THE NEW ZEALAND
MATHEMATICAL SOCIETY (INC.)

# NEWSLETTER

## CONTENTS



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# PUBLISHER'S NOTICE

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The homepage of the New Zealand Mathematics Society with URL address:
http://www.math.waikato.ac.nz/NZMS/NZMS.html
This newsletter is available at: http://smis-www.massey.ac.nz/~maths/NZMSnews.html
Items for submission to this journal should be submitted as text files to g.dejoux@massey.ac.nz
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# EDITORIAL

## *Restructuring*

This month marks the end of the Department of Mathematics at Massey University, a department that I have belonged to for 26 of its 35 year existence. It also marks the end of the initiative which we worked towards, in creating FIMS, the Faculty of Information and Mathematical Sciences. The department has had a number of reorganisations in the past, spawning first the Department of Computer Science and then the Department of Statistics. Starting in the Faculty of Science, we then moved into Social Sciences, had a period ex faculty, and then to FIMS.

From January 1, 1998, the members of this department will belong to the College of Sciences, the largest of the four colleges of Massey University. The College of Sciences has incorporated most members of the five Science and Applied Science Faculties. The College is itself being organised into 8 institutes, reflecting mainly the interlinking research groupings, with teaching organisation being administered on a college wide basis. Mathematics, along with Physics and (Physical) Chemistry, being core disciplines which support all the other areas, are grouped into the Institute of Fundamental Sciences. Although there will be no formal administrative substructures, the three disciplines will retain their identities, with collective grouping names yet to be determined.

On our Palmerston North campus, the mathematicians, statisticians and computer scientists will go to different institutes, and the Information Systems staff to the College of Business, while at our Albany campus, the mathematicians will be remain with their former FIMS colleagues in the Institute of Information and Mathematical Sciences.

Why? A reorganisation was seen as necessary to address the structure of a multi campus university, and in particular the College of Sciences needed to enhance its research capabilities, particularly to exploit the reputation built up in the Applied Sciences (Veterinary, Technology and Agriculture Sciences). In the teaching area, there were a number of near duplicate programmes, delivered by different departments, for example mathematics was taught by our technology, education and aviation colleagues as well as in our department.

From a personal level, I will be moving into the Science Tower to be on the same floor as my most frequent collaborator, who is in Plant Biology. Although we have successfully cooperated for years from opposite sides of the campus, this will bring our students and post docs into close proximity. The remaining mathematicians will probably remain in their current location until a refurbishing and extension is completed over the next couple of years.

In our society, public funded institutions are being restructured. It seems like a bulldozer pushing through existing structures, reducing to rubble what has been carefully crafted over many decades. It is unlikely other universities can completely resist this trend, although greater resistance elsewhere has seen restructuring proposals watered down. Will it work at Massey? We must try to make it work. More, we must recognise the potential of the breakdown of inter departmental boundaries, and the building of interdisciplinary research groups.

We must also seize this new opportunity to develop the potential research linkages. It would be a good outcome if our support role in the applied sciences is more fully recognised with the appropriate transfer of resources. Mathematics underpins most of the modelling in those areas, and even though much may be of a relatively low level, professional mathematicians are in a position to judge the levels and see the potential extensions. Having this component recognised in the funding applications should benefit both parties.

Watch this space!

*Mike Hendy*

# LOCAL NEWS

## AgResearch

Tatiana Soboleva, previously Professor of Mathematical Physics from Donesk in the former Soviet Union has been awarded an Agresearch Senior Fellowship to work on the dynamical systems underlying gene expression. An aspect of this work concerns the expression of the myostatin gene which controls double muscling in cattle. Tanya is based at Ruakura, and visited Grasslands and Wallaceville this month as part of her induction strategy.

At Ruakura, Kumar Vetharaniam, Clyde Daly and Dave McCall have begun work on a model of chemical reactions in meat after slaughter, in order to predict rates of pH and hence meat quality fall under different processing conditions. Graeme Wake remains a regular visitor to the Grasslands campus, discussing problems in hill land sustainability with Dave Barker, Greg Lambert, Alec Mackay and Ken Louie. David Baird (Lincoln) spent two weeks in the UK in September, attending the International Genstat Conference and working on new developments as part of the Genstat team. Lesley Hunt (Lincoln) has been granted an AgResearch Ph D scholarship, which she will take up in February 1998; she will be investigating the social impacts of the change from sheep to dairy farming.

Neil Cox, Martin Upsdell and Harold Henderson from Ruakura, David Baird, Lesley Hunt and Dave Saville from Lincoln, participated in the Australasian "Biometrics 97" conference in Adelaide in December. Paper titles to hand are: Harold Henderson and Dennis Cook: "On graphing paired data"; Dave Saville "Is normality necessary?"; Lesley Hunt: "Why do we do it? What statisticians enjoy about the practice of statistics."; David Baird: "Statistical aspects of the tussock moth eradication program.".

Tracey Flux, an MSc student in the Maths Department at Massey University and jointly supervised by Robert McKibbin (MU), Harry Clark, Paul Newton and Ken Louie, gave a seminar at Massey on October 28 entitled "A model for grass growth based on tiller numbers". On the same day Mick Roberts (Wallaceville) gave a seminar at Auckland entitled "The convolution strikes back".

And we've been writing FRST bids.

*Mick Roberts*

## UNIVERSITY OF AUCKLAND

### School of Mathematical & Information Sciences

Gaven Martin and George Seber have been elected as Fellows of the Royal Society of New Zealand.

The Marsden Fund grants for 1997-1998 include 6 in Mathematical and Information Sciences. John Butcher received a grant for his project on "Theoretical and practical investigations in numerical analysis", and Chris Wild received a grant for his project on "Semiparametric methods for response-selective and missing data problems".

### Department of Computer Science

Dr Georgy Gimel'farb, a pioneer of computing in the USSR, is now a Senior Lecturer at the Tamaki Campus.

Dr Karsten Schluens, (from the Technical University of Berlin) is an Honorary Research Fellow at the Tamaki Campus.

Dr Marjo Lipponen, a Post-Doctoral Fellow at Tamaki campus, has been awarded the 1996 Nevanlinna Prize for the best Mathematics PhD Thesis in Finland (1996). She wrote her thesis "On Primitive Solutions of the Post Correspondence Problem" under the supervision of Professor Arto Salomaa. She is currently working in the area of applications of finite automata to quantum mechanics and quantum computation.

Jennifer Lennon's book on "Hypermedia Systems and Applications: WorldWide Web and Beyond" (Springer-Verlag, New York, 1997) was launched at a Departmental party. Soon after that, Jennifer attended the WebNet Conference at Toronto, where many people told her that they intend to use her book.

Both John Hamer and Richard Lobb have received 1997 University of Auckland Distinguished Teaching Awards through the Faculty of Science. There was a third award to a member of the Psychology Department.

#### Seminars

Robert Sheehan, "Scooting through EdMedia 97".

Dr Georgy Gimel'farb, "Multi-view terrain reconstruction".

Gordon Alford, "Explicitly constructing a universal extended H system".
Sunny Thor Daniels, "A parallel programming language based on finite-state machines".
Dr Torbjörn Törnkvist (Ericsson Computer Science Lab, Stockholm), "An overview of the Erlang programming language, related research and its industrial use".
Dr. Mark Levene (University College, London), "Towards an understanding of minimaxing game trees with random leaf values".
Julian Harris, "Interact 97: human-computer interaction in computer science and in industry".
Dr Alan Creak, "HHI (human-human interaction) in rehabilitation systems".
Dr Richard Lobb, "Impressions of SIGGRAPH '97".
Dr Clark Thomborson, "The economics of large-memory computations".
Dr Jennifer Lennon, "What's new in the HMU".
Professor Reinhard Laue (University of Bayreuth), "Isomers, groups, t-Designs -- a constructive approach to group actions".
Dr V. E. Cazanescu (Bucharest University), "The algebra of the programs".
Professor Helmut Thiele (University of Dortmund), "Investigating approximate reasoning and fuzzy control by concepts of functional analysis", and "Mathematical foundations of fuzzy cluster analysis".
Professor John G. Cleary (Waikato University), "A rational reconstruction of adaptive systems".
Dr Christian Collberg, "Protecting Java programs through code obfuscation".
Dr Clive Ruggles (Leicester University), "Meta-information systems, resource discovery, and open learning".
Professor Karel Culik II (University of South Carolina), "Finite state methods for image compression and manipulation", and "Small aperiodic sets of Wang tiles and cubes".
Dr Nikhil R. Pal (Indian Statistical Institute, Calcutta), "Fuzzy image segmentation algorithms".
Dr Andy Duller (University of Wales, Bangor), "Paradise: A self-organising neural network for image pattern recognition".

## Department Of Mathematics

Dr Shayne Waldron is now a Lecturer.

John Butcher has been appointed Head of the Applied and Computational Mathematics Unit until January 1999.

Bill Barton and Mike Thomas have been appointed to joint Headship of the Mathematics Education Unit until December 2001, on the understanding that at any one time, just one of them will hold the position.

Congratulations to Graeme Wake, who has accepted an appointment as Professor of Applied Mathematics at the University of Canterbury. Also he is to be awarded the degree of DSc by VUW in December 1997. He has resigned from his position here, as from 1998-5-31. He will continue to coordinate the BTech (Industrial Mathematics) programme until then.

Recent visitors include Professor Reinhard Mennicken (University of Regensburg) and Dr Rodney Weber (the Australian Defence Forces Academy in Canberra). Dr Mark Nelson, Royal Society of London Research Fellow from the University of Leeds, Department of Fuel and Energy and the Centre for Nonlinear Studies, is visiting New Zealand for a year, based at the Tamaki campus. His research is in theory of thermal ignition and applied differential equations/dynamical systems.

The conference on "Women As An Influence In Mathematics Education", which was held in the Department of Mathematics on 1996 November 29 in honour of Jill Ellis, was reported in Newsletter 69. The Proceedings of that Conference were published on 1997 August 21, at a Departmental function. Copies of that book (134 pages, plus Supplement) are available (@ $20) from the SMIS.

A Symposium on Algebra and Combinatorics, in honour of Peter Lorimer, was held on the afternoon of November 20th. Professor Marston Conder gave an introduction to "The scientific work of Professor Peter Lorimer", Professor Anne Street (University of Queensland) gave a lecture on "Ramsey theory and the contributions of Peter Lorimer", and Professor Cheryl Praeger (University of Western Australia) gave a lecture on "Symmetric graphs and Lorimer's theorem". At the Departmental dinner that evening, to honour Peter on his retirement, many people spoke tributes to him, and letters with tributes from numerous mathematicians were

read out. Peter was much gratified by his farewell gift from the Department, of a blown glass artefact by Gary Nash.

**Seminars**

Dr Patty McKenna, "Competition graphs and their generalizations".

Dr Colin Fox, "Using Markov chain Monte-Carlo to perform conductivity imaging".

Professor Aimo Hinkkanen (University of Illinois at Urbana-Champaign), "Functions of bounded type".

Professor Reinhard Mennicken (University of Regensburg), "Spectral theory for systems of differential operators of mixed order and applications" (2 lectures).

Dr Alex McNabb, "Extensions of Ussing's flux ratio theorem".

Dale Winter (University of Michigan), "Calculus and pre-calculus at the University of Michigan", and "Complete solutions to Einstein's equations".

Tsukasa Yashiro, "Immersions from 3-manifolds into $\mathbb{R}^4$".

Dr Bill Barton, "TIMSS: What it tells us and what it doesn't",

Dr Ron Gribben (University of Brunei - Darussalam), "On the heat impulse methods for deducing sap velocity".

Dr Colin Please (University of Southampton), "Some mathematical models of cell motion in tumours".

Alexander Kraegeloh, "Random evolutions".

Dr Bruce Calvert, "Existence and bounds for a resistive network".

Elizabeth Sneyd, "Interval graphs".

Dr David Budgett (Department of Engineering Science), "Fast Fourier Transforms".

A-Professor Don Nield (Department of Engineering Science), "Modelling mushy zones".

Mamokgethi Setati (Centre for Cognitive Development, Vista University, South Africa), "To switch or not to switch: a black teacher's dilemma".

Dr Aner Shalev (Hebrew University of Jerusalem), "Groups and probability".

Kerry Richardson, "A report on the recent Summer Topology Conference".

Professor David Ragozin (University of Washington - Seattle) "Rotation-invariant kernels on spheres: a geometric introduction to harmonic analysis without spherical harmonics".

Professor Jean-Paul Calvi (Universite Paul Sabatier - Toulouse), "Univariate Lagrange interpolation", "Some multivariate generalizations", and "Some applications of Kergin interpolation to Lagrange interpolation".

Professor Boris Pavlov, "Spectral problems in the theory of quantum gates".

Dr Rodney Weber (Australian Defence Forces Academy, Canberra), "Bifurcating combustion behaviour".

Ali Jaballah, "The number of intermediary rings in some ring extensions".

Chris King, "Topological dynamics - an introduction".

Professor Reinhard Laue (University of Bayreuth), "Isomers, groups, t-designs - a constructive approach to group actions".

Dr Michael Roberts (AgResearch, Wallaceville), "The convolution strikes back".

Dr V. E. Cazanescu (University of Bucharest), "Semantic equations and Birkhoff's theorem".

Dr Mike Meylan, "Spectral analysis of the Boltzmann equation".

Professor John Butcher, "Stability barriers for numerical methods for ordinary differential equations".

Jiling Cao, "The theory of quasi-uniform function spaces".

Professor Maximilian Ganster (Technische Universität, Graz), "Resolvability with respect to an ideal".

## Department of Statistics

Alastair Scott attended a conference at the University of Nebraska, where he was pleased to discover that the statistics software package R, developed by Ross Ihaka and Robert Gentleman, is being extensively applied and intensively developed by groups of enthusiasts, especially in Germany.

Thomas Yee has gone to Stanford University for four months, to collaborate with Trevor Hastie.

James Curran has been awarded a post-doctoral fellowship by the Foundation of Research, Science and Technology, to work for 2 years with Professor Bruce Weir (expatriate from New Zealand) in the Program in Statistical Genetics at North Carolina State University at Raleigh, North Carolina. Bruce Weir is one of the world's foremost statistical geneticists, and he is the leading researcher in the statistical interpretation of genetic forensic evidence.

James studied in the Department of Statistics at the University of Auckland, and he graduated PhD in April 1997. His research

was funded by the first ESR scholarship in Forensic Science, an initiative that encourages the co-operation of ESR and academic institutions. He was jointly supervised by Dr John Buckleton of ESR and Associate Professor Chris Triggs. In his thesis James considered statistical problems arising in the interpretation of transfer evidence, which may be fragments of glass, paint, semen, blood, or other body fluids. Much of the research considered evidence when glass fragments from the perpetrator's clothing are recovered from the crime scene, or when fragments from the crime scene are subsequently recovered from a suspect. James enhanced the understanding and theory in this field in several different ways. James's software is currently used in casework in New Zealand, and it is being tested in a number of foreign laboratories. Specifically, the British Government laboratory has expressed an interest in amalgamating software, and the manufacturers of the forensic glass-measuring equipment have also approached ESR for possible use of the software in distribution with their product.

James has been invited widely to speak internationally on his work. He has built on a long tradition of glass forensic evidence research in New Zealand, and the long-term co-operation between ESR and Auckland University built in part on the work of Chris Triggs, John Buckleton and Kevan Walsh, and it advances New Zealand's position significantly. The recent interest in obtaining training and lecturers from New Zealand for teaching in the USA, UK, Europe, Australia and Asia, is evidence of New Zealand and ESR's growing profile in this area, which comprises one of the largest and most useful forms of forensic evidence.

James leaves to join the top DNA evidence school in the world, which has strong associations with New Zealand through Bruce Weir and John Buckleton. It is hoped that he will continue to contribute to New Zealand and ESR's reputation in this field as well.

**Seminars**

Dr Geoffrey Pritchard, "Arranging items into pairs, or how to sort your laundry".

Dr Thomas Yee, "A Reduced-rank multinomial Logit model".

Dr Gareth James (Stanford University), "Classification problems and PaCTs".

Dr Zvi Drezner, (California State University - Fullerton), "Tabu search model selection in multiple regression analysis".

Dr Peter Smith (Victoria University of Wellington), "Performance analysis of mobile radio systems with space diversity in a variety of environments".

Professor Klaus J. Miescke (University of Illinois - Chicago), "Bayes sampling designs for selection procedures".

*Garry J. Tee*

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## UNIVERSITY OF CANTERBURY

In the thick of marking and assessments, this correspondent will be brief! To our great pleasure, the department has filled two professorial positions, beginning next year. Professor Graeme Wake has accepted appointment to the Chair in Applied Mathematics, to begin on 1 June, 1998. Dr Malcolm Faddy, from the University of Queensland has accepted the Chair in Statistics, to begin in August, 1998. In addition, we will have a new lecturer in applied maths beginning the first of January, Dr Alan Wilms who has completed his thesis at Cornell University. Furthermore, Peter Renaud has accepted the responsibility to continue for three more years as Head of our Department, modulo a breathing spell next year for study leave. To complement the three additions, Frank Lad has announced his retirement as of the end of January. We are currently enjoying a visit from Mike Powell of Cambridge who continues to work with Rick Beatson, and we are concluding a most enjoyable visit from Jeff Rosoff from Aldolphus College in Minnesota. He will conclude his sabbatical year in 1998 with a few months at Otago.

*Frank Lad*

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## MASSEY UNIVERSITY

### Department of Mathematics

**Continuous Process Restructuring Department:**

Readers have no doubt been following the rise and rise of Massey University with interest. (The secret's in the leveraging, guys.) The home campus, now known as the Turitea

Site of the Palmerston North Campus of Massey University, has not been spared change, as the nine Faculties were remade into five Colleges, creating a bums rush amongst the ex-departments.

You can imagine that this dominated coffee-room gossip to an almost nauseating degree all year, with, as befits mathematicians, much time devoted to nomenclature, from titles ("School" or "Institute"?) to slogans ("Massey: the only university with Playland") to vision statements ("To Make Money").

Now that the dust has settled - well, almost - mathematics, physics, and chemistry will be merged to form the Institute of Fundamental Sciences within the College of Sciences. Professor David Parry will head the new Institute. Although the administration is still promising no redundancies and we move away from EFTS-based funding for the Institutes, the College is EFTS funded and will have to shed staff through attrition over the next few years. However, the greater emphasis on research, collaboration, funding, and the PhD programme may ultimately make for a stronger academic environment. Two staff members, (John Giffin, and Mahyar Amouzegar) will join the Institute of Information Science and Technology (without Information Systems, who are moving to the College of Business), as will most of the former Statistics Department, while John Hudson of Computer Science (really a mathematician) joins Fundamental Sciences. Got that? Meanwhile, Albany has been allowed to maintain its status quo, getting its own Institute of Information and Mathematical Sciences, headed by former FIMS dean Jeff Hunter. Adrian Swift will be moving to Albany to join them.

**Staffing**

Kee Teo, Mike Hendy, and Charles Little have received University funding for a postdoctoral fellow to work on chromatic polynomials (which specify the number of proper vertex colourings of a graph with a given number of colours).

It is hoped that Feng-Ming Dong, National University of Singapore, will take up this position in January.

Nicolas Robidoux arrived, *en famille*, in late August to begin work with Robert McLachlan as a Marsden Postdoctoral Fellow, by way of Montreal, Albuquerque, Los Alamos, and Hawaii. (One wonders if Palmerston North can compete. We do have better surfing than Los Alamos and are warmer than Montreal.) His thesis, to be completed real soon now, is on natural discretizations of div, grad, and curl operators, and he and Robert have begun applying these ideas to related conservative PDEs.

The mathematics department (which, after all, still exists until 31/12/97) recently moved premises from the second to the fourth floor of our tower. It's much more spacious and has a better view - we can even see our Institute colleagues in *their* tower across the campus.

The Journal of Applied Mathematics and Decision Sciences, begun by Mahyar Amouzegar (see newsletter #70), celebrated the appearance of its first issue with a launching party in October. Mahyar compared the process to having ants eat off his honey-soaked body. (How does he know?) Annual subscriptions are a bargain $25, but never mind the price, feel the quality!

Robert McKibbin and PhD students Chris Palliser and Tammy Smith all attended, and presented papers at, the annual New Zealand Geothermal Workshop held at the University of Auckland 12-14 November.

Due to the untimely death of his PhD supervisor Professor Wolfgang Vogel, Nick Allsop will be completing the technical part of this thesis abroad. He leaves soon to spend a year working with Professor Vogel's colleague Professor Jürgen Stückrad at the University of Leipzig.

Maria Hermannsson recently returned to Roskilde University, Denmark, after spending several months here collecting material for her master's thesis, a comparative study of the "position of mathematical proof" in the equivalent of 6th and 7th form mathematics in Danish and New Zealand high schools.

Professor Michael Hendy was successful in the 1997 Marsden Fund round, being awarded a total of $479,000 over three years for collaborative studies with biologist Professor David Penny, in biomathematics and DNA sequence analysis. This includes funding for a post doctoral fellowship and a PhD studentship to join the local group of about 10 already working in this field.

A confluence of visitors prompted Robert McLachlan to organize a seminar day,

hopefully entitled the "First inaugural annual Wellington-Manawatu regional one-day conference on applied and computational mathematics," scheduled for 26 November. The speakers were Igor Boglaev, Clive Marsh, Robert McLachlan, and Nicolas Robidoux (Massey); John Butcher (Auckland); John Harper, Lindsay Johnston, and Mark McGuinness (Victoria); Reinout Quispel (La Trobe); and Stephen White (IRL). If you couldn't attend, the abstracts and references will be placed on our web page.

Glenda Anthony is no doubt pleased that the New Zealand Association of Mathematics Teachers fifth biennial conference is over and done with. The organizational work required was enormous and she received a standing ovation from the participants at the conclusion.

The conference, dubbed "Get in the Know", was held in Palmerston North in October and was attended by over 400 mathematics educators, including teachers from Thailand, Australia, Denmark and Nuie. The conference programme included plenary sessions, 135 workshops and special interest group meetings. Technology sessions, including graphic calculators, software applications and Internet sessions, proved extremely popular. The wide range of mathematics in context workshops: Creative Maths; Get in the Groove with Maths and Music; Mathematics of Escher Art; Why Count Cars and Cricket Scores?; The Mathematics of Kites (New Zealand Education Review, Oct 15); and Braids and Mathematics (Evening Standard, Oct 8), provided a host of activities to take back to classrooms.

The Bevan Werry address by Dr Gordon Knight, *I've Been Thinking: Reflections on 55 Years in Mathematics*, discussed the decline in interest in mathematics and teaching. Gordon asked the delegates: "When was the last time you told someone that maths was a wonderful career? ..." We have a responsibility, as a profession, to tell people that, in spite of the frustration and difficulties of teaching, it is a challenging, wonderful and essential part of society." Reflecting on his own teaching career, he said it had been "challenging and extraordinarily rewarding, I have loved being a maths teacher. It is the best possible thing I could have done in my life."

**Seminars**
**Mathematical Modelling Discussion Group**

Dr Clive Marsh, "Adaptive minimax control: $H_\infty$ control with emphasis on near future performance".

Dave Smith, "Review of flow shop scheduling methods".

James Clarke, Zane Gemmell, Ken Miller and Julie Boyd (Honours students in Industrial OR), "Modelling competition in vehicle routing".

Gordon Sutton (ANU), "Nonlinear predictive control: a comparison between linear-robust and non-linear approaches".

Tuoc Trinh, "A time-space transformation for laminar boundary layer transport and identification of a new type of partial derivative".

Tuoc Trinh, "A new class of Navier-Stokes solutions using limiting conditions. Case study: laminar flow of non-Newtonian fluids in annuli".

Li Vun Chong, "Numerical simulation of the self-heating of milk powders".

**Mathematics Seminars**

Robert McLachlan, "Simulating water: the molecular dynamics of rigid body motion".

Jacques Verstraete, (University of Natal), "Thomassen's path theorem for 2-connected planar graphs".

Nicolas Robidoux, "Discretizing Hodge stars, eliminating quantifiers in parallel, and conditioning grid Jacobians".

Igor Boglaev, "Domain Decomposition Algorithms on serial and parallel computers".

Nicolas Robidoux, "Natural discretizations of div, grad and the diffusion operator on rough grids with discontinuous material properties".

Allister Campbell, "Finite difference methods and boundary value problems".

Tammy Smith, "Modelling of hydrothermal eruptions".

Tracey Flux, "A model for grass growth based on tiller numbers".

Chris Palliser, "Modelling geothermal brines".

Maria Hermannsson, Roskilde University, Denmark, "The position of proof in Danish and New Zealand high schools".

*Robert McLachlan*

# UNIVERSITY OF WAIKATO

## Department Of Mathematics

In late November, a retirement function was held for Graham French. At this function, speakers spoke about Graham's contribution to the Department and University over a period of nearly 30 years. This included his willingness to accept new tasks, his commitment to good teaching, and his commitment to helping students. We wish him well for the future. Graham will not be totally disappearing in the immediate future. Early next year, he will be teaching our summer school first year courses.

Ingrid Rinsma-Melchert will continue to work half-time in 1998. In the meantime, a limited term half-time lectureship has been advertised.

In late August the department held a retreat at the Okoroire Hot Springs Hotel (about 45 minutes drive south of Hamilton). During this retreat a departmental planning document for the years 1998-2000 was produced.

A number of DPhil students have completed their degrees this year. Stefan Henton and Yuchuan (Michael) Wang have graduated, Martin Glanvill and Zhu Nan passed their orals, while Alec Zwart and Richard Fabling have recently submitted their theses.

Hajime Ishihara from the Japan Advanced Institute of Science and Technology visited Douglas Bridges for three weeks in August. They continued their nine year research collaboration on constructive functional analysis and operator theory. At the start of Ishihara's visit, a one-day workshop on logic in computer science was held in Auckland. Douglas spoke at this workshop as did his DPhil. student Luminita Dediu.

Douglas was overseas in Europe for most of October. He presented talks at the First Workshop on Formal Topology in Padova, Italy, and at a conference on Mathematical Utility Theory in Essen, Germany. Between these two conferences, he gave various talks in Vienna, including two talks to final-year high school students about life and study in New Zealand.

Douglas' book 'Foundations of Real and Abstract Analysis' (Springer-Verlag GTM 174) has just been published.

Ian Craig is still on study leave. He has recently returned from the first overseas part of his leave. This time was spent at the Institute for Astronomy, University of Hawaii, and at the University of St Andrews in Scotland.

### Seminars

H. Ishihara (Japan Advanced Institute of Science and Technology), "Constructivity, Computability and Complexity on Real Numbers".

E. Kalnins, "Remarks on the Sine Gordon Equation".

D. Bridges, "Riesz, Fubini, and Lebesgue-the integral as an antiderivative".

*Stephen Joe*

## Department of Statistics

Nye John has recently returned from 13 days in China. He was an invited member of the Statistics Delegation and visited Shanghai, Hangzhou and Beijing. The purpose of the visit was to share information with Chinese statisticians in a series of meetings and informal discussions.

1998 will see the launch of a new journal "The Australian and New Zealand Journal of Statistics". This will be an amalgamation of the New Zealand Statistician and the Australian Journal of Statistics. The new journal is to be jointly edited by Murray Jorgensen and Simon Sheather from the University of New South Wales, the current editors of the existing publications, respectively. Simon recently visited the department for editorial discussions with Murray on setting up the new journal.

Dave Whitaker will return shortly from his leave, spent at the University of Lancaster. He is currently working with Michael Wright on methods in optimisation.

It is with regret that the department farewells two members. Jane Andrew is returning to England after two years as a full time tutor. Jocelyn Dale will leave in December, but will remain in Hamilton. She will continue to contribute to the University in the capacity of Honorary Lecturer.

Judi McWhirter has successfully defended her DPhil thesis entitled "Modelling Pulsatile Data: Estimation of Parameters and Dispersion Matrix."

**Seminars**

Assoc Professor Simon Sheather (Australian Graduate School of Management, University of New South Wales) "A robust dimension reduction technique based on inverse regression"

William G. Warren (Department of Fisheries and Oceans, St Johns, Newfoundland) "Spatial Analysis of Marine Populations".

Lyn Hunt (University of Waikato) "Fitting a mixture model to three-way data with categorical and continuous variables"

*Judi McWhirter*

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# BOOK REVIEWS

## General Topology II (Compactness, Homologies of General Spaces), A.V. Arhangel'skiĭ (ed.)

Encyclopaedia of Mathematical Sciences, Vol. 50, Springer-Verlag, Berlin-New York-London, 1996, 256pp, DM 148.00. ISBN 3-540-54695-2.

Perhaps nothing captures better the dominant perception of general topology by the wider mathematical public than the following amusing story from topological folklore. It is said that when the eminent Polish topologist Professor Kuratowski was asked in 1980 shortly before his death to name what constituted, from his viewpoint, the most recent important development in general topology, he replied: "The invention of paracompactness by Dieudonné in 1944".

This reply is symptomatic of the typically lukewarm attitude towards general topology. These days, it is believed by many that the concept of a topological space is understood well enough to justify shifting the research emphasis elsewhere. Resorting to a powerful astrophysical metaphor suggested by Jean Dieudonné himself, general topology has already left the Main Stream of research mathematics. (The inventor of paracompactness would certainly be the one to know!) The obvious consequences of such an acquired reputation, fair or not, are dramatic: general topology's share in the progressively meagre pie of research grants and academic jobs is dwindling.

And living through hard times general topology is indeed. The plight of general topologists seems gloomy even in comparison to the quagmirish situation the entire community of research mathematicians has suddenly found itself in. General topologists no longer hold sufficiently influential posts in academia and as a result, the job prospects in the West for both new PhD's and emigré topologists from the East look depressingly bleak. A good indicator of the standing of a particular branch of mathematics in the research community is the worldly success enjoyed by its leaders, and here general topology is a loser. Alexander Dranishnikov, arguably the brightest general topologist of my generation (mid-thirties to mid-forties), after having left the fSU, occupies a relatively modest academic position for someone of his level of achievement - a Full Professorship at the University of Florida. Even such an area of mathematics as general algebra, which is also commonly labeled as being "off the Main Stream," is faring much better: just remember such an ex-Siberian as Efim Zelmanov, a Yale Professor and Fields Medal recipient, belonging to the same generation of researchers!

By contrast, the purely mathematical substance of general topology is nothing short of being 'everywhere dense'. This area of knowledge penetrates each corner of mathematics and, by transitivity, many branches of theoretical physics, computer science, and even chemistry. General topology studies *continuity* in the most general context imaginable - and this concept goes far beyond mathematics alone. The mission of general topologists is to preserve their area of knowledge in a good working condition - and this can *only* be achieved through continual research. Is it not ironic, then, that a guardian priest of such a fundamental conceptual core of mathematics, having paramount importance for our understanding of everything else, becomes these days a much less desirable new staff

member than someone doing research in, say, the theory of quantum groups?

Mathematics could probably have survived the effects of a hypothetical removal from it of the entire theory of quantum groups (that is, those Hopf algebras, possibly with additional structure such as norm or valuation, generated by multiplicative matrices), even if such pointless surgery would have left modern mathematical research substantially depleted. But imagine removing from mathematics all the concepts and ideas of general topology - and you will be left with very little if anything at all: for example, can you think of any advanced branch of mathematics that can be done without using *compactness*? Not only functional analysis, Lie theory, and mathematical logic would then collapse, but even quantum groups themselves would be greatly impaired. And to *truly* understand what compactness is about, it is not enough to learn a few equivalent definitions and basic properties and examples of compact spaces. Most of us might be just consumer users of compactness, but there is always a need in professionals devoting most of their time to research in this particular area alone. Once such devoted scholars are gone, so is the understanding of the concept - it is as simple as that.

The book under review is one volume in a series that does much to explain to mathematicians what the present day general topology has on offer. This volume is formed by two separate surveys, and the first one is *Compactness*, written by Alexander V. Arhangel'skiĭ. It is written so as to underline the many links of the concept with the rest of mathematics. The author maintains a fine balance between technicalities of general topology and constructions from functional analysis and topological algebra.

The notion of a compact space has numerous equivalent definitions, and the survey starts with their outline, as well as closely related concepts, important on their own, such as countable compactness and pseudo-compactness. The relationship between these concepts and conditions under which they coincide is studied. The exact place of compacta in the spectrum of topological properties is then determined. The theory of compact spaces is rich in truly fundamental results and constructions that every mathematician is forced to have working knowledge of: the Tychonoff product theorem, universality of Tychonoff cubes, the Stone-Čech compactification, Cantor set and representability of each metric compactum as its continuous image. All of those can be found in the survey.

There are also a number of concepts and results that are not so widely known but still are of fundamental importance and certainly deserve being known better, as they might find their way into applications in the bordering disciplines. Among these, the survey treats dimension of compacta, ordered compacta, the construction of absolute, scattered compacta, metrizability conditions for compacta, the coincidence of net weight and weight of a compactum, perfectly normal compacta, sequentiality and Fréchet-Urysohn property, tightness, $G_\delta$ -subsets, homogeneous compacta, mappings onto Tychonoff cubes, dyadic compacta, compactifications with given properties. I wish to mention separately the classical result by Arhangel'skiĭ: the cardinality of a compactum satisfying the first axiom of countability does not exceed $2^{N_0}$.

The survey treats those compacta coming from functional analysis, especially in connection with work by Grothendieck, Corson, Namioka and others. Such results as the Stone-Weierstrass, Krein-Milman, and Bourbaki-Alaoglu theorems are also included and discussed. The Banach-Stone theorem about two compacta, $X$ and $Y$, being homeomorphic if and only if the Banach spaces of continuous functions, $C(X)$ and $C(Y)$, are isometric, leads to an interesting problematic: which properties are shared by two compacta, $X$ and $Y$, provided $C(X)$ and $C(Y)$ are isomorphic with some natural locally convex topology? A number of fixed point results are surveyed, as well as Dugunji compact spaces and extensors.

Then the survey proceeds to the Gelfand-Naimark duality, spectra of rings with Zariski topology, and the Stone spaces of Boolean algebras. Pontryagin's duality theory is glimpsed at. Joint versus separate continuity and topological fields conclude the article.

The second survey in the volume is *Homology and Cohomology Theories of General Spaces*, by Evgeniĭ G. Sklyarenko. Even though one might remark that the subject of the survey belongs, strictly speaking, to *algebraic* rather than *general* topology, the setting chosen is so general as to fully justify the present

affiliation. Instead of doing (co)homology theory for either locally compact spaces or at most CW-complexes (spaces admitting a triangulation in a somewhat generalized sense), the author presents what is probably the most general approach possible, that in the realm of *sheaf theory*. And here comes the concept which in itself provides an ample *raison dêtre* for general topology: that of a *sheaf*. While serving as *the* foundational setting for modern geometry, the concept of a sheaf on a topological space is so deeply rooted in general topology as to be inseparable from it and to require a lot of topological research to keep it healthy and developing.

Recall that a sheaf, $\mathbb{S}$, of rings on a topological space $X$ is an assignment of a ring, $\mathbb{S}(U)$, to each open subset $U \subseteq X$, and of a ring homomorphism, $\rho^U_V$: $\mathbb{S}(U) \to \mathbb{S}(V)$ to each pair of open sets $V \subseteq U$, in such a way that the resulting collection of rings and homomorphisms agree with each other so as to satisfy five natural axioms. One basic example is the so-called sheaf of germs of continuous functions on a topological space $X$, where $\mathbb{S}(U) = C(U)$ is the ring of all continuous real-valued functions on $U$ and each $\rho^U_V$: is the restriction homomorphism. This sheaf is called the *structure sheaf* of a topological space. A pair consisting of a topological space $X$ and a sheaf $\mathbb{S}$ of rings on it is called a *ringed space* and constitutes one of the major objects of importance in mathematics of our time. Topological spaces, smooth and analytic manifolds, algebraic and analytic varieties, and superspaces - all of them are, first and foremost, ringed spaces. What really matters in geometry, is (co)homology groups of sheaves on topological spaces rather than those of spaces themselves - while the latter theories fall in the scheme and can be recovered as those of the structure sheaves.

Here is a brief survey of the contents: classical theories (mainly simplicial and singular (co)homology, including cell complexes), Čech and Alexander-Spanier cohomology theories, an introduction to sheaf theory, cohomology with coefficients in a sheaf, cohomology of pairs, de Rham theorem and Dolbeault's cohomology, Leray spectral sequence, Čech cohomology revisited in the light of sheaf theory, homology theory, products, axiomatic approaches, spectral properties, dimension and duality.

The two surveys are furnished with extensive bibliographies and a common index. The present reviewer believes that the volume can be successfully used both as an introduction and as a source of continual reference to *compactness* and *general (co)homology theories* - and surely the great importance of both concepts throughout mathematics secures for the volume under review a prominent place on our bookshelves.

That books of such high quality and great substance are still produced is a good indicator of an area of knowledge remaining very much alive. In fact, we all need general topology too much to write it off, whether we realize it or not. As to general topologists themselves, I dare say that their brains constitute a priceless global treasure of our humankind worth cherishing and preserving.

Thoroughly trained and sophisticated, those are the brains of hard problem-solvers, and probably to a greater extent so than in many other areas of research. A cleverly made investment in general topology will eventually pay back - be it a global visionary programme currently implemented in Mexico which country is recruiting excellent mid-career mathematicians from the former Soviet bloc, or a local effort of an individual researcher putting aside time to learn more about general topology from a book like the one under review.

*Vladimir Pestov*

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## 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, University of Auckland (email: alcorn@math.auckland.ac.nz)

| | |
|---|---|
| **Andersson,** | Topics in complex analysis. (Universitext) 166pp. |
| **Arney C,** | Principles and practice of mathematics. (Textbooks in Mathematical Sciences) 705pp. |
| **Bak J,** | Complex analysis (2nd ed). (Undergraduate Texts in Mathematics) 255pp. |

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|---|---|
| **Bauer FL,** | Decrypted secrets: methods and maxims of cryptology. 448pp. |
| **Bhatia R,** | Matrix analysis. (Graduate Texts in Mathematics, 169) 340pp. |
| **Boerger E** | The classical decision problem. (Perspectives in Mathematical Logic) 482pp. |
| **Bronstein M,** | Symbolic integration I. (Algorithms and Computation in Mathematics) 299pp. |
| **Bürgisser P,** | Algebraic complexity theory. (Grundlehren ..., 315) 618pp. |
| **Conway JH,** | The book of numbers. 320pp. |
| **Cox D,** | Ideals, varieties, algorithms. (Undergraduate Texts in Mathematics) 550pp. |
| **Deza MM,** | Geometry of cuts and metrics. (Algorithms and Combinatorics, 15) 587pp. |
| **Diestel R,** | Graph theory. (Graduate Texts in Mathematics, 173) 250pp. |
| **Dixon JD,** | Permutation groups. (Graduate Texts in Mathematics, 163) 360pp. |
| **Ewald G,** | Combinatorial convexity and algebraic geometry. (Graduate Texts in Mathematics, 168) 300pp. |
| **Gelfand SJ,** | Methods of homological algebra. 372pp. |
| **Gustafson KE,** | Numerical range. (Universitext) 225pp. |
| **Hilton P,** | Mathematical reflections. (Undergraduate Texts in Mathematics) 270pp. |
| **Hjab O,** | Introduction to calculus and classical analysis. (Undergraduate Texts in Mathematics) 295pp. |
| **Jacobson N,** | Finite-dimensional division algebras over fields. 278pp. |
| **Kirsch A,** | An introduction to the mathematical theory of inverse problems. (Applied Mathematical Sciences, 120) 310pp. |
| **Künig H,** | Measure and integration. 260pp. |
| **Martini H,** | Excursions into combinatorial geometry. (Universitext) 420pp. |
| **Martzloff J-C,** | A history of Chinese mathematics. 485pp. |
| **Naber GL,** | Topology, geometry and gauge fields. (Texts in Applied Mathematics, 25) 260pp. |
| **Packel E,** | Animating calculus: Mathematica notebooks for the laboratory. 290pp. |
| **Perko,** | Differential equations and dynamical systems (2nd ed). (Tests in Applied Mathematics, 7) 540pp. |
| **Pollatsek H,** | Laboratories in mathematical experimentation. (Textbook in Mathematical Sciences) 300pp. |
| **Redfern D,** | Maple ODE lab book. 150pp. |
| **Roman S,** | Introduction to coding and information theory. (Undergraduate Texts in Mathematics) 300pp. |
| **Schwalbe D,** | VisualDSolve: visualization differential equations with Mathematica. 290pp. |
| **Sethuraman BA,** | Rings, fields, and vector spaces. (Undergraduate Texts in Mathematics) 160pp. |
| **Taylor,** | An introduction to measure and probability. 320pp. |
| **Ueberhuber C** | Numerical computation I and II. 474pp and 495pp. |
| **Wu J** | Theory and applications of partial differential equations. (Applied mathematical Sciences, 119) 430pp. |
| **Zachary J** | Introduction to scientific programming. 420pp. |

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# UCALC

David Corbier is a software developer, who would like to bring your attention to UCALC for review in the New Zealand Mathematics Society Newsletter. UCALC is a multipurpose calculator program which includes an expression evaluator, equation solver, integrator, 2D/3D equation plotter, unit converter, user solution modules and more.

An innovative feature, User Solution Modules, allows the user to define a problem by simply providing a formula. UCALC figures out all the underlying math, and prepares a user friendly form which can then solve problems based on the given formula.

UCALC 4.0 was selected as a reviewer's pick on many popular sites such as ZDNET, CNET's download.com, several WUGNET forums, Windows95.com, Softseek.com, WindowsCentral.com, and more.

You will find all the information, including a downloadable evaluation copy at http://www.ucalc.com

# GRANTEES' REPORTS

## Tina Chan: University of Auckland

During 1-5 September, 1997, I attended an international conference, NUMDIFF, in Halle, Germany and gave a talk, "Graph theoretic structures for Runge-Kutta and other methods". Because all the participants lived in the same hotel, the warmth and sociable conference made it easy to meet, and to engage in enlightening discussions with many of the sixty participants.

Later, I participated in SciCADE97, in Grado, Italy, during 15-19 September, 1997. A talk, "An algebraic approach for Runge-Kutta methods and other related methods", was given at that time. This large conference (over 200 participants) gave me a great opportunity to get in touch with almost all the experts in the part of Numerical Analysis in which I work. I really benefited from giving my presentations, attending the lectures and frequently talking to other participants, especially with Professor G. Wanner. The opportunities of discussing my own work with others were extremely helpful for my work.

I am very grateful to the New Zealand Mathematical Society, the Mathematics Department at The University of Auckland and the University of Auckland Graduate Research Fund. I am also grateful to Professor J C Butcher for his support through a Marsden Fund grant. I wish to thank the New Zealand Mathematical Society for the student travel grant which partly supported my participation.

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## David Chen: University of Auckland

With the aid of the grant from the New Zealand Mathematical Society, I visited Europe from 1st September to 22nd September. During this time, I attended two numerical analysis conferences. The first of these, "NUMDIFF 8" was held in Alexisbad, Germany, from 1st to 5th September 1997. The second, "SciCADE97" was held in Grado, Italy, from 15 to 19 September 1997.

These conferences gave me opportunities to communicate with many experts in my field. In Germany, I presented a talk "Effective order singly-implicit Runge-Kutta method and variable stepsize" and submitted a paper for the conference proceedings.

In Italy, my talk, "Truncation error and stability for variable ESIRK methods" was arranged in the "Generalised Runge-Kutta method" symposium. Presenting my work to international audiences in this way has been a valuable experience. After attending those two conferences, I think I have gained many valuable experiences. It is very exciting to know that the next "SciCADE99" will be held in Queensland, Australia. And the 3 years series of Auckland Numerical workshops will start in June in 1998. They are going to give many opportunities for researchers.

I am very grateful to the council of New Zealand Mathematical Society for supporting my participation and giving me a chance to present and submit my results at these conferences. I would also like to thank the Department of Mathematics and the research committee of University of Auckland and the Marsden fund through my supervisor Professor J.C. Butcher for their financial support.

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## Andrew Hill: University of Auckland

During 13-19 July, 1997, I was one of some 350 participants in the XIIth International Congress of Mathematical Physics held at the University of Queensland, Brisbane. There was a vast array of speakers in all areas of mathematical physics, including integrable models and algebraic methods, which were of



Cont'd on P18

# CENTREFOLD

## Gillian Thornley

***President, New Zealand Mathematical Society, 1989-91***

It is only a journey of a few metres for me to go to the office of my friend and colleague, Gillian Thornley. However it has been a long and demanding academic journey for the young Gillian Brown from her family's Murchison dairy farm, to her current position as Senior Lecturer in mathematics at Massey University. Geographically her journey has taken her to distant places such as Toronto and Trinidad, while her career path has had to negotiate motherhood, various short term and part time jobs in teaching and research.

Gillian won a scholarship and attended Nelson College for Girls for 5 years, before she went on to the University of Canterbury in 1958 to start a Science degree. Like some other girls' schools even today, there was inadequate support for the sciences, with no classes in Physics. Her proposal that some of the senior students wanting to study physics should attend the Boys' College was not accepted! Hence she was at a considerable disadvantage doing first year physics at Canterbury.

In her third year she chose mathematics as her major. Among her contemporaries were Beatrice Hill (Tinsley) and Brent Wilson, with Dean Halford and David Alcorn one year ahead. She continued into the MSc programme. At that time the first year graduate programme was fully prescribed, 3 papers in Pure and 3 in Applied Mathematics. In her second year she completed her thesis on Finsler Geometry, under the notional supervision of HoD, Derek Lawden. However as Derek was on leave for a full year, Gillian was essentially without supervision and had to develop her own independent research skills. Her thesis was examined by Henry Forder.

Gillian's plan had been to go Secondary teaching, but on gaining first class honours, she was encouraged to continue her research. She did however spend two terms teaching at Marlborough Girls' College before she took up a Teaching Fellowship at the University of Toronto in 1963. When she arrived she was the only woman postgraduate student in mathematics at U of T. (Subsequently a second woman Betty MacIntosh (Johnston) from New Zealand joined her.) Her supervisor was Ray Vanstone, although she also worked with Hanno Rund, who was there on leave from South Africa. Her thesis topic in Metric Differential Geometry followed on from her masterate.

On her return to New Zealand, she took up a Lectureship at Canterbury University for 2 years. At this time she wrote up results from her thesis for her first two research publications and she renewed her acquaintance with John Thornley, who was to become her husband. John was about to take up a three year appointment with the World Student Christian Federation in Trinidad. Gillian applied for, and received a Lectureship at the Trinidad campus of the University of the West Indies. It was there that they were married. Gillian found that on changing her name, she could either be addressed as "Dr Brown-Thornley", or as "Mrs Thornley", but not "Dr Brown"! Gillian had 2 very colourful, but academically frustrating years at UWI, including a period

of Acting HoD. The five other staff of the Division of Mathematics and Statistics were all in applied mathematics or statistics, the teaching loads were high, in excess of ten contact hours per week, and there were no resources or opportunities to continue research. The campus was a satellite to the main campus in Jamaica, but there was poor communication and little contact with that campus.

At the completion of John's contract, they returned to Nelson for 2 ½ years, were their two children, Louise and Matthew were born. During this time she did some part time tutoring at Nelson Polytechnic, and also made contact with Professor Jim Campbell, who had moved to Nelson on his retirement from Victoria University.

John then moved to an academic publishing job in Wellington, but there was no opening at Victoria for Gillian. She spent the next 8 years in various jobs in Wellington, all temporary, and mostly part time. These included teaching evening classes at Wellington Polytechnic, a ¼ time job at the College of Education, one year sharing a temporary lectureship with Sharlene Forbes at Victoria and another year sharing a research position with Mary Fama, working for Ian Dick in the Mines Department. This last position included developing a model of the New Zealand economy (independent of the model developed by the Treasury) in order to predict future trends in the energy sector as a result of the oil price shocks. In this they found some alarming predictions under free market policies, including the large scale unemployment, which has subsequently come to pass.

In 1980 she was successful in obtaining a permanent academic position, being appointed to a Lectureship at Massey University, but at the same step on the scale she left 10 years earlier! This time it was John who had to follow, he has since been employed in various part time and temporary jobs, and learned the requirements of being a "house husband". In 1982 she was promoted to a Senior Lectureship, a level she may well have attained at Canterbury in 1968, had she stayed there.

Gillian had been an active member of our Society, even before she came to Massey. She was a member of the Council from 1978-81 and from 1985-92. On the first term she was Secretary, and in her second term was Publications Convenor, and then from 1989 to 1991, the first, and to date, the only woman who has been elected President of the Society. During this period she represented the Society at the IMU meeting in Kobe, the only woman President among all the societies represented there.

Heavy teaching loads, a disproportionate university committee workload (where gender balances were sought) and the long gap in her research activity all made her return to her research activities more difficult. Nevertheless, she has continued this activity, and has successfully supervised two PhD students, Nicola Jane in Differential Geometry and Mary Day in gender issues in mathematics.

As well as her research interest in Differential Geometry, she has developed a research interest in Mathematics Education, especially in gender issues and participated in the ICMI study on Gender and Mathematics held in Sweden in 1993.

It is obvious that the gender issue has had an impact on her career, it is difficult to imagine a male contemporary having to spend so much time "out in the cold" between the two periods of full time university appointments. Also, being absent for 15 years from a research environment has made her return to active research much more impressive.

Gillian has been identified as a diligent teacher, and perhaps this has led to her having a greater than average teaching load. She attended the conference on Undergraduate Teaching held at Queensland University last month. An observation was made that almost half the participants were women, certainly in a far greater proportion than in university departments. Perhaps this is a reflection of a more caring role into teaching, or maybe a more balanced attitude by women academics? Certainly in a male dominated vocation, women like Gillian have a harder path to follow and probably are less likely to achieve their appropriate levels in the promotion rounds with criteria based solely on research output. These are issues which I am not well qualified to judge.

*Mike Hendy*

*Grantees' Reports cont'd from p15*

particular interest to me. Moreover, I had the opportunity to hear several contemporary luminaries speak about their work.

I presented a poster on generalised Drinfel'd-Sokolov hierarchies and had some fruitful discussions as a result. Furthermore, I learned a lot from conversing with and listening to the talks of other researchers in related areas, thus broadening my own awareness of recent developments in these fields.

I would like to thank the New Zealand Mathematical Society for its financial support which afforded me the chance to attend such a stimulating conference.

## Saraswathi Kota: University of Auckland

The annual conference of the International Group for the Psychology of Mathematics Education was held from 14-19 July in Finland. I was looking forward to attending as many of these international conferences as possible to meet new researchers and educators who are striving to understand the psychology behind the art and science of mathematics education. The proceedings from the previous conferences reveal high quality research by scholars from across the globe. This, I gathered would be an ideal ground to gain a panoramic view of this relatively young field and its members. This proved to be so. I discussed my own research topic at every opportunity with various people. I also presented a paper on the relationship between problem solving and affective factors and gender differences, which was well received.

For the past few years I have had a growing idea that the gender differences which have been rooted in our society for generations either curb or encourage particular type of behaviours. This may influence the 'affect' which in turn may effect the students' processes and their ability to solve mathematical problems. It was heartening to discover that this idea is shared by many others. The novel approach and the analysis I have used to bring out this gender effect was appreciated by other researchers.

This theme also figured in my post-conference presentations on problem solving at the Open University and South Bank University, United Kingdom and Bangalore University, India. The valuable suggestions from Dr Shiu and Dr Winbourne and Professor Khajapeer and their colleagues at the respective universities were constructive and pertinent to my study.

I took the opportunity to attend some presentations related to my area of work. The ones which left a strong impression follow: In the area of algebraic thinking: Stacy and MacGregor's paper was interesting and they verbalised in clear terms what is often perceived about the way students think in a classroom situation.

In the area of affective domain: Vermeer et al conducted a study similar to mine in the Netherlands though their work was chiefly confined to one single affective factor and a younger age group. DeBellis and Golden described a tetrahedron showing an arrangement of various components of affective domain and the inter-relationships between these components in the context of problem solving.

Problem Solving: Stein's paper has given a possible theoretical basis for the psychological processes behind the problem solving behaviour of elementary school children. English indicated links between problem solving and problem posing in seventh grade students.

There are some other papers related in a general way to the area of my research. The ideas of these researchers and discussions about the methodology of research with them has helped me clarify my thinking and gain a composite view of the relationship between problem solving abilities and affective factors of secondary school children.

I enjoyed immensely the conference travel and my stay at Finland. Once the main business of the conference was concluded I went form sightseeing in Lathi and I was very impressed with their facilities for sports. The science and technology museum in London was also impressive.

I thank the New Zealand Mathematical Society for their grant to assist me to attend a conference such as this and to benefit so greatly from it.

## Anjana Singh: University of Auckland

I am very grateful to the New Zealand Mathematical Society, the Mathematics Department at The University of Auckland and The University of Auckland Graduate Research Fund for their financial support which has enabled my participation at two international conferences in Europe in September, 1997. I am also grateful to Professor J.C. Butcher for his support through a Marsden Fund grant.

First I attended the conference, NUMDIFF 8, in Halle, Germany, and presented a talk "Diagonally Implicit Multistage Integration Methods, DIMSIMs". As all the participants stayed at a hotel where the conference was held, it gave me a lot of opportunities to have informal discussions which are very valuable to me. At the second conference, SciCADE 97, held in Grado, Italy, my talk was "DIMSIM methods with variable stepsize". This was a much bigger conference where I met most of the prominent researchers in my field. It was very interesting to meet them in person, having read their published papers. I learnt a lot from their talks and from discussions with them. This has renewed my enthusiasm and interest in my research.

I wish to thank the New Zealand Mathematical Society for the student travel grant which has partly supported my participation.

# *CONFERENCES*

****** 1998 ******

January 5-11 (Auckland) **First International Conference on Unconventional Methods of Computation CDMTCS**
Contact M Dinneen (secretary)
email: mjd@cs.auckland.ac.nz
home page: http://www.cs.auckland.ac.nz/CDMTCS/docs/news.html

February 9-13 1998 (ETH Zurich, Switzerland) HYP-98 **Seventh International Conference on Hyperbolic Problems, Theory, Numerics, Applications**
Contact HYP-98, c/- Seminar for Applied Mathematics, ETH Zentrum, CH-8092, Zurich, Switzerland.
email: hyp98@sam.math.ethz.ch WWW: http://www.sam.math.ethz.ch/~hyp98/index.html

June 21-26 (Singapore) **5th International Conference on Teaching Statistics (ICOTS-5)**
Contact Brian Phillips, School of Mathematical Sciences, Swinburne University of Technology, P O Box 218, Hawthorn, Victoria 3122, Australia.
email: bphillips@swin.edu.au

July 6-10 (Brisbane, Queensland) **23rd Australasian Conference on Combinatorial Mathematics and Combinatorial Computing**
Contact Elizabeth Billington, Department of Mathematics, University of Queensland, Brisbane, Queensland 4072, Australia.
email: ejb@maths.uq.oz.au

July 9-10 (Hervey Bay, Queensland) **Workshop on New Methods in Applied and Computational Mathematics (NEMACOM '98)**
Contact NEMACOM '98, C/- Dr S Olliveira, Department of Computer Science, Texas A&M University, College Station, TX 77843-3112, USA.
email: nemacom98@cs.tamu.edu
website: http//www.cs.tamu.edu/faculty/oliveira/nemacom98/

July 13-16 (Adelaide) **3rd (Biennial International) Engineering Mathematics and Applications Conference (EMAC '98)**
Contact Conference Chair EMAC 98, A/Professor Jagannath Mazundor, Department of Applied Mathematics, The University of Adelaide, Adelaide, SA 50501, Australia
email: jmazunda@maths.adelaide.edu.au
website: http://www.maths.adelaide.edu.au/Applied/EMAC98

# NEW ZEALAND MATHEMATICAL SOCIETY NOTICES

## 1998 New Zealand Mathematics Colloquium

The 1998 Colloquium will be held at Victoria University, Wellington from Sunday 5th to Thursday 9th July. The Colloquium is the best opportunity each year for mathematicians in New Zealand to get together, present their latest research, hear what others are doing, discuss developments in the subject, in teaching, moan about the latest political decisions and generally enjoy the company of those for whom talking maths is a source of pleasure.

We want to keep the registration fee as low as possible, while maintaining the traditional standard of invited lectures, and we hope this will enable as many mathematicians as possible to attend. We are especially keen that students both attend and give talks on their research work. The Aitken Prize will be awarded to the best talk or paper presented by a student at the Colloquium. Students pay a reduced registration fee and are encouraged to seek financial assistance from their Department/School or the New Zealand Mathematical Society for travel costs.

In addition to invited and contributed talks, there will be a session on the report of the MoRST Review of Mathematical Sciences, presentation of the New Zealand Mathematical Society Research Awards and the annual general meetings of the New Zealand Mathematical Society and ANZIAM.

Thursday is Mathematics Education Day. Parallel streams will focus on school level education and on tertiary level education with opportunities to discuss the interface between them. We are very keen that those attending stay and contribute to this day as we believe there are very important issues facing mathematics teaching at all levels.

A First Circular giving details of fees etc will be produced in December. For further information, please contact Dr Peter Donelan, Colloquium Convener, School of Mathematical Sciences, Victoria University, P O Box 600, Wellington, e-mail peter.donelan@vuw.ac.nz, phone 04 495-5233 ext 8318, fax 04 495-5045 or see the web page at
http://cantor.math.vuw.ac.nz:1998/.

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## Notice to Students Planning to Attend the 1998 New Zealand Mathematics Colloquium

(1) The 1998 New Zealand Mathematics Colloquium will be held at Victoria University of Wellington from Sunday 5 July until Thursday 9 July. Students who wish to apply for financial assistance to attend this Colloquium should do so when they send in their registration form. The Colloquium organisers are empowered to distribute funds on behalf of the New Zealand Mathematical Society. Further information about the Colloquium may be found on the WWW page `http://cantor.math.vuw.ac.nz:1998/` and in the notice above.

(2) The New Zealand Mathematical Society offers a prize, known as the Aitken prize, for the best contributed talk by a student at the annual New Zealand Mathematics Colloquium. It consists of a cheque for New Zealand $250, accompanied by a certificate. Entrants for the prize should clearly indicate their willingness to be considered for the award when they register their intention to contribute a talk at the Colloquium. Further information about the Aitken prize will published in the April 1998 issue of the New Zealand Mathematical Society Newsletter.

# NZMS Accreditation

The Society has decided that there will now be Graduate Members, Accredited Members and Fellows of the New Zealand Mathematical Society. Next year the Accreditation Committee which has been set up by the Council, will consider the next round of applications. The deadline is Monday March 2nd, 1998. If you would like to be considered or would like to nominate someone could you send for application forms to

The Accreditation Secretary
C/- Department of Mathematics and Statistics
University of Otago
P O Box 56
DUNEDIN.

To help you understand better what each of the categories of accreditation are, I have added a copy of Article IV of the Constitution.

## ARTICLE IV: OPTIONAL ACCREDITATION

An Ordinary Member (or Reciprocity Member) may apply to the Council to become a Graduate Member, Accredited Member, or Fellow. The Council shall make and issue, and may revise from time to time, Rules which shall give effect to the following requirements.

(1) A Graduate Member shall have completed a degree or diploma at a recognised university or other tertiary institution, the studies for which shall include mathematics as a major component, and shall be currently employed or occupied in the development, application or teaching of mathematics.

(2) An Accredited Member shall have completed a postgraduate degree in mathematics at a recognised university or other tertiary institution, or shall have equivalent qualifications, and shall have been employed for the preceding three years in a position requiring the development, application or teaching of mathematics.

(3) A Fellow shall be a person who currently has or previously has had the qualifications of an Accredited Member and who, in addition, is deemed by the Accreditation Committee (see paragraph below) to have demonstrated a high level of attainment or responsibility in mathematics and to have made a substantial contribution to mathematics or to the profession of mathematician or to the teaching or application of mathematics.

An Honorary Member shall have the right to become a Fellow immediately upon application to the Council and without payment of a fee.

The Council shall establish an Accreditation Committee to consider applications for designation as a Graduate Member, Accredited Member or Fellow, and to administer the Rules described in the first paragraph of this Article. In its determinations, the Accreditation Committee shall discount interruptions to employment such as temporary unemployment and parental leave.

A Graduate Member may use the abbreviation GNZMS, an Accredited Member may use the abbreviation MNZMS, and a Fellow may use the abbreviation FNZMS. These designations and the corresponding abbreviations are the rights of that class of Member only while the member remains a financial member of the Society and while the occupational requirements outlined in the first paragraph of this Article continue to be satisfied. The occupational requirements shall be deemed to be satisfied by Honorary Members and in the case of interruptions to employment such as temporary unemployment and parental leave, and they shall not be applied in the case of retirement or promotion to an administrative or other position.

A fee shall accompany each application to the Accreditation Committee. The fee shall be additional to the annual subscription charged by the Society and shall be the only charge for accreditation. The fees are: Fellow $100, Accredited member $75, and Graduate member $50. These are one-off fees. If you have any queries could you please direct them to me at the above address or by email (dholton@maths.otago.ac.nz).

*Derek Holton,*

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## BUILDING THE FIRST COMPUTER

On Thursday August 28th, in the University of Auckland Computer Science paper 415.790 HISTORY OF COMPUTERS AND COMPUTING, I told the graduate students about the first computer to operate. Alan Turing and his assistants at Bletchley Park had designed electromechanical machines which cracked the ENIGMA cyphers, and so in November 1942 Turing was sent by Churchill as his scientific ambassador to the USA. At that time the German High Command adopted Geheimschreiber, a cypher machine much more advanced than ENIGMA. Max Newman (who had taught logic to Turing) realized that only electronic equipment could operate fast enough to crack Geheimschreiber.

At Bletchley Park in January 1943, Max Newman persuaded Flowers, Coombs and Chandler (engineers at the Post Office factory at Dollis Hill) to undertake the construction of a huge electronic machine. The engineers accomplished miracles, and in December 1943 the first COLOSSUS was operating at Bletchley Park, efficiently decyphering Geheimschreiber messages.

Bletchley Park was kept totally secret until 1974, and the UK government still keeps much information about COLOSSUS under the tightest security restrictions. However, it is known that COLOSSUS contained 1500 thermionic valves (the Mark 2 machines contained 2500 valves), and although its storage capacity was extremely small it did have an if-statement; and so it is now acknowledged as the first computer to operate. In June 1996 a reconstruction of COLOSSUS began operating at Bletchley Park.

At that point in the lecture, I told the students that "I am pleased to introduce to you David Bolam, who has kindly agreed to tell us how he built COLOSSUS"!

Mr Bolam explained that in December 1943, when he was a young technician with the Post Office in England, he was assigned to the Post Office factory at Dollis Hill. Dr Coombs summoned 8 technicians (including David Bolam), and told them that they were to work on a project so secret, that he hoped that they would never learn the purpose of it. If ever they heard of something which they thought might be the outcome of their work, then they must never (under penalty of the Official Secrets Act) indicate that they knew anything about it. From December 1943 to September 1944, David Bolam tested enormous numbers of electronic components and selected those which passed the most stringent tests. The components which he selected were assembled into huge racks of electronic circuitry, with David Bolam constructing large control panels. The assembled racks were tested thoroughly, and then the separated racks were loaded onto a van, which took them to an undisclosed destination.

In the 1960s David Bolam came to New Zealand, to convert the telephone exchanges to electronic operation. In 1976 he read one of the first books about Bletchley Park, and only then did he learn that the machines which he had helped to build were COLOSSUS computers. A few weeks before that lecture he had visited Bletchley Park, where he inspected the reconstruction of COLOSSUS, and he had been particularly pleased to see that the control panel which he had constructed had been reproduced very accurately in that reconstruction.

When David Bolam finished his talk, the students applauded him most enthusiastically. I commented to them they could hardly expect to learn the history of computing from any source more authoritative than David Bolam, one of the team of technicians who built the first computer.

*Garry J. Tee*

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# ICMI Study
## On the Teaching and Learning of Mathematics at University Level

The purpose of this Discussion Document is to raise important issues related to the study of the teaching and learning of mathematics at university level and to stimulate discussion and research on these topics as background for a conference to be held in Singapore in December 1998. After this conference, a publication covering the fundamental areas of the topic will be published in the ICMI Study Series. The main aspects of the Study will also be presented at ICME-9 in Makuhari, Japan in the year 2000. It is anticipated that the Study will be of interest to those concerned with the teaching of mathematics at the university level, to mathematics educators undertaking research in related areas, and to many other people with an interest in university level mathematics. The conference and publication related to this Study are likely to have a positive influence on the understanding and practice of the teaching and learning of mathematics at university level in the early years of the 21st century.

### 1. Why a Study on the Teaching and Learning of Mathematics at University Level?

A number of changes have taken place in recent years which have profoundly affected the teaching of mathematics at the university level. Five changes which are still having considerable influence are (i) the increase in the number of students who are now attending tertiary institutions; (ii) major pedagogical and curriculum changes that have taken place at pre-university level; (iii) the increasing differences between secondary and tertiary mathematics education regarding the purposes, goals, teaching approaches and methods; (iv) the rapid development of technology; and (v) demands on universities to be publicly accountable. Of course, all of these changes are general and have had their influence on other disciplines. However, because of its pivotal position in education generally, and its compulsory nature for many students, it could be argued that these changes have had a greater influence on mathematics than perhaps on any other discipline.

There is no doubt that, in many countries, significantly more students are now entering university and taking mathematics courses than was the case ten years or so ago. On the other hand, an increasingly smaller percentage of students appears to be opting for studies which require substantial amounts of mathematics. Thus university departments are faced with a double challenge. On the one hand, they have to cope with the influx of students whose preparation, background knowledge and even attitudes are quite different to those of past students. On the other hand, they have to attract students to pursue studies in mathematics, where employment opportunities and well-paying jobs appear not to be as certain as in some other disciplines.

Some new developments in the teaching and learning of mathematics attempt to come to grips with these issues. For example, alternative approaches to calculus and linear algebra in the United States reflect, in part, attempts to make these subjects more engaging and meaningful for

the majority of students. There have been content changes too, with increased emphases in some universities on applications and modelling, history and philosophy of mathematics, and so on. But a general perception remains in some quarters that the teaching of mathematics at the undergraduate level has not to date made sufficient effort to deal with the backgrounds and needs of present day students.

There is also often perceived to be a discontinuity between mathematics education in secondary schools and mathematics education in universities. Certainly the levels of ambition and demand placed on students are increased at the tertiary level. There is not the same attention paid to learning theories in the delivery of university mathematics as there is in the teaching of the subject at lower levels. University teaching methods tend to be more conservative. Often university teachers have joint responsibility for research and teaching. This is clearly beneficial but it can cause more emphasis to be placed on mathematical research in places where that is the main criterion for promotion.

Teachers of university mathematics courses, on the whole, have not been trained to, and do not often consider educational, didactic or pedagogical issues beyond the determination of the syllabus; few have been provided with incentives or encouragement to seek out the results of mathematics education. In days gone by responsibility was placed largely on students' shoulders: it was assumed that faculty's responsibilities were primarily to present material clearly, and that 'good' students would pass and 'poor' ones fail. The climate today is that academic staff are considered to have greater overall responsibility for students' learning. The role of instruction (specifically, of lectures) and staff accountability are being reconsidered.

Worldwide, increasing use is also being made of computers and calculators in mathematics instruction. Much mathematical software and many teaching packages are available for a range of curriculum topics. This, of course, raises such issues as what such software and packages offer to the teaching and learning of the subject, and what potential problems for understanding and reasoning they might generate. It would be good to collect examples of the use of information technology and software which enrich students' experience of mathematics and result in better understanding and learning.

Many academic mathematicians are aware of changes occurring around them, and of experimentation with different teaching approaches, but they have limited opportunities to embrace change owing to faculty structures and organisation. Further, the relationships between mathematicians in mathematics departments and their colleagues in mathematics education are often strained, with less productive dialogue between them than there might be. The same can be said of relationships between mathematicians and engineers, economists, etc., even though mathematics service teaching to students in other disciplines is an enormous enterprise. These general factors tend to work against, or delay, improvements in the teaching and learning of mathematics, particularly for those students whose main interests are in other disciplines.

As a result of the changing world scene, ICMI feels that there is a need to examine both the current and future states of the teaching and learning of mathematics at university level. The primary aim of this ICMI Study is therefore to pave the way for improvements in the teaching and learning of mathematics at university level for all students. To achieve this aim it is important for the professionals involved to

- exchange views and experiences from a wide variety of places and backgrounds;
- report about developments and projects that have taken place;
- consider the contributions from theory and research, and identify areas still to be investigated.

More specifically the Study will cover the following and related points:

* to identify, review, encourage and disseminate, research in educational matters at the tertiary level;
* to identify and describe major approaches to tertiary mathematics teaching within different cultures and traditions;
* to identify obstacles which might prevent the learning of mathematics;
* to discuss equity and other issues relating to mathematics education at university level;
* to discuss the goals of teaching mathematics to a range of students with different backgrounds and needs, and who should be responsible for that teaching;
* to find ways to meet changing needs without compromising the integrity of the subject;
* to identify, publicise, and expose to scrutiny, new teaching methods and the positive use of technology;
* to discuss the transition and the relations between secondary school and university;
* to consider ways to improve the preparation of teachers of mathematics at university level.

Leading up to and during the Conference relating to this Study, it is expected that there will be debate as to why mathematics is taught and what mathematics education is at university level. In addition, consideration will be given as to what is the current teaching and learning situation in universities, what it is believed that the situation should be, and how desired changes can be effected.

**2. Themes and Issues Pertaining to Research on the Teaching and Learning of Mathematics at University Level.**
Most academic mathematicians know little about the research that has been undertaken in mathematics education in general, or at the tertiary level in particular. Generally speaking, they are unaware of the methods used by researchers in education. One of the most valuable aspects of the current study is that it could collect together the major findings of mathematics education research, review them, and make them readily accessible to a wide audience. The potential usefulness and limitations of this research should then be considered in the light of the practice of teaching. At the same time, it would be valuable to determine research areas which have not yet been explored and to encourage work in them.

The following questions are of particular interest for the Study. What is mathematical understanding and learning, and how are these achieved? What are the underlying theories behind these and how do they relate to teaching at university level?

What research methods are employed in mathematics education? What are the major research findings of mathematics education? What are the obstacles to having teaching practice become informed/influenced by research findings?

Might insights into the nature of the learning process play out differently at different grade levels? Are the theories that are relevant at school level, relevant at university level as well? Is there a need for theories that are specific to university level?

What research has there been into traditional and alternative methods of teaching and what do the results of such research tell us?

In what ways can teaching change to take into account the different background, abilities and interests of the learner? What methods are effective for teaching large classes?

What do we know about the learning and teaching of specific topics such as calculus and linear algebra? Are there characteristics which are relevant to specific topics? Are there characteristics which are pertinent to a number of topics?

What alternative forms of assessment exist? How can assessment be used to promote better learning and understanding?

What are the mathematical competences that are required in the different professions?

What are students' attitudes and beliefs concerning mathematics? What causes them to change? How do these affect their enrolments and success in courses with substantial mathematical components?

What are the effects of the use of technology in the teaching and learning of mathematics? In what ways can technology be used to enhance understanding?

What important issues are under-represented in the research literature and how can researchers be encouraged to work in these areas?

**3. Themes and Issues Pertaining to Practice** We divide this section into four parts: Clientele, Curriculum, Student Activity and Pedagogy.

**Clientele** The students who are of interest for this Study include all those students who are taught mathematics at university level, whether as mathematics majors, as students of other subjects using mathematics as a service course, as prospective mathematics teachers, or as recipients of some form of general 'mathematics appreciation' course. Hence we are addressing the needs of not only future research mathematicians but also other categories of future mathematics professionals as well as graduates in other disciplines who require varying amounts of mathematical knowledge, skill or insight.

For several reasons, in many countries there has been a move to mass education at university level. As a result many mathematics departments are providing courses for a much wider range of ability and needs than was formerly the case. Simultaneously with this increase in student numbers, there has been a change in the kind of student preparation in secondary schools as well as in students' interests and motivation. Consequently many students have not met material which was in most secondary school curricula of the 1970s. In addition they may have been taught by an approach which places more emphasis on the intuitive and pragmatic. Some university mathematics departments have been slow in recognising these changes in their student intake. Others have developed new courses to cope for the range of content needs but have made few pedagogical concessions. There are a number of special groups of students including potential teachers of school mathematics, scientists, engineers. What should the interaction between mathematical and professional knowledge be? To what extent do these groups need specially designed courses?

**Curriculum** By curriculum we mean matters pertaining to the purposes, goals and content of mathematics education. Current curricula may need to be reconsidered for at least two reasons. There are the different student needs that were mentioned above and there are the developments in mathematics itself.

As far as the changing clientele is concerned, it is not clear that its constitution or its needs have been adequately considered. What are the professional aspirations of our student

population? Will they go on to be teachers, to work in industry, to be academics, etc.? How should the curriculum be shaped to meet the needs of these groups?

What changes are, or should be, taking place in the curriculum? Some mathematical subject areas are on the decline while others are in the ascendancy. What is the rationale for the changes? Are some content areas now less important and should other areas take their place?

Mathematics as a rapidly developing research field is continuously undergoing changes with new fields arising, changes of emphasis, and so on. At present we notice strong interactions between different branches, an increasing interest in applications, the development of an experimental approach, etc. To what extent is and should this evolution be reflected in the teaching of the subject at undergraduate level?

**Student Activity** Here we wish to discuss the various ways in which students might be induced to interact with mathematical content, both inside and outside the classroom. What forms of study and what activities are currently used in the teaching of mathematics? Do different forms of engagement (e.g., in "mathematics labs" where students explore families of mathematical objects using computers) have the potential to result in better learning in different subjects? Two of the central issues here are the role of the student and the attitude towards the subject. Under what circumstances should the student's role be to receive information and when should it be to interact with the content in more dynamic ways (including exchanges with their teachers and with other students)? Under what circumstances should the subject be presented as a set of skills (algorithms), as a set of processes or as a combination of these? The attitude of the teacher will require different reactions and actions from students.

**Pedagogy** By pedagogy we mean the teachers' orchestration of teaching and learning environments and situations, examined both from the descriptive/analytic position (what is the case?) and the normative position (what ought to be the case?).

Some areas of mathematics are met by students before they enter university and the approaches they have met in school may well be quite different from those which are common in universities. Mathematics majors, for example, have to meet a more formal approach to calculus/analysis. What are the best ways to effect this change of approach? But, given the changes in clientele referred to earlier, it is likely that the transition to university teaching poses problems for all students. How can the transition from school to university be best accomplished? This raises the issue of the philosophical approach to the subject. Many courses appear to concentrate on content knowledge. The emphasis seems to be on learning certain algorithms or theorems and applying them in controlled situations. This hides the creative and problem solving aspects of the subject. Should more emphasis be placed on the way that mathematicians think and create? Should there be more emphasis on students' problem solving capabilities as opposed to their learning the results the subject produces? How can the impact of problem-based lectures, the use of computers, project work and so on, be assessed? One of the issues that requires discussion is the importance placed upon teaching by universities generally. In many universities, promotion is based largely on research output, with teaching having a minor role. In such places, there is little incentive for academics to put more emphasis on their teaching. There are, of course, many academics who put quite a lot of work into their teaching. Should the profession through its national bodies, show that it recognises the importance of teaching at the university level? Another relevant issue is, where and how do academics learn to teach? Some universities have courses for their staff but these often do not go into any great depth in particular subject areas. Should more formal instruction be given and, if so, by whom and of what type?

Now that there is relatively ready access to computers, graphical calculators and calculators, it is worth examining to what extent we can release our students from some of the drudgery experienced by past generations. How has the new technology changed the content and philosophy of the curriculum? How can mathematics majors benefit from using computer technology? How can majors in other subjects benefit? Should existing programmes be delivered in the same way as in the past or can technology assist in the development of higher order skills or other more important skills?

### 4. Themes and Issues Relating to Policy

Policy issues naturally fall into two groups: those relating to society at large and those which are the concern of a specific university or university department.

**Society** The amount of control that society, through its government, takes over its universities, varies considerably from country to

country. In most countries, government provides the majority of the financial support for its universities. Hence, at least indirectly, government's policies will affect individual departments. How are these policies formed? What influence can and should mathematicians and mathematics educators have on them? The previously mentioned increasing number of students at the university level has, in many nations, occurred either explicitly or implicitly as the result of government policy. Is there cause for satisfaction with the result of this policy or is there a need to change or modify it in some way?

The mathematical community is convinced of the importance of mathematics both for its own sake and for the contribution that it ultimately makes to society. It is not clear that society in general also holds this position. Perhaps it does not realise what it takes to generate the contribution mathematics can make. What does the mathematical community need to do to make society aware of the mathematical requirements of society and how these can be achieved? What does the mathematical community need to do to make mathematics more visible in a competitive environment? In what ways should society provide its citizens with the basic ideas and philosophy of mathematics and its impact on our lives, both from a philosophical and practical point of view?

**University** In some countries the difference between universities and other tertiary institutions is the fact that research takes place in universities. In such countries, universities have a research culture in which it is assumed that most lecturers will engage in research. To what extent should the teaching of mathematics be delivered by lecturers who are engaged in some form of research?

In some countries, university degrees are of a general nature and cover a range of topics. In other countries, there are more directed programmes for students to follow. What is more, some of the more applicable areas of mathematics may be taught outside a mathematics department by engineers, statisticians, physicists, etc. To what extent should courses be general and to what extent should they be specific to each user group? To what extent should courses be taught by mathematicians and to what extent should they be taught by experts from other appropriate fields?

What then is the role of a department of mathematics at the end of the twentieth century, given that there is a tendency for non-mathematics departments to teach their own mathematics? (This is not only for bureaucratic reasons but also because these departments are often dissatisfied with the gap between the content and approach they require and the content and approach of mathematics departments.) Should departments of mathematics be responsible for all of the students taking mathematics at its university or should it concentrate on its traditional clientele, the mathematics majors? Will departments which do not teach a range of students remain viable in an environment where a balanced budget, rather than education, is the main concern of administrators? What cooperation can there be with other disciplines for whom mathematics is a service course? In some cases there is an overlap in the material being taught in courses by a mathematics department and a service department. Are there good reasons for continuing this practice?

Clearly no university department can teach all branches of mathematics. Are there fundamental branches of the subject which should be in all programmes? How should the balance be struck between suitable major components? How strongly are incoming students influenced by career prospects in mathematics? How should this affect the courses offered and the advice given to prospective students?

**5. Call for Reaction** The work of this Study will take place in two parts. The first consists of a conference which is to be held in Singapore from December 8 to 12, 1998. English will be the language of the conference. The conference will be a working one where every participant will be expected to be active. Current planning is for a limited attendance of about 75 persons.

Given the style of the conference, we anticipate a variety of types of contributions that will be presented in plenary sessions, working groups, panels and short presentations. Presentations may include position papers, discussion papers, surveys of relevant areas, reports of projects, or research papers of an educational nature. We invite you to make a submission for consideration by the International Programme Committee no later than 1 May 1998. Submissions should be up to three pages in length and may be emailed, faxed or sent as hard copy. They should be related to the problems and issues identified in this document but need not be limited to these alone. You might also draw to the attention of the Committee, the names of other people whom you feel ought to be invited, stating the type of the contribution they might make. We would

appreciate knowing the nature and results of related studies in this area.

Participation in the conference is by invitation only. Invitations to those whose submissions have been accepted will be made in July 1998. At the same time invitees will be asked to produce a longer version of their submission for publication in the pre-conference proceedings. The Study organisers are seeking funds to provide partial support to enable participants from non-affluent countries to attend the conference but it is unlikely that full support will be available for any one individual. All contributions and suggestions concerning the content of the study and the conference programme should be sent to Derek HOLTON, Chair, IPC, ICMI Study, Department of Mathematics and Statistics, University of Otago, P O Box 56, Dunedin, New Zealand. email: dholton@maths.otago.ac.nz fax: (+64-3) 479 8427 The second part of the Study is a publication which will appear in the ICMI Study Series. This publication will be based both on the contributions requested above and the outcomes of the conference working group and panel deliberations. The exact format of the publication has not yet been decided but it is expected to be an edited, coherent book which it is hoped will be a standard reference in this field for some time.The planned timetable for the Study is as follows: 1 May 1998: Deadline for worldwide reaction to this Discussion Document.

1 July 1998: The Study conference programme and the list of invitees to be finalised.

8-12 December 1998: Study conference, Singapore.

1 March 1999: Deadline for the submission of papers to the study publication.

31 July-7 August 2000*:Presentation of main considerations and findings, ICME-9, Makuhari, Japan.

1999-2001: The editors produce the study volume.

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# THE NEW ZEALAND MATHEMATICAL SOCIETY (INC.)

## APPLICATION FOR FINANCIAL ASSISTANCE

Please fill in where appropriate

Name of applicant: .....

Address: .....

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Academic affiliation / Official status / Present position:

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NZMS status: Ordinary member ..... Student member .....

Other (give details) .....

Signature: ..... Date: .....

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| Type of assistance sought | Amount |
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| (a) Student Travel Grant | ..... |
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| (e) Other (please specify below) | ..... |

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Estimated total expenditure:

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- Estimated total expenditure (please include a breakdown of this expenditure, e.g. conference fees, travel, accommodation, etc.)

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- List all previous support of this kind you have received from the NZMS in the past five years.

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- Please describe your reasons for making this application and the plans you have for spending the grant if your application is successful:

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- Please list any supporting documents or other evidence (attached to your application):

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- Supporting statement from Supervisor, Head of Department or person of responsibility.

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Please send this application (and any supporting documents or other evidence) to:

Dr Stephen Joe, Secretary, N.Z. Mathematical Society,
Department of Mathematics, The University of Waikato, Private Bag 3105, Hamilton.

The NZMS Council normally considers these applications at its meetings in July and November each year, but applications may be considered at other times in exceptional circumstances.

# Situation Vacant

## Attention to graduate students in Mathematical, Computing or Biological Sciences

Molecular Ecology and Evolution Research Centre
College of Sciences,
Massey University
Palmerston North
New Zealand.

Bioinformatics is a rapidly expanding and exciting new field at the interface of biology, mathematics, and computing. Contributions are made by people from all three disciplines to the analysis of DNA sequences. A major overview of the of this new discipline is in Nature, 25th Sept, 417-421 (1997). The Massey University research group described below are leaders in Australasia, especially in evolutionary aspects, both in theory and in applications.

Applications are invited for a PhD scholarship, to undertake a programme of research and study in the field of "Biomathematics and DNA sequence analysis" within the Molecular Biology and Evolution Research Centre. The successful applicant would be joining an existing team, lead by Professors Mike Hendy (Mathematical Biology) and David Penny (Theoretical Biology), which includes 9 Masters and PhD students, 2 Post Doctoral Fellows, 2 Research Fellows.

This research team has been particularly active in extracting the historical information contained in biological sequences (DNA, RNA and protein sequences), both in developing new techniques and in the interpretation of their application in a number of areas of current biological interest. The team also has strong international linkages.

Further information regarding the current research activities of the group can be viewed at our website:

http://www.massey.ac.nz/~wwplbio/research/farside/programs.htm

The successful applicant would be expected to have completed abachelor honours (at least 2(1)) or masters degree in mathematics, statistics, computer science or in the biological sciences, and have a strong interest in one of mathematics, biology and computing, and an interest in the other two areas. A research project within the expertise of the group will be found to suit the strengths and interests of the applicant. The applicant would be expected to participate in the regular research discussion sessions and interact with the other researchers.

The scholarship, funded from a Marsden Fund grant will be available for 3 years, and will be at the rate of NZ$12,000 per year (tax free). Applications containing a full curriculum vitae and the names of 2 referees, should be submitted to Professor Hendy at the address above, by February 28, 1998. The student would be expected to begin her/his studies about April 1998.

Enquiries regarding this project can be sent by email either to:

M.Hendy@Massey.ac.nz
or
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## The circular restricted three body problem and an interesting orbit

Even though the classical gravitational orbit problem is completely understood for two bodies, it starts getting difficult for three bodies. However, the problem can be tamed in one limiting case; this is when two of the bodies are so massive compared with the lightest of them that it is a fair approximation to assume that they orbit around each other without any effect on their motion due to the light body. The light body, on the other hand moves under the gravitational attraction of the two heavy bodies. Things become even simpler if the motion of the two heavy bodies about their common centre of mass is exactly circular. In this case it is convenient to freeze their motion and to express the motion of the light body relative to a coordinate system fixed to the heavy bodies.

Suppose the ratio of masses of the two heavy bodies are $1-\mu : \mu$ and that the centre of mass is fixed at the origin. The scales can be chosen so that the distance between the bodies is exactly 1 and that they are moving about their common centre of mass with unit angular velocity. Assume that the plane in which they move is the $XY$ plane. At some specific time, the two heavy bodies will be at the positions $(1-\mu)[\cos(t),\sin(t)]^T$ and at $-\mu[\cos(t),\sin(t)]^T$ respectively. Write the position of the light body as $X$, $Y$ and $z$ the, because of the gravitational attraction of the heavy bodies, its equations of motion, given that units are chosen suitably, are

$$\begin{aligned} X'' &= -(1-\mu)(X+\mu\cos(t))R^{-3} - \mu(X-(1-\mu)\cos(t))S^{-3}, \\ Y'' &= -(1-\mu)(Y+\mu\sin(t))R^{-3} - \mu(Y-(1-\mu)\sin(t))S^{-3}, \\ z'' &= -(1-\mu)zR^{-3} - \mu zS^{-3}, \end{aligned}$$

where

$$R^2 = (X+\mu\cos(t))^2 + (Y+\mu\sin(t))^2 + z^2, \quad S^2 = (X-(1-\mu)\cos(t))^2 + (Y-(1-\mu)\sin(t))^2 + z^2.$$

Make the substitution $\mathbf{X} = P(t)\mathbf{x}$, where $\mathbf{X}$, $\mathbf{x}$ and the rotation matrix $P(t)$ are given by

$$\mathbf{X} = \begin{bmatrix} X \\ Y \end{bmatrix}, \quad \mathbf{x} = \begin{bmatrix} x \\ y \end{bmatrix}, \quad P(t) = \begin{bmatrix} \cos(t) & -\sin(t) \\ \sin(t) & \cos(t) \end{bmatrix}.$$

It is easy to see that $P'(t) = P\left(t+\frac{\pi}{2}\right)$ so that

$$\mathbf{X}''(t) = P(t)\mathbf{x}''(t) + 2P\left(t+\frac{\pi}{2}\right)\mathbf{x}'(t) + P(t+\pi)\mathbf{x}.$$

Solve for $\mathbf{x}''$ by multiplying by $P(-t)$ and we find that

$$\begin{aligned} x'' &= x + 2y' - (1-\mu)(x+\mu)r^{-3} - \mu(x-1+\mu)s^{-3}, \\ y'' &= y - 2x' - (1-\mu)yr^{-3} - \mu ys^{-3}, \\ z'' &= -(1-\mu)zr^{-3} - \mu zs^{-3}, \end{aligned}$$

where $r$ and $s$ are equal to $R$ and $S$ respectively, but written in terms of $x$, $y$ and $z$

$$r^2 = (x+\mu)^2 + y^2 + z^2, \quad s^2 = (x-1+\mu)^2 + y^2 + z^2.$$

It is interesting to ask whether or not there exist points where the small body can stay without moving and whether there exist periodic orbits. The answer to both of these questions is "yes". There are exactly five "libration points" (or "Lagrange points" to name them after their discoverer) for which $x'' = y'' = z'' = 0$, if $x' = y' = z' = 0$. There is an infinite family of periodic orbits some of which have been utilised by the space programme.

Even though the three body problem is notoriously difficult and "exceeds, if I am not mistaken, the force of any human mind" (quoted words of Isaac Newton), quite a lot is known about the restricted version of the problem we have discussed here. The restricted problem yields reasonable approximations for the earth-moon and sun-earth systems. Like many problems in astronomy, predictions from the theory have sometimes preceded observation. Lagrange predicted the presence of asteroids at two of the libration points of Jupiter (the two which are not collinear with the planet and the sun) and these were much later observed for Jupiter and also for Earth.

In principle, it is also possible to obtain what can be described as a "horseshoe orbit", in which a small body more or less shares the same orbit as the lighter of the two heavy bodies and seems to approach it from one side then the other, retreating in between times to wander round the heaviest body. This has now been observed in our own sun-earth system. In fact the asteroid with whom we share this strange relationship has as its orbit a path much more complicated than a simple horseshoe. This asteroid known as 3753 (1986 TO) has had its path carefully identified and understood only this year. To read about it you can start with the web page at `http://www.asteroid.yorku.ca/companion/`

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