THE NEW ZEALAND MATHEMATICAL SOCIETY (INC.)

NEWSLETTER

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Contents

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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`stephenj@math.waikato.ac.nz`)
The newsletter is available at: `http://IFS.massey.ac.nz/mathnews/NZMSnews.html`
Editorial enquiries and items for submission to this journal should be submitted as text or LaTeX files to
`r.mclachlan@massey.ac.nz`.

EDITORIAL

This is the final editorial in a series of eighteen, since I took over as editor in 1994. I have appreciated the opportunity to make comments in this way in each issue. It has provoked a small but positive response from readers. However my imminent antipodean translocation has persuaded me that it is time to end this task, and I am delighted that Robert McLachlan has so eagerly agreed to continue the editorship. I am sure that it is healthy for the editorship to rotate among the members of the society from time to time.

The editor's task has not been demanding. The regular contribution of the Society's Secretary, the Sub-editors and Honorary Correspondents has made this almost a sinecure. I have not attempted to impose major changes on the newsletter. I found the previous editorial policy a sensible and convenient precedent to follow. The editorials and the yearly listing of our graduating research students have been added to the regular departments, as has the president's column that Graeme Wake initiated last issue. The unexpected death in 1996 of Matt Varnish (aka Derrick Breach) brought to an end the unique series of back page cryptic crosswords. This was irreplaceable. I am extremely grateful to John Butcher who has packed so many amazing mathematical treasures into the series of one page mathematical miniatures that have taken its place.

Another of the editor's pleasures is in organising the regular centrefold, honouring the contributions of mathematicians among us. This issue commemorates Graham Weir, who leads the Applied Mathematics Group in IRL, the remnant of the Applied Mathematics Division of the DSIR. It has been a significant year for Graham, as you will read. I failed to record among the anniversaries last issue, that this year is also the 50th anniversary of the founding of the AMD.

Also in this issue I have the pleasure of presenting the text of Wilf Malcolm's plenary address to the 1999 colloquium at the University of Canterbury. This insightful recollection deserves re-presentation and preservation here.

Hence once again thankyou to all of the contributors who make this newsletter live. Thankyou also to the readership for your interest, and lastly thankyou to Robert McLachlan for taking over the editorship. I look forward to a continuing lively and informative newsletter in coming years.

Mike Hendy

PRESIDENT'S COLUMN

2 December 1999

Millennium madness is upon us. The debate on when the 3rd millennium starts and the 2nd ends is a bit pointless from most points of view - noting especially the similar comments made by our Editor a little while ago. What if we had chosen a number system of base 12 as many advocate? This would mean next year we would only be 272 years into the second "millennium" with 1,456 years to go until 2000 A.D. (base twelve). Number patterns do, however, serve to increase numeracy, so perhaps we can be glad of that. I used to sometimes mischievously list our former street address number as the "smallest cube that can be written as the sum of squares in two different ways". It could have restricted the number of visitors!! Now we live at the street address with the lowest perfect number!!.

We have appointed our NZMS Lecturer for 2000, Professor John Guckenheimer (see elsewhere), and are expecting the Forder Lecturer 2001 (Dr Tom Korner of Cambridge), hopefully due here in the first half of that year. Council approved the appointment of a NZMS Research Awards Committee to recommend to the President, the recipient(s) in 2000. These will be announced at the 2000 NZ Mathematics Colloquium in Hamilton, scheduled to be in November of that year.

The Council meeting in November (by e-mail) concurred with my suggestion that our first President, Professor David Vere-Jones, be elected as a Honorary Life Member on his retirement from a Professorship in Mathematics at Victoria University of Wellington in January 2000. We wish him well in his ongoing work in Statistical Research Associates. Bouquets are rare these days, so we are glad of this very big one. Well done David.

I hope the New Year sees the continuation of the activities of the RSNZ Electoral College in Mathematical and Information Sciences. We need to collectively seek ways to further the role of mathematics in New Zealand. Council approved the appointment of myself and one other (to be announced) as NZMS representatives for 2000. The profile of Mathematics needs an increase and it is "up to us".

Early next year we have two important mathematics events in New Zealand: the NZ Mathematics Research Institute workshop on "Computability, Complexity and Computational Algebra" in Kaikoura kicks off the year in January, closely followed by the ANZIAM 2000 meeting in Waitangi in early February. The latter event has a subsidiary meeting, the "McNabb Symposium" in Auckland, which marks the 70th birthday of our senior mathematics FRSNZ in New Zealand, Dr Alex McNabb.

I was pleased to see the recognition of the role of mathematics in the renaming of the National Standards Body in Science and Technology (of NZQA) to Science, Mathematics and Technology. Under a Labour-led coalition these could well be more significant.

This issue of the Newsletter marks the end of the term of our current Editor, Professor Mike Hendy of Massey University. We warmly thank Mike for his very good efforts in producing 18 issues under very tight deadlines. The Newsletter represents our most significant regular service to our members. Our new editor, Dr Robert McLachlan, also of Massey, is to succeed him.

I, and the other Council members, wish you and your families a happy Christmas and holiday season.

Graeme Wake
President

LOCAL NEWS

AGRESEARCH

Barbara Dow has "rejoined" the AgResearch team at Ruakura, moving from HortResearch where she has been since the Crown Research Institutes were formed. She will be based at the Dairying Research Corporation. Martin Upsdell and Harold Henderson participated in Biometrics 99 at Hobart in December.

The Grasslands (Palmerston North) campus was visited by Prof. Przemyslaw Prusinkiewicz from the Department of Computer Science at the University of Calgary. He demonstrated software developed by himself and his students which showed the growth of plants using some basic recursive rules (Lindenmayer systems). Particularly impressive was the graphics capability of the software (several of his students have ended up working for the computer graphics sections of U.S. film studios!)

Mick Roberts

UNIVERSITY OF AUCKLAND

School of Mathematical and Information Sciences

The SMIS was formed in 1995, to link the Departments of Mathematics, of Statistics and of Computer Science. The SMIS is to be dissolved on 1999 December 31.

No announcement has yet been made, about any new organizational structure to succeed it.

Computer Science

The eminent computer scientist Professor Sergey Goncharov, Dean of the Department of Mechanics and Mathematics of Novosibirsk University, visited the Computer Science Department and the Centre for Discrete Mathematics and Theoretical Computer Science from December 2nd to 10th.

Seminars

A series of seminars on Turing machines, computability and complexity has been given by Bakhadyr Khoussainov and Michael Dinneen, to prepare people for the Mathematics Workshop, to be held at Kaikoura on January 7th to 15th.

Colin Beardon (University of Plymouth), "The Visual Assistant: designing software for creative users".

Dr Ian Watson (University of Salford), "A distributed case-based reasoning application for engineering sales support".

Mathematics

Associate-Professor M. K. Vamanamurthy was honoured on his retirement by a symposium on November 19. His colleagues Glen Anderson (Michigan State University) and Matti Vuorinen (University of Helsinki) attended, with support from our Department. The following lectures were presented at the Vamanaposium:

Marston Conder, "Introduction";
Gaven Martin, "Conformal geometry";
John Butcher, "Some Diophantine equations related to the Hardy-Ramanujan tax";
Glen Anderson, "A quasi-story of Three Guys";
Bruce Calvert, "Local and global extrema for polynomials in several variables";
Ivan Reilly, "Vamanamurthy's topological work";
Matti Vuorinen, "Conformal invariants and quasiconformmal mappings";
Tadeusz Iwaniec, "The failure of lower semi-continuity for linear distortion";
David Gauld, "Meticulous Keen Versatile, a mathematical tribute to MKV";
M. K. Vamanamurthy, "Quasiconformal distortion".

Vaman was presented with a coffee-table made of teak, and the celebrants then attended dinner at Langford's Restaurant on Mount Eden, where Vaman was given some books to place on that table.

Congratulations to Ye Yoon Hong and Mike Thomas for receiving the Best Paper Award at the 7th International Conference on Computers in Education, (held at Chiba, Japan, in November 1999), for their paper "Super-Calculators and Mathematics Examinations".

Norm Levenberg attended the Midwest Several Complex Variables Conference at the Fields Institute in Toronto, and the Wallenberg Symposium in Several Complex Variables in honour of Prof. Christer Kiselman's 60th birthday.

Recent visitors include Dr Bettina Eick (University of Kassel), Prof. Avinoam Mann (Hebrew University of Jerusalem), Dr Scott Murray (University of Chicago), Prof. Steven Pride (University of Glasgow), Dr Axel Schneider (University of Oxford), Prof. Vladimir Peller (Kansas State University), Prof. Tadeusz Iwaniec (Syracuse University), Prof. Glen Anderson (Michigan State University) and Dr Matti Vuorinen (University of Helsinki).

Our first four Doctors of Philosophy in Topology graduated in September: Jiling Cao from China, Sina Greenwood from NZ (with Samoan ancestry), Abdul Mohamad from Iraq and Tsukasa Yashiro from Japan.

Congratulations to John Duncan, who has been awarded a Fulbright Scholarship for study in the USA.

The 1999 Auckland Numerical Ordinary Differential Equations Workshop (ANODE99) was held here on August 16-20. The workshop, organized by John Butcher, Robert Chan, Nicolette Goodwin and Allison Heard, was one of a series of international workshops in numerical analysis held in Auckland over the last several years. The workshop was attended by 63 academic participants from over 16 countries. In addition to the many interesting museums and experiences offered in the city of Auckland, there were opportunities to visit the rain forest and see a beautiful waterfall, and to stroll along a magnificent unspoiled black sandbeach. The meeting included three morning sessions consisting of lectures on specific themes, allowing a more in-depth presentation than is usually possible. The themes were: Dynamics of General Linear Methods (Ernst Hairer and Pierre Leone), The Joint Spectral Radius of Families of Matrices, with Applications to Stability Theory (Marino Zennaro and Nicola Guglielmi) and Sensitivity Analysis and Optimal Control for Large-Scale Dynamical Systems (Linda Petzold and Radu Serban). The remaining talks were organized into a minisymposium and covered a wide range of topics in numerical ordinary differential equations, including stochastic differential equations, delay equations, software, waveform relaxation techniques, and differential-algebraic equations. There was much opportunity for discussion, including an interesting panel session on the last day.

A Group Theory Workshop was held on November 22-23, with visitors supported by the Marsden Fund and our Department of Mathematics. The following lectures were presented:

Dr Bettina Eick	(Kassel), "Algorithms for infinite polycyclic groups".
Prof. Avinoam Mann	(Jerusalem), "On the number of groups having a certain number of generators or relations".
Dr Scott Murray	(Chicago), "Using subgroup chains in algorithms".
Dr Axel Schneider	(Oxford), "Classifying *p*-groups by hyperclass".
Peter Dobcsanyi,	"A parallel implementation of the Low-Index Subgroups algorithm".
Prof. Steve Pride	(Glasgow), "The geometry of group extensions".

Joel Schiff and his wife Christine operate their backyard observatory in Takapuna. On September 27 their computer detected an unknown asteroid, which has now been officially named as "1999 S09", by the Harvard Smithsonian Center for Astrophysics.

Seminars

Dr Sina Greenwood and Prof. David Gauld,	"Highlights of the Summer Topology Conference in New York".
Prof. Jim Verner	(Queen's University at Kingston, Ontario), "Some ramifications of the derivation of explicit Runge–Kutta pairs".
Dr John McKenzie,	"Involutions on integral group rings".
Dr Paul Turner	(Heriot-Watt University in Edinburgh), "Loopy geometry and topology".
Dr Mohan Chinnappan and Dr Bruce Calvert,	"Knowledge and processes underlying proofs and analysis".
Prof. Jialin Hong	(Chinese Academy of Sciences), "Some schemes preserving the weak invariance for nonautonomous linear Hamiltonian systems, and an application".
Dr Majid Ali,	"GCD and LCM of multiplication ideals".
Dr Maxine Pfannkuch,	"Perceptions and practice of assessment in mathematics education: An initial analysis of Year 3 and 6 teachers".

Prof. Vladimir Peller	(Kansas State University), “Approximation by analytic matrix functions”.
Prof. C. J. Goh,	“No plane please, support with a cone”.
Douglas K. Russell,	“The symmetry groups of non-rigid molecules: a Lie algebraic and group contraction approach”.
Dr Tsukasa Yashiro,	“Constructing immersions from three-manifolds to four-dimensional space”.
Prof. Slawomir Kolodziej	(Jagellonian University , Krakow), “The Monge-Ampere equation”.
Prof. Thomas Branson	(University of Iowa), “Kato inequalities”.
Dr Abdul Mohamad and Prof. Ivan Reilly,	“Report on the Topology Meeting in Yokohama”.
Prof. E. B. Saff	(University of South Florida), “Distributing many points on a sphere”.
Dr Derek Holt	(University of Warwick), “Dehn algorithms, combings, and formal language theory”.
Alona Ben-Tal,	“Symmetry breaking and symmetry restoration in nonlinear forced oscillators”.
Brian Van Dam,	“Highlights of the Belfast Conference”.
Dr Rod Gover,	“From Riemannian to conformal geometry”.
Prof. David Gauld,	“Weak conditions implying metrisability of a manifold”.
Prof. Dame Anne Salmond	(Pro Vice-Chancellor for Equal Opportunities), “Two Worlds at The University of Auckland” (1999 Aldis Lecture).
Sasha Rubin,	“Algebraic structures and finite automata”.
Prof. Tadeusz Iwaniec	(Syracuse University), “Quasiharmonic Fields” (3 lectures).
Dr Abdul Mohamad,	“Diagonal conditions which imply metrizability in topological spaces, with application to manifolds”.
Prof. Marco Abate	(Univ. of Rome II), “Dynamics of holomorphic maps tangent to the identity”.
Dr Jozef Siran	(Slovak Technical Institute, Bratislava), “Triangle group representations and regular maps”.
Prof. Alastair Scott	(Department of Statistics), “Analysing data from case-control studies”.
Dr Myung Ho Kim	(Rutgers University), “A geometric model for information retrieval systems, and a set of relevant documents”.
Dr Bettina Eick	(University of Kassel), “Computing automorphism groups of p-groups”.
Prof. Stephen Simons	(UCSB), “Hahn-Banach and minimax theorems”.
Dr Paul Hafner,	“Musings on representations”.
Dr Tsukasa Yashiro,	“Liftabilities of low dimensional immersions”.

Dr Andy Begg	(University of Waikato), “Enactivism: an emerging theory”.
Prof. Dan Archdeacon	(University of Vermont), “Variations on a theme of Kuratowski”.
Kerry Richardson,	‘Scheduled relativisation of instructions”.
Dr Avinoam Mann	(Hebrew University of Jerusalem), “Growth conditions for residually finite groups”.
Dr Andrew Pullan	(Department of Engineering Science), “Electrical imaging of the heart”.
Dr Joel Hillel	(Concordia University), “Current research involving introductory linear algebra and dynamic geometry software”.
Dr Georgy Gimel’farb	(Computer Science Department), “Gibbs random fields in image modelling”.

Statistics

Members of SMIS will be delighted to hear of the award of the Hector Medal to Professor George Seber. The Hector Medal is the premier scientific award in New Zealand, which is awarded each year by the Royal Society of New Zealand. George’s award recognises his enormous contribution to Statistics through his research, writing and teaching career spanning 40 years. We offer George our warmest congratulations on this great honour. The medal is awarded to a mathematical or informational scientist every third year.The last award was to Professor John Butcher, in 1995.

Dr Paul Murrell and Dr Marti Anderson have been appointed as Lecturers.

Dr Brian Eastwood and Dr Vera Eastwood, who had been on unpaid leave, have resigned from the Department.

Professor Don McLeish and his wife Professor Cyntha Struthers are visiting from the University of Waterloo, for about 9 months. He will teach a masters course on Monte Carlo/Finance in the 1st Semester of 2000.

The Clinical Trials Research Unit and the Department of Statistics held a Biostatistics Workshop on Applied Survival Methodology, on December 1-3. The workshop speakers were Prof. John D. Kalbfleisch (University of Waterloo), Prof. Gilbert Mackenzie (University of Keele), Dr Robert Gentleman and Dr Alain Vandal.

Seminars

Dr. Marti Anderson	(University of Sydney), “A new method for non-parametric multivariate analysis of variance”.
Prof. Andrew Barbour	(University at Zürich), “Thresholds for some epidemic models”.
Prof. Richard E. Barlow	(University of California - Berkeley. ORSNZ Invited Lecturer for 1999), “Accelerated life testing at the Lawrence Livermore Laboratory”.
Paul Winton	(Manufacturing Systems Group, University of Auckland), “Position location for the factory of the future: Bayesian performance predictions”.
Dr. Helge Blaker	(Mathematical and Information Sciences, CSIRO), “Some ways of extending Stein’s estimator to regression”.
Dr Samuel Manda	(Green Lane Hospital), “A Bayesian analysis of multivariate survival data from a multi-stage sampling design”.
Dr. Mark van der Laan	(University of California - Berkeley), “Estimation in censored data models”.
Dr Gilbert MacKenzie	(Keele University), “A non-proportional hazards model for multi-state stochastic processes”.
Prof. Keith Worsley	(McGill University), “Detecting shape changes via non-isotropic random fields”.

Garry J. Tee

UNIVERSITY OF CANTERBURY

Department of Mathematics

Firstly, the department would like to heartily congratulate our current Head of Department, Professor Douglas Bridges, who has been awarded the degree of D.Sc. from Oxford University for contributions to constructive analysis. Professor Bridges recently gave two invited lectures at the minisymposium on "Constructivity, Complexity, and Fuzziness," held at the University of Dunarea de Jos, Galati, Roumania. Professor Bridges then travelled onwards to Vienna, to conduct research with Dr. Peter Schuster and Dr. Hajime Ishihara.

Dr Graham Weir, currently employed at Inudstrial Research Limited, has been awarded the degree of D.Sc. by the University of Canterbury for contributions in applied mathematical modelling.

Professor Graeme Wake has been awarded the Marsden Medal for contributions in mathematics and its use in New Zealand Science. This is the first time the Marsden Medal has been awarded to a mathematician in its 24 year history.

The 25th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing is being held at the University of Canterbury from Dec. 4th to Dec. 8th, 2000. The organizers of this conference are Dr. Mike Steel and Dr. Charles Semple. More information may be found by accessing the following website:

`http://www.math.canterbury.ac.nz/accmcc.shtml`

The department was priveleged to receive visits from a number of eminent mathematicians and statisticians, amongst them Professor Richard E. Barlow. Professor Barlow is the Invited Lecturer for the Operational Research Society of New Zealand for 1999. A list of these visitors, together with the title of any seminars they presented is given below.

Seminars

Prof. Jef Thas	(Erskine visitor), "Finite geometries, varieties, and codes".
Dr. Granville Tunnicliffe Wilson	(Lancaster University), "A class of modified high order autoregressive models with improved resolution of low frequency cycles".
Prof. E. B. Saff	(Erskine visitor — University of South Florida, Tampa), "An overview of potential theory and its applications", "Distributing many points on a sphere" and "Orthogonal polynomials from a complex perspective".
Prof. Mark Rizzaldi	(Humboldt State University — California, and University of Auckland), "Statistical analysis of ordinal-valued observations: a problem from phenology."
Prof. Bob Chapman	(University of Guelph, Ontario, Canada), "Symmetry in object recognition".
Dr. Philip W. Sharp	(University of Auckland), "Low order numerical schemes for classes of functional equations."
Prof. Richard E. Barlow	(University of California), "An historical perspective on research in reliability".
Prof. Tadao Takaoka	(Computer Science Department), "Efficient algorithms for combinatorial generation."
Prof. Benny Chor	(Department of Computer Science, Technion, Israel), "A Geometric approach to betweenness."
Dr. Bill Barton	(University of Auckland), "An archaeology of mathematical concepts: sifting languages for mathematical meanings."

Chris Price

INDUSTRIAL RESEARCH LIMITED

Applied Mathematics

The funding of the Crown Research Institutes is being restructured. This restructuring includes an increase in support of applied research (the **N**ew **E**conomy **R**esearch **F**und) and a refocussing of the goals of fundamental research (**S**trategic **P**ortfolio **O**utcomes). We are optimistic that this restructuring will be an opportunity to develop new interests without weakening our traditional strengths.

Graham Weir, John Burnell and Shaun Hendy were successful with their Marsden bid, *Granular Plasticity*, in the 1999 funding round. Graham has just returned from a trip to the US and Europe. He presented papers on granular flow and mixing at the Annual AIChE Conference and at a meeting at the University of North Carolina in the US. He also represented New Zealand by presenting results at the IEA meeting in Pisa on deep geothermal energy. Graham also became an IRL Distinguished Scientist earlier this year.

Stephen White spent a week on the island Lihir in October (a tropical "paradise" a mere 3° south of the equator) investigating the geothermal system beneath a large open pit gold mine on the island. Earlier this year, Steve visited Japan to present results on the modelling of rock alteration at Kakkonda. Warwick Kissling has attended the Stanford and the Auckland Geothermal Workshops this year. Shaun Hendy visited the IWR at the University of Heidelberg in September and participated in the EMS Summer School on *the numerical simulation of flows*.

There are several new faces around Applied Maths at the moment. Katie Espie has recently joined us as a vacation student. Katie will be supervised by Kit Whithers. Brent Walker will also be with us over the summer, and possibly well into next year, before he starts his PhD studies in the UK. Brent will be working with Shaun Hendy and Jeff Tallon (IRL Material Physics).

Finally, harking back to earlier this year in February, Applied Maths hosted the very successful *Second Annual Wellington-Manawatu Regional One-Day Conference on Applied and Computational Mathematics*. This was an opportunity for all in attendance to celebrate John Harper's distinguished research career.

Shaun Hendy

MASSEY UNIVERSITY

Mathematics, Institute of Fundamental Sciences

We are pleased to welcome Matt Perlmutter to the institute as a postdoc. Matt has just completed a PhD in geometric mechanics with Jerry Marsden at Berkeley (finishing at Caltech), and he joins Robert McLachlan's Marsden-funded project on geometric numerical DEs.

Ruahine '00: Barbara Holland and Mike Hendy are organising the annual research group meeting of mathematical and biological students and researchers in mathematical phylogeny at the Ruahine Lodge in Dannevirke from February 21-25, see the details on our web-page

`http://www.massey.ac.nz/%7Ewwifs/`

`ruahine2000.htm`

This meeting will probably have about 30–40 researchers, the majority from NZ, together with perhaps 10 visitors from other countries. (So far we have registrants from NZ, Australia, France, Sweden, US and Israel.) We design this meeting to encourage our PhD students to participate, so the accommodation is not luxurious (i.e. we can afford to pay for them from our research grants) and the programme is informal and fun. It is an opportunity for the Mathematicians to share cultures with the Biologists (in more ways than one!)

An Evening for Mathematics Teachers and University Staff

The mathematics and statistics groups got together to host an evening on 20 October for mathematics teachers entitled Mathematics for a new Millennium. It was planned in conjunction with a group of teachers and the idea was to share information and learn from one another. The programme ran from 4-8pm with a break for snacks and conversation. The first part consisted of four brief presentations of different areas of mathematics/statistics.

Fifteen Minutes of Fantasy – Ideas Opportunities and Challenges, Professor Graham Wood, Professor of Statistics.

Decisions, Decisions! What is Operations Research? Dr John Giffin.

What Goes Up Must Come Down – Modelling with Mathematics, Professor Robert McKibbin, Professor of Applied Mathematics.

The Data Mining Revolution – Responding to new Opportunities with Technology, Dr Siva Ganesh.

This was followed by discussion in small groups. After tea Geoff Gibbs, a project facilitator from the Ministry of Education, brought us up to date with the likely shape of Achievement 2001—a bewildering experience for some university staff, but the teachers had plenty of questions and comments arising from their recent consultations on the issues. We were delighted that teachers came from as far afield as New Plymouth, Hawkes Bay and Hutt Valley. They were enthusiastic and appreciative of the opportunity to meet in this way and provided a number of suggestions for another maths evening next year.

Tammy Smith, Patrick Rynhart and Robert McKibbin attended the 21st NZ Geothermal Workshop held at the University of Auckland during November. Tammy and Patrick presented papers describing their research work on hydrothermal eruptions.

Amongst the Institute's new initiatives for 1999 was the "Millennium Honours List". Thirty stage 1–3 undergraduates majoring in physics, chemistry, and mathematics, were selected, and received—apart from the honour, naturally—a study room and a promise of help finding summer jobs in the institute and nearby CRIs. In mathematics we are pleased to have Adrian Kitson working on numerical PDEs and Michael Langton and Rochelle West working on mathematical phylogeny.

Robert McLachlan, Matt Perlmutter, Mike Meylan (Albany), and Rua Murray (Waikato) recently got together for a *kleines Oberwolfach* held in the town of Coromandel. For three days we talked mathematics (and politics and real estate) late into the night, interspersed with field trips to local cafés and beaches. We all agreed it should be held again, say twice a month.

Congratulations to Katherina Huber, who is following in the footsteps of Sonya Kovalevskaya by taking a job in Sweden. Kathi has been with us for two years as a postdoc working with Mike Hendy and David Penny, and has now won a Lectureship in Discrete Mathematics at the new Mid Sweden University in Sundsvall. This is a new, small university "strategically located in the heart of Scandinavia, with Stockholm less than 400 kilometers to the south" (according to the region's web page). Attractions include the northern lights and having to learn Swedish within the year. We will all miss Kathi's contributions to the institute, but with the phylogeny group's links to Germany, she is certain to remain an important part of the group.

Seminars

Nicolas Robidoux,	"Discretizing compositions of spatial differential operators".
John Hudson,	"Braids, word problems, and automata".
Prof. Robert McKibbin,	"Pollen—where does it go, where is it from?"
Rua Murray	(University of Waikato), "Stochastic stability and the computation of invariant measures".
Barbara Holland,	"Outgroups and the accuracy of phylogenetic trees".
Kee Teo,	"Chromatic classes of bipartite graphs".
Robert McLachlan,	"What kinds of dynamics are there? Geometric integration and the Cartan diffeomorphism groups".
Matt Perlmutter,	"Symplectic reduction: an overview and some new results".
Catherine McCartin	(Victoria University of Wellington), "Parametric complexity of improvement strategies".
Prof. Robert McKibbin,	"Up, down and a chase".

Robert McLachlan

UNIVERSITY OF WAIKATO

Department of Mathematics

There is not really much to report in this last Waikato column of the millennium (please, no arguments about when the next millennium really starts). A farewell morning tea was recently held for Ali Jaballah. He has been working half-time in the department for the last two years and has just taken up a new position in Qatar. He still intends to visit Hamilton a few times a year so he will not be entirely absent from us.

Kevin Broughan is still on study leave in the US. We expect him to be back in New Zealand towards the end of December. In his absence, Alfred Sneyd has been Acting Chairperson.

Stephen Joe attended the Workshop on the Complexity of Multivariate Problems which was held in Hong Kong in October. Ernie Kalnins is another overseas traveller. He is spending three weeks at the University of Minnesota working with Willard Miller Jr.

As regards the item in the previous column on the proposal to install a cellphone transmitter on the roof of our building, everything seems to be in limbo. It is not clear whether the proposal is going ahead or not.

Seminars

P. Judge	(National Center for Atmospheric Research, Boulder), "Non-uniqueness of atmospheric modelling".
L. Mestel	(University of Sussex), "The early days of stellar structure theory".
N. Fung,	"The irrationalities of π and $e^{\frac{1}{2}}$.
I. Hay,	"Techniques of portfolio analysis".
S. Somasundaram,	"Analytic reconnection solutions".
R. Matuku,	"The mathematics of option pricing".
R. Gover	(University of Auckland), "Conformal differential geometry and tractor calculus".

Stephen Joe

Department of Statistics

December 1999 saw a large contingent of Waikato statisticians heading across the ditch to attend Biometrics99 in Hobart. Nye John, David Whitaker, Bill Bolstad, Lyn Hunt, Judi McWhirter and James Curran, together with honorary lecturer Harold Henderson (of AgResearch) all attended.

Nye John is due to return from sabbatical in the new year. In the latter part of his leave, he has been involved in the current review of the business office of the International Biometrics Society. He also attended a Statistics Networking Forum held at Woollongong, Australia, in October. David Whitaker, who has been acting chairperson in Nye's absence, is eagerly looking forward to his return.

The department welcomed James Curran early in September and also farewelled our senior tutor, Sharon Gunn, in December. Sharon is returning to Melbourne. We congratulate James on his recent success in receiving an award from the Joint Presidents of the UK Forensic Science Society and the California Association of Criminalists. The award is made biannually to a young practitioner for a significant contribution to the field of forensic science. The award will enable James to attend the spring meeting of the associations in Napa, California to give a talk.

Murray Jorgensen and Bill Bolstad are currently involved in a joint project with a group from the Computer Science Department, analysing internet traffic data. Bill will be on sabbatical in 2000. He plans to attend three conferences as part of his leave, the International Society of Bayesian Analysis conference in Crete, the Nordic Conference of Mathematical Statistics in Norway and finally the International Biometric Conference at Berkeley, California.

Upcoming visitors to the department include Dr Ken Russell, Associate Professor of Statistics at the University of Woollongong, Australia, who is due to visit the Department for approximately six weeks, from 2nd January until 13 February 2000. During his stay, Ken will be working with Nye John. We are also being visited by Dr Dan Coster, Associate Head of the Department of Mathematics and Statistics at Utah State University. He will be spending approximately six months with us, arriving in New Zealand just prior to Christmas and starting work in the New Year.

Seminars

Matthew Dalgety	(BCMS(Hons) Student), "Establishing a most probable range using existing Most Probable Number estimation techniques."
Dr Murray Jorgensen,	"Minimum Message Length Inference for finite mixture models."
Dr Henri Moolman	(University of Zululand, Durban-Umlazi Campus), "A heuristic solution to the examination time-table problem."
Dr Murray Jorgensen,	"Approaches to Model Selection in mixture model clustering and Bayesian Networks."
Dr Chris Triggs	(Department of Statistics, University of Auckland), "Some statistical problems in the interpretation of mixtures of DNA profiles."
Bonnie Law	(Department of Statistics, University of Auckland), "Estimation of allele frequencies in the ancestral Maori population."
Dr Russell Millar	(Department of Statistics, University of Auckland), "Bayesian nonlinear state space modeling and comparison of implementation in BUGS and ADMB."

Judi McWhirter

VICTORIA UNIVERSITY OF WELLINGTON

Irene Pestov, who had got her PhD in Mathematics from Victoria in 1996 under the supervision of Mark McGuinness jointly with Graham Weir of IRL, is now, after a brief postdoc in Sendai (Japan), employed in Canberra as a Research Scientist with the Land and Water Sciences Division, Bureau of Rural Sciences of the Australian Ministry of Agriculture, Fisheries and Forestry (AFFA). She is continuing her work on ground water modelling, but her present object of study is the Great Artesian Basin of Australia.

No surprise then that Vladimir Pestov is spending the second half of the year on a visiting position with the Computer Sciences Lab of the Australian National University and the Australian Cooperative Research Centre for Advanced Computational Systems (ACSys). He is engaged in a collaborative project on geometric issues arising in analysis of large datasets, in particular the nature of the *dimensionality curse*. In September Vladimir gave a talk on the geometry of similarity search at the 10th International Conference on Database Expert Systems and Applications (DEXS'99) in Florence, and briefly visited IHES (Paris). Later he spoke at the Workshop on Data Mining held at ANU. In November he came back to Wellington for a week to do his share of exam marking.

Finlay Thompson, who graduated with Honours from our department in 1995, has since obtained a PhD degree in mathematical physics from SISSA (International School of Advanced Studies) in Trieste, Italy, and has now come back for a one-year postdoc with Vladimir Pestov, supported from the Marsden Fund project on Supergeometry.

John Harper duly returned from his 6-month absence in USA, UK and the Netherlands with more unsolved problems about bubbles and drops than solved ones. His visit to Birmingham which was foreshadowed in Newsletter 76 was postponed until next July, at a one-week IUTAM symposium on free boundary problems. It will be followed by a three-week programme at the Isaac Newton Institute for Mathematical Sciences, Cambridge, on free boundary problems in industry, at which he is to be one of the invited participants. (His will not be the only Antipodean input: one of the three organisers of that programme is from Australia and so are several invited participants. There is also one other participant with NZ connections: Andrew Lacey, who was a VUW postdoc 1980–82 and is now a Professor of Applied Mathematics at Heriot-Watt.)

Geoff Whittle attended the Graph Theory conference in Oberwolfach in October where he gave a plenary talk. In November he is off to the USA and Canada for 4 weeks., where he will be visiting Robin Thomas at Georgia Tech, Jime Geelen at the Fields Institute in Toronto and James Oxley at Louisiana State University.

Andrew Tideswell from Wellington East Girls' College has been awarded a Teacher Scholarship for 2000 from the Ministry of Education to pursue an MSc on the effect of using Graphics Calculators on Learning. He will be working with Lindsay Johnston and Megan Clark in the School of Mathematical and Computing Sciences.

The Mathematics and Science Education Centre at VUW hosted a symposium on Post-Constructivist Education Theory on November 4 and 5 which attracted mathematics, science and health educators from universities and colleges of education from all over the country. This symposium was sponsored by BP (NZ) Ltd and Mitsubishi Motors.

Rod Downey has spoken at the Combinatorics conference in Queensland University, has a visitor (S. S. Goncharov from Novosibirsk) for 2 weeks from the 17th of November, and is off to Singapore on the 12th.

Mark McGuinness spent 5 interesting days in Antarctica, helping Joe Trodahl (physicist) do some light scattering experiments with sea ice in McMurdo Sound. It was cold, white, vast and mercifully sunny. Kerry Landman from the University of Melbourne will be visiting Mark for a week from 6 December. Also, Mark is reluctantly assuming the responsibilities of Programme Director for mathematics for a year from 1 Dec 1999 (this is a reduced version of department chair).

Ka kite

Mark McGuinness

MATHEMATICS AND THE UNIVERSITIES

An Address for the 1999 New Zealand Mathematics Colloquium
University of Canterbury, 6-9 July, 1999

Introduction

Most people will know that cheap, albeit clever jibe of George Bemard Shaw: He who can, does; he who cannot, teaches. It is often used to denigrate the role and profession of teaching. In this address I want to turn that attitude on its head and to affirm the pre-eminent role of teaching both in the continuing life and development of mathematics

and of the universities. To teach is to do and, more challenging, to explain and to interpret. To teach is to do and to enable others to do. To teach is to bring about understanding, and understanding is the essence of knowledge.

Of course, I admit at once that this affirmation of the strategic importance of the role of teaching is not a disinterested one. I freely admit to my personal interest in the case to be argued. But this personal interest is not to be seen as a conflict of interest. Indeed, I understand that it provides the reason as to why I have been invited to speak at this Colloquium and timetabled within this Education Day - to reflect on my years as a teacher of university mathematics along with my involvement in the life of universities more generally.

Wellington Teachers College and Readiness for Learning

I went first from high school, Feilding Agricultural High School, to Wellington Teachers Training College, as it was known then in 1951, to train as a primary school teacher. How fortunate I was. The two years I spent there were the most formative of all my years in formal education. Up to that time academic learning was an alien experience, based on information to be learnt and reproduced for examination purposes. It made no contact with my growing awareness of the world as I experienced it from within. I do not blame the school or its teachers on this account. It was a function of my own development and underlines the importance of personal maturation in educational considerations. Readiness for learning is an important factor in determining learning strategies.

Yes, there was a readiness for learning when I began my time at Wellington Teachers College. But it was the quality of the institution of those years and of its staff under the leadership of Principal A.J.Waghom and Vice-Principal W.J. Scott that made my time there so valuable.

An important element of the educational philosophy of the college of those years was that first of all a teacher had to be an educated person. Yes, skills and techniques of classroom management were important but could not be a substitute for those primary qualities of mind and understanding that can and should sustain a lifetime of professional responsibility. Even in those years there were arguments that teacher training should be more technology and skills based. In terms of pre-service training of teachers, I believe the College established the right priority - be concerned to encourage the maturing of the prospective teacher as a fully educated person along with the acquiring of the technical skills to support him or her in the immediate professional demands.

I would advocate that this same priority should be maintained in pre-service teacher education and training today, as indeed I would argue for all other university - based professions. Education is more than training, although it includes it, as knowledge is more than acquiring information, although it includes it.

Thirty years after graduating from the College I wrote an Open Letter for the Centenary Publication. Let me read some excerpts from that letter.

“An Open Letter to Pat MaCaskill. (Pat was Head of the English Department at the College during my time as a student and now was editing the Centennial publication) Yes Pat, but what? Yes, I did say I’d write you something for the Centennial Publication. But that was long months ago when the inflation of ego through being invited had not reckoned with the reality of actual performance.

“You say, ‘Take an hour or so off from cube roots and administration and write me a few hundred words or so.’ It sounds so easy put like that. But it puts me at risk. It stirs memories that the present security of middle age (written, you recall in 1980!) may find it difficult to cope with.

“Would I welcome meeting across the gap of nearly thirty years the youth of seventeen I then was? A more sobering thought: what if he should find me now quite alien to his interests and vision of life? Indeed, what if he should see the cube roots and administration, of which you speak, as a means of escape from the kind of life he intended for me?

“What common ground can I find with him so that the meeting is one of mind and spirit, not an awkward, shuffling, embarrassed silence.

“I believe I shall find such common ground in the direction of my sharing with him my present vision of what matters in life, a vision that forms a sustaining philosophy for the practice of education.

“We shall talk of personal growth, made possible and sustained within stable and maturing relationships. We shall speak of friendship and love, of home and family. There is no substitute for these in the experience of life.

“We shall talk of education, formal and informal. We shall reflect on goals such as the attainment of knowledge that leads to richness, indeed nobleness of mind; the development of skills that enable satisfying accomplishments in career and service of others; the formation of settled purpose of heart that leads to appreciation and attainment of the good. We shall share desires of an understanding of life that expresses itself in attitudes of respect and responsibility; in thankfulness, wonder and worship in recognition of the fruitfulness of life; in compassion with the suffering and deep hurt that is the experience of life for so many.

“Finally, we shall talk as companions on a common pilgrimage of faith. For it was that College youth of long years ago that first sensed the Spirit of God making actual in his life the leadership of Jesus Christ.

“See where you have led me, Pat, with your simple request! May it be a continuing feature of the College that it encourages all who come within its influence to reach out for the true and the best. That has been its mark on my life. For this I am glad."

I covet for those who graduate from our Colleges of Education today that in fifty years time they too will look back in gratitude to the intellectual vision they have received during their College (and University) years. Gratitude that its depth and breadth of comprehension has been able to sustain and enrich the whole course of their professional life.

My Mathematical Experience

But where has your mathematical experience come from, I hear you ask? The College encouraged its students to take part-time courses at Victoria University College. Coming from school I had not intended to do so. Sitting at the front in an assembly of first year students I remained seated at first when those who intended to do university study were asked to stand. Compelled by the noise of those standing I looked back behind me. It seemed that everyone was standing up, so I too stood up. On such a basis are some academic choices determined!

Those who stood were subsequently interviewed. What course will you take at University, I was asked? I had no strong preference. Perhaps Mathematics, I said. I had done no better at mathematics at school than at other subjects but it seemed a reasonable suggestion. No, was the response, students from the College who have attempted Maths I at the University over the last several years have all failed it. You had better do English I. So English I it was! With generous tutorial support from the College I managed to pass English I. The next year, because I had passed a unit the previous year I was allowed to take two units of my own choice, and chose the feared Maths I and Education I. Successful in these I was allowed to combine my probationary year as a primary teacher with full-time university study and so continued on at University, eventually graduating with a Masters degree in Mathematics, followed sometime later by the Maths. Tripos at Cambridge University, England.

This led to my appointment at the end of 1960 to a lectureship in mathematics back at Victoria University, where I continued until the end of 1984 apart from three years working full-time with ,a Christian student organization. In my final three or four years at Victoria University I became increasingly involved with development and management across the University more generally. In 1985 I shifted to Waikato University where I served as Vice-Chancellor for almost ten years during a period of substantial academic development and expansion for that University.

And now my career has come full circle. Since the beginning of 1997 I have had the privilege of serving as a visiting professor in the Department of Mathematics of the University of Brunei Darussalam, and engaged again in the teaching of mathematics. As I have commented in a recent article I cannot think of a more satisfying end-run to my professional career than this involvement again with students and with the teaching of mathematics.

Where to for Mathematics and the Universities?

You may remember the conversation of Alice with the Caterpillar in Alice in Wonderland. “I am lost”, says Alice, “can you tell me which way I should go?” “Where do you want to go?”, asked the Caterpillar. “I don’t know”, said Alice. “Well then”, said the Caterpillar, “it really doesn’t matter which direction you take!”

Does it matter in what way mathematics develops over the next period of time as an academic discipline? Does it matter in what ways the universities in New Zealand develop within the broader field of tertiary education? It only matters if we have reasonably clear views of the goals we would like to see achieved and sustained. Yes, I believe there are such goals and these need to be constantly articulated and reviewed. It is obvious that my own understanding of such goals will have been shaped in important ways by the nature of my own experiences over the years. It is for this reason that I have indicated something of my personal background. Where we have come from not only gives perspective to our present position but also plays a part in determining our future directions.

But of more importance to determining the ongoing role of mathematics as an academic discipline is a clear understanding of the nature of mathematics as an intellectual activity. In determining how it should develop, and in explaining why it should continue as a major subject at all levels of formal education, we must take account of its internal character as well as the demands of the external environment of our present society.

Similarly, we need to be clear about the essential character of a university as an educational institution if we wish to gain a proper understanding of its continuing role in our society. Yes, a university is a provider of services, to use the present jargon, but the nature and quality of the services it can best provide must be determined in accord with its character as an intellectual community, and not alone by the demands and requirements of those external to it.

What then is the nature of mathematics as an intellectual discipline? And, separately, what is the nature of a

university as an educational institution? It is these two questions I wish to take up in the balance of this address, commenting on each within the limits of the available time, and suggesting some inter-action between them.

A Model for Intellectual Activity

Let me suggest to you a naturalist, or observational model of Intellectual Activity, within which I will make specific the nature of mathematical activity.

The primary component of the model is the Individual Consciousness. Intellectual awareness belongs first of all to the individual person; to me, to you.

The second component of the model is the maturing Intuitive Awareness that each individual has of itself, and of the world external to that self, including awareness of other selves.

The third major component of the model is the dynamic component. Each self, each individual develops within its own Intellectual Awareness thoughts and concepts that articulate and represent that awareness. A critical element in this dynamic component is the development of language and the communication of ideas between individuals. Through symbolic representation we both represent and shape our intuitive understanding of the world external to us, including our understanding of our objective selves as part of that external world.

In a moment I will seek to make more specific the nature of mathematical activity within the framework of this model. But I want first to note the importance of the model for intellectual activity as a whole. For me a university has a primary role to nurture and sustain the intellectual focus and awareness of society. If this is so then it is important to be able to understand the nature of human intellectual activity. Secondly, while I shall seek to make specific the particular characteristics of mathematics as an academic discipline, I also wish to make plain that it is only one particular expression of our over-all intellectual response to and participation in the world as we both find it to be, and as we shape it and give it form in our intellectual comprehension.

You will note, too, that I have termed the model an observational or naturalist model. I have sought to describe a framework of intellectual activity that enables one to identify and understand the different philosophies of knowledge that have been developed over time, although not necessarily to decide between them. I hope to demonstrate this a little in the case of the sub-model of mathematical activity.

A Sub-Model for Mathematical Activity

This sub-model of mathematical activity can be identified by specifying the primary mathematical intuitions that mathematical knowledge and understanding seem to be chiefly concerned with. One such characterization of these intuitions is as follows.

The geometrical- dynamical intuitions: Extensions in space-time.

The numerical intuitions: Counting and measuring.

The logical intuitions: Reasoning and proving.

Mathematical reality is found in the interplay between the intuitive awareness of these primary realities and the creation and organization of the symbolic systems developed to articulate that awareness and give it shape and form.

Is mathematics discovered or created? This model enables one to say it is both created and discovered. This brings together opposing views. G.H. Hardy was of the view: “I believe that mathematical reality lies outside of us, and that our function is to distover or observe it, and that the theorems which we prove are simply our notes of our observations.” In opposition to this, Raymond Wilder writes: “Mathematics is something that man himself creates, and the type of mathematics he works out is just as much a function of the cultural demands of the time as any of his other adaptive mechanisms.”

Rob Goldblatt, in the foreword to his recent text on the hyperreal number system, puts it very succinctly: “Mathematical understanding develops by a mysterious interplay between intuitive insight and symbolic interpretation.”

Some Trends in Mathematics Education - The Chicago Reform Movement

Within this model of mathematical activity one can affirm the positive aspects of the many programs of reform in mathematical education that have arisen over this century, without having to be dominated by one to the exclusion of the legitimate insights of others. In the early part of the century the so-called Chicago Reform Movement emphasized the need for the unification of pure and applied mathematics within curriculum developments. This need remains with us to the present day, perhaps even more so with the extensive range of technologies where mathematics plays a vital part.

I admire greatly the work of people such as Graeme Wake, Alex McNabb and other colleagues, who are making significant contributions in using mathematical models to advance understanding of a wide range of physical and biological situations. But mathematical modeling is not a specialist part of mathematics, different in kind to other mathematical activities. All mathematics is modeling. No, we are not all taken up with modeling the world of biological phenomena. For some of us our focus is on those primary intuitions of number, space or logic and the systems we build seek to represent or model those developing intuitions.

All mathematics is the outcome of our interaction with our envirorunent, but this environment is wide in its interpretation. Yes, it includes our physical environment, but it also reaches out to our social and intellectual environment. Indeed, the very mathematics we develop, itself becomes incorporated into that environment and so becomes the object of ongoing consideration.

The New Maths Reforms

In the late fifties and early sixties of this century we experienced the impact of the so-called New Maths Reforms in mathematics education. Some of us here were involved in some of the activity of that time, and Christchurch was the centre for significant initiatives at the secondary school level. A major concern of the reforms was that school mathematics was too much out of touch with the developments in mathematics as an academic discipline. (Although not stated at the time, I believe this to be the case with some of the university curricula as well. Although I had done a four-year Masters degree in Mathematics at Victoria University College, it was not until I went to Cambridge in 1958 to 1960 that I was introduced to the structural and axiomatic developments in so-called modern algebra, including group theory. That experience was intensely satisfying and made me a firm supporter of many of the changes proposed at that time, as well as seeking to give them expression in my own university teaching.)

But as happens so often with reform programs, needed changes become one-sided and necessary balance in implementation is lost. The proper desire to identify mathematical principles and structures to provide students and pupils with a better understanding of the nature of mathematical knowledge became overtaken by an abstraction of treatment that increasingly distorted the proper nature of the mathematical activity. Its zenith here in New Zealand was reached in the propagation of a syllabus for primary schools by the then Department of Education in which the language and ideas of sets were mistakenly used as a conceptual vehicle for the development of basic number properties and procedures. In a published letter written to the Department in those years I commented that the introduction of the language and ideas of sets into school syllabuses was like the introduction of gorse into New Zealand. Its introduction was for a good initial purpose, to meet the need for robust hedge planting. But, allowed to run free, it has become a nation-wide scourge.

None the less, I stand by the positive intent of those reforms. Mathematical activity is the continuing interaction between our intuitive awareness and the formal manipulation of the symbolic systems we develop to give shape and form to that intuitive awareness. In the foreword to a text on Number and Structure I wrote at that time I made the point that: “Structure is not some isolated content to be studied in itself (at least not in the first instance), rather it is a way of thinking, a mathematical turn of mind, that gives access to significant mathematical situations. An emphasis on structure, and the use of the axiomatic method does not do away with the need for intuitive processes in mathematical activity. Its role is to clarify intuition, to make its concepts more precise and more susceptible to logical discussion, to penetrate its presuppositions more deeply and to discern more clearly its logical consequences; its role is to complement and extend the intuitive levels of thought but not to replace them.”

The Constructionist Views

In more recent times Constructionist views, outstandingly pioneered in this country by the late Roger Osborne of Waikato University, have led to debate on the nature of mathematical activity, and indeed scientific activity more widely. In terms of the model I have suggested, mathematical knowledge is as much a function of the intellectual awareness of the person who is entering into that knowledge as it is of the external world and of the formal systems by which that world is given shape and expression. No, this does mean that each individual person must reconstruct those systems for himself, or herself, as if they were not already developed, as some critics of the constructionist position have maintained. Those systems of established knowledge are already part of the outer environment to the emerging individual consciousness. But that individual has to internalise those systems if the knowledge is to become his or her own.

Inaugural Address

In the abstract I prepared for this address I mentioned an inaugural address I gave following my appointment as Professor of Pure Mathematics at Victoria University in 1975. The address was entitled: Mathematics - A Carrier of Values for the University. The address was set in the context of recognising the primary function of the university as having to do with the nurture and propagation of the intellectual life and activity of society. I quoted with approval the words of McMillan-Brown, a Foundation Professor of this University, in its establishment as Canterbury University College. “The function of the University is to stir into active life the higher faculties, the imagination, the reasoning, the powers of comparison and most of all the power that grasps a subject in its entirety, systematises and transfers it into a living part of the mind.”

I then argued that mathematics as an academic discipline exhibits features and values that should be adhered to in the wider intellectual activity of the university. In the detail of the address I elaborated on three of those values: that of intellectual beauty, that of the power of abstract thought and that of the dynamic of intellectual motivation. On reading again the text of that address in preparation for this present one, I find myself in continuing agreement with its basic thesis.

No doubt others would identify different aspects of the mathematical activity as important to the intellectual life of the university. But everyone who is a teacher of mathematics in the university will want to acknowledge the unity that binds together the intellectual life of mathematics as an academic discipline whilst fully recognising the diversity within its many activities. As education is more than training, as teaching is more that instruction, as knowledge is more than information, so is scholarship more than research. Teaching and research come together in scholarship. Thus it is, the mathematical scholar will both exemplify the values that sustain the continuing life and integrity of the whole discipline of mathematics, whilst also helping to provide the opportunities whereby others can enter into its understanding and participate in its accomplishments.

The Nature of a University

In the final section of this address I want to refer, albeit very briefly, to what I consider to be one of the most important aspects of what it is to be a university. As I mentioned earlier the first course I took at University was English I. One of the set texts for the course was Cardinal Newman's: The Idea of a University. In retrospect I appreciate the wisdom of those responsible for that course that they thought it important that students should come to some understanding of the nature of the institution in which their intellectual life was being nourished and developed. It is important that all who are associated with universities today here in New Zealand should have a deep understanding of their essential nature so that universities can continue to play their proper role in our society.

One can identify three main watershed periods in the development of universities in New Zealand. The first was the establishment in the 1870's of the University of New Zealand and the consequent development of the various constituent university colleges. The second was the report of the Currie Commission in 1959, leading to the dis-establishment of the University of New Zealand, the granting of full university status to each of the constituent colleges and the setting up of the University Grants Committee as a buffer between the direct action of Govermnent and the management of the universities.

The third watershed period, I believe, is that associated with the reforms of the late 1980's in tertiary education and focused in the legislation of that period. The consequences of those reforms, for good and ill, are with us today with further legislative changes currently being proposed. One of the most positive outcomes to the legislative changes of the 1990 Education Amendment Act was the very clear statement concerning the essential characteristics of universities, together with the extraordinarily good statement on the nature and responsibilities of Academic Freedom. I am relieved to see that in the current Government White Paper indicating changes to the legislation these provisions will be maintained.

You will be familiar with the listed characteristics of universities: Their primary concern with advanced learning and their primary aim being to develop intellectual independence; the interdependence of their teaching and research; their operating enviromnent of international standards of teaching and research; their function as a repository of knowledge and expertise, and finally their role as a critic and conscience of society.

The Role of a Critic and Conscience of Society

It is this final characteristic that I wish to comment on: The role of the university as critic and conscience of society. It is important that we understand the depth and responsibilities of this statement. The word conscience provides a significant component to this understanding. The role of critic is not one of being a particular pressure group in society criticising particular actions or policies of the government of the day. It is not primarily a political function. It is a creative and positive role and one for the long term. It is to enable society to discern more clearly its fundamental values and to shape and develop its continuing life in accord with them.

The legislation states that a university is primarily concerned with advanced learning; its principal aim is to develop intellectual independence. This gives the clue to its role as a critic and conscience of society. It fulfills that role through the nurturing and maintaining of those qualities of mind that give people the intellectual capacity and resources to exercise moral and social judgements for themselves. It is fulfilled through creating and maintaining a community in which freedom of thought and expression is fundamental, a community in which all knowledge is open to rational enquiry and contestable on the basis of available evidence.

The touchstone of a university's expression of conscience will always be human dignity and human well-being but its characteristic outcome will be to enable people, individually and in community, to examine and affirm their own moral and social values for living. By increasing understanding it will promote positive acceptance of diversity and difference in human experience.

The Need for Academic Freedom

It is in this context that we see the importance of the statements in the legislation that the academic freedom and the autonomy of universities are to be preserved and enhanced. The legislation makes plain that academic freedom includes the freedom of academic staff and students to question and test received wisdom, to put forward new ideas and to state controversial or unpopular opinions. It means the freedom of the universities and their staff to determine the subject matter of courses within it. It means the freedom of the universities to appoint their own staff.

Yes, in exercising this academic freedom and institutional autonomy a university must act in accord with the highest ethical standards and be open to public scrutiny as to the maintenance of those standards, and be accountable for the proper use of the resources made available to it. But it is only through the exercise of its academic freedom, safeguarded by its institutional autonomy, that a university will be able to accept and fulfill a role as a critic and conscience of society.

The Contribution of Mathematics to the University's Role of being a Critic and Conscience of Society

A university's role as a critic and conscience of society is a function of its intellectual character and focus. What contribution then can mathematics as an academic discipline make to this role? I believe a considerable one!

Yes, an important aspect of this contribution will be the way in which mathematics is used in science and technology. But it is more than this. The motivation for the collective activity of mathematics is the human need and urge to make rational sense of the complexity of phenomena which comprise the evolving reality of which we are part. And this reality is not just that of the physical, natural and technical environment, it also includes our social, cultural and spiritual envirorunent.

In terms of the model I suggested to you earlier in the address, mathematics involves the operational activity of the mind in forming conceptual or theoretical models of aspects of our experience of reality. Richard Bellman's comment is apt: "It was above all Galileo who uttered the famous dictum "Mathematics is the Language of Science". Today, this can be enlarged to: Mathematics is the Language of Rationality."

The key to human progress lies in the best use of our intellectual resources and the exercise of rational processes of thought is an important, but not the only component of those resources. And it is in the development of our rational processes of understanding that we will recognise the legitimate diversity in human experience and understanding. How well this is recognised in the history of mathematics itself Is physical space Euclidean or non-Euclidean in its structural form? The development of mathematical understanding enables us to affirm both as legitimate expressions of aspects of our intuitive spatial awareness. Which of classical logic or intuitionist logic best represents our intuitive processes of thought? Are infinitesimal numbers a legitimate expression of our number intuitions? The processes of rational consideration enable us to understand how each of these is a legitimate expression of the diversity of human understanding.

How desperately we need to find ways to accommodate and affirm differences in human experience and understanding across the world today. This will not come about by the imposition of military authority or be the inevitable outcome of the free reign of market forces. It requires the nurture of human understanding and peoples free and able to exercise their own judgements, in their own interests and in the interests of others. The universities of the world have a major role to play, long term in the continuing pursuit of such an ideal. Mathematics, as a major intellectual discipline must be an active contributor to this role. Indeed, given its affinity with the scientific disciplines on the one hand, its intellectual character as an art form and its strong links to philosophical reflection and analysis, it could be argued that it has a central role to play.

The Pursuit and Attainment of Truth

What is the meaning and purpose of the university and of the intellectual life which is promoted within it? As I commented in my Inaugural Address, and as remains the case today, how reluctant we are to speak of the pursuit and attainment of truth. But for the well being of the university I believe we must be so explicit. It is the attainment of truth that must provide the compass bearing for all its activities.

A major strand in Greek thought, which shapes so much of our traditions of intellectual life is that truth is seen principally in terms of its rational and cognitive elements. Truth is seen as rational coherence. But it is more than this. In Hebrew understanding, and reflected in most, if not all of the major world religions, is the awareness that truth is moral before it is rational, although it is both. Yes, truth is a growing account of all aspects of the world as we find it to be, including a growing understanding of ourselves and of our participation in that world. But truth also has to do with the attainment of the good, with righteousness and right living, with social justice and fair dealing, with mercy and forgiveness, with love and fidelity. Truth is an affair of the heart, illuminated by the mind and sustained by the will. In the end truth is a way of life, served by reason, but never its possession.

I commend to you such a vision of the role and purpose of a university, within which the discipline of mathematics is sustained and carried forward.

By Wilf Malcolm

CENTREFOLD

Dr Graham Weir
Head, Applied Mathematics, Industrial Research Limited

Graham Weir is one of the leading mathematical modellers in New Zealand. He has provided key leadership in the applications of mathematics from within the recently formed (1992) Crown Research Institutes which, being output driven, are not focussed on individual disciplines. Mathematics being often in the role of "consultant to the consultants" it is less visible "in the field". Yet to those of us who are practitioners know of the strong underpinning and auditing role mathematical science has in strategy determination, decision support etc. As head of one of the largest mathematics groups in the Crown Research Institutes, Graham has been well-placed to foster inter-disciplinary scientific applications in which mathematics plays a significant role.

Our subject of this article is from the University of Canterbury, where he gained an honours degree in physics (1971), a masters degree in mathematics (1974) and a PhD in mathematics under the supervision of Distinguished Alumni Awardee - Professor Roy Kerr in 1977. After this he entered government science, initially in the Department of Scientific and Industrial Research, then onto Industrial Research as a survivor of the difficult restructuring exercise over 1990-2.

Graham's work has centred on continuum mechanics especially non-standard applications of heat and mass flow. He contributed greatly to the analysis of geothermal phenomena and is a key player in the large exercise led by New Zealanders in understanding this. The problems of multiphase fluid flow are intrinsically hard and he is never daunted by the need to develop new techniques to assist in their analysis. Of course, any good applied mathematician is problem-driven and the toolbox approach means that many different approaches are necessary as different problems come our way. Graham has worked also in corrosion analysis, diffusion in soils, and, with startling success lately, on powder flows. This latter problem with its very non-Newtonian characteristics means completely new frameworks are needed. Attendees of the 1999 New Zealand Mathematics Colloquium were rewarded by a fine general talk on "granular flows" by Graham, where he was the "NZ Branch of ANZIAM invited speaker". It was one of the highlights of this conference. He and his colleagues were awarded a Marsden fund in this area in 1999.

As I write this in December 1999, I have just received notice that Graham has been successful in the obtaining of a higher earned Doctorate (of Science) at the University of Canterbury. This is for his outstanding contributions in applied mathematics. The citation includes statements like those below.

> "Dr Weir's work [shows] breadth, competence and clarity of his mathematical modelling, especially in the geosciences. In each country with a tradition in applied mathematics there seems to be only a handful of modellers who have the imagination and dedication to take on the daunting modelling challenge posed by most situations involving, loosely, "multiphase flow in porous media". What has happened in the last decade is that mathematicians are having to work on an expanding stage and address a wider and wider audience and Dr Weir's research career is a model of the flexibility that is now required".

Graham is the first higher doctorate graduate in Mathematics at the University of Canterbury and this is a justifiable recognition of his contributions. He is to be capped at the graduation ceremonies in April.

His employers recognise his abilities too. Industrial Research Limited made him one of only four Distinguished Scientists earlier this year and he received a Ministerial Award for Scientific Achievement in 1987. The Royal Society of New Zealand gave him a Bronze Medal in the Science and Technology awards exercise in 1996.

Internationally he is well-known in all these areas (heat and mass flow etc.) and he has contributed to developments in geothermal reservoir engineering in China and Japan.

Colleagues in Industrial Research Limited gain from his missionary role in furthering the role of mathematics in government science. Many summer students have been mentored by him at the beginning of their careers and speak highly of his leadership there.

The last decade has been a difficult one for mathematics in government science. That it has survived, and is now gaining strength, is due in no small way to Graham's steady stewardship and leadership. Combined with his relaxed friendly personality, and the support of his lovely family, Graham is a worthy successor to the tradition of Wooding and McNabb which has helped propel New Zealand Applied Mathematics to a high stature internationally.

We congratulate Graham on his continuing achievements especially the D.Sc from his alma mater.

Graeme Wake

Centrefolds Index

BOOK REVIEWS

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)

Ainsworth M (ed), The graduate student's guide to numerical analysis '98. 250pp.

Artmann B, Euclid - The creation of mathematics. 350pp.

Bremaud P, Markov chains. 510pp.

Crauel H, Stochastic dynamics. 475pp.

Dineen S, Complex analysis on infinite dimensional spaces. 543pp.

Fayolle G (ed), Random walks in the quarter plane. 156pp.

Frazier MW, An introduction to wavelets through linear algebra. 300pp.

Grimmett G, Percolation. (2nd ed) 444 pp.

Guillemin VW, Supersymmetry and equivariant de Rham theory. 228pp.

Hibbard A, Exploring abstract algebra with Mathematica. 495pp.

Hirsch F, Elements of functional analysis. 393 pp.

James IM, Topologies and uniformities. 230 pp.

Kress R, Linear integral equations. (2nd ed) 390pp.

Lang S, Math talks for undergraduates. 110pp.

Langtangen HP, Computational partial differential equations. 684pp.

Marsden JE, Introduction to mechanics and symmetry. (2nd ed) 515pp.

Matousek J, Geometric discrepancy. 221pp.

Mignotte M, Polynomials. 320pp.

Neukirch J, Algebraic number theory. 571pp.

Padberg M, Linear optimization and extensions. (2nd ed) 501pp.

Peitgen H-O, Fractals for the classroom: Strategic activities, Vol. 3. 130pp.

Rade L, Mathematics handbook for science and engineering. (4th ed) 540pp.

Ribenboim P, The theory of classical valuations. 415pp.

Richter-Gebert J, The interactive geometry software Cinderella. (CD-ROM with booklet, 143pp).

Thomas JW, Numerical partial differential equations. 576pp.

Wang Y, Hua Loo-Keng: a biography. 350pp.

Yong J, Stochastic controls. 400pp.

Zhang F, Matrix theory. 288pp.

CONFERENCES

2000

January 3-7 (Adelaide)**Kruskal 2000: Conference on Integrable Systems in celebration of Martin D. Kruskal's 75th birthday**\\
Contact Nalini Joshi.
e-mail: \verb|Nalini.Joshi@adelaide.edu.au|
home-page: {\tt http://www.maths.adelaide.edu.au/Kruskal

January 7-15 (Kaikoura)**Mathematics Workshop.**
Contact Rod Downey. (See details below.)
e-mail: \verb|rod.downey@vuw.ac.nz

January 22-24 (Calcutta, India)**International Symposium on Mathematics and Mathematical Sciences (ISMMS 2000).**
Contact Dr. M.R. Adhikari, Secretary, Calcutta Mathematical Society.

February 7-8 (Auckland)**McNabb Symposium: Applied Mathematics in Depth.**
Contact Graham Wake. (See details below.)
e-mail: \verb|g.wake@math.canterbury.ac.nz

February 8-12 (Copthorne Resort, Waitangi, Bay of Islands, New Zealand)**ANZIAM 2000: The 36th Applied Mathematics Conference**
Contact Professor David Ryan (See details below)
e-mail: d.ryan@auckland.ac.nz|
home-page: {\tt http://www.esc.auckland.ac.nz/Organisations/anziam2000

February 21-25 (Ruahine Lodge, Dannevirke)**Ruahine `00 -- A Meeting of Phylogenetic Analysts**.
Contact Mike Hendy
e-mail: \verb|m.hendy@massey.ac.nz|
home-page: {\tt http://www.massey.ac.nz/\%7Ewwifs/ruahine2000.htm

June 14-16 (Sydney)**Conference on Mathematics and Computers in Sport**
Contact Graeme Cohen
e-mail: \verb|g.cohen@maths.uts.edu.au

October 23-27 (Manila, Philippines)**The Third Asian Mathematical Conference**
e-mail: \verb|amc2k@math01.cs.upd.edu.ph|
home-page: {\tt http://math01.cs.upd.edu.ph/AMC2000/

November 26-29 (University of Waikato)**2000 New Zealand Mathematics Colloquium**
Contact Ian Hawthorn
home-page: {\tt http://www.math.waikato.ac.nz/Coll2000/

ANZIAM 2000
The 36th ANZIAM Applied Mathematics Conference
Tuesday 8 February - Saturday 12 February, 2000
Copthorne Resort, Waitangi, Bay of Islands, New Zealand

The 36th ANZIAM Annual Applied Mathematics Conference and Annual Meeting of ANZIAM will be held at the Copthorne Resort in Waitangi on the shores of the Bay of Islands, New Zealand from the evening of Tuesday 8 February 2000 to lunchtime on the following Saturday 12 February.

The annual conference of ANZIAM, is an established annual gathering of applied mathematicians, scientists and engineers with wide-ranging interests. It provides an interactive forum for presentation of results and discussions by students, academics and other researchers on applied and industrial problems derived in many scientific fields and amenable to quantitative description and solution.

Further information from the web page: { http://www.esc.auckland.ac.nz/Organisations/anziam2000} or e-mail anziam2000@auckland.ac.nz

Registration: Registration forms can be obtained from the web page. Please return the registration form together with the appropriate fee before 10 December 1999

Accommodation: You will need to book your own accommodation. This can be done from the ANZIAM 2000 web page.

2000 NEW ZEALAND MATHEMATICS COLLOQUIUM

The first colloquium of the new millennium will be hosted by the Department of Mathematics at the University of Waikato. Because of difficulties in obtaining accommodation for participants during the middle of the year, the 2000 Colloquium will be held from Sunday November 26 to Wednesday November 29.

You'll enjoy the Waikato springtime. Take note of this change from the usual timing and mark these dates on your calendar or in your diary. More information about the Colloquium will be available in the next issue of the Newsletter as well as the Web page http://www.math.waikato.ac.nz/Coll2000/

Ian Hawthorn
Secretary, NZMC2000 Organizing Committee

NOTICES

NEW ZEALAND MATHEMATICAL SOCIETY VISITING LECTURER 2000

The Council of the Society is pleased to announce that the NZMS Visiting Lecturer for 2000 is

Professor John Guckenheimer
Mathematics Department
Cornell University
New York.

John is known internationally for his work in the theory of dynamical systems and neural networks and their application to various phenomena. More generally, he also recently served as President of the Society for Industrial and Applied Mathematics (SIAM), which is the largest organisation in the world in this area. (Like ANZIAM, it is affiliated with ICIAM -- the international grouping of regional organisations in IAM). Members will note his interesting general article in the most recent issue of SIAM NEWS (October/November 1999).

John is expected to visit the five University Centres outside of Christchurch in the period immediately from June 5, at the conclusion of his committments as an Erskine Fellow in the Department of Mathematics Statistics at the University of Canterbury. These are likely to begin in early May. It is realised that he may end up visiting some Departments close to or in the mid-year examination period, but this is unavoidable. He is expecting to be accompanied by his wife.

Can Departments please each advise us of a contact person to coordinate arrangements and inform us of this by 31st January 2000?

Graeme Wake

LATIN AMERICAN RELATIONS

The Latin American Studies Programme at the University of Auckland is compiling a directory of New Zealand academic and research relations with Latin America.

Research done by New Zealand institutions on Latin America or in cooperation with Latin American institutions, is an area which can be expected to expand, the profile of which this directory has already contributed to raise - preliminary copies of the directory have been requested by both MFAT and MORST as preparation for the respective ministers who headed delegations to South America. Copies were also circulated among representatives of both government and the private sector, as well as among the diplomatic representatives of Latin American countries, at a Seminar on Foreign Policy and Trade with Latin America organised by our programme last October. Copies are sent to all those who submit entries, and will also be given to visitors from Latin America to the University of Auckland.

As well as this directory, we plan to circulate information gathered regarding research grants available in order to promote research on, with, and by Latin Americans in New Zealand.

So far we have managed to survey most universities and some CRI's but would of course like to include all the research and/or academic links to Latin America in this directory.

We therefore kindly ask for your cooperation in circulating the form included at the end of this message to the members of your society.

A copy of the current version of the directory, which we are in the process of updating, is included for your further information.

Thank you very much for your help.

Cristina Parra, PhD
Research Assistant
Latin American Studies
University of Aucklad
e-mail: \verblc.parra@auckland

A copy of the form and current version of the directory can be obtained from \verblc.semple@math.canterbury.ac.nz

NEW ZEALAND MATHEMATICAL OLYMPIAD COMMITTEE

The focus of the activities of our Committee is the preparation, selection, training and participation of the New Zealand team in the International Mathematical Olympiads (IMO). New Zealand teams have participated since the 29th IMO in Canberra in July 1988. We have had a fair measure of success, winning silver mdeals in 1988 and 1995, one bronze medal in 1992, 1995 and 1999, two bronze medals in each of the years 1989, 1990, 1991, 1993, 1997, 1998, three bronze medals in 1996 and four bronze medals in 1994. There have also been several ``honourable mentions'' which are gained for full marks in at least one question if no medal is won.

However our Committee believes it has a much more important and wider brief than to send a team to the IMO. That is to foster excellence in mathematics in New Zealand high schools, and to challenge the gifted students of mathematics. To this end we have offered, since 1991, a certificate course for up to 200 senior secndary students each year who have been nominated by the heads of the mathematics departments of their schools. This is a correspondence course based on a series of 15 booklets written by Professor Derek Holton of the University of Otago, who was the leader of the New Zealand team at each of the first three IMO's contested by a New Zealand team and again in 1993/4/6/7. We see this as a good way to get appropriate enrichment material into the hands of mathematics teachers. The first certificate course was so successful that the next year an advanced certificate course was inaugurated and has continued ever since. In both courses the student is given one assignment per month for six months of the academic year, along with three special projects. This work is marked by PhD students and returned to the enrollees along with model solutions. On succesful completion of a course a student receives an attractive certificate normally presented at a school assembly.

Formerly during the May school holidays but now in January we run a week-long training camp in Christchurch for the best 20 students we can find in the whole country. At the end of that week of intense activity we select a squad for further training from whom the team of six to represent New Zealand at the forthcoming IMO is chosen. We find that the opportunity to gain selection to the team and to represent New Zealand overseas is a great incentive to sustained interest and high-level performance on the part of the students involved in our activities.

During the ``camp'' a workshop has also been run for teachers to encourage them to use challenging material to extend the more able students at their schools.

Another feature of our programme is a series of seminars for talented students at various times throughout the year to introduce them to the ideas and topics involved. We try to encourage laterial thinking so that success is not just a question of having been drilled in particular methods. These ``cluster groups'' are held at several locations and we hope to arrange more of them.

Further details and application forms for the 2000 Certificate course may be obtained from the Secretary, Professor Gordon Hookings, Mathematics Education Unit, The University of Auckland, Private Bag 92019, Auckland.

EXPERIENCES OF DOCTORAL STUDENTS IN MATHEMATICS IN NEW ZEALAND -- SUMMARY

Margaret Morton University of Auckland Gillian Thornley Massey University

This paper discusses information obtained by questionnaire from doctoral students in mathematics and mathematics education in New Zealand universities. The topics covered include their financial support, what motivated them to pursue a doctorate, how they negotiated their choice of topic and supervisor, the level of satisfaction they are

experiencing from their studies, and their career expectations. The findings suggest that the graduate research experience could be improved for many students by simple measures such as the departments providing comprehensive information on the study/research process, research facilities and departmental procedures; monitoring the level of funding for scholarships; and fostering graduate student networks both within and across disciplines.

The authors wish to thank the New Zealand Mathematical Society for a grant of \$500 which helped fund this research. A full copy of the report is available through the Auckland Mathematics Department Report Series.

GRANTEES REPORT

I wish to thank the NZMS and the department of Mathematics at The University of Waikato for their support and their contribution towards my expenses for two conferences in Algebra in Rome and in Vienna, and to enable me to visit the University of Muenster in Germany, during the first two weeks of June 1999.

The workshop in Rome was on Commutative Algebra, held during June 2-5, in two parts at Universita degli Studi di Roma ``La Sapienza", and at Universita degli Studi ``Roma Tre." The main theme of the first part was ``One-dimensional commutative Noetherian rings," while the main theme of the second part was ``Commutative rings in a not necessarily Noetherian setting". My contribution was towards the second theme with a paper on the number of intermediate rings. There were about 64 participants at these two conferences mainly from Europe and neighbouring countries and the states, I was the only one from the Pacific region.

The second conference I also attended is the 58th workshop on general algebra hosted by The Institute for Algebra and Computational Mathematics at The Vienna University of Technology. I spoke on the ``Cardinality of the set of fuzzy ideals." There were more than 100 participants mainly from European countries. The proceeding of this conference is going to be published under the title ``Contributions to General Algebra 12, Proceedings of the Vienna Conference June 1999," by Verlag Johannes Heyn, Klagenfurt, Austria.

I also visited the Graduate College of The University of Muenster, Germany, where I spoke on ``the number of intermediate rings" at their seminar of algebraic geometry and number theory.

I thank the Society for their financial support that enabled to participate at these conferences and to visit these universities where I could share my results with many specialists and discuss with them some research problems.

Ali Jaballah Department of Mathematics The University of Waikato

CORRIGENDUM

NMZS RESEARCH AWARDS

In my lecture on ``The first 25 years of the New Zealand Mathematical Society" (Newsletter 76, August 1999, 30-35), the list of NZMS Research Rewards (p.35) included Vladimir Pestov for 1995. In fact both Vladimir Pestov and Neil Watson won NZMS Research Awards in 1995.

Garry J. Tee

MATHEMATICAL MINIATURE 10

World Mathematical Year 2000 and the New Millennium

Hilbert marked the end of the nineteenth century, and the start of the twentieth century, by enunciating his 23 famous problems. We are now approaching the end, not just of a century, but of a millennium, and we should be prepared to think on an even more lavish scale. We could even try to reflect what has happened to mathematics during the nearly 2000 years of the Christian Era – or Common Era – that have so far elapsed. The very fact that there is some disagreement as to when the new millennium starts, reminds us of one of the greatest advances that mathematics has made: the introduction of the number zero, not only into standard mathematical usage, but also into popular consciousness. In my early days of computing much was made of the advantages of counting from zero, rather than one, but when the first compilers came along, counting from one suddenly became obligatory again. When telephone numbers had to be dialled, people from other countries seemed to think the arrangement of the digits on our dials, 0 to 9 in clockwise order, was eccentric but I still think we were the only ones in the right.

If you try to see what is going on in the plans for the World Mathematical Year 2000 by consulting the website `http://wmy2000.math.jussieu.fr/` you soon learn that countries in the Northern Hemisphere habitually use names of seasons as though they were dates. For example the newsletters issued in connection with WMY 2000 are identified as Newsletter 1 Summer 1993 to Newsletter 6 Autumn 1998 and Newsletter 7 Spring 1999. This reminds us that the earth is no longer considered to be flat and that there exists a Southern Hemisphere with differently-phased seasons. A wider significance, which has been crucial to scientific developments, with consequent effects on the way mathematics is used in science, is the modern insistence, at least in principle, on relating scientific

theory to experimental verification.

What are the great mathematical achievements of the last 2000 years? I suppose the questions that were being thought about at the beginning of this epoch were “the duplication of the cube", “squaring the circle" and a proof from the axioms of congruence of the Euclidean parallel axiom. The first two questions describe geometrical constructions that are now known to be impossible and the reasons go well beyond geometry. Ruler and compass constructions produce only multiples of a basic length that lie in a field consisting of the rational numbers extended so as to be closed under the function $x \mapsto \sqrt{1+x^2}$. And neither $\sqrt[3]{2}$ nor π is in this field. These considerations are related to the discovery of irrational and ultimately transcendental numbers and to Galois theory. Attempts to prove the parallel axiom led to constructions that eventually became basic tools of hyperbolic geometry. The possibility that questions that can be stated in an unambiguous way but might not have definite answers was a revolutionary idea and led eventually to the work of Gödel. The continuum hypothesis and the axiom of choice now have to be thought of, not as conjectures to prove or disprove, but as options for us to choose from. Far from causing doubts about fundamental questions, mathematics has now been revealed as a much deeper and much richer subject than anyone might have supposed 2000 years ago.

Returning to the World Mathematical Year, a browse through its list of projects reveals one New Zealand item. This is the international TIME (Technology in Mathematics Education) conference to be held in Auckland on 11-14 December 2000. For details see `http://math.auckland.ac.nz/TIME2000`. I don’t know if other New Zealand activities can be officially scheduled at this late stage but it would be wonderful if a WMY flavour could be incorporated into events that are happening anyway. I am aware of at least two suitable events, the ANZIAM conference in Waitangi 8-12 February and the NZ Mathematics Colloquium in Hamilton 26-29 November, and I am sure that some WMY spin is possible. The next of the series of ANODE numerical analysis workshops that we organise in Auckland will be at the end of the year, or possibly in the first few days of 2001. This will be a good time to review a century of scientific computation and I hope our programme can recognise this.

This (Southern Hemisphere) summer marks the retirement of Vamanamurthy and the seventieth birthday of Alex McNabb. Even though they work in completely different parts of mathematics, they both enjoy problems and each is a dab hand with special functions. Hence, I suspect one of them will be the first to send me a new proof of a little identity that I once needed and eventually managed to prove. Of course a more interesting problem, and one that I have no ideas about, is to discover a more general result, of which this is a special instance. Perhaps the more general result will involve an arbitrary orthogonal polynomial system, rather than just the Laguerre polynomials, $L_0 = 1, L_1(t) = 1 - t, L_2(t) = 1 - 2t + \frac{1}{2}t^2, \ldots$. And now the problem:

Let n be a positive integer and t a real number. Define $a_0, a_1, a_2, \ldots, a_n$, and $b_0, b_1, b_2, \ldots, b_n$, by

$$\begin{aligned} a_0 &= 1, & b_0 &= 1, \\ a_1 &= t - 1, & b_1 &= 1 - t, \\ a_k &= \tfrac{(-1)^{k-1}}{k+1} L'_{k+1}\big((k+1)t\big),\ k \geq 2, & b_k &= \tfrac{(-1)^{k-1}}{k} t L'_k\big((k-1)t\big),\ k \geq 2. \end{aligned}$$

Prove that

$$a_0 b_n + a_1 b_{n-1} + a_2 b_{n-2} + \cdots + a_n b_0 = 0.$$

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