THE NEW ZEALAND MATHEMATICAL SOCIETY (INC.)

NEWSLETTER

Number 75 April 1999 ISSN 0110-0025

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PUBLISHER'S NOTICE

This newsletter is the official organ of the New Zealand Mathematical Society Inc. This issue was assembled and printed at Massey University. The official address of the Society is:

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`http://www.math.waikato.ac.nz/NZMS/NZMS.html`
The newsletter is available at: `http://www.massey.ac.nz/~wwifs/mathnews/NZMSnews.html`
Editorial enquiries and items for submission to this journal should be submitted as text or LaTeX files to `m.hendy@massey.ac.nz`.

EDITORIAL

Marsden Fund

As I write this editorial, a few of New Zealand's mathematicians are busy polishing up their full research proposals for the Marsden Fund, and pondering their chances of success. A larger number, having had their preliminary proposals rejected, are wondering what they might be able to do in order to be invited to submit a full proposal. A few more fortunate already hold a Marsden contract. However, there are many research mathematicians, who for one reason or another, did not submit a preliminary proposal this year. Why not? What is quite alarming to me is that the number of applicants to the mathematical and information sciences panel has declined significantly over the last three years, at a rate greater than that to any other panel.

According to data released by the Marsden committee[1], the number of preliminary applications to the Mathematical and Information Sciences (MIS) panel (which includes Statistics and Computer Science) was 46, a drop from the 81[2] who applied in 1998, and the 114 who applied in 1997. This suggests that the researchers are interpreting their chances of success as low and therefore do not see the time required preparing a preliminary application as a worthwhile investment. Although the number of applications to the Marsden fund are dropping overall, the MIS decline is much greater than that to any other panel.

We see from the Table below, that the proportion of MIS preliminary applications in 1999 was less than 57% of the number in 1997. Among the other panels, only Biochemical and Biomedical Sciences at 81%, had more than a 10% drop in their share from the 1997 proportions. This has serious implications for research support for our discipline. Firstly the allocation the Marsden funds to the panels for new projects each year is in proportion to the number of preliminary applications to each panel. Thus the research support for MIS projects is going to be significantly reduced. Further, as moves are in train to channel some of the research funds currently bulk funded to the universities, into competitive schemes modeled on the Marsden or PGSF funds, we are at risk of having a reduced share from that source too.

Why does our discipline have a different attitude when applying to Marsden? Is it that the "odds" seem too high? Is it that our need is less? It has been suggested that researchers in other fields generally have more opportunities to apply for research grants, and hence have more experience in applying and a generic grant application once prepared, can then be tailored to various funds. Perhaps the mathematicians have a lower experience in grantmanship, not having so many opportunities in previous years?

Whatever the reason, we are facing serious erosion in the potential funding in the mathematical sciences. What should we do? We could lobby for a different allocation scheme, but no such sensible alternative has been suggested to me. A more positive approach is to lobby our colleagues to be more active in making applications. Rather than seeing these as "canon fodder" for the more successful, we should see our effort in making a preliminary application as: a useful first step in planning our own research over the next few years; as a demonstration to our colleagues and supervisors of the seriousness of our research activity; as a means of promoting our discipline to the university administrators as a serious research field; and as a mechanism of reversing the decline in research funding that comes into our disciplines. A decrease in the total number of applications to the Marsden fund is not going to convince our politicians that we are underfunded in research.

Another risk is that the MIS panel might be absorbed into some other panel, perhaps PSE. Although that might not necessarily be disadvantageous, it is certainly risky. The majority of panelists will not be of the mathematical sciences, the preliminary judgements will be made by scientists less knowledgeable in our areas than those at present. To me this possibility should be avoided.

Hence I urge ALL researchers within the mathematical sciences to make continued applications to the Marsden fund, even from those to whom direct success may seem a remote possibility. A general increase in research funding is essential to our disciplines if we hope to sustain an effective research activity, as well as for the health of science generally and in the long term, the viability of our nation. As long as we recognise an unsuccessful preliminary application is not in itself a waste. It motivates us to put plans on paper, it sends a message to those holding the purse strings of our needs, it does indicate to our administrators that mathematicians have serious research resource needs, and in the end it enriches the whole of our community. It is also a prepared template for further applications in succeeding years.

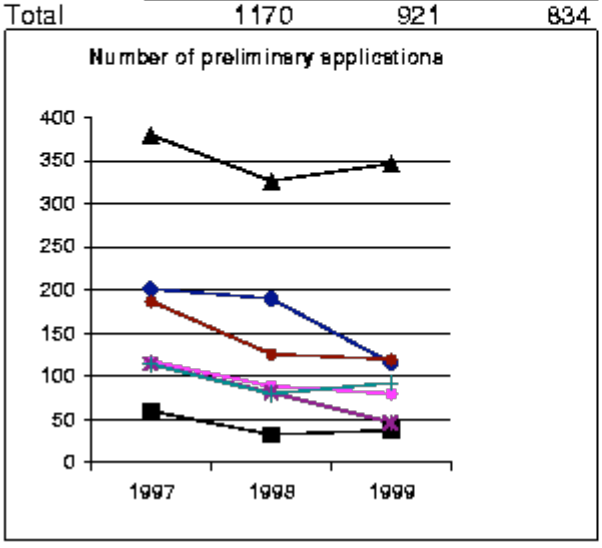
[1]Royal Society of New Zealand Science and Technology Alert # 71, April 1999 http://www.rsnz.govt.nz/news/digest/alert71.html

[2]http://www.rsnz.govt.nz/awards/index.html

Preliminary bids to Marsden Fund, 1997–99

Number of applications

	1997	1998	1999
BB	201	190	115
ESA	117	88	79
Hum	59	32	37
LS	379	326	346
MIS	114	81	46
PSE	187	125	119
SS	113	79	92
Total	1170	921	834



Percentages of applications

	1997	1998	1999
BB	17.2%	20.6%	13.8%
ESA	10.0%	9.6%	9.5%
Hum	5.0%	3.5%	4.4%
LS	32.4%	35.4%	41.5%
MIS	9.7%	8.8%	5.5%
PSE	16.0%	13.6%	14.3%
SS	9.7%	8.6%	11.0%

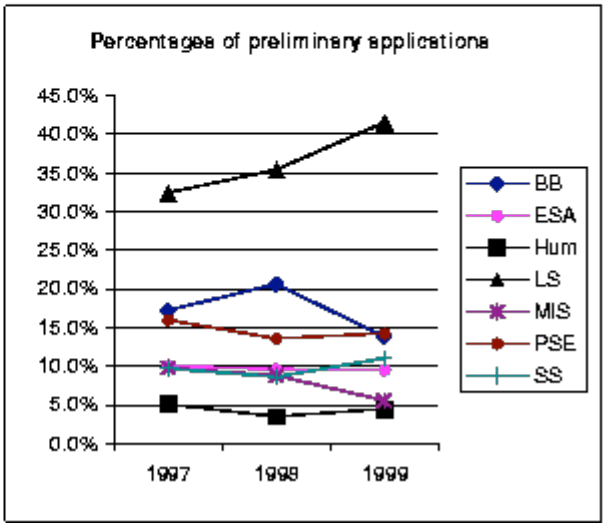


Figure 1:Key: BB (Biochemical and Biomedical Sciences), ESA (Earth Sciences and Astronomy), Hum (Humanities), LS (Life Sciences, which in 1999 was split into two panels - "Cellular, Molecular, and Physiological Biology" and "Ecology, Evolution and Behaviour"), MIS (Mathematical and Information Sciences), PSE (Physical Sciences and Engineering) and SS (Social Sciences).

Mike Hendy

STOP PRESS. It is with much sadness that we received news that Gail de Joux passed away at the Arohanui Hospice, Palmerston North, yesterday. Gail was a mathematics secretary at Massey University. She was the technical editor of this newsletter from 1994 to her retirement last year.

Mike Hendy 14-5-99

LOCAL NEWS

AGRESEARCH

The latest AgResearch newsletter 'Science and technology achievements' section starts with the story 'Math/biology link promises better reproductive techniques in cattle and humans'. It reports 'Improved human fertility, better methods of breeding from productive cattle and a greater understanding of the links between genes and the effects they produce will all result from novel research at AgResearch Ruakura. There, the team of Tony Pleasants, Tanya Soboleva, Jim Peterson, Ken McNatty (at Wallaceville), with assistance from Fiona Rhodes (DRC), have combined their talents in agricultural research and mathematical modelling to give AgResearch a unique competitive advantage. Professor Graeme Wake (Canterbury University) and Dave McCall introduced mathematics to agricultural problems and together they established the mathematical biology team within AgResearch. Tanya's special contribution was to develop a dynamic model of follicle development capable of dealing with genetic interactions. This complex model was unique because the characteristics it described related directly to biological phenomena.

Peter Johnstone and Harold Henderson attended the International Biometric Conference in Cape Town in December. They are also the Australasian representatives on the Council of the International Biometric Society. Ken Louie and Mick Roberts attended the Second Annual Wellington-Manawatu Regional One-day Conference on Applied and Computational Mathematics, held at Gracefield on January 26.

By the time you read this Rowland Kao will have left Wallaceville for a position with the Epidemiological Modelling Group at the Institute for Animal Health, Compton, UK.

Mick Roberts

UNIVERSITY OF AUCKLAND

School of Mathematical and Information Sciences

Barbara Miller-Reilly and Ivan Reilly both had Research and Study Leave for Semester 2 1998, and were based at the Open University at Milton Keynes, and at the University of California - Berkeley. Barbara presented a paper at the Fifth Annual Conference of Adults Learning Maths - A Research Forum (ALM-5) at Utrecht in July 1998, and she gave a workshop at the 41st Annual Asilomar Mathematics Conference in California, December 1998. Ivan presented papers at the following conferences:

Convergence and Topology, Erice, Sicily, Italy.

Topology and its Applications, Gyula, Hungary.

The Second Galway Topology Conference, Oxford, England.

Both Barbara and Ivan also attended the International Conference on Symbolizing and Modeling in Mathematics Education at Utrecht in June 1998, the Mathematics Education and Society Conference at Nottingham in September 1998, and the conference on Recent Trends in Fuzzy Mathematics, at Thessaloniki in Greece.

Department of Computer Science

A farewell function was held for Alan Creak, Bob Doran and Mike Lennon, upon their retirement from the Department. Alan sang his farewell speech, to the ground-bass of the ubiquitous Canon by Pachelbel, sung by Peter Gibbons.

Conferences

From January 17 to 21, the Australasian Computer Science Week '99 was held here. That incorporated the 22nd Australasian Computer Science Conference, the 4th Australasian Computer Architecture Conference, the 10th Australian Database Conference, the 5th Australasian Theory Symposium, and the 2nd Discrete Mathematics and Theoretical Computer Science Conference. Most of the Departmental staff were busy on the Local Committee, with Bob Doran as Chairman. Two hundred and ten people registered for those conferences, including about 43 students from around the world. The invited speakers were Ian Witten (Waikato University), Gary Walsh (University of Ottawa), Monica Lam (Stanford University), Antonio Restivo (University of Palermo), Joseph Goguen (University of California, San Diego), Rod Downey (Victoria University of Wellington), Janos Pach (Hungarian Academy of Sciences, New York University) and Joseph Halpern (Cornell University).

Seminars

Larry Carter	(University of California, San Diego), "Multithreading and the Tera MTA Supercomputer".
Kevin Novins	(University of Otago), "Effective volume sampling of solid models using distance measures".
V. Vieru	(Canadian Computing Office), "Call center technologies - a practical approach".
Dr Brian A. Barsky	(University of California, Berkeley), "Geometric modeling and scientific visualization of the human cornea".
T. Rajkumar	"A hybrid risk assessment model using Artificial Intelligence techniques".
Paul Qualtrough	"Understanding the world by gathering evidence".
Danielle Bernstein	(Kean University, Union, New Jersey, and Research Fellow, University of Auckland), "Women, men and computing".
Dr Jeanne Ferrante	(University of California, San Diego), "Transformations for high performance".

Department of Mathematics

Retirement of John Butcher An international symposium was held in our Department, from 1998 December 14 to 16, to honour Professor John Butcher on his retirement. For three days from 8.30 a.m. to about 6 p.m. the assembled participants presented their talks at an average of about 10 per day, as a tribute to John and to mark their respect for John the scholar, and their affection for John the man. About 12 participants came from overseas, to join the people from New Zealand. Tributes from non-mathematical New Zealanders included those from Prof. Sir John Scott (President of the RSNZ), Prof. Philippa Black (Acting Deputy Vice-Chancellor (Academic)), Prof. Ralph Cooney (Dean of the Faculty of Science), and (in absentia) Sir Ian Barker, Chancellor of the University. Mathematical lectures were presented by Prof. C. T. H. Baker (University of Manchester), Dr Igor Boglaev (Massey University), Prof. Douglas Bridges (Waikato University), A-Prof. Kevin Broughan (Waikato University), Dr Bruce Calvert (University of Auckland), Dr Robert Chan (University of Auckland), Prof. Marston Conder (University of Auckland), Prof. Alan Feldstein (Arizona State University), Prof. Joe Flaherty (Rensselaer Polytechnic Institute, USA), Prof. Rob Goldblatt (President of the NZMS), Nicolette Goodwin (University of Auckland), Prof. Arieh Iserles (Cambridge University), Bethanna Jackson (University of Auckland), Dr Young Ik Kim (Dankook University, Korea), Andrei Korobeinikov (University of Auckland), Prof. Peter G. Lowe (University of Auckland), Prof. Gaven Martin (University of Auckland), Dr Alex McNabb (CSIRO, Canberra), Dr Ander Murua (University of the Basque Country, San Sebastian), A-Prof. Don Nield (University of Auckland), Dr Mike Osborne (Australian National University, Canberra), Dr Reinout Quispel (La Trobe University, Bundoora), Dr Philip Sharp (University of Auckland), Anjana Singh (University of Auckland), Prof. Manfred Trummer (Simon Fraser University, Canada), A-Prof. M. K. Vamanamurthy (University of Auckland), Prof. Anant W. Vyawahare (Nagpur University, India), Prof. Graeme Wake (University of Canterbury), Prof. Gerhard Wanner (University of Geneva), Will Wright (University of Auckland) and Shinji Yamamoto (University of Canterbury). John himself delivered a talk entitled "Beyond DESIRE", that (inter alia) set out some of his ambitions for ongoing research. (Mathematicians like John never really retire!)

The symposium provided an opportunity for social gathering, both at an excellent dinner at Langton's Restaurant on Mount Eden and at a convivial barbecue at the home of John and Jenny Butcher.

The organising committee comprised Dr Robert Chan (Chair), Prof. Marston Conder, Mrs Nicolette Goodwin, Mrs Bev Grove, and Dr. Allison Heard. The quality of this well-organised meeting and of the individual contributions were a clear indication of the high regard in which John Butcher is held. The next meeting in the ANODE Series will be held in Auckland on 1999 August 16 to 20.

Dr. Rod Gover has now taken up his appointment as Lecturer. His main research interests include differential geometry and twistor theory as well as their applications and interaction with complex analysis, representation

theory and mathematical physics.

Gaven Martin is now Head of Department for a 3-year term, in succession to Marston Conder. He spent much of our summer in Finland and other places. Marston Conder has been awarded a D.Sc. degree by Oxford University.

Paul Bonnington has been elected as the sub-professorial member of the University of Auckland Information Technology Committee for a two-year term of office.

Jianbei An has been awarded a special salary increment in the Senior Lecturer scale, and Eamonn O'Brien has been promoted to Senior Lecturer.

Paul Bonnington and Margaret Morton have been awarded a 3-year Marsden Fund grant (of $43,500 per annum) in a round of additional awards made by the Marsden Fund.

David Gauld has returned from leave, which he spent in Mexico City, at Oxford and Alaska. He then attended conferences in China and in India. Boris Pavlov spent part of the summer at St Petersburg University, and in March he attended a conference at Moscow University. Eamonn O'Brien visited Australian National University and the University of Sydney. Norm Levenberg helped coordinate a Multidimensional Complex Dynamics Workshop at Indiana University; and he gave seminars at the universities of Michigan, Toronto, Uppsala, Mid-Sweden University and the Jagellonian University at Krakow. After Colin Fox's customary camp on the Antarctic sea-ice, he spent much of the summer shivering in the English winter.

Bill Barton on his leave has visited several universities and conferences in United States of America, Canada, England and Spain.

Recent visitors include Prof. Dom de Caen (Queen's University, Ontario), Prof. Vladimir Oleinik (St Petersburg University), Prof. Mike Atkinson (St Andrews University, visiting the Departments of Computer Science and of Mathematics), Barrie Galpin (Open University) and Prof. Mike Shaughnessy (Portland State University, Oregon; visiting the Departments of Mathematics and of Statistics).

Junying (Shirley) Huang has a University Doctoral Scholarship, Edward Rosser has a University Masters/Honours Scholarship, and Michael Prestidge has an Arts Faculty Masters Scholarship.

Workshop on Group Theory and Combinatorics

A two-day workshop on Group Theory and Combinatorics was held on 1999 February 18 to 19. The following lectures were given:

Prof. Dom de Caen	(Queen's University, Kingston, Ontario), "Association schemes related to Kasami codes and Kerdock sets".
Dr Stephen Glasby	(University of the South Pacific, Suva, Fiji), "Writing representations over a proper sub-field", and "Towards an O'Nan-Scott theorem for linear groups over finite fields".
Prof. Marston Conder	"A question on the number of classes of involutions in a 2-group".
Dr Mike Dinneen	(Department of Computer Science), "Recent work on the (delta,time) broadcast network problem".
Dr Jianbei An	"Dade's conjectures for finite classical groups".
Prof. Peter Neumann	(University of Oxford), "Cyclic matrices over finite fields".
Prof. Cheryl Praeger	(University of Western Australia), "A cyclic meataxe? Using cyclic matrices to design and analyse algorithms for finite matrix groups".
Sanja Todorovic-Vasiljevic	"Bounds for the number of automorphisms of a non-orientable surface of given genus".
Prof. Charles Leedham-Green	(Queen Mary Westfield College, London), "Recognising tensor products and tensor induced matrix groups".
Prof. Vaughan Jones	(Universities of Auckland and California), "Loop groups and operator algebras".
Prof. Mike Atkinson	(University of St Andrews), "Trees and priority queues", "Permutations and generalised stacks", and "Restricted Permutations" (joint seminar with Computer Science Dept.).
Prof. Dom de Caen	(Queen's University, Kingston, Ontario), "Graphs with few distinct eigenvalues", and "Are there any finite projective planes of orders $4k+2$?".

Dr Zouwei Shen (National University of Singapore), “Affine frames in $L_2(R^2)$".

Barrie Galpin (Open University), “Tapping into mathematics with a graphics calculator".

Prof. Nira Dyn (Tel Aviv University), “Subdivision schemes - an overview".

Dr Alan Delos Santos (Ateneo de Manila, Philippines). “The use of the TI-92 calculator in Pre-Calculus and Calculus classes at university level"

Prof. David B. Gauld , “Torsion in the group of homeomorphisms of powers of the long line".

Dr. Alexander Isaev (ANU), “Characterisation of hyperbolic complex manifolds by the dimensions of their automorphism groups".

Prof. M. D .E. Conder , “Experimental Algebra – Do computers outperform coffee in producing theorems?"

Prof. Mike Shaughnessy (Portland State University, Oregon), “Students’ beliefs and conceptions in probability and statistics”.

Dr John McKenzie , “Two-generator Kleinian groups".

Prof. Vladimir Oleinik (St. Petersburg University), “Hilbert theorem on lemniscates and spectrum of the perturbed shift".

Prof. Charles Leedham-Green (University of London), “Recognising matrix groups".

Abdul Mohamad , “A result on $\aleph_1$-compact spaces".

Dr Geoff Nicholls , “Perfect simulation for Bayesian inference".

Prof. Gaven Martin , “The Hilbert-Smith conjecture for quasiconformal actions".

Dr. Sergei Fedorov , “On the boundedness of the weighted Hilbert transform in multiply-connected domains".

Dr Mohan Chinnappan , “Variance between teacher and student schema".

Statistics

A Departmental function was held to mark the formal retirement of George Seber. But George will continue to teach some courses here. Alastair Scott is one of a team of 4 researchers who have received a Health Research Council award of $1,230,000 over 3 years. This award is to study the rate of medical mishaps nationally through sloppy hospital treatment, and it is the largest award yet made by the HRC for a public health study. Prof. Simo Puntanen (Tampere University, Finland) has returned for a further visit here. Prof. Mike Shaughnessy (Portland State University, Oregon) is a visiting lecturer to the Departments of Mathematics and of Statistics Departments. He is a leading international authority in statistics education.

Seminars

Dr Paul Cowperthwaite (Massey University), “A stochastic model for rainfall time series with applications in engineering hydrology".

Dr Shane Henderson (Department of Engineering Science), “Estimation of stationary densities of Markov chains".

Dr Saralees Nadarajah (University of Plymouth), “Some recent developments in extreme value theory".

Prof. David R. Brillinger (University of California, Berkeley), “Modelling the motion of animals".

Dr John Neuhaus (University of California), “Closure of the class of binary generalized linear models in some nonstandard settings".

Dr Geoff Nicholls (Department of Mathematics), “Perfect simulation via simulated sintering".

Garry J. Tee

Department of Engineering Science

We have a new lecturer, Piaras Kelly (BSc, U.Coll. Dublin, PhD Oxford), who has been doing Post-Doc research at the Oxford Orthopaedic Engineering Centre (modeling knee prostheses) and at the University of Oxford (modeling plasticity at fatigue crack-tips). His current research interests are the development of mathematical and numerical techniques in the fields of contact and fracture mechanics with applications to composites and bioengineering.

Engineering student numbers have not declined, but we have not been immune from the University's current staff reduction process. We have had an OR position frozen for four months (fortunately now freed up), and your correspondent, who has 24 years service in the Department of Mathematics Department and 13 in the Department of Engineering Science, is moving to a part-time contract. Except for a reduced teaching load, he does not expect much change in his way of life for a couple of years at least. The second edition, revised and substantially expanded, of the book by Nield and Bejan, Convection in Porous Media, has just been published by Springer-Verlag, New York. The book has become established as the standard reference book in its field.

Mike O'Sullivan is on leave this year, but will be around for a lot of the time besides visiting such places as Berkeley and the United Kingdom. Andrew Mason is also on leave, while Andrew Pullan and Andy Philpott have recently returned form leave.

We have a brand new teaching computer laboratory with 36 PC's, and a new technician, Alice Cornelius, who is responsible for it.

David Ryan and his research group have been awarded a prize by IPENZ for their work on optimised crew scheduling systems at Air New Zealand.

Visiting the department are Jacob Bear from the Technion in Haifa, who is giving some lectures on flow in porous media as part of our Environmental Fluid Mechanics course, and Horst Hamacher from the University of Kaiserslautern, who is giving lectures on facilities location in a part 4 OR course.

Don Nield

UNIVERSITY OF CANTERBURY

Professor Douglas Bridges, a specialist in constructive mathematics and the foundations of analysis, has taken up the Chair of Pure Mathematics here at Canterbury. Professor Bridges joins us after 10 years at Waikato University, and makes us perhaps the only department in the country which has two Professors who are qualified soccer referees.

Dr. Marco Reale has taken up a lectureship in Statistics. Dr Reale gained his first degree from the First University of Rome, and went on to obtain a Doctorate from Lancaster University. Dr Reale's specialities include graphical models and time series. Whilst at Canterbury he intends to work on wavelets applied to financial time series.

Visitors

The department has recently had the pleasure of hosting a number of visitors. Amongst them were Associate Professor Noriaki Suzuki from Nagoya University, and Dr Katsunori Shimomura, from Ibaraki University, both of whom were visiting Associate Professor Neil Watson.

Professor John Brindley (Leeds) and Dr Andy MacIntosh (Leeds), were visitors of Professor Graeme Wake.

Other visitors include Dr James Lawry (Oxford), Professor Murray Muraskin (Queensland), Dr Charles Pearce (Adelaide), and Dr Sebastian Bocker (Bielefeld).

Conferences

The Workshop in surface approximation and visualization was held at Canterbury in mid-February. The workshop was very successful, and attracted a large number of international participants, especially from Singapore, Australia, Germany, and the United States.

The conference was organized by Keith Unsworth (Lincoln), Shayne Waldron (Auckland), and Rick Beatson (Canterbury). The organizers wish to thank the following organizations for financial and other support: NZMS, ANZIAM, Hoare Research Software, Lincoln University, and the Universities of Auckland and Canterbury.

The biomath group hosted a successful week-long international conference/workshop in Kaikoura in early March. Called 'Kaikoura'99', it attracted 32 participants from twelve countries, and four disciplines – mathematics, biology, statistics and computer science – to address contemporary problems in evolutionary molecular genetics.

Highlights of the meeting included a keynote address by Professor David Penny, (Massey University) "Big bangs, explosive radiations - or science", and a demonstration of new software for phylogenetic analysis developed in the US/Germany that includes several features originating from research in New Zealand.

The meeting was held at the University of Canterbury's Edward Percival Marine Laboratory, and organised by Mike Steel, with help from Charles Semple and Andy McKenzie. It was the fourth in a series that have been held in New Zealand over the last decade, including a similar conference in Kaikoura in 1996. A full programme of the meeting, is available via the Biomathematics Research Centre web site – http://www.math.canterbury.ac.nz/biomath.html The organisers wish to acknowledge support from the Marsden fund.

Many of the overseas participants stayed on in New Zealand to continue collaborations at Canterbury and Massey Universities for periods ranging from 1 week to several months.

Charles Semple and Mike Steel are also organising the annual Australia-New Zealand combinatorics meeting in November 2000.

Seminars

Associate Professor Noriaki Suzuki	(Nagoya University), "A uniqueness theorem for harmonic functions".
Dr Katsunori Shimomura	(Ibaraki University), "Calorific morphisms between Euclidean spaces".
Professor John Brindley	(Leeds), "Opportunities, dangers, and control methods in chaotic mechanical systems".
Dr Andy MacIntosh	(Leeds), "Ignition of combustible fluid in porous media".
Dr James Lawry	(Oxford), "Ray asymptotics for high frequency wave propagation and convection-diffusion".
Professor Murray Muraskin	(Queensland), "Mathematical aesthetic principles / non-integrable systems".
Dr Charles Pearce	(Adelaide), "Inclusion properties for classes of convex functions".
Dr Sebastian Bocker	(Bielefeld), "Patching up X-trees".

Chris Price

MASSEY UNIVERSITY

Mathematics, Institute of Fundamental Sciences

After a year of discussion in 1997, and a year of getting to know our new institute of Fundamental Sciences in 1998, we are eagerly anticipating finally moving to our new offices in the refurbished Science Towers. This is to take place on Monday 12 April, and apparently nothing can go wrong. Sadly for the rest of us, we will be leaving behind Glenda Anthony, who is transferring to the College of Education, and John Giffin, who has joined the Institute of Information Sciences and Technology—we suspect so that he doesn't have to move offices.

January was a time for travelling. Igor Boglaev, Dean Halford, Robert McKibbin, Robert McLachlan, Tammy Smith, David Pidgeon, and Marijcke Vlieg made up the Massey contingent who travelled to the 2nd annual Wellington–Manawatu Applied and Computational Mathematics Conference, held this year at IRL, Petone, where a good time was had by all, especially, as I recall, afterwards in the Petone high street. Tammy Smith, Robert McLachlan, and Robert McKibbin participated in the Mathematics in Industry Group in Brisbane, working on modelling chocolate bloom (the 26 week old Tim Tams, despite exhibiting severe bloom, disappeared almost immediately) and polymer coating using fluidised beds. Institute members also went to ANZIAM and to the Canterbury visualisation meeting.

Kee Teo is to leave shortly to take up a visiting professorship for 7 weeks at the Prince of Songkla University in Thailand. He will give lectures and seminars on graph theory and chromatic polynomials as well as conducting a three day workshop on the latter topic. We look forward to continuing links between Massey and the emerging universities in Thailand.

We are very pleased that Chris Palliser, who completed his PhD in mathematics last year under Robert McKibbin, will be staying in our Institute. He has been appointed Marsden Postdoctoral Fellow working with David Parry on the structure of fibrous proteins.

After missing out in the initial announcements of the 1998 Marsden Fund grants, Igor Boglaev was thrilled to get a Christmas phone call informing him that he would receive a grant after all, being awarded $103,000 for research in parallel algorithms for singular perturbation problems.

Robert McLachlan has returned from a very successful and enjoyable period at the MSRI, Berkeley, as part of their special semester on the Foundations of Computational Mathematics. Many of you will know the MSRI's superb building set high up in the Berkeley hills and of the great research atmosphere there. He reports that he had an incredibly productive time and would like to go out for a latté at the Caffe Med right now.

In March we enjoyed a social visit from Mahyar Amouzegar, who left us last year for RAND in Santa Monica. He thinks his new job is great, but quality of life less so. Mid-winter visits to Idaho Air Force bases are well down the list.

In some late breaking restructuring news, Massey has run out of subject numbers, having reached 99. Clearly this is a problem of the magnitude of Y2K, but not to worry: a fix is in the pipeline. 100 will be added to all existing numbers, allowing, why, *hundreds* of new subjects! We think a little discussion with mathematicians about the integers might have helped.

Seminars

Mark Nelson	(University of Leeds), "Investigating generic properties of flammable materials through the use of dynamical systems methodology."
Manfred Trummer	(Simon Fraser University), "Resolving boundary layers with spectral collocation methods."
John Hudson	"Constructing surfaces using alpha-shapes and homology."
John Brindley	(University of Leeds), "Reactant leakages and lagging fires: unwelcome physics-chemical nonlinearity."
Sir Michael Berry	(University of Bristol), "Levitation with meditation" and "Quantum mechanics and the Riemann zeros."

Robert McLachlan

UNIVERSITY OF OTAGO

The department is reorganizing its papers again, this time at the request of the University, which has decided that all papers below 400-level must have more than 6-points. This has been a massive communal effort led by Professor Holton.

Two new Teaching Fellow appointments have been made: Warren Palmer (previously of Kavanagh College) and John Enlow, replacing Aaron Bruhn and Allyson Seyb. Aaron and Allyson are still to be seen around the Department as they are completing their MSc's.

Pressures of being a head of department and visits by many colleagues, family and friends prevented Vernon Squire from joining the New Zealand Sea Ice Programme team that went aboard the Nathaniel B. Palmer icebreaker in December. Instead Josh Downer, an Otago PhD student joined the cruise, helping with a project to look at interactions between ice floes and their dynamics. Although conditions were rather calm, one good experiment was achieved in a coherent band of sea ice near the ice margin; the data are currently being processed. Vernon did participate in a strategic planning meeting in Monterey, California, in March. The purpose of the meeting was to set up a framework for Antarctic sea ice experiments for the coming decade, and a Science Steering group has been set up to do this. The science plan nears completion and will be published as a living document on the Web, and in hard copy form. Monterey was a pleasant place to visit, although it was difficult to get used to all students in the Naval Postgraduate School wearing ties. Vernon's Marsden grant with Colin Fox is now entering its final year. Some of the mathematics that has been attempted has proved to be very difficult, but progress has been made in both Auckland and in Otago. Unfortunately what promised to be a very fruitful developing collaboration with Emeritus Professor V.T. Buchwald of the University of New South Wales ended when Ted died last year.

Dr Caryn Thompson is on leave for the first six months of this year at Dalhousie University, Canada.

Dr Peter Fenton has returned from study leave at Virginia Tech, Blacksburg, Virginia, and Imperial College, London. He said he 'loved every minute!'.

Derek Holton attended the ICMI Conference on the Teaching and Learning of Mathematics at University Level, held in Singapore from 5-14 December 1998. There are to be two publications arising from this conference. The first is a set of selected papers that will appear in the first issue next year of the International Journal of Maths Education in

Science and Technology. The second is a review of the whole field of tertiary maths education and will appear in a study volume to be published by Kluwer, hopefully in the year 2000 too.

Bryan Manly attended the 3rd International Conference on Biostatistics and Biometry which was held in Banaras Hindu University, Varanasi, India from 18 December 1998 – 5 January 1999. He also visited the University of Poona to visit Dr S A Paranajape, who was recently funded by the Commonwealth Universities Association to work with him in Dunedin.

Visitors

Professor Sir Michael Berry FRS, 1999 Forder Lecturer, began his tour in Dunedin. He gave three public talks: "Seven Wonders of Physics", "Quantum Mechanics and the Riemann Zeros", and "Levitation without Meditation". The first was a Science Division Open lecture; it was particularly well attended and was reported in the Otago Daily Times, Tuesday 16th March 1999. Sir Michael also spent time talking to research groups in Mathematics and Physics. And he managed to see some penguins and a seal at Sandfly Bay!

As well as Dr Richard Anderson-Sprecher and Dr Gary Zerbe (mentioned in the last Newsletter), we have three other overseas academics visiting from January to March.

Prof John Rayner of the University of Wollongong is spending part of his study leave at Otago where formerly he was a staff member. His area of research is non-parametric statistics, particularly goodness of fit.

Dr John Sheehan of the University of Aberdeen is working on combinatorics and graph theory with Professor Derek Holton and Dr Robert Aldred.

Professor Keith Nicholson of the University of Calgary is working with Dr John Clark on ring and module theory.

Competitions

Each year members from the Mathematics and Statistics Department administer the Problem Challenge Competition which is aimed at helping intermediate level children learn to solve problems. This year 33,000 pupils at 700 schools around New Zealand are participating.

The National Bank Junior Mathematics Competition is also administered by the Department for third, fourth and fifth form students throughout the country. This year 12,000 pupils from 230 schools are involved in the competition.

Both of these competitions are designed to challenge students at various levels and assist with the learning process.

Postgraduate Students

Three postgraduate students have finished their degrees.

John Alsop was awarded his PhD in Statistics. His thesis title was 'On the Temporal Stability of Populations' and his supervisor was Professor Bryan Manly.

Alexandra Hawke was awarded an MSc with Distinction in Statistics. Her thesis title was 'Modelling individual tree growth of improved genotypes of Pinus radiata in a progeny trial with adjustment for spatial covariance'. Alex's supervisor was Dr Caryn Thompson.

Paul Lau Ngee Kiong was awarded his PhD in Mathematics Education. His thesis title was 'Problem solving as an approach to the teaching and learning of mathematics', and his supervisor was Professor Derek Holton.

Seminars

James R. Murphy, Professor of Biostatistics	(University of Colorado Health Sciences Center, Denver, USA), "Using bivariate survivor functions to select a good surrogate variable for death in animal experiments".
John Rayner	(School of Mathematics and Applied Statistics, University of Wollongong, Australia), "Modelling ties in the sign test and How order affects the sign test".
Gary O. Zerbe, Professor of Biometrics	(Department of Preventive Medicine and Biometrics, University of Colorado Health Sciences Center, Denver, USA), "Towards a general linear model based on permutation by".

Forder lecturer 1999, Prof. Sir Michael Berry	(Department of Physics, Bristol University), “Seven wonders of physics”; “Quantum mechanics and the Riemann zeros”; “Levitation without meditation”.
Gareth Hegarty	(University of Auckland), “Existence of Solutions for nonlinear evolution equations”.
Dr John Sheehan	(University of Aberdeen), “Hamiltonian Cycles”.

Lenette Grant

UNIVERSITY OF WAIKATO

Department of Mathematics

Dr Rua Murray has been appointed to a lectureship in our department. He is currently based at the University of Victoria in Victoria, Canada and is expected to arrive here around the middle of the year. At the University of Victoria he is working as a postdoctoral fellow supported by the Pacific Institute for the Mathematical Sciences. His area of research is in dynamical systems.

The three-year term of the joint Chairpersons Kevin Broughan and Alfred Sneyd ended at the start of the year. The department is now headed by Kevin as sole Chairperson.

As with other tertiary institutions, our university is undergoing restructuring. From next year, the plan is for the School of Computing and Mathematical Sciences and the School of Science and Technology to merge into a new faculty to be called the Faculty of Science. So it appears that everything has gone full circle since the three departments in our School were once part of the Science School.

In previous years, our two first year courses in calculus and algebra have been full year ones. This year we are running them both as semesterized courses. Each of them will be offered in both semesters.

As I wrote this column, the 1999 Forder Lecturer, Professor Sir Michael Berry, has just completed his series of three lively and informative talks. We were all intrigued by the spinning-top floating above a magnetised slab.

Alfred had Yves Fautrelle from the Institut National Polytechnique in Grenoble as a visitor for two months at the beginning of the year. They continued their collaboration on magnetohydrodynamics.

Ernie Kalnins also has a visitor. Professor George Pogosyan from the Laboratory of Theoretical Physics at the Joint Institute for Nuclear Research in Dubna, Russia is visiting Ernie for six weeks until early April. They are continuing their work on superintegrability.

Ian Craig, Alfred, Paul Watson and two postgraduate students went to the ANZIAM conference held in Mollymook in February.

Seminars

Sir Michael Berry	(Bristol University), “Diffraction of atoms by real, complex, and imaginary crystals of light”; “Seven wonders of physics”; “Levitation without meditation”.
J. Brindley	(University of Leeds), “Nonlinearity in the ocean; plankton population dynamics”.
Y. Fautrelle	(Institut National Polytechnique, Grenoble), “Instability of liquid metal free surfaces under the influence of alternating magnetic fields”.
M. Nelson	(University of Leeds), “Investigating generic properties of flammable materials through the use of dynamical systems methodology”.

Stephen Joe

Department of Statistics

Recent visitors to the Department have included Emlyn Williams (CSIRO, Australia) for another short visit to work with Nye John and David Whitaker. Hans Hockey was also here for a short time although he worked mainly at Ruakura. The department also welcomes David Johnson from Loughborough University in the UK who will be here from March to June. Whilst he is here he will be furthering his research in academic timetabling in collaboration with David Whitaker and Professor Les Foulds in the Management School. With David Whitaker he hopes to

develop some joint research into heuristic methods for use in course timetabling. He is also assisting in the tutorial programme for the first year management statistics course.

Murray Jorgensen is currently on sabbatical. He will be working with Dr Geoff McLachlan until he returns at mid-year. Nye John attended GENSTAT99 held in Lorne, Australia, in early February. He will be on sabbatical during the second half of this year. Sharon Gunn was a presenter at LOGOS#5 on recent issues in Statistical Education, held in the Mathematics Education Unit of the University of Auckland at the end of March.

The Waikato Centre for Applied Statistics will present a one-day workshop on Categorical Data Analysis, by Professor Alan Agresti, University of Florida on Thursday 8 July, 1999. This is immediately following the New Zealand Statistical Association 50th Anniversary Conference, which will be held at the Victoria University of Wellington.

Chido Gandanzara has submitted her master's thesis entitled 'An Interactive Computer Simulation Exercise for SPC Students'. She has now returned to her home to Zimbabwe.

Recent Seminars

Dr Rod Ball	(NZ Forest Research Institute), "Testing Scientific Hypotheses-the Baysian approach versus P -values".
Murray J. Mackinnon	(Consulting Statistician, North Vancouver), "Data Mining and Knowledge Discovery in Databases-an Overview".
Dr Saralees Nadarajah	(University of Plymouth), "Some Recent Developments in Extreme Value Theory".

Upcoming Seminars

Dr David Johnson	(Loughborough University), "Triangular approximations in continuous random variables in risk analysis".
Dr Ray Littler	"The challenge of statistical practice: how does it help us teach?".
Dr I-Ming Liu	"Strategies for modeling a categorical variable allowing many category choices".

Judi McWhirter

BOOK REVIEWS

Set Theory

(2nd ed) by Thomas Jech, *Perspectives in Mathematical Logic*
Springer-Verlag, 1997, DM 168.00. ISBN 3-540-63048-1.
This is a "second edition" of Jech's classic 1978 monograph. More on this later.

This book is definitely not light reading, and definitely not an introductory text in either set theory or even forcing. Kunen's book is very much better. The book does indeed cover all the relevant material but the demands on the reader caused by the pace and brevity would discourage the tyro.

The book is meant to be the standard reference text for mature mathematicians with a thorough grounding in basic model theory, axiomatic set theory, and the basics of forcing. For such an audience, the book is very fine. Want to know the story about Suslin's problem? Or about measurable cardinals? Or about iterated forcing? Here's where to turn. It will be discussed fully and economically.

The book covers virtually all the *basic* streams of basic advanced set theory. Chapters 1 and 2 discuss the fundamentals, the axioms of ZFC and transitive models, constructable sets, ordinal definability, and the consistency of the GCH. Chapter 3 looks at forcing, genericity, and Boolean valued models. Chapter 4 is concerned with some applications of forcing such as Suslin's problem, Martin's axiom, and various combinatorial problems. Iterated forcing is discussed in detail. Chapters 5 and 6 are devoted to various large cardinal hypotheses and their applications. Measurable cardinals, Silver's theorem, compact cardinals and ultrafilters are discussed, as are the use of forcing for large cardinals. Finally the last chapter is devoted to classical descriptive set theory. All the basic material on Borel, analytic, and projective sets is given. Solovay's model where all sets are Lebesgue measurable is constructed and various determinacy consideration treated. Finally, applications of forcing in the model theory of the reals are discussed.

In the twenty years since the publication of the first edition, there has been an explosion of results in set theory. While this is supposedly a second edition, in fact it is reprinting of the first edition with eight pages of corrections attached. So, while the book truly constitutes a thorough and complete treatment of advanced set theory as per 1978, the advances since then are not mentioned. For instance, Woodin's name does not occur anywhere, and only one paper by Shelah is referred to. This is unfortunate not so much for what is covered, the material is still basic, necessary and relevant, but for the lack of treatment of topics such as pcf theory, proper forcing, scales in $L(\Pi)$, and the connections between large cardinal hypotheses and determinacy, to name but a few. (These are but a small selection, I am not an expert here.) Even lacking a treatment, what would have been really nice would have been just the addition of notes saying where things have gone to in the last twenty years. For instance, after seeing Solovay's model, we need a mention the Shelah fact that the inaccessible cannot be taken away, and a reference.

So my conclusion is that this is a very fine book, which is a *must* for any worker in set theory. It is however unfortunately dated, and is really only a standard reference for set theory up to 1978. Its place is now more of a basic springboard for modern set theory. I am glad to have my copy.

I should remark that when I finished this review I e-mailed Jech to ask what the story was. He tells me that he is currently writing a truly revised version to bring the 1978 version up to date, and that should appear in two years.

Rod Downey
University of Wellington

CENTREFOLD

John Harper

At the end of last year, Professor John Harper retired from the Mathematics Department at Victoria University. Ross Renner delivered farewell comments to the Academic Board to honour John. The following is Ross's tribute:

"This is not a farewell. Certainly, John Harper is about to take early retirement, but he has a simple plan. And remember, I am referring to the man whose meticulous attention to detail we have all come to know and love. John's plan is to return to Victoria in the New Year, and continue with his research, undistracted by students, University committees, or the arcane workings of the Academic Board.

"So rather than a farewell, this is a tribute.

"John Harper has had a long and distinguished association with Victoria since he enrolled here with a coveted Junior Scholarship in 1956. He graduated MSc with 1st Class Honours in 1960, and then, with an even more coveted Senior Scholarship, he studied at the Department of Applied Mathematics and Theoretical Physics at Cambridge University in England. After gaining his PhD there in 1964, he lectured at Bristol University until he returned to Victoria, in 1968, to take up a Senior Lectureship in Mathematics. He was promoted to Reader in 1975, and later, to the personal Chair of Applied Mathematics in 1993, after a 10-year moratorium on personal chairs was lifted.

"His early scientific reputation was established in fluid mechanics, in which he is still publishing, and still a leading authority. But, as a result of his association with Victoria's Institute of Geophysics, he published a series of papers

that brought an unprecedented level of mathematical brilliance to the seemingly impossible problem of plate motion, in the theory of plate tectonics. These are the terrestrial processes that build mountains, and cause earthquakes. He achieved this, working alone in relative isolation, and went on to win for himself and this University, the highest international reputation.

“Acknowledgments of his research have included The New Zealand Geophysics Prize, a higher Doctorate of Science from Cambridge, and the election as a Fellow of the Royal Society of New Zealand.

“A referee for his Doctorate of Science wrote, "Harper’s papers represent Applied Mathematics in the finest Cambridge tradition, combining deep physical insight with mathematical brilliance. He has always tackled hard, scientifically interesting problems, and on the whole, his contributions have been unquestionably significant”.

“I myself would describe John as one of the few great polymaths. Over the years that our two careers have criss-crossed, we have had many moments of quiet conversation in the course of which I have peppered him with my minor mysteries like, how did Kepler make measurements precisely enough to determine the orbit of Mars?. Or, if neutrinos have mass and account for the dark matter in the universe, how did they reach earth before the light from Supernova 1987A? And to all the questions, John would either know the answer, know a reference to the answer, or sometimes, and this was most unsettling, he would simply go away and work the answer out."

>From John’s CV we learn in addition that John was born in New Zealand 60 years ago, is married with 2 adult children. During his career he has made many contributions outside of his direct university responsibilities. The list of society’s to which he has held positions of responsibility include: Carter Observatory Board (NZ Government appointee 1969–77); NZ National Committee for the Lithosphere (1981–82); NZ Mathematical Society (Council member 1984–87) Wellington Branch, Royal Society of NZ (Secretary 1982–83, Vice-President 1984–88, President 1988–90), Astronomy and Geophysics Section (Chairman 1977); Royal Society of NZ (Council member elected by Member Bodies 1987–90) International Association of Seismology and Physics of the Earth’s Interior Organising Committee for the 27th General Assembly, Wellington, January 1994 (Treasurer); NZ Geophysical Society (Council member: 1994) Australian and NZ Industrial Applied Mathematics (Chair 1995).

Further he has supervised four MSc and two PhD students, is on the editorial board of three international research journals and has twice held visiting positions at Cambridge University.

Mike Hendy

Centrefolds Index

Foundations of Real and Abstract Analysis

by Douglas S. Bridges, *Graduate Texts in Mathematics, 174*
Springer-Verlag, New York, 1998, 322pp, US$44.95, ISBN 0-387-98239-6.

This book is a skillfully-crafted text on essential analysis. It covers those parts of analysis found in every mathematician’s toolkit: real variables, integration on the line, metric spaces, normed and Hilbert spaces, and the rudiments of functional analysis. As a reference it is comprehensive, accurate, and an outstanding source of problems. However this text is really meant for serious upper-level students who are ready to learn some necessary and exciting analysis. It is smartly divided into two parts; the first covers classical analysis and the second abstract analysis. The topics in each part are carefully sequenced so as to maximize flexibility for the lecturer. One could use this text for either a one-semester course in real analysis or abstract analysis, or for a full-year fast-paced comprehensive course covering both real and modern analysis. Indeed, it is possible to move through the entire book with a highly-motivated, sharp group of students within one full academic year.

Consider comparing this book with any of the established texts dealing with higher analysis. In level of difficulty and scope it is most similar to the two classics *Real Analysis* by Royden, and the Springer Graduate text *Real and Abstract Analysis* by Hewitt and Stromberg. Rudin’s *Principles of mathematical Analysis* is comparable to the book under review in difficulty, but is restricted to classical analysis and was written for students of a different era. The other two standard texts by Rudin, *Real and Complex Analysis* and *Functional Analysis*, are more demanding both in content and accessibility. In contrast Bridges’ book is likely to be more readable and digestible. His style of writing is inviting, yet politely provocative. There are many historical and interesting bibliographical references throughout. These references serve to benchmark the subject of analysis and its history within mathematics as a whole. Students will appreciate this. Some texts of comparable accessibility, but considerably less comprehensive, are *Introduction to Analysis* by Gaughan, *Modern Analysis* by Ruckle, and *Introduction to Real Analysis* by Brabenec. Of all the texts cited above, the text under review is quite superior in its exercise collection. It contains about 750 problems dealing with the whole vista of analysis. It offers the student and the lecturer maximal incentive and opportunity to explore. In volume, this collection of exercises is perhaps second only to the exceptional one found in Stromberg’s *An Introduction to Classical Real Analysis*.

Part one of this text deals with real analysis. It is subdivided into two chapters and occupies about 100 pages. The topics covered in the first chapter are standard: sequences and series, continuity, differentiability, Riemann integration and calculus. The inclusion of this basic material serves several purposes. It makes the text accessible to

senior undergraduate mathematics students who have seen just a few semesters of calculus and who are taking their first serious course in analysis. This chapter also establishes the prerequisites, the notation, and the exercise structure for the whole book. Individual exercises are grouped in sets which are then strategically arranged throughout the text material. Bridges is careful to inform in the preface that many theorems and concepts are first presented within the exercise sets themselves. The second chapter covers more advanced real analysis. After assimilating the material in this part only, students could appreciate probability theory, approximation theory, numerical analysis, complex analysis, advanced differential equations, or Fourier series. Some of the exercises in part one deal with Cantor's theorem as a refined version of Cantor's classical diagonal argument, the classical Weierstrass's construction of a continuous function which is nowhere differentiable, and the Riemann-Lebesgue lemma.

Part two is a self-contained and thorough treatment of modern analysis. There ar four chapters: metric spaces, normed spaces, Hilbert spaces, and basic functional analysis. This part forms the core of the text and is about 170 pages long. One could easily use this part alone to teach a one or two-semester course in modern analysis to students who already have prerequisites in real analysis and perhaps linear algebra. It could also serve as a useful reference for other subjects where modern analysis is an important tool. After working hard through the material in part two, students would be well-prepared to deal with advanced areas such as operator theory, approximation theory, abstract harmonic analysis, topological vector spaces, spectral theory, quantum mechanics, or mathematical physics. Samples of the exercises include the p-adic metric on the rationals, a general version of the extreme value theorem for continuous functions, the fundamental theorem of approximation theory for normed spaces, and, not surprisingly, the complex version of the Hahn-Banach theorem. There are also problems of an experimental nature whereby hints and pointers are given as incentive for students to explore alternative proofs of well-known results. One example of such a problem asks to devise a proof of the Stone-Weierstrass theorem while eliminating reference to the Weierstrass approximation theorem. Another problem suggests an alternative proof of Picard's theorem for the existence of solutions to ordinary differential equations.

This book has extra value because of the reference section, index, and in particular, the three appendices. The first is a sketch of Bishop's treatment of the construction of the real line. In about a half dozen pages students will gain some insight into what a real number actually is and how the basic arithmetic operations are defined within the constructive approach. For those desiring deeper knowledge of constructive analysis, the author points to two of his well-known texts in the reference section. The second appendix is a mini essay on the axioms of choice and Zorn's lemma. The final appendix is unusual for a book of this type and scope. It shows how some of the concepts and methods of modern analysis are used in the theory of Pareto optimality within mathematical economics. The reference section is accurate and comprehensive. It lists 57 items, many of which were used in the writing of the book and others serving as supplements. About a quarter of the items listed are original papers in journals. some of these are accessible to beginning graduate students and only a few are not in English. An unfortunate typographical error occurs in the section; it is the omission of the author's surname in the citing of his third book as a reference. The index consists of six pages. It is deep, accurate and easy to use.

It was a pleasure and inspiration to read this excellent book, *Foundations of Real and Abstract Analysis*. It comes well-recommended. The reviewer also had the pleasure of meeting Douglas Bridges at the 1998 International Congress of Mathematicians in Berlin.

Raymond GrinnellUniversity of the West Indies

General Topology II (Compactness, Homologies of General Spaces)

A.V. Arhangel'skii (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'skii. 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 pseudocompactness. 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 contructions that every mathematician is forced to have working knowledge of: the Tychonoff product theorem, universality of Tychonoff cubes, the Stone-Cech 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_δ-subsets, homogeneous compacta, mappings onto Tychonoff cubes, dyadic compacta, compactifications with given properties. I wish to mention separately the classical result by Arhangel'skii: the cardinality of a compactum satisfying the first axiom of countability does not exceed $2^{\aleph_0}$.

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 problematics: 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 Evgenii 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 d'etre* 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, $\mathcal{S}$, of rings on a topological space X is an assignment of a ring, $\mathcal{S}(U)$, to each open subset $U \subseteq X$, and of a ring homomorphism, $\rho_V^U: \mathcal{S}(U) \to \mathcal{S}(V)$, 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 $\mathcal{S}(U) = C(U)$ is the ring of all continuous real-valued functions on U and each ρ_V^U 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 $\mathcal{S}$ 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), Cech 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, Cech 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 México 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
Victoria University of Wellington

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)

Aigner M, Proofs from THE BOOK. 220pp.
Arnold L, Random dynamical systems. (Springer Monographs in Mathematics) 586pp.
Aubin J-P, Optima and equilibria. An introduction to nonlinear analysis. (Graduate Texts in Mathematics, 140) 430pp.
Berberian SK, Fundamentals of real analysis. (Universitext) 496pp.
Bingham NH, Risk-neutral valuation. (Springer Finance) 296pp.
Bix R, Conics and cubics. A concrete introduction to algebraic curves. (Undergraduate Texts in Mathematics) 300pp.
Bollobas B, Modern graph theory. (Graduate Texts in Mathematics, 184) 410pp.
Capinski M, Measure, integral and probability. (Springer Undergraduate Mathematics Series) 227 pp.
Crabb MC, Fibrewise homotopy theory. (Springer Monographs in Mathematics) 341pp.
Deboeck GJ, Visual explorations in finance. (Springer Finance) 258pp.
Gasquet C, Fourier analysis and applications. (Texts in Applied Mathematics, 30) 450 pp.

Gentle JE, Numerical linear algebra for applications in statistics. (Statistics and Computing) 230 pp.
Giaquinta M, Cartesian currents in the calculus of variations I, II. (Ergebnisse der Mathematik und ihrer Grenzgebiete 3. Folge/ A Series of Modern Surveys in Mathematics, 37, 38) 711pp & 697pp.
Goldblatt R, Lectures on the hyperreals: an introduction to nonstandard analysis. (Graduate Texts in Mathematics, 188) 289pp.
Goldreich O, Modern cryptography, probabilistic proofs and pseudorandomness. (Algorithms and Combinatorics, 17) 182pp.
Griess R, Twelve sporadic groups. (Springer Monographs in Mathematics) 169pp.
Gustafson GB, Advanced engineering mathematics. (Texts in Applied Mathematics, 28) 755pp.
Habib M, Probabilistic methods for algorithmic discrete mathematics. (Algorithms and Combinatorics, 16) 323pp.
Hahn A, Basic calculus: from Archimedes to Newton to its role in science. (Textbooks in Mathematical Sciences) 540pp.
Harris JW, Handbook of mathematics and computational science. 1056pp.
Hilbert D, The theory of algebraic number fields. 350pp.
Ihlenburg F, Finite element analysis of acoustic scattering. (Applied Mathematical Sciences, 132) 235pp.
Jungnickel D, Graphs, networks and algorithms. (Algorithms and Computation in Mathematics, 5) 589pp.
Karatzas I, Methods of mathematical finance. (Applications of Mathematics Stochastic Modelling and Applied Probability, 39) 407pp.
Lam T-Y, lectures on modules and rings.(Graduate Texts in Mathematics, 189) 500pp.
Megginson RE, An introduction to Banach space theory. Graduate Texts in Mathematics, 183) 596pp.
Protter MH, Basic elements of real analysis. (Undergraduate Texts in Mathematics) 275pp.
Ranicki A, High-dimensional knot theory. (Springer Monographs in Mathematics) 646pp.
Redfern D, The Matlab 5 handbook. 520pp.
Resnikoff HL, Wavelet analysis. 540pp.
Simo JC, Computational inelasticity. (Interdisciplinary Applied Mathematics, 7) 430pp.
Simpson SG, Subsystems of second order arithmetic. (perspectives in Mathematical Logic) 444pp.
de Souza PN, Berkeley problems in mathematics. (Problem Books in Mathematics) 500pp.
Sznitman A-S, Brownian motion, obstacles and random media. (springer Monographs in Mathematics) 353pp.
Tveito A, Introduction to partial differential equations: a computational approach. (Texts in Applied Mathematics, 29) 415pp.
Vein R, Determinants and their applications in mathematical physics. (Applied Mathematical Sciences, 134) 490pp.
Wallace DAR, Groups, rings and fields. (Springer Undergraduate Mathematics Series) 248pp.
Wong MW, Weyl transformations. (Universitext) 185pp.

CONFERENCES

1999
New Zealand
Mathematics
Colloquium
University of Canterbury

Tuesday, 6 July (evening) – Friday, 9 July

The Department of Mathematics and Statistics invites you to participate in NZMC 99 hosted in our new facilities at the University of Canterbury in Christchurch.

The Colloquium will cover the breadth of mathematics research in New Zealand and will include two **Special Themes:**

- Thursday – Financial Mathematics
- Friday – Secondary/Tertiary Mathematics Education

Invited Speakers:

- **Craig Ansley** (Auckland) "Mathematics and Finance – Marriage or Affair"
- **Peter Fenton and Coralie Daniel** (Otago) "The role of history in the teaching of mathematics"
- **Wilf Malcolm** (Brunei) "Mathematics and the Universities – Backwards and Forwards in Space and Time"
- **Burkard Polster** (Adelaide) "Pretty Pictures of Geometries – Selling Real Estate in Finite Geometries"
- **Neil Trudinger** (Canberra) "What is happening in PDE theory now?"
- **Graham Weir** (Industrial Research Ltd., Wellington) ANZIAM Speaker "Sound Waves in Granular Media"

Accommodation:

Rooms have been reserved at Rochester and Rutherford Halls on campus and can be booked when you submit your registration. Invited speakers are encouraged to stay in the Halls to facilitate informal discussion.
Fees:

- Registration: $95 (regular), $50 (student), $35 (one day); $5 discount if payment received before May 1st.
- Accommodation: $38/night, includes continental breakfast
- Conference Dinner Thursday night: $40

Notice to students:

The New Zealand Mathematics Society (NZMS) provides some funding to help support students who wish to attend this conference, and also awards the Aitken prize (a certificate and cheque for $250) for the best contributed talk by a student. Application for this support funding and/or willingness to be considered for the Aitken prize should be made on the conference registration form.

Conference information and electronic registration and abstract submission are available from the conference web page:

http://www.math.canterbury.ac.nz/colloq.html

Please use the electronic registration and abstract submission facilities. For more information, visit the conference web page or email the conference organisers at nzmc99@math.canterbury.ac.nz, or write to: NZMC 99, Dept. of Maths and Stats, University of Canterbury, Private Bag 4800, Christchurch, New Zealand.

FINANCIAL SUPPORT FOR STUDENTS TO ATTEND THE 1999 NZ MATHEMATICS COLLOQUIUM

The 1999 NZ Mathematics Colloquium will be held at the University of Canterbury during the period 6-9 July 1999. Students who wish to apply for financial assistance to attend this Colloquium should do so on the colloquium registration form. The Colloquium organisers are empowered to distribute funds on behalf of the New Zealand Mathematical Society.

AITKEN PRIZE (NZMS STUDENT PRIZE)

The New Zealand Mathematical Society offers a prize, known as the Aitken prize, for the best contributed talk by a student at the annual NZ Mathematics Colloquium.

Named in honour of the New Zealand born mathematician Alexander Craig Aitken, this prize will be offered for the fifth time at the 1999 Colloquium to be held at the University of Canterbury during the period 6-9 July 1999.

The prize will consist of a cheque for NZ$250, accompanied by a certificate.

Entrants for the prize must be enrolled (or have been enrolled) for a degree in Mathematics at a university or other tertiary institution in New Zealand in the year of the award. During the Colloquium, they should give a talk on a topic in any branch of the mathematical sciences.

A judging panel will be appointed by the NZMS Council, and make recommendations to the NZMS President and Vice-President for the prize. Normally the prize will be awarded to one person, but in exceptional circumstances the prize may be shared, or no prize may be awarded.

Entrants should indicate their willingness to be considered for the prize on the colloquium registration form.

McNABB SYMPOSIUM: APPLIED MATHEMATICS IN DEPTH

on the occasion of Dr Alex McNabb's 70th Birthday

A 1–2 day symposium focussing on heat and mass transport (and related topics) to mark Dr McNabb's long and continuing contributions to Applied Mathematics will be held as follows:

Venue: University of Auckland (Tamaki Campus), Auckland, New Zealand.

Time: Monday 7th February and Tuesday 8th February (am) 2000 (prior to ANZIAM 2000 at Waitangi, Bay of Islands, North Auckland, New Zealand).

Contributions are invited to this symposium from all areas of Applied Mathematics. See the web page: `http://www.math.canterbury.ac.nz/McNabb.html` [Buses from this meeting are expected to be available from the Tamaki Campus to transport participants to the venue of ANZIAM 2000 (Waitangi) in time for the opening of that meeting.]

Dr Alex McNabb is one of New Zealand's most well-known Applied Mathematicians and has made major contributions to problems in heat and mass transport, iron-ore extraction, membrane diffusion, etc. His colleagues in New Zealand and overseas acknowledge his contributions.

Papers will be published in a special volume of the Journal of Applied Mathematics and Decision Sciences and will be required to be submitted in full by 30th November 1999, edited by Professors Robert McKibbin and Graeme Wake. Abstracts are due in August 1999.

Further information from the web page or **g.wake@math.canterbury.ac.nz**

June 29 - July 2 (Dunedin) **NZAMT 6 2000 Minus One, Dunedin 1999.**
e-mail: cdaniel@maths.otago.ac.nz
home-page: http://www.dce.ac.nz/nzamt6

July 5-7 (Victoria University of Wellington) **New Zealand Statistical Association 50th Anniversary Conference**
e-mail: nzsa99@mcs.vum.ac.nz
home-page: http://www.mcs.vuw.ac.nz

July 5-9 (Darwin) **24th Annual Conference on Combinatorial Mathematics and Combinatorial Computing (24ACCMC).**
The conference precedes a Joint Australian and American Mathematical Society Conference to be held in Melbourne Australia beginning July 11th 1999.
For inclusion on further mailing lists send your address to:
e-mail: ntcomb.cs.edu.au.
homepage: http://www.cs.nut.edu.au/homepages/rsvp/ACCMCC99.html

July 6-9 (Christchurch) **1999 New Zealand Mathematics Colloquium.**
e-mail: nzmc99@math.canterbury.ac.nz
home-page: http://www.math.canterbury.ac.nz/colloq.html

July 11-16 (Melbourne) **Australian Mathematical Society 43rd Annual Conference.**
home-page: http://www.maths.monash.edu.au/~ams99

August 9-13 (Kingfisher Bay Resort, Queensland) **SCICADE 99: Conference on Scientific Computing and Differential Equations.**
Contact Kevin Burrage.
e-mail: kb@maths.uq.edu.au
home-page: http://abacus/maths.uq.edu.au/~kb/scicade99

September 20-24 (ANU, Canberra) CTAC 99: **10th Biennial Computational Techniques and Applications Conference and Workshops.**
Contact David Harrar II.
e-mail: David.Harrar@anu.edu.au
home-page: http://www.maths.anu.edu.au/conferences/CTAC99/

September 23-25 (Christchurch) **First Western Pacific/Third Australia-Japan Workshop on Stochastic Models.**
Contact Professor Malcolm Faddy.
e-mail: M.Faddy@math.canterbury.ac.nz

November 21-24 (Laguna Quays, Queensland) **Delta 99 Symposium on Modern Undergraduate Mathematics: The Challenge of Diversity.**
Contact Milton Fuller.
e-mail: m.fuller@cqu.edu.au
home-page: http://www.sci.usq.edu.au/delta99/

November 29 - December 3 (Sydney) **Group Theory and Computation**
Contact Laci Kovacs.
e-mail: kovacs@maths.anu.edu.au

NOTICES

NOTICE OF ANNUAL GENERAL MEETING

The Annual General Meeting of the New Zealand Mathematical Society will be held during the 1999 NZ Mathematics Colloquium at the University of Canterbury on Wednesday 7 July 1999 after the last talk of the day. The exact time and place of the AGM are currently being arranged.

Items for the Agenda should be forwarded by Tuesday 25 May 1999 to the NZMS Secretary, Dr Stephen Joe, Department of Mathematics, The University of Waikato, Private Bag 3105, Hamilton (fax number: (7) 838 4666, email address: stephenj@math.waikato.ac.nz).

CALL FOR NOMINATIONS FOR NZMS COUNCIL POSITIONS

The terms of office of three Council members (Rick Beatson, Vivien Kirk, and Robert McLachlan) come to an end in 1999, and nominations are called for the resulting vacancies.

The term of office of a Council member is three years. Council members may not serve for more than six years in succession.

Nominations should be put forward by two proposers. The nominee and the two proposers should be current Ordinary or Honorary members of the NZMS. The nominations, including the nominee's consent, should be forwarded by Tuesday 8 June 1999 to the NZMS Secretary, Dr Stephen Joe, Department of Mathematics, The University of Waikato, Private Bag 3105, Hamilton (fax number: (7) 838 4666, email address: stephenj@math.waikato.ac.nz). If nominations are sent by email, the two proposers and the nominee should each send separate email messages to the Secretary.

2000 NZMS VISITING LECTURESHIP

The New Zealand Mathematical Society coordinates and provides some financial support for a tour of New Zealand universities by a visiting mathematician. Usually this person-known as the NZMS Visiting Lecturer-will spent two to three days at each of the six main university centres, and give at least two lectures at each place: one for a general audience, and one more closely tied to his or her own particular research interests.

Recent NZMS Visiting Lecturers have included John Loxton (Macquarie University), Andreas Dress (University of Bielefeld), Colin Maclachlan (University of Aberdeen), Roger Grimshaw (Monash University), Valerie Isham (University College London), and John Fauvel (Open University).

Nominations for the 2000 NZMS Visiting Lectureship are now being requested by the NZMS Council. Names of suitable candidates, along with a brief description of their current position and field(s) of interest, should be sent by 30 June 1999 to the NZMS Secretary, Dr Stephen Joe, Department of Mathematics, The University of Waikato, Private Bag 3105, Hamilton (fax number: (7) 838 4666, email address: stephenj@math.waikato.ac.nz).

NZ MATHEMATICS RESEARCH INSTITUTE (INC)

The NZ Mathematics Research Institute has now been registered as an incorporated society, and has also been granted tax-free and charitable status under various sections of the Income Tax Act 1994.

As indicated in earlier communications, the aims of this Institute are to promote research in mathematics in New Zealand, and to promote the dissemination within New Zealand of worldwide developments in mathematical research. Its activities are intended to complement and enhance those of the NZ Mathematical Society and NZ university mathematics departments in this respect.

Up to now its principal activity has been running a series of summer meetings on particular fields of mathematics, with a small number of world class mathematicians invited to give a number of lectures on topics currently at the forefront of research in their field.

Five summer meetings have been run so far, on knot theory, 4-manifolds and the numerical solution of ODE's (Huia, December 1994), statistical mechanics and conformal field theory (Tolaga Bay, January 1996), discrete groups and geometry (Tolaga Bay, January 1997), geometric analysis (Napier, January 1998), and harmonic analysis (Raglan,

January 1999). The next meeting will be held in Kaikoura in January 2000, on the theme of “Computability, Complexity, and Computational Algebra".

The Institute is grateful to the Marsden Fund and the University of Auckland for financial assistance in running these meetings, especially for the support of graduate students and the accommodation costs of participants.

Donations are welcome(!), as are suggestions for themes for future meetings. Suggestions may be made to any of the NZMRI Directors: Vaughan Jones (Berkeley), David Gauld (Auckland), Marston Conder (Auckland), Rod Downey (VU Wellington) and Gaven Martin (Auckland). Donations of $5 or more qualify for a tax rebate under the terms of the Income Tax Act 1994.

1999 Raglan Summer Research Workshop

The annual summer workshop organised by the New Zealand Mathematics Research Institute was held this year at Raglan, from January 3 to 9. Initially oriented to Harmonic Analysis on Riemann surfaces, the main topic was gradually transformed and finally it covered many wider parts of mathematics. The total number of participants was about 60, including approximately 25 students among them: 10 from Auckland, 5 from Christchurch, 6 from Hamilton and others from abroad.

The main lectures were given by:

- Carleson (Sweden) on graphs, manifolds and circle packing
- K. Uhlenbeck (USA) on classical mechanics, solitons and integrability
- V. Jones (NZ and USA) on statistical mechanics
- S. Trei (USA) on Harmonic analysis, exponential bases and Bellman function
- B. Williams (USA) on dynamical systems
- H. Short (France) on braid-groups and a topological application
- V. Vinnikov (Israel) on applications of Harmonic Analysis on Riemann surfaces to systems of commuting operators
- S. Avdonin (Australia) on applications of Harmonic Analysis to Control Theory
- V. Gershkovich (Australia) on noncommutative geometry and application of it to robotic systems
- S. Naboko (Russia) on analytic operator - functions with positive imaginary part
- L. Bos (Canada) on wavelets
- S. Fedorov and B. Pavlov (Auckland) on applications of Harmonic Analysis on classical and multiply-connected domains to the spectral theory of differential and difference operators

Almost all lectures were designed for advanced graduate and postgraduate students, and were very well attended by students. Probably this was the result of careful preparation for the workshop: Professors Gaven Martin and Boris Pavlov gave about 25 hours of preparatory lectures in total for students of universities in Auckland, Christchurch, Wellington and Hamilton. These lectures were reasonably well-attended, and most of the attendees came to Raglan.

Each lecture at Raglan was designed to bring students to the latest achievements in the corresponding domain of mathematics, and so the total sum of lectures has given a good review of essential parts of modern analysis.

The students obviously appreciate these efforts - in particular they suggested that the organising committee collect and distribute files or hard-copies of lectures, and it is intended to meet this request.

Generally the workshop at Raglan was a success. The weather was beautiful - probably organised by the Director of the School. It was particularly pleasing that there were so many well-prepared young women who challenged students from other cities and countries. It was pleasing to observe the students talking during breaks with L. Carleson, Karen Uhlenbeck, Vaughan Jones and other distinguished lecturers. Vaughan Jones and David Gauld organised exciting sport activities - surfing and hiking - and both provided reasonably good weather for it. One student (Sikimeti) got briefly lost in the mountains, which added to her popularity. At the end, in a marvellous place overlooking Raglan Harbour, the traditional fabulous barbecue organised by Vaughan Jones gave a last perfect touch to the whole event.

1999 Call for Proposals on Mathematics Education in Universities International Congress on Mathematics Education (ICME-9)

The ninth International Congress on Mathematics Education (ICME-9) will be held in Tokyo-Makuhari, Japan, July

31-August 6, 2000. Web site: http://www.ma.kagu.sut.ac.jp/ icme-9/index.html

By this announcement we invite inquiries and proposals for contributions to the Working Group for Action 5 (WGA5) of ICME-9 on “Mathematics Education in Universities.” This working group will have three or four two-hour sessions during the Congress for the purpose of working and thinking together about broad and systemic issues in university mathematics education.

WGA5 is intended to be a forum for exchanging ideas and promoting further communication about university mathematics education among individuals from different nations of the world in order to identify existing issues and search for resolutions. Thus most of the time of the Working Group will be devoted to discussion, not to lectures or presentation of papers.

To facilitate planning, we invite suggestions and proposals from potential participants. In particular, we seek proposals for national reports that survey, for a particular country, important issues facing university mathematics education such as changes in students, teaching, or curriculum; impact of textbooks, tests, technology; and government policy, hiring, and funding. We also welcome other proposals for brief presentations that may be appropriate for discussion in the Working Group.

(Note: Many special topics such as teacher preparation, two-year colleges, and technology are the subject of other Working Groups. Also, since English is the official language of the Congress, all presentations and discussion in WGA5 will be in English.)

Please send inquiries and proposals by e-mail to both of the co-organizers of WGA5 named below.

Lynn Arthur Steen steen@stolaf.edu Department of Mathematics, St Olaf College, Northfield, MN 55057, USA.

Qi-xiao Ye yeqx@sun.ihep.ac.cn Department of Applied Mathematics, Beijing Institute of Technology, P O Box 327, Beijing 100081, China.

Derek Holton

MATHEMATICAL MINIATURE 8

The Quadratic Residue Theorem

This MINIATURE will overlap slightly with MINIATURE number 7 but, to make it as self-contained as possible, no reference will be made to the individual results which were stated there and mainly left as exercises. Let p and q be odd primes. Then the “Quadratic residue theorem" states that if either or both of these primes is congruent to 1 (mod 4), then q is a quadratic residue of p iff p is a quadratic residue of q. On the other hand, if each of p and q is congruent to 3 (mod 4) then one and one only of p and q is a quadratic residue of the other. This is often stated using the “Legendre symbol" $(\frac{x}{p})$ which has the value 1 if x is congruent to a perfect square (mod p) (that is, if x is a “quadratic residue" of p), and to -1 if no such perfect square exists (that is, x is a “non-residue"). Using this notation we have

$$\left(\frac{q}{p}\right)\left(\frac{p}{q}\right) = (-1)^{\frac{p-1}{2}\frac{q-1}{2}},$$

where we note that the exponent of -1 is even iff at least one of p and q is congruent to 1 (mod 4).

This result once existed only as an experimentally supported conjecture until Gauss stepped in and produced a number of different proofs. The proof that will be presented here will make use of a result known as “Gauss’s Lemma" which states that, if x is not a multiple of p,

$$\left(\frac{x}{p}\right) = (-1)^{\mu},$$

where μ is the number of members of the set $\{x, 2x, 3x, \ldots, (\frac{p-1}{2})x\}$ which are congruent (mod p) to members of the set $\{\frac{p+1}{2}, \ldots, p-2, p-1\}$ (rather than to members of the set $P = \{1, 2, \ldots, \frac{p-1}{2}\}$). Stepping back a little further, we can use as a criterion for x being a quadratic residue of p, the fact that $\left(\frac{x}{p}\right) = x^{\frac{p-1}{2}} \pmod{p}$. This result, known as “Euler’s criterion", follows by considering the polynomial equation $t^{p-1} - 1 = 0 \pmod{p}$ and its factorisation $(t^{\frac{p-1}{2}} - 1)(t^{\frac{p-1}{2}} + 1) = 0 \pmod{p}$. All the remainders (mod p), that is the members of the set $S = \{1, 2, \ldots, p-1\}$, satisfy the unfactorised equation (by the Fermat theorem) and hence exactly half of them satisfy each of (i) $t^{\frac{p-1}{2}} - 1 = 0 \pmod{p}$ and (ii) $t^{\frac{p-1}{2}} + 1 = 0 \pmod{p}$. Because exactly half of the members of

S are quadratic residues and because these necessarily satisfy (i), the preliminary lemma follows.

Let r be any positive integer relatively prime to p and let x be a member of the set P. We will look at what happens when rx is divided by p to give a quotient m and a remainder r. The quotient is given by $m = \left[\frac{rx}{p}\right]$, where the brackets $[.]$ denote "integer part of" and the remainder is either $x' \in P$ or $p - x'$ where $x' \in P$. It is easy to verify that the set of x' values for all members $x \in P$ is exactly P. From the identity $rx = pm + r$, we have

$$rx = \begin{cases} p\left[\frac{rx}{p}\right] + x', & \text{for } p-\mu \text{ values of } x, \\ p\left[\frac{rx}{p}\right] + p - x', & \text{for } \mu \text{ values of } x. \end{cases} \tag{1}$$

Gauss's lemma follows by interpreting (1) modulo p and forming the product for all $x \in P$. It follows that

$$r^{\frac{p-1}{2}} \prod_{x \in P} x = (-1)^{\mu} \prod_{x \in P} x \pmod{p},$$

and because the product is not zero (mod p), the result follows.

As a step towards proving the quadratic reciprocity theorem, replace r by the odd prime q in (1) and now interpret the formula (mod 2). This time we *sum* over all $x \in P$ and we find

$$\sum_{x \in P} x = \sum_{x \in P} \left[\frac{qx}{p}\right] - \mu + \sum_{x \in P} x \pmod{2},$$

where we have exchanged addition and subtraction where it has suited us because we are working modulo 2. It follows that μ is congruent (mod 2) to the number of lattice points in the set $(0, \frac{p}{2}) \times (0, \frac{q}{2})$ in the plane lying *beneath* the line $py - qx$. Reverse the roles of p and q and let ν denote the number of members y of $Q - \{1, 2, \ldots, \frac{q-1}{2}\}$ such that yq is congruent (mod p) to a member of the set $\{\frac{q+1}{2}, \ldots, q-2, q-1\}$; thus $\left(\frac{p}{q}\right) = (-1)^{\nu}$. With the roles of p and q interchanged we see that ν is congruent (mod 2) to the number of lattice points in $(0, \frac{p}{2}) \times (0, \frac{q}{2})$ *above* $py - qx$. Because p and q are primes, no lattice point actually lies on the line and hence $\mu + \nu$ differs by an integer multiple of 2 from the total number of lattice points. However, the total number of lattice points in this rectangle is simply $\frac{p-1}{2}\,\frac{q-1}{2}$.

We now fill in the details as follows:

$$\begin{aligned} \left(\frac{q}{p}\right)\left(\frac{p}{q}\right) &= (-1)^{\mu}(-1)^{\nu} \\ &= (-1)^{\mu+\nu} \\ &= (-1)^{\frac{p-1}{2}\,\frac{q-1}{2}} \end{aligned}$$

John Butcher, butcher@math.auckland.ac.nz