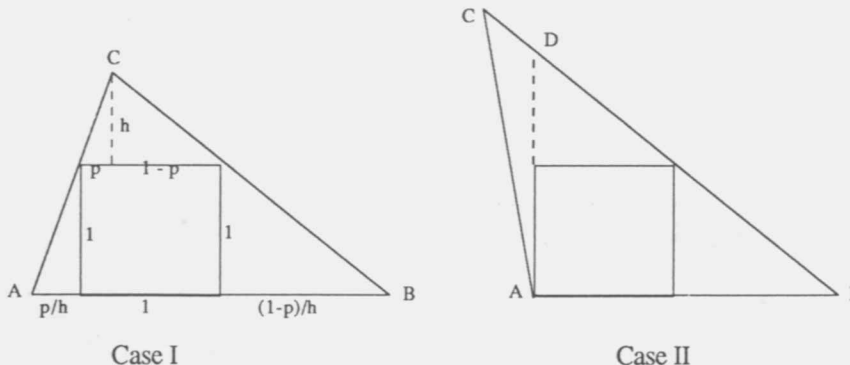
Case I   Case II

It is clear that in Case II, triangle ABC is of greater area than triangle ABD, which in turn can be considered a special case of Case I with angle A a right angle and p = 0. Hence we need only consider Case I, with $0 \leq p \leq 1$.

The area of the triangle in Case I is

$$\Delta = \frac{1}{2}(1 + h)\,(1 + \frac{p}{h} + \frac{1-p}{h}) = \frac{1}{2}(1 + h)(1 + \frac{1}{h})$$

Differentiation with respect to h shows that this area Δ is a minimum when h = 1, in which case the area is $\Delta = 2$, so for any given triangle we must have $\Delta \geq 2$ as required.

(ii) Any triangles with h = 1 will have $\Delta = 2$, so there is a whole family of triples of interior angles satisfying this requirement. Setting h = 1 in the diagram above and allowing p = cot(A) to range over the interval [0, 1/2], the family is

$$\{ (A,B,C) \mid \arctan(2) \leq A \leq \frac{\pi}{2}, \quad B = \arctan\!\left(\frac{1}{1 - \cot(A)}\right), \quad C = \pi - A - B \ \} .$$

Here each triple is ordered with $A \geq B \geq C$. The range of B is $[\,\pi/4,\ \arctan(2)\,]$ and that of C is $[\,\pi/4,\ \arctan(4/3)\,]$, so given any angle in the interval $[\pi/4, \pi/2]$, it is always possible to find two other angles which will form a triple satisfying $\Delta = 2$, and if the angle lies in the interval $(\,\pi/4,\ \arctan(4/3)\,]$, two such triples will exist. The only possible isosceles triples are $(\pi/2, \pi/4, \pi/4)$ and $(\arctan(2), \arctan(2), \arctan(4/3))$.

P18 Pythagoras in the limit (Kit Withers and Donal Krouse, AMD Wellington). Let $q_x(N)$, $[q_y(N), q_z(N)$, respectively] be 1/N times the number of distinct positive integer solutions to $x^2 + y^2 = z^2$, $0 < x < y$, with $x \leq N$ [$y \leq N$, $z \leq N$, respectively.] Find $\lim_{N \to \infty} q_x(N)$, $\lim_{N \to \infty} q_y(N)$, $\lim_{N \to \infty} q_z(N)$

[Note Kit and Donal compute $q_x(50) = 0.70$, $q_y(100) = 0.18$, $q_z(100) = 0.13$.]

SOLUTION (submitted by Ted Zulauf, Waikato University).

[**Editorial note:** In his covering letter, Professor Zulauf comments that he finds $q_x(50)= 2$, $q_z(100) = 0.52$, which is at variance with the proposers' computations. The difference is in fact a consequence of the editor's omission of a further crucial condition in the problem, which had asked for the solutions x, y, z to be **relatively prime**. In this case computations appeared to show that $q_x(N) \to 1, q_y(N) \to 0$, $q_z(N) \to 0$ when the count is restricted to relatively prime triples. We apologise for this omission.

Professor Zulauf further suggests that the behaviour of $q_x(N)/(\ln N)^2$, $q_y(N)/\ln N$ and $q_z(N)/\ln N$ would be of interest. Below we give his solution to the problem as originally printed showing the three sequences are unbounded. We welcome further comment on this problem.]

Let $q_x(N)$ [$q_y(N), q_z(N)$, respectively] be 1/N times the number of distinct positive integer solutions to $x^2 + y^2 = z^2$, $0 < x < y$, with $x \leq N$ [, $y \leq N$, $z \leq N$ respectively]. Then $q_x(N), q_y(N)$ and $q_z(N)$ all $\to +\infty$ as $N \to +\infty$. Since obviously $q_x(N) \geq q_y(N) \geq q_z(N)$, it suffices to show that $Q(N) = q_z(N) \to +\infty$ as $N \to +\infty$. We shall, in fact, prove that

$$Q(N) = (\pi/8)\, T(N) + 0(1) \text{ as } N \to +\infty,$$

where

$$T(N) = \sum_{k=1}^{N} \frac{|\mu(2k)|}{k} \ \to +\infty \text{ as } N \to +\infty.$$

[μ is Moebius' Function, so that $|\mu(2k)| = 1$ or 0 according as k is a square free odd integer or not.] It is well known that all distinct positive integer solutions to $x^2 + y^2 = z^2$, $0 < x < y$ are given, each exactly once, by

$$z = j(m^2+n^2), \quad x = j\min\{m^2 - n^2, 2mn\}, \quad y = j\max\{m^2 - n^2, 2mn\},$$

where m and n are co-prime integers, $m > n > 0$, mn is even, and where j is any positive integer. Writing $j = k L^2$, where k is square free, we set $z = k \{(Lm)^2 + (Ln)^2\}$. If k is even, we may write

$$z = (k/2)\{(L\bar{m})^2) + (L\bar{n})^2\}$$

where $\bar{m} = m + n$, $\bar{n} = m - n$, so that $\bar{m}$ and $\bar{n}$ are co-prime, $\bar{m} > \bar{n} > 0$, $\bar{m}\bar{n}$ is odd. Hence the number $NQ(N)$ of positive integer triples (x, y, z) with $x^2 + y^2 = z^2$, $x < y < z \le N$, equals the number of positive integer triples (k, m, n) with $k(m^2 + n^2) \le N$, $m > n$, $|\mu(2k)| = 1$.

Let $S(N)$ be the number of positive integer pairs (m,n) with $m^2 + n^2 \le N$, $m > n$. Then

$$N\,Q(N) = \sum_{k=1}^{N} |\mu(2k)|\, S\left(\frac{N}{k}\right).$$

Further, putting $M = \sqrt{(N/2)}$ and $f(x) = \sqrt{(2M^2 - x^2)} - x$,

$$S(N) = \sum_{n=1}^{[M]} [f(n)] = \sum_{n=1}^{[M]} \int_{n-1}^{n} [f(x)]\,dx + O(M) \to \int_{1}^{M} f(x)\,dx + O(M)$$

as $N \to +\infty$. Hence, as $N \to +\infty$,

$$S(N) = (\pi/4)\,M^2 + O(M) = (\pi N/8) + O(\sqrt{N}),$$

$$N\,Q(N) = (\pi/8)\,N\,T(N) + O\left(\sum_{k=1}^{N} \sqrt{N/k}\right) = (\pi/8)\,N\,T(N) + O(N).$$

It remains to show that $T(N) \to +\infty$ as $N \to +\infty$. If p ranges over all primes, and if $s > 1$, then

$$\sum_{k=1}^{\infty} \frac{|\mu(2k)|}{k^s} = \prod_{p>2} (1 + p^{-s}) = \frac{1}{1 + 2^{-s}} \prod_{p} \left(\frac{1 - p^{-2s}}{1 - p^{-s}}\right) = \frac{2^s}{2^{s+1}} \frac{\xi(s)}{\xi(2s)}$$

where ξ is Riemann's Zeta function. Since $\xi(s)/\xi(2s) \to +\infty$ as $s \to 1^+$, this implies that $\sum \dfrac{|\mu(2k)|}{k}$ diverges to $+\infty$.

[More precisely, $T(N) = (4/\pi^2) \ln N + O(1)$, which implies that $Q(N) = (1/2\pi) \ln N + O(1)$, as $N \to +\infty$.]

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Mike Hendy and
Graeme Wake

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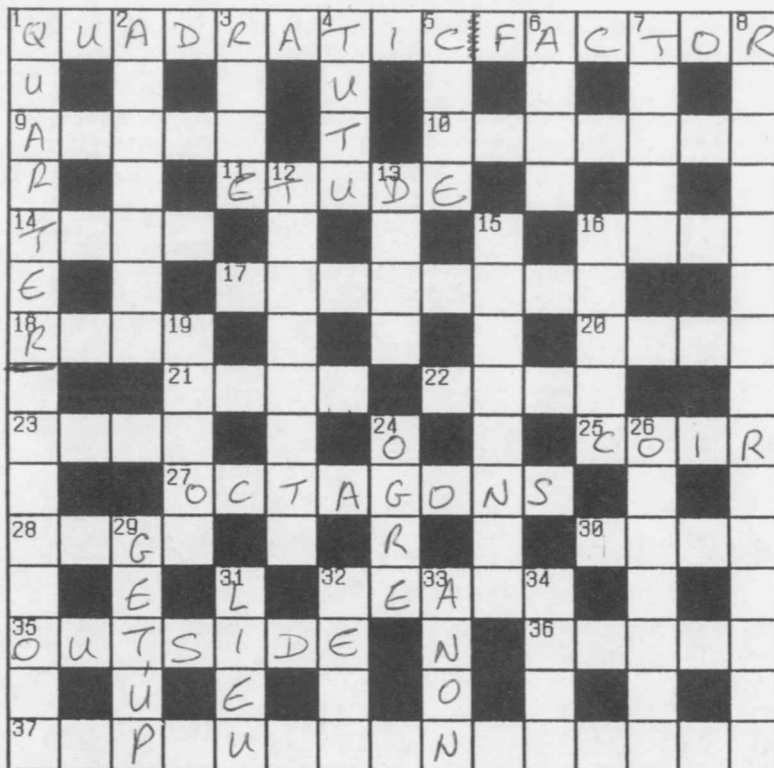---

Crossword No. 30 Solution

Astute followers of the game will have noted that the clues for 20 down and 21 down were interchanged. The great Sir Richard sometimes bowls a wrong'un.

CROSSWORD

by Matt Varnish

The completed grid contains handwritten answers including: QUADRATICFACTOR (top row), ETUDE, OCTAGONS, COIR, OUTSIDE, and others.

Across

2. Cad quit cart for a servant on the square giving algebraic component (9,6)
9. The most and nothing recycled the given fact (5)
10. Paralellogram of the first water (or rough?) (7)
11. Musical piece confused duet with key (5)
14. In this faashion the olibanum (4)
16. All even or not initially age (4)
17. A number of face guards for which 2 is apt (7)
18. About shirt god's vermin (4)
20. Penniless Neddy out in force (4)
21. Deep water flounder at point with residue in Warsaw? (4)
22. Eastern bird in case of needle (4)
23. She chose to hide nymph (4)
25. Co-heir without him is on the mat (4)
27. No cats go for figures (8)
28. A token (one of twelve?) (4)
30. Holy alien! Let it be (4)
32. 6.3.37? (5)
35. Tedious exterior (7)
36. Shortened 32 in joint on river (5)
37. The aged who turn as in Nature's pages (15)

Down

1. Do they provide justice four times an hour? (7-8)
2. Dividing part Capone, I almost cite (7)
3. I am in again and it is cold (4)
4. Stuttered reproach before brute skirt (4)
5. Fish and a quarter make the rules (4)
6. The first to figure? (4)
7. Reciprocal node is turn of speech (5)
8. Summing up in radicals for restorations (15)
12. Offspring puts foot wrong about obstruction (8)
13. Act now! for small Dutch coin (4)
15. Volume satisfies (8)
16. Detector as the dive begins (at sea?) (5)
19. Club, wooden for lowest (4)
24. Game back about giant (4)
26. Concoct a plan with parallel texts (7)
29. Arise in rig-out (3-2)
31. In place of fifty vowels (5)
32. Big piece of hard water (4)
33. Soon nameless (4)
34. Goat once under obligation in Scotland (4)

(The solution to Crossword No. 30 is on the previous page.)