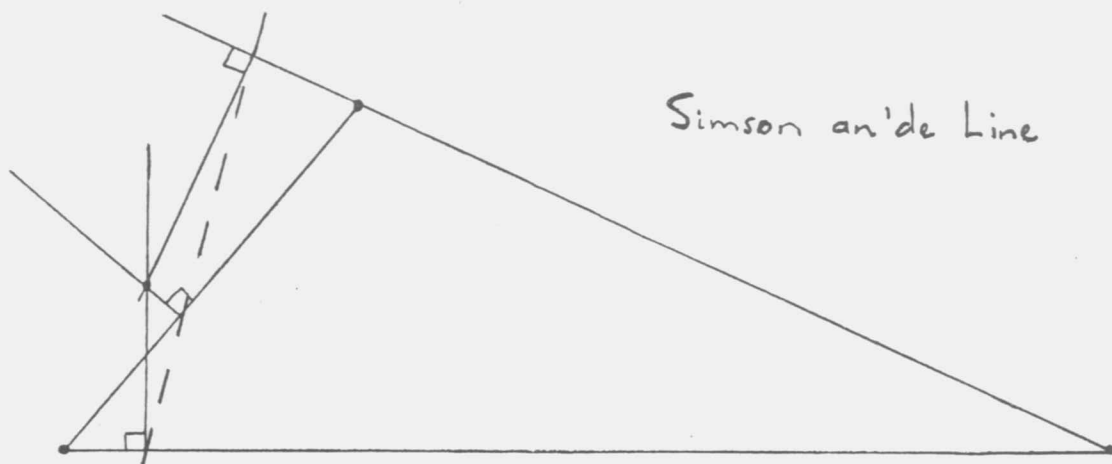


# THE NEW ZEALAND MATHEMATICAL SOCIETY

## NEWSLETTER



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## SPECIAL GENERAL MEETING

A Special General Meeting of the New Zealand Mathematical Society will be held on Monday, 19 May 1986, at the University of Canterbury, Christchurch. (Time: 7.00 p.m. to be confirmed.) The meeting will be held during the 21st New Zealand Mathematics Colloquium, and will immediately precede the Annual General Meeting of the Society. Details of the venue will be advertised at the Colloquium. The purpose of the meeting is to ratify the decisions made at the last Annual General Meeting, held in Australia in May 1985.

## ANNUAL GENERAL MEETING

The twelfth Annual General Meeting of the New Zealand Mathematical Society will be held on Monday, 19 May 1986, at the University of Canterbury, Christchurch. (Time: 7.10 p.m. to be confirmed.) The meeting will be held during the 21st New Zealand Mathematics Colloquium and will immediately follow the Special General Meeting announced above. Details of the venue will be advertised at the Colloquium.

## NOMINATIONS TO COUNCIL

The following nominations have been received for positions on the next Council. Each is accompanied by a brief biographical sketch of the candidate.

## INCOMING VICE-PRESIDENT:

Prof. Brian Woods, University of Canterbury,  
B.E. (NZ), D.C.Ae., F.I.M.A.

Brian Woods graduated in engineering in 1954, joined the Defence Science Corps, which sponsored him for two years at Cranfield (U.K.), studying aerodynamics. He was seconded to the Royal Aircraft Establishment, Farnborough, and later joined it (1956-65). He became a mathematician overnight in July 1968 as a lecturer (then, senior lecturer) in applied mathematics at Leeds University. In 1969, he was appointed to a chair in mathematics at Canterbury University, responsible for engineering mathematics. He served on the Council of the NZMS in the early 70's, convened the National Committee on Mathematics (1980-83), and now serves on the National Committee for Theoretical and Applied Mechanics. His current research centres on magmatic flows.

Proposer: Ivan Reilly

Seconder: Brent Wilson

## COUNCIL:

Dr John Shanks, University of Otago

After a B.Sc. from Liverpool, John Shanks gained an M.Sc. and a D.Phil. from Oxford, in Numerical Analysis. He was appointed at Otago in 1974 and is presently a Senior Lecturer. He has research interest in extrapolation methods and numerical integration. He has served on the NZMS Council as Secretary (1983-84) and Treasurer (1984-86).

Proposer: Ivan Reilly

Seconder: John Curran

Dr Gillian Thornley, Massey University  
M.Sc. (Hons) Canterbury 1963 Ph.D. Toronto 1965.

Lecturer in Mathematics at Canterbury (1966-67) and at the University of the West Indies (1968-69). Produced children in 1970 and 1971, and worked part-time in Polytechnics, Teachers' College, the Victoria University of Wellington, and the Ministry of Energy, before returning to a full-time position at Wellington Polytechnic in 1978 and Massey University in 1980. Present position is Senior Lecturer in Mathematics. Research interests in differential geometry. Served on NZMS Council 1978-80 and as Secretary 1980-81. Currently NZMS co-ordinator for overseas visitors.

Proposer: Mike Carter

Seconder: Brian Hayman

## News and Local News

D.S.I.R.

### A.M.D., Wellington

Rolfe Tomlinson has had a stimulating time working in Wellington and Auckland on optimum size of production systems, and on strategic planning. Rolfe give several public lectures which were particularly well attended. He has now returned to Warwick.

Roger Young, formerly of VUW, has been appointed to the Maths Physics section after post doc work with Brian Gray at Macquarie. Roger will be working on geothermal problems.

Peter Burgess has been appointed to the Computing section as graphics specialist. DSIR has recently purchased the US National Bureau of Standards package DATAPLOT and one of Peter's tasks is to assist with its evaluation.

Phillipa Safey has left Lincoln to begin music studies in Melbourne.

Donal Krouse, formerly of HO, has been appointed to the Industrial Statistics section.

G.J.W.

### AUCKLAND UNIVERSITY

#### Department of Mathematics & Statistics

A small stream of overseas visitors arrived in the Department in January. On short term visits were Professor E.A. Bender, University of California, San Diego and Professor L.B. Richmond, University of Waterloo, Ontario.

Professor Warren J. Wong of the University of Notre Dame will be with the Department until the end of June. Professor Wong specialises in Finite Groups. Post-doctoral Fellow Dr L.A. Székely of Eötvös University, Budapest, is at Auckland for one year and specialises in Combinatorics.

Two new faces appear in the ranks of our temporary tutors and we welcome Ms Sina Greenwood and Dr Keith Daynes to the Department.

Dr Jan Harding, Centre for Science and Mathematics Education, Chelsea College of London, who is an internationally-known specialist on girls and science education, visited this country on Tuesday, 18 February, at the invitation of the British Council and Curriculum Development Division of the Department of Education. Dr Harding gave a seminar entitled 'Girls and Science Education' whilst at Auckland.

#### Seminars:

Professor A.F.M. Smith (University of Nottingham) 'Bayesian methods of multiparameter problems'.

Professor B. Richmond (University of Waterloo), 'Minimum matchings of  $n$  random points in the unit square have length  $C\sqrt{n}$  with probability asymptotic to 1'.

Dr M. Dodson (University of York), 'Diophantine approximation and stability'.

Dr M. Iwasaki (National Defence Academy, Japan), 'Robustness of the Blue implied estimator of regression coefficients against autocorrelation in disturbances'.

Professor J.A. Robinson (Logic Programming Research Center, Syracuse University), 'The future of logic programming'.

Professor H.D. Patterson (AFRC Statistics Unit, University of Edinburgh), 'The use of incomplete block designs in U.K. variety trials'.

Dr P.J. Thomson (Institute of Statistics and Operations Research, Victoria University), 'Forecasting visitor arrivals to New Zealand: an elementary analysis'.

Dr P. Smith (University of Warwick), 'Curves, differential operators and finite dimensional algebras'.

Dr L.A. Székely (Eötvös University, Budapest), 'Measurable chromatic number of geometric graphs and sets without some distances in Euclidean space'.

I.L.R.

#### Department of Computer Science

By the end of enrolment week, 432 students had enrolled for the course 'Introduction to Programming' (first half of the year), and 425 had enrolled for its sequel 'Introduction to Computer Science' (second half of the year). The comparable numbers for 1985 were 361 and 371. The service course 'Introduction to Computing' had 225 enrolments (205 in 1985). The total number of enrolments for all Stage 2 courses was 615 (452 in 1985), for all Stage 3 courses was 391 (321 in 1985), and for all postgraduate courses was 102 (79 in 1985). Lecture rooms and laboratories are accordingly somewhat more crowded than they were last year.

John Whale has returned from leave in England.

Professor Charlie Colbourn (University of Waterloo, Ontario) and Professor Su Yun-Lin (Ginan University, China), are both visiting. The latter gave a seminar 'On tiling a polygon with triangular tiles with minimal cost'.

Dr Manfred E. Trimmer, from M.I.T. gave a seminar on 'Stability of spectral methods for partial differential equations'.

Professor Rudi Mathon, from the University of Toronto, gave a seminar on 'The beauty and complexity of iteration', dealing with computer art based on Julia sets.

G.J.T.

#### MASSEY UNIVERSITY

Dr John Hearne has recently arrived from the University of Natal, Pietermaritzburg, South Africa, to take up a three-year post-doctoral fellowship. His field of interest is system dynamics, and he intends to investigate the stability of the structure of the N.Z. dairy industry by formulating a mathematical model for the system. He is accompanied by his wife and three children.

Neville Jeans and Sirimathie Wewala have been appointed as Junior Lecturers for 1986, and Oliver Jones, Gerard Palmer, Robert Crawford and Shirley Dixon as Graduate Assistants.

Dick Brook will be on leave for the whole of 1986. He and his wife will be spending some five months in India, where Dick will be working at the Indian Statistical Institute in Calcutta. After that they will be embarking on an extended globetrotting campaign too complicated to describe here.

Adrian Swift will be on leave at the University of Aston in Birmingham during April, May and June.

#### Seminars:

John Maindonald (A.M.D., Mt Albert), 'Apple transport in wooden bins'.

Dr G.S. Hall (University of Aberdeen), 'Lie transformation groups in mathematics and physics'.

Dr Kee Teo, 'Semimodular lattices of finite length'.

M.R.C.

## VICTORIA UNIVERSITY

A second new lecturer is to join us in June: Dr Rod Downey, who has a Ph.D. from Monash and is currently at the University of Illinois at Urbana-Champaign. His field is mathematical logic, like Colin Bailey whose appointment was announced in the last Newsletter.

Linh Nguyen (thesis topic, time series), Mark Kirkwood and James Hunter (both in relativistic quantum mechanics) are joining us as Junior Lecturers, and Lie Wong Siong (seismology) and Mark Walkington (time series) as Teaching Assistants. All five of them are doing M.Sc.

David Vere-Jones will be returning from sabbatical in Oxford for the second term.

Dr David Gubbins and Dr Alan Smith (both from Cambridge) will soon be Visiting Fellows in Earth Sciences working with Jim Ansell and John Harper; Prof. Donna Jurdy (Northwestern) will have returned home from her Visiting Fellowship by the time this Newsletter appears.

Accurate student numbers are notoriously hard to get in the first week of term when this report had to be prepared, but as far as we can see they are fairly similar to last year's. One second-year course has doubled, but it had halved last year.

J.F.H.

## CANTERBURY UNIVERSITY

Department of Mathematics

David Robinson has returned from a year on study leave, visiting Australia (Deakin and Sydney), Britain (Open University and East Anglia), Holland (Utrecht) and U.S.A. (Georgia and Florida). The main topic of his leave was the study of branching in plants. He returned with data on several hundred species of flowering plant. He has developed two different symbolic representations to replace the verbal descriptions in present use.

Frank Gair has returned from a year's leave spent mainly at Wye College of the University of London. While there he studied the effects of inflation on a partially indexed economy. He also made brief visits to Stanford Research Institute, M.I.T., London School of Economics, and the University of Melbourne.

Neil Watson has just completed twelve months' study leave. For the first few weeks he was in Australia, initially at the Third Australasian Mathematics Convention, and then at the University of Queensland. His recent 'return' went almost unrecognised, because for almost the whole of his leave he has been in the department, writing a book on parabolic partial differential equations, which is almost finished.

In December, Graham Wood attended a meeting in Hungary, devoted to the global optimization problem, where he found himself the only representative from Australasia. He gives an account of the meeting elsewhere in this issue.

John Deely is spending the first six months of his leave at the University of Purdue. He then plans to move on to England and Europe.

Kevin O'Meara has departed for a year's leave at the University of Connecticut.

At the end of February, the staff came together in a social gathering to farewell Ting-On To, who has retired after 16 years of dedicated service to the department. Dr and Mrs To will shortly leave for an extended visit to China.

In promotions announced last November, Neil Watson was promoted to Reader and Ian Coope to Senior Lecturer.

Alan Thompson has successfully completed his doctorate, under the supervision of Derrick Breach. His thesis is entitled 'A census of 3-(12,6,4) and 2-(11,5,4) designs'.

Current enrolments indicate that the roll will be slightly greater than last year's, and so the final roll should exceed 8000 for the second year in succession. Total Arts enrolments show a small increase, and Science a similar small decrease.

The department's computing and word-processing power is being rapidly enhanced, in three ways. The NCR Tower minicomputer has been given a new main processor and two I/O boards, so improving its responses. Five Mac-XT micros have been purchased. These support T3, a word-processor which can call on 1000 immediately accessible symbols, for secretarial-mathematical work. The departmental secretaries and some staff are steadily mastering this new technology. The Mac-XT's also support TEX, a high-quality document formatter, giving print-quality finish. This will ultimately provide the means to send 'papers' to some journals on floppy disc, ready for printing, avoiding tedious proof-reading by correspondence. Finally, the quality of output from the HP Laser Jet printer has to be seen to be believed. Once these devices are all wired together, the power and speed available will revolutionise that side of the department's work. Yes, we still have typewriters, but for how much longer?

#### Seminars:

Professor P. Lorimer (University of Auckland), 'Some graphs, their groups and geometry'.

Professor I.M. James (University of Oxford), 'Fibrewise general topology'.

Dr G.S. Hall (University of Aberdeen), 'Curvature and metric in general relativity'.

Professor Charles J. Colbourn (University of Waterloo), 'Improving bounds on network reliability'.

R.S.L.

#### Department of Electrical and Electronic Engineering

Our main mathematical news is of 'Artificial Intelligence' which has been the cause of a week of computing-and-all-that conferences held here (17 - 21 Feb.). The focus has been Dr John Andreae (Reader in EEE) whose unique approach to AI attracted a galaxy of wide-brimmed-hatted stars (Brian Gaines, David Hill, Ian Witten, Brian Wyvill, John Cleary and Mildred Shaw) from Calgary, who stimulated wide-ranging discussions of expert systems, computing-state-of-the-art, etc. Ian Witten stays here, as an Erskine Fellow, until well into April, giving various lectures, seminars and general talks.

R.H.T.B.

#### OTAGO UNIVERSITY

Robert ("Tank") Aldred is "visiting" the University of Otago from the University of Melbourne in order to complete his Ph.D. in Graph Theory under Professor Holton. In addition, Tank is working with Derek on some problems involving cubic graphs.

Mr Peter Brook who originated the Mathletics (with Steve Baird) in 1976 and the Computer Olympics in 1984 (both in Dunedin), and who is an experienced high school teacher of both Mathematics and Computer Science in Dunedin, is now pursuing an M.A. in graph theory under Dr John Clark.

This year, Ms Chhondira Chatterjee (Assistant Lecturer) and Mrs Janet Levy (Half-time Assistant Lecturer) will 'replace' Professor Ivor Francis who is on leave at the Deming Institute in Auckland.

Mr Stephen Cranefield and Mr Stephen Harvey (both of whom received First Class Honours in Mathematics in 1985) will share an Assistant Lectureship this year.

Mr Peter Johnstone and Mr Roger Littlejohn of Invermay Agricultural Research Station MAF will each teach half of a Part 3 statistics paper.

Mr John Rayner has returned from his leave at CSIRO's Division of Mathematics and Statistics in North Ryde, Australia, where he was collaborating with John Best.

Dr Gerrard Liddell visited Australia last December to present a paper on 'Modular Software for Mathematics Education' at the Computer Aided Learning in Tertiary Education (CALITE) Conference in Melbourne and to attend a one day seminar on 'Artificial Intelligence and Expert Systems' at RMIT given by Professor Marvin Minsky. In January Gerrard ran a summer school course on 'Programming: Pascal on the Macintosh'.

Dr Fred Lam gave a short course on 'Experimental design in Pharmaceutical Sciences' to staff and students in the Department of Pharmacy in early February.

Associate Professor Bryan Manly and Ms Chhondira Chatterjee attended an advanced conference on weighted distributions and related weighted methods for statistical analysis and interpretation of encountered data, observational studies, representativeness issues, and resulting inferences, at the Delhi Centre of the Indian Statistical Institute in January. Bryan gave a paper on the comparison of biological distance matrices, and then visited the Applied Statistics Unit at the University of Kent in the U.K.

Professor Derek Holton (together with John Curran, David Hill, and John Rayner) is setting up a New Zealand wide junior mathematics competition for Forms 3, 4, and 5 --- to be sponsored by the National Bank, and to be held for one hour, on 30 April 1986. Each student will be competing against students in their own form level and there will be a first prize of \$80, a second prize of \$60, and a third prize of \$40 at each form level. In addition there will be a number of outstanding awards worth \$20 and rather more students will gain certificates of merit.

Professor Derek Holton has reconvened the Otago Regional Syllabus Committee (Mathematics). At its first meeting concern was expressed by the secondary teachers regarding the unavailability of information and materials for teaching the two new Bursary Mathematics courses - especially Bursary A (Mathematics and Statistics).

#### Seminars:

Professor L.B. Richmond (University of Waterloo, Canada), 'The probabilistic analysis of a matching problem'.

Professor E.A. Bender (University of California, San Diego), 'The number of convex polyhedra'.

Dr C. Little (Massey University), 'The Hadamard and geometric lattices'.

Professor C.J. Colbourn (University of Waterloo, Canada), 'Bounding network reliability via edge-packing'.

G.O.

#### WAIKATO UNIVERSITY

Much to the relief of our statisticians, Peter Hill's vacancy has been filled: Dr Murray Jorgenson will join us in May, from the M.A.F. in Wellington.

Graham French returned from leave, mainly at Amherst, full of enthusiasm for lattices, "M.K." (Bennett) and other attractions...

Sandy McClymont has just ended his four-month visit, working at his usual anti-social hours - after midnight - with Ian Craig on solar atmospheric.

Deidre Shea has also joined us, as Laboratory Supervisor, while working on her M.Sc.

#### Seminars:

Prof. R. Tomlinson (Institute for Management Research and Development, University of Warwick), 'Diseconomies of Scale in production systems'.

Dr A.N. McClymont (University of Hawaii), 'Theory of fast flows in the solar atmosphere: an observation riddle resolved'.

Dr J. Kautsky (Flinders University), 'Robust eigenstructure assignment in control system design'.

Prof. C.J. Colbourn (University of Waterloo, Ontario), 'Bounding network reliability via edge-packing' and 'Improving bounds on network reliability'.

Mr G.J. Tee (Computer Science, Auckland University), 'Dr Edmond Halley, mathematics and comets'.

M.S.



*I. Reilly, C. Maiden (Auckland Vice-Chancellor), I. James and M. Conder discuss the Forder Lectureship. (Photo - Pamela Russell)*

#### THE FORDER LECTURESHIP:

#### PROGRESS REPORT

Prof. I.M. James, President of the London Mathematical Society, visited Auckland recently, to discuss the details of this co-operative scheme. On returning to London, he summarised the talks in a letter to Prof. Reilly (President of the NZMS), the relevant part of which appears below:

Although the selection of the first Forder lecturer was left entirely to the LMS, at the express wish of the NZMS, the regular procedure will be as follows. You will let us know, by the end of May 1987 and at the same time every second year thereafter, whether you wish us to select another Forder lecturer and if so which area or areas of mathematics would be preferred. We will then draw up a short list and send it to you for comment, but after that the final selection will be made by us.



I hope you will feel free to suggest individual names, if you so wish, on the understanding that we will be almost certainly wishing to consider other names as well. I also hope that in proposing the subject area or areas you will bear in mind that the LMS is primarily concerned with the theoretical rather than the practical aspect of mathematics, and that (as I understand it) Henry Forder's own interests were on the pure side of the subject.

As agreed earlier, the financial arrangements are that the LMS will be responsible for the cost of the lecturer's travel to New Zealand and back. It is hoped that another body, such as the British Council or the Royal Society, may assist with this in which case it may be necessary, for procedural reasons, to ask the NZMS to make applications for such support.

It has also been agreed earlier that the lecturer should be expected to spend approximately four weeks in New Zealand and that the NZMS will arrange to cover the cost of the lecturer's internal travel and living expenses, bearing in mind that in some cases the lecturer may be accompanied by his or her spouse. Although the details of the lecturer's visit will be arranged directly with the lecturer by the NZMS, all six New Zealand universities will be given the opportunity to participate if they so wish.

After the return of the second Forder lecturer the LMS will review the working of the scheme and of course the NZMS will be invited to comment at that stage. Up to that point, at least, I suggest that it should be quite sufficient for us to proceed on the basis of this letter without any more formal agreement.

Finally I would like to stress that the LMS is most anxious that the Forder scheme should be an addition to, and not a replacement for, what is available under other such schemes, and will form part of endeavours to strengthen cooperation between our two countries in the field of mathematics.

In relation to this I would take the opportunity to refer to one or two other matters which came up in the discussions which took place during my visit. First of all we would like to see the exchange agreement between the two Royal Societies more fully utilized for visits which can be justified in terms of research, and I hope you will do what you can to ensure that the existence of this scheme becomes better known. Secondly we would be glad to do something to facilitate temporary inter-faculty exchange, which I gather would be of interest on your side. Thirdly, we will look into the point you made about the relative difficulty experienced by students in obtaining satisfactory finance for graduate study in the UK.

#### HONORARY CORRESPONDENTS

Prof. R.H.T. Bates	Electrical and Electronic Engineering Department, University of Canterbury, Private Bag, Christchurch.
Dr M.R. Carter	Department of Mathematics and Statistics, Massey University, Palmerston North.
Mr M. Doherty	Department of Statistics, Private Bag, Wellington.
Dr J.F. Harper	Mathematics Department, Victoria University of Wellington, Private Bag, Wellington 1.
Dr J. Heath	School of Maths & Science, Wellington Polytechnic, Private Bag, Wellington.
Dr M.A. Jorgensen	Biometrics Section, Ministry of Agric. & Fish., Private Bag, Wellington.
Mr R.S. Long	Department of Mathematics, University of Canterbury, Christchurch.
Mr J.H. Maindonald	DSIR-AMD, Mt Albert Research Centre, Private Bag, Auckland.
Dr G. Olive	Department of Mathematics & Statistics, University of Otago, P.O. Box 56, Dunedin.
Mr K. Perrin	Department of Mathematics Education, Teachers College, Secondary Division, P.O. Box 31065, Christchurch 4.
Assoc. Prof. I.L. Reilly	Department of Mathematics & Statistics, University of Auckland, Private Bag, Auckland.
Dr D.M. Ryan	Theoretical & Applied Mechanics, University of Auckland, Private Bag, Auckland.
Dr M. Schroder	Mathematics Department, University of Waikato, Private Bag, Hamilton.
Mr G.J. Tee	Department of Computer Science, University of Auckland, Private Bag, Auckland.
Dr G.J. Weir	Applied Mathematics Division, DSIR, Private Bag, Wellington.
Mr I.F. West	Fisheries Research Division, P.O. Box 297, Wellington.

## PRINCE &amp; PRINCESS OF WALES SCIENCE AWARDS SCHEME

Dr Peter Thomson, a Senior Lecturer in Statistics at the Victoria University of Wellington, and a member of the NZMS, has been awarded a grant to study at the Institute of Statistical Mathematics, Japan, in a time series group. The research has application to geophysics, seismology, rainfall modelling and economic time series.

## FEEDBACK

Not long ago, the NZMS decided to help New Zealand students get to overseas conferences. The first grants were made last year, to R.P.K Chan at Auckland, I. Janjic-Rinsma at Canterbury and I. Levi, formerly at Canterbury and now at the University of Hawaii, Manoa. Their reports to the President appear below, slightly edited and without the expressions of gratitude...

Robert Chan:

I attended the 3rd Australasian Mathematics Convention held at the University of New South Wales, Sydney, May 13-17, 1985. There I was able to report on progress in my Ph.D. research and presented a talk entitled "Extrapolation methods for ordinary differential equations based on Runge-Kutta formulae". The abstract of my paper is as follows:

"A certain class of one-step numerical methods for ordinary differential equations shares with symmetric quadrature formulae the property of possessing an asymptotic error expansion in even powers of the stepsize. In this paper we examine these methods with a view to identifying those which are suitable for practical algorithms. In particular, we wish to achieve suitable stability behaviour for use with stiff problems and at the same time to minimise the high implementation costs usually associated with implicit Runge-Kutta methods."

I also had the opportunity of attending many interesting talks, meeting other mathematicians, and making new contacts with people working in related fields.

Ingrid Janjic-Rinsma:

Last year the NZMS awarded me a postgraduate student travel fund to aid me in attending the thirteenth Australasian Conference on Combinatorial Mathematics and Computing. The Conference was held in Sydney and 52 participants mainly from Australia and New Zealand attended. It began on the evening of Sunday, 25 August with a welcoming party and ended at noon on Friday, 30 August. During the week 39 papers were presented consisting of 9 invited talks and 30 short talks. The AGM of the Combinatorial Mathematics Society of Australasia took place on Thursday before the annual dinner. This was held at International House, where most of the participants stayed.

The Conference was fortunate that Professor P. Erdős from Hungary, and Professor R. Stanton from Manitoba, both leading figures in the fields of graph theory and combinatorics were able to attend. The talks covered graph theory, design theory and computing. Some were strictly theoretic; others resulting from wide ranging applications, e.g. encryption methods and weaving.

My talk concerned the constructibility of layouts with given outerplanar adjacency graphs and constraints. I spoke about how this could be done for the convex polygon case and discussed my own research in the rectangular case. Several talks related closely to my own work. Dr R. Eggleton (Newcastle) spoke about the rectilinear drawings of graphs. Dr P. Eades (Queensland) gave two talks; one "Heuristics for drawing two-layered networks", the other concerning "the Spremb Graph Drawing System". Both of them were interested in my work and we were able to hold some valuable discussions. Professor C. Colbourn (Waterloo), whose papers on outerplanar graphs I have used, suggested extending my work to series parallel graphs and gave some useful references.

I also met several other Ph.D. students which was interesting for discussing and comparing similar problems. This was the first conference I have attended and I found it very rewarding. Not only were the talks stimulating but also valuable was the change to meet others working in the same areas. I have established some contacts and hope for future correspondence. Overall, the Conference was an enjoyable worthwhile experience.

Inessa Levi:

At the end of 1984 I was awarded a Post-Graduate Student Travel Grant. It partially covered my expenses for attending the Third Australasian Mathematics Convention (University of New South Wales, Sydney, May 13-17, 1985) and the Third Annual Algebra Conference of Victoria (La Trobe University, Melbourne, May 18-19, 1985). At the Convention in Sydney I presented a paper entitled "Automorphisms of Normal Transformation Semigroups", and at the Conference in Melbourne I presented a paper entitled "On the set of Ranges of a Transformation Semigroup".

I met a number of specialists in Semigroup Theory, amongst them are Prof. K.D. Magill and Prof. S.S. Magill (SUNY at Buffalo, New York), Prof. G.B. Preston, Dr T.E. Hall, Dr D.C. Trueman (Monash University, Melbourne), and I attended a number of talks in Algebra and related areas.

#### IMA JOURNAL OF APPLIED MATHEMATICS

I would like to inform readers that I (Professor Graeme Wake, Department of Mathematics and Statistics, Massey University, Palmerston North) have accepted the position as an Associate Editor of the Institute for Mathematics and its Applications (IMA) Journal of Applied Mathematics (U.K.). This Journal covers all branches of mathematics of relevance in applications with particular emphasis on problems arising in industry. Further, the new Executive Editor (Dr J.R. Ockendon) has set the policy to "strengthen the Journal's international coverage of modern analysis and differential equations" especially as it relates to the primary aim.

As an Associate Editor I would like to encourage authors to submit research papers and review articles in the above fields, either to myself at the above address or direct to the Executive Editor, for consideration for the IMA Journal of Applied Mathematics. Readers should note that it is planned in future to include at least one survey article on recent progress in topical fields of mathematics and its application in each volume of the Journal.

Graeme Wake

#### BASIC SKILLS IN MATHEMATICS

This is the title of a series of 13 'teach yourself' modules on elementary algebraic manipulation, trigonometry and so on. The complete series can be obtained for \$10 a copy from the author,

S.D. Forbes,  
c/o Mathematics Department,  
Victoria University of Wellington,  
Private Bag,  
Wellington.

## Conferences

\*\*\*1986\*\*\*

- May 12-16  
(Perth) *30th Annual Meeting of the Australian Mathematical Society*  
Details from R.P. Sullivan, Department of Mathematics, University of Western Australia, Nedlands WA 6009, Australia.
- May 19-23  
(Singapore) *Combinatorics and Graph Theory Meeting*  
Details from C.C. Chen, Department of Mathematics, National University of Singapore, Lower Kent Ridge Road, Singapore 0511.
- May 19-21  
(Christchurch) *New Zealand Mathematics Colloquium*  
Details from B.A. Woods, Department of Mathematics, Canterbury University, Christchurch, New Zealand.
- May 20-23  
(College Park, Maryland) *International Conference on the Physics of Phase Space*  
Details from Y.S. Kim, Department of Physics and Astronomy, University of Maryland, College Park, Maryland 20742, U.S.A.
- May 28-30  
*The Mathematics and Applications of Remote Sensing*  
Danbury Management Centre; details from I.M.A., see below (b).
- June 1-5  
(Makone, Japan) *First Japan Conference on Graph Theory and its Applications*  
Details from Jin Akiyama, Department of Mathematics, Tokai University, Hiratsuka, 259-12 Japan.
- June 1-8  
(Lublin, Poland) *Ninth International Conference on Analytic Functions*  
Details from J.G. Krzyz, Instytut Matematyki UMCS, Plac Maria Curie-Sklodowskiej 1, 20 031 Lublin, Poland.
- June 2-6  
(Salisbury, Maryland) *Mathematical Modelling*  
Details from B.A. Fusaro, Department of Mathematical Sciences, Salisbury State College, Salisbury, Maryland 21801, U.S.A.
- June 2-6  
(Zadar, Yugoslavia) *Seventeenth Yugoslav Congress of Theoretical and Applied Mechanics*  
Details from Yugoslav Society of Mechanics - Seventeenth Congress 1986, Kneza Milosa 9/1, Yu-11000 Beograd, Yugoslavia.
- June 3-6  
(Lille, France) *IMACS International Symposium on Modelling and Simulation of Lumped and Distributed Control*  
Details from P. Borne, Institute Industriel du Nord, 59-651 Villeneuve d'Ascq, France.
- June 9-19  
(Minneapolis, Minnesota) *Stochastic Differential Systems with Applications to Control Theory, Electrical/Computer Engineering and Operations Research*  
Details from I.M.A., see below (a).
- June 15-20  
(West Lafayette, Indiana) *Fourth International Symposium on Statistical Decision Theory and Related Topics*  
Details from S.S. Gupta, Department of Statistics, Purdue University, West Lafayette, Indiana 47907, U.S.A..
- June 16-20  
(Grado, Italy) *Fifteenth International Symposium on Rarefied Gas Dynamics*  
Details from Conference Secretariat, Fifteenth Rarefied Gas Dynamics Symposium, Istituto di Meccanica, Facolta' di Scienze, Universita' di Trieste, P. le Europa 1, 34127 Trieste, Italy.

- June 17-21  
(Singapore) *Analysis Conference*  
Details from Organising Committee, Analysis Conference, Department of Mathematics, National University of Singapore, Lower Kent Ridge Road, Singapore 0511, Republic of Singapore.
- June 23-28  
(Marseilles, France) *La Combinatoire*  
Details from A.Z. Meier, CIRM, Luminy Case 916, Route Léon-Lachamp 70, F-13288 Marseilles Cedex 9, France.
- June 24-27  
(Antibes, France) *Seventh International Conference on Analysis and Optimization of Systems*  
Details from INRIA, Service des Relations Extérieures, Bureau des Colloques, Domaine de Voluceau-Rocquencourt, B.P. 105-78153 Le Chesnay, Cedex, France.
- June 30-July 4 *Tenth Prague Conference on Information Theory, Statistical Decision Functions and Random Processes*  
Details from Tenth Prague Conference, Utia Csav, Pod Vodarenskou Vezi 4, 182 08 Praha 8, Czechoslovakia.
- July 1-2  
(Oxford) *Mathematics in Major Accident Risk Assessment*  
Details from I.M.A., see below (b)
- July 1-4  
(Lyon, France) *European Turbulence Conference*  
Details from J. Mathieu, Ecole Centrale de Lyon, Laboratoire de Mecanique des Fluides, Boite Postale 163, F-69131, Ecully Cedex, France.
- July 2-12 *LMS Symposium on Non-classical Continuum Mechanics: Abstract Techniques and Applications*  
Details from A.A. Lacey, Department of Mathematics, Heriot-Watt University, Riccarton, Edinburgh EH14 4AS, Scotland.
- July 7-9  
(Oxford) *The Mathematical Theory of the Dynamics of Biological Systems*  
Details from I.M.A., see below (b).
- July 7-11  
(Hull) *Non-Standard Analysis and its Applications*  
Details from N.J. Cutland, Department of Pure Mathematics, University of Hull, Hull HU6 7RX, England.
- July 7-11  
(Novosibirsk, Siberia) *Fourth International Conference on Boundary and Interior Layers - Computational and Asymptotic Methods*  
Details from BAIL Secretariat, c/o Boole Press Ltd, P.O. Box 5, 51 Sandycove Road, Dun Laoghaire, Co. Dublin, Ireland.
- July 14-26  
(Toronto) *Oscillation, Bifurcation and Chaos: An International Conference in Differential Equations*  
Details from W.F. Langford, Department of Mathematics and Statistics, University of Guelph, Guelph, Ontario, Canada N1G 2W1.
- July 15-17  
(Tokyo) *Symposium on Recent Advances in Simulation of Complex Systems*  
Details from Japan Society for Simulation Technology, c/o Union of Japanese Scientists and Engineers, 5-10-11 Sendagaya, Shibuya-ku, Tokyo 151, Japan.
- July 21-26  
(Leuven, Belgium) *International Congress on Computational and Applied Mathematics*  
Details from L. Wuytack, Department of Mathematics and Computer Science, University of Antwerp-UIA, Universiteitsplein 1, B-2610, Antwerp/Wilrijk, Belgium.
- July  
(Oxford) *I.M.A. Control Group Conference*  
Details from I.M.A., see below (b)
- July 22-26  
(Edmonton) *Conference on Constructive Function Theory*  
Details from Constructive Function Theory - 86, Department of Mathematics, University of Alberta, Edmonton, Alberta T6G 2G1, Canada.
- July 23-31  
(Corvallis, Oregon) *1986 Corvallis Conference: Quadratic Forms and Real Algebraic Geometry*  
Details from W.B. Jacob, Department of Mathematics, Oregon State University, Corvallis, Oregon 94331, U.S.A.

- July 27-30 (Vancouver) *Tenth Summer Symposium on Real Analysis*  
Details from P.S. Bullen, Department of Mathematics, University of British Columbia, 121-1984 Mathematics Road, Vancouver, British Columbia, Canada V6T 1Y4.
- July 27- August 1 (Seattle) *Thirteenth International Biometrics Conference*  
Details from G. van Belle, Department of Biostatistics, University of Washington, Seattle WA 98195, U.S.A.
- July 28 - Aug 1 (Iowa City, Iowa) *Conference on Singularities*  
Details from R. Randell, Department of Mathematics, University of Iowa, Iowa City, Iowa 52242, U.S.A.
- July 28 - Aug 1 (Arlington, Texas) *Seventh International Conference on Nonlinear Analysis and Applications*  
Details from V. Lakshmikantham, Department of Mathematics, University of Texas, Box 19408, Arlington, Texas 76019, U.S.A.
- July 29 - Aug 1 (Canton, New York) *Conference on Continuous Time, Fractional and Multiobjective Programming*  
Details from C. Singh, Department of Mathematics, St Lawrence University, Canton, New York 13617, U.S.A.
- July 30 - Aug 1 (Bethesda, Maryland) *Conference on Universal Algebra and Lattice Theory*  
Details from G. Hutchinson, Building 12A, Room 3045, DCRT-LSM, National Institutes of Health, Bethesda, Maryland 20205, U.S.A.
- July 30 - Aug 2 (Palo Alto, California) *Computers in Mathematics*  
Details from R.D. Jenks, IBM Research Center, P.O. Box 218, Yorktown Heights, New York 10598, U.S.A.
- August 3-11 (Berkeley) *International Congress of Mathematicians*  
Details from ICM-86, P.O. Box 6887, Providence RI 02940, U.S.A.
- August 6-9 (New Haven, Connecticut) *First IMACS Symposium on Computational Acoustics*  
Details from D. Lee, Code 3332, Naval Underwater Systems Center, New London, Connecticut 06320, U.S.A.
- August 11-16 (Victoria, B.C.) *Second International Conference on Teaching Statistics (ICOTS 2)*  
Details from T. Lietaer, University Extension Conference Office, University of Victoria, P.O. Box 1700, Victoria, British Columbia B8W 2Y2, Canada.
- August 18-22 (Dortmund, West Germany) *Bifurcation, Analysis Algorithms Applications*  
Details from T. Küpper, FB Mathematik, Universität Dortmund, Postfach 50 05 00, D-4600 Dortmund 50, Federal Republic of Germany
- August 23-26 (Innsbruck, Austria) *International Symposium on Probability and Bayesian Statistics*  
Details from R. Viertl, Institut für Statistik und Wahrscheinlichkeitstheorie, TU Wien, A-1040 Wien, Austria.
- August 25-29 (Prague) *Sixth Prague Topological Symposium*  
Details from Z. Frolik, Matematický ústav ČSAV, Žitná 25, 115 67 Praha 1, Czechoslovakia.
- Aug 25 - Sep 13 (Berkeley, California) *Microprogram on Nonlinear Diffusion Equations and their Equilibrium States*  
Details from Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, California 94720, U.S.A.
- September 4-7 (Poznan, Poland) *Polish Symposium on Interval and Fuzzy Mathematics*  
Details from J. Albrycht, Institute of Mathematics, Technical University of Poznan, ul. Piotrowo 3a, 60-965 Poznan, Poland.
- September 7-9 (Cardiff) *The Mathematics of Surfaces*  
Details from I.M.A., see below (b)
- September 8-13 (Halle) *Algebra-Tagung Halle 1986*  
Details from Algebra-Tagung 1986, Sektion Mathematik, Martin-Luther-Universität, Universitätsplatz 6, Halle-Wittenberg, DDR-4010 Halle, German Democratic Republic.

September 8-14 *First World Congress of the Bernoulli Society for Mathematical Statistics and Probability*  
(Tashkent, U.S.S.R.) Details from K. Krickeberg, U.E.R. de Mathématiques, Logique Formelle et Informatique, Université de Paris V, 12 rue Cujas, F-75005 Paris, France.

September 22-26 *IFAC-IMACS Symposium on Simulation of Control Systems*  
(Vienna) Details from I. Troch, Technische Universität Wien, Wiedner Hauptstrasse 6-10, A-1040 Wien, Austria.

September 22-27 *Orthogonal Polynomials and their Applications*  
(Segovia, Spain) Details from F. Marcellan, Departamento de Matemáticas, Universidad Politécnica de Madrid, Calle Gutierrez Abascal 2, E-28006 Madrid, Spain.

September 23-25 *Optimization and Simulation of Large Scale Systems*  
(Reading) Details from I.M.A., see below (b).

September 29-30 *Computers in Mathematical Research*  
(Cardiff) Details from I.M.A., see below (b).

October 5-9 *International Symposium on Operator Theory*  
(Ann Arbor, Michigan) Details from F.J. Beutler, Department of E.E.C.S., East Engineering Building, The University of Michigan, Ann Arbor, Michigan 48109, U.S.A.

December  
(Oxford) *Cryptography and Coding*  
Details from I.M.A., see below (b).

\*\*\*1987\*\*\*

January 26-30 *56th Congress of the Australian and New Zealand Association for the Advancement of Science*  
(Palmerston North, N.Z.) Details from Dr M. Baxter, Dept of Microbiology & Genetics, Massey University, Palmerston North, New Zealand.

June 15-July 3 *Microprogram on Commutative Algebra*  
(Berkeley, California) Details from Mathematical Sciences Research Institute, 1000 Centennial Drive, Berkeley, California 94720, U.S.A.

June 23-26 *Sixth IMACS International Symposium on Computer Methods for PDE's*  
(Bethlehem, Pennsylvania) Details from IMACS Secretariat, Department of Computer Science, Rutgers University, New Brunswick, New Jersey 08903, U.S.A.

August 24-28 *Conference on Differential Equations "Equadiff '87"*  
(Xanthi, Greece) Details from J. Schinas, Equadiff '87, Democritus University of Thrace Section of Applied Mathematics, 67100 Xanthi, Greece.

(a) Institute for Mathematics and its Applications,  
University of Minnesota, 514 Vincent Hall,  
206 Church Street S.E., Minneapolis,  
Minnesota 55455, U.S.A.

(b) The Deputy Secretary,  
The Institute of Mathematics and its Applications,  
Maitland House, Warrior Square, Southend-on-Sea,  
Essex SS1 2JY, England.

Appel, Haken and the rest were not the first to solve the 'Four Karla Problem', since George Smiley beat them to it.

- John 'the Square'



Thomas Lee Taylor



## Centrefold

MICHAEL SAUNDERS

Dr Michael A. Saunders was the inaugural recipient of The Mathematical Programming Society William Orchard-Hays Award in Computational Mathematical Programming. This award,

"for his innovative mathematical work which has advanced significantly the design and implementation of nonlinear programming algorithms, and for establishing the standard in versatile, reliable and available software in this field",

was presented to him by Prof. G.B. Dantzig in a ceremony during the 12th International Symposium on Mathematical Programming, at M.I.T. on 5 August 1985.

This event justifies a brief and regrettably impersonal look at his career ... perhaps someone can flesh out the bones.

Born in 1944 in Christchurch (N.Z. of course), Dr Saunders graduated from the University of Canterbury: 1962-65, B.Sc. with First Class Honours in mathematics. Since then, he has divided his time between the A.M.D. of the D.S.I.R. (1965-67, 1972-74, and 1977-79 as Scientific Officer and then as Scientist) and Stanford University (1967-72, gaining M.Sc. and Ph.D. in computer science, 1975-77 and 1979 on, as Research Associate and then Senior Research Associate in the Systems Optimization Laboratory at the Department of Operations Research). In addition, he had short spells in the National Physical Laboratory, Teddington, England (October 1972, as Visiting Research Fellow) and the Department of Mathematics, University of Linköping, Sweden (May - June 1981, as Guest Professor).

G.J. Tee

## Problems

Graeme Wake at Massey University has agreed to take over this feature, beginning with the August issue. He will tell you more about his ideas then, but meanwhile, do let him know about your problems - and about your answers to earlier ones. (If I find time, I may reveal the origin of the 'nags, tags and flags' ... )

\* This centrefold really is a fraud. The only picture of Dr Saunders that we could find, would not stand enlargement or printing.

# Notices

MASSEY UNIVERSITY

POST-GRADUATE SCHOLARSHIP IN APPLIED MATHEMATICS

(Tenure: three years)

An opportunity has arisen for a post-graduate student to participate in a program of Ph.D. research into the mathematical modelling of the effects of water content on the ignition characteristics of brown coal. The project will involve working with a group concerned with the formulation, solution, and experimental verification of the appropriate differential equation model. The funding has been provided by the Department of Scientific and Industrial Research. It is expected that the appointee will have considerable mathematical expertise, some sympathy for experimental work, and have qualified for an honours degree in engineering or science. Emolument will be equivalent to the University Grants Committee Post-graduate scholarship (currently \$8000 p.a.) and is tax free.

Persons interested should contact Professor Graeme Wake, Department of Mathematics & Statistics, Massey University, Palmerston North. Full applications should also be sent to Professor Wake at this address by 31 May 1986\* and should contain a statement of academic record, and the name of a person to whom reference can be made, and a starting date.

\*Apply as soon as possible - this is a firm deadline!

## THE LONDON MATHEMATICAL SOCIETY

Burlington House, Piccadilly, London W1V 0NL

Incorporated by Royal Charter

The Society was established in 1865 for the promotion and extension of mathematical knowledge. Members of the New Zealand Mathematical Society are very welcome to join the London Mathematical Society under the Reciprocity Agreement, which enables certain formalities to be dispensed with and a reduced subscription to be applied. For the year 1985/86 the reduced subscription is 3.00 (US\$5.00).

Members of the New Zealand Mathematical Society may commence or continue their reciprocity membership of the London Mathematical Society during periods of temporary residence in the United Kingdom. They may then take advantage of all the facilities offered to London Mathematical Society members, such as use of the Society's extensive Mathematical Library at University College, London. They are also welcome to attend Society meetings, which take place about seven times a year.

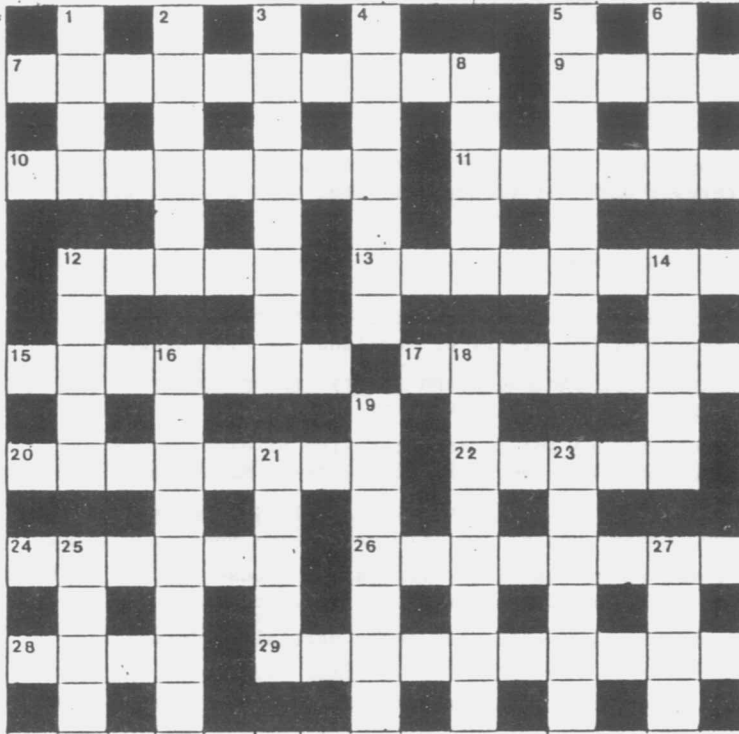
Members of the New Zealand Mathematical Society resident outside the United Kingdom may be chiefly interested in subscribing to the periodicals of the L.M.S. These are the Bulletin, the Journal and the Proceedings of the London Mathematical Society. One volume of the Bulletin is published per year, and two volumes each of the Journal and Proceedings. Members of the New Zealand Mathematical Society may purchase periodicals at special rates on condition that they are for personal use of members and not for the supply of libraries or similar institutions.

The London Mathematical Society also publishes a series of Monographs, Lecture Notes, Students Texts and the proceedings of its Instructional Conferences. Members may purchase these books at a discount of 25%.

Full particulars of the activities of the L.M.S. and application forms for reciprocity membership may be obtained from the Administrative Assistant of the L.M.S. at the above address.

# Crossword

No. 18 'NAY, WE ARE SEVEN' by Matt Varnish



Down:

1. The extent before the house (4)
2. Uneven left-over (3,3)
3. Fold a fiver (that is right) for checker (8)
4. Barely runs about starkers - not right! (7)
5. Burntwood for drawing fish carbon (8)
6. Nearly fall at the church's east end (4)
8. Royal look of any glare or large lager (5)
12. Healthy round five is to part have about fifty (5)
14. Mad about Annie (5)
16. Perhaps a centurion who sells wax lights (8)
18. End lamer to be with the Mayor (8)
19. Ties up the estate with a letter's adornments (7)
21. Breathless I Ching topping (5)
23. Graduate mariner is hard rock (6)
25. Intend a mingy form of the last word (4)
27. Funny bone for uncited lunatic (4)

Across:

7. Yul Brynner, Steve McQueen, James Coburn, Charles Bronson, Horst Buchholz, Robert Vaughan (4,6)
9. Prudence, Fortitude, Temperance, Justice, Faith, Charity (4)
10. Howard Keel, Jeff Richards, Russ Tamblyn, Tommy Rall, Marc Platt, Matt Mattox (8)
11. Brewer, Stewer, Davy, Widdon, Hawk, Cobley (6)
12. Bishamon, Daikoku, Fukurokuju, Jurōjin, Benten, Ebisu (5)
13. Virginia Gibson, Nancy Kilgas, Jane Powell, Norma Doggett, Julie Newmeyer, Betty Carr (8)
15. Alcyone, Maia, Merope, Taygete, Celaeno, Asterope (7)
17. Palatine, Capitoline, Quirinal, Viminal, Esquiline, Aventine (7)
20. Maximian, Malchus, Marcian, John, Denis, Constantine (8)
22. Merek, Phecda, Alcor, Mizar, Alkaid, Megrez (5)
24. Bonfilias, Falconieri, Bonagiunta, dell'Antella, Sostegni, Ugucione (6)
26. Polynices, Capaneus, Parthenopaeus, Hippomedon, Tydeus, Amphiaraus (8)
28. Trelawney, Lloyd, Turner, Bancroft, Ken, White (4)
29. Holland, Zealand, Utrecht, Friesland, Groningen, Overijssel (10)

## CROSSWORD No. 17 Solution

Across:

7. J.E. Littlewood; *A Mathematician's Miscellany*. 9. Joseph Hall; *Virtues and Vices (1608)*.
10. Rudyard Kipling; *The Day's Work* (referring to a locomotive). 11. Samuel Butler; *Hudibras*.
12. William Blake; *Auguries of Innocence*. 13. Dante Gabriel Rossetti; *The Blessed Damozel*.
15. James Sloane Gibbons; *Three Hundred Thousand More*. 17. Jean Ingelow; *Work*.
20. Henri Poincaré; Author's Preface, *The Foundations of Science*, translated by G.B. Halstead.
22. G.H. Hardy; as quoted by C.P. Snow in *The Saturday Book No. 8*.
24. George Orwell; *Animal Farm*. 26. Walter de la Mare; *Five Eyes*.
28. Alexander Pope; *Epistle to Dr Arbuthnot*. 29. William Wordsworth; *I Wandered Lonely as a Cloud*.

Down:

1. Tick, 2. Utopia, E. Perigean, 4. Forgery, 5. White-eye, 6. Clue, 8. Debts, 12. Boito, 14. Thoby, 16. Banneret, 18. Nihilism, 19. Tenders, 21. Aglow, 23. Ramrod, 25. Rood, 27. Ruth.

## Visitors

Correct at 3 March 1986

The information is arranged as follows: name of visitor; home institution; whether accompanied; principal field of interest; dates of visit; principal host institution; principal contact; comments.

### Definite Visits:

Professor C.J. Colbourn; University of Waterloo, Ontario; wife; combinatorics, graph theory, computer networks; 5 Jan 1986 - 31 May 1986; University of Auckland; Dr P.B. Gibbons.

Professor C. Godsil; Simon Fraser University, Canada; graph theory- group theory; June - August 1986; University of Otago; Professor D.A. Holton.

Dr J.A. John; University of Southampton; spouse and children; design of experiments; 1 Feb 1986 - 31 Jan 1987; DSIR Applied Maths Auckland Substation; Dr J. Maindonald.

Professor Leonid Pismen; Technion-Israel Institute of Technology, Haifa; nonlinear dynamics and chemical instabilities; June 1986; Massey University; Professor G.C. Wake.

Professor M.D. Plummer; Vanderbilt University, Nashville, Tennessee; spouse and two children; graph theory; June - August 1986; University of Otago; Professor D.A. Holton.

Professor Ivar Stakgold; University of Delaware; wife; nonlinear partial differential equations; Jan - Feb 1987; Massey University; Professor G.C. Wake.

Dr L.A. Szekely; Eötvös L. University, Budapest; combinatorics; Jan 1986 - December 1986; University of Auckland; Dr N.C. Wormald.

Professor Warren J. Wong; University of Notre Dame, South Bend, Ind.; wife and one child; finite groups; 20 December 1985 - 30 June 1986; University of Auckland; Dr M.D.E. Conder.

### Very Likely Visits:

Dr Agnes Hertzberg; Imperial College of Science and Technology; design of experiments, biometrics; September 1986; DSIR Applied Maths Auckland/Wellington; Dr J. Maindonald.

Professor John Howie; St Andrews University, Scotland; wife; algebraic semigroups; 15-20 April 1986; University of Auckland; Professor I.L. Reilly.

Dr Peter M. Neumann; The Queen's College, Oxford; wife?; group theory, algebra, history of algebra; September 1986; University of Auckland; Dr M.D.E. Conder.

Dr Desmond Patterson; ARC Unit of Statistics, University of Edinburgh; design of field experiments; 10-15 March 1986; DSIR Applied Maths Auckland; Dr J. Maindonald.

One of the main aims for this listing is to enable institutions other than the principal host institution to invite visitors to spend time with them. Anyone wishing to issue such an invitation should do so through the listed principal contact.

Please Note: The production of these lists and the coordination of visits is dependent on my receiving information. When you have information about a visit, whether it be definite, very likely or possible, would you please forward the information to me at the earliest convenience.

Next Deadline: 5 July 1986.

Gillian Thornley (NZMS Visitors' Coordinator), Department of Mathematics and Statistics, Massey University, Palmerston North.

# Secretarial

## MINUTES OF THE EIGHTEENTH COUNCIL MEETING OF THE NEW ZEALAND MATHEMATICAL SOCIETY

held in the Science Centre, Wellington, on 2 December 1985

PRESENT: Ivan Reilly (in the Chair), Mike Carter, Marston Conder, John Harper, Murray Jorgensen, Charles Little, John Shanks, Brent Wilson.

Also in attendance: Lindsay Johnston and Dean Halford (by invitation).

The meeting was declared open at 10.10 a.m.

1. APOLOGIES: Earl Irving (President of N.Z.A.M.T.), Ernie Kalnins  
Moved from the Chair that apologies be accepted

CARRIED

2. MINUTES OF THE 17TH COUNCIL MEETING (ON 27 MAY 1985):

Moved (MCo/JS) that the Minutes be adopted as a true record of the proceedings of that meeting

CARRIED

3. MATTERS ARISING FROM THE MINUTES:

- (a) Discussion took place on the matter of nominations to the National Committees.

Moved (JH/MCo) that Gloria Olive be nominated for a further three-year term on the National Committee for Mathematics

CARRIED

Moved (JH/MCo) that in the event of nominations for National Committees being required at times other than those closely following times of Council meetings, the President and Secretary should circulate this information to Council members in order to obtain their suggestions

CARRIED

It was also resolved to ask the RSNZ to provide the Council with a timetable of calls for such nominations, as well as closing dates for applications and nominations for RSNZ awards and other such matters.

- (b) JS reported that there had been some difficulty in finding a new Auditor.

Moved (MJ/JH) that the Treasurer be empowered to seek the services of a commercial Auditor if necessary

CARRIED

At this point, Lindsay Johnston arrived to talk about the Sixth Form texts. See item 7(a). Upon LJ's departure, the meeting turned back to matters arising from the Minutes of the previous Council meeting.

- (c) IR reported that Professor I.M. James, President of the London Mathematical Society, was currently in New Zealand, and that he would announce that Professor E.C. Zeeman would be the first Forder Lecturer, visiting New Zealand in May 1987.

Discussion followed. IR urged that the Society should promote the Public Relations side of this visit, and suggested that the Forder Lecturer might be asked to give a mini-series of lectures at the 1987 Colloquium. It was resolved that the organisers of the 1987 Colloquium should be approached about this. MJ suggested also that a

meeting could be set up to introduce Professor Zeeman to the Minister(s) of Education and Science when the visit takes place, and Council members agreed that such a meeting was well worth promoting.

- (d) The results and judges' comments from the 1985 Mathematics Project Competition for teachers were circulated, and some thought was given to the future of the competition. It was agreed that the competition should take place next in 1990, and thereafter on a five yearly basis if this proved satisfactory.
- (e) Some debate occurred on the subject of the quorum for AGMs held outside New Zealand. It was recognised that an AGM must be held each year, and the Society should continue to hold an AGM in Australia whenever the New Zealand Colloquium takes place in conjunction with the annual meeting of the Australian Mathematical Society. No change in the quorum for these meetings was recommended. Once again it was agreed that a special meeting was needed to ratify the decisions of the last AGM, and this special meeting should occur immediately before the next AGM, in 1986.
- (f) BW reported on arrangements for the 1986 Post-graduate Thesis Competition. He proposed that each entrant be provided with a form, to be submitted by the entrant's supervisor with comments on the quality of writing in the thesis, and that these forms could be used to assist in the judging process. Some objections to this proposal were raised, but it was noted that the comments on these forms would not be used as the main criteria for assessment of the entries. It was agreed that BW should handle both the advertising and the judging of the competition for 1986, and the results should be announced at the Colloquium in Christchurch (May 1986).
- (g) Discussion on the matter of additional funds for the development of mathematics was postponed until the end of the meeting.
- (h) JH distributed a written report which he and MJ had prepared concerning the NZMS archives, and also produced a detailed list of the contents of boxes held in the archives (at the Science Centre).

Moved (JH/MCa) that Dr Margaret Harper be thanked for her assistance in cataloguing the NZMS archives.

CARRIED

Moved (JH/MCa) that copies of publications of other organizations need not be kept in the NZMS archives.

CARRIED

MJ reported that some gaps had been found in the archival collection of NZMS Newsletters, even after Dr John Curran had furnished the copies he had held during his term as Newsletter Editor. MCo announced that Dr P. Ramankutty of Auckland University had kindly donated his own copies of the missing issues, and these were subsequently placed in the Archives. MJ agreed to send a small number of the surplus copies of recent issues to the current Newsletter editor (Dr Mark Schroder at Waikato University), and to dispose of the rest.

Moved (JH/MCo) that writers of NZMS publications should be asked to send one copy of each new publication to the NZMS archivist, in addition to the two copies which must be sent to the National Library

CARRIED

JH agreed to act as the NZMS archivist, and it was decided that his name should be added to the list of NZMS officials.

- (i) Brief consideration was given to the matter of a special general meeting (to ratify the decisions of the last AGM). It was resolved that a Notice of Special General Meeting be sent out together with the Notice of the Annual General Meeting, in or before the April 1986 issue of the Newsletter.

## 4. CORRESPONDENCE:

Moved from the Chair that the inwards correspondence be accepted and the outwards correspondence be noted

CARRIED

## 5. MATTERS ARISING FROM THE CORRESPONDENCE:

- (a) The Society's subscription to the CSMA Newsletter was questioned. It was agreed that such newsletters ought to be received only in exchange for the NZMS Newsletter, and otherwise no subscription should be paid.
- (b) Council noted with appreciation the \$500 donation from Professor J.T. Campbell.
- (c) On the matter of mathematical visitors to New Zealand, MCo advised that the organisers of the 1986 Australian Mathematical Society Conference had asked to be advised of anyone who might be a suitable invited speaker for that conference. It was noted that also Dr Gillian Thornley (co-ordinator of visitors) should be advised on this matter.
- (d) Consideration was given to requests by Professor Derek Holton for financial support for various mathematical activities. The first of these was a regional conference in Combinatorial Mathematics, and it was agreed that IR and MCo should ascertain the expected size and duration of this conference and offer the appropriate amount of support up to a maximum of \$300. The second request was for support of a New Zealand contingent to the 1988 International Mathematical Olympiad. After some discussion it was reconfirmed that such support ought to be left to N.Z.A.M.T. and to individual members of the Society, and that the organisers of the contingent should be offered the use of the Newsletter should they wish to publish their activities. The final request concerned a contribution towards the costs of travel to New Zealand by a distinguished overseas mathematician. It was noted that the Society is not in a position to provide such support, and that there are alternative sources for this sort of finance. MCo agreed to write to Professor Holton and suggest these alternatives.
- (e) MCo requested advise (as Secretary) on the advertisement of RSNZ awards. It was agreed that a timetable of these and other matters should be obtained from the RSNZ, and that whenever possible such items should be advertised in the Newsletter, or otherwise circulated to Council members and/or Heads of Departments of Mathematics.
- (f) A response was formulated to an inquiry from the National Research Advisory Committee as to whether the Society would like to participate in a review of the needs of research in mathematics and statistics. Council members unanimously agreed that the Society should participate, and that collaboration with the Statistical Association and the Operations Research Society should be sought, and also that the National Committees be contacted on this matter. MCo agreed to reply positively to the N.R.A.C.'s inquiry, and invite them to submit a more detailed proposal which could perhaps be placed in the April 1986 issue of the Newsletter.
- (g) Consideration was given to a request for comments on the government reports "Sport on the Move" and "Recreation and Government in New Zealand". It was decided to make no comment.
- (h) Brief discussion took place on a suggestion by JH that universities and other governmental institutions be encouraged to utilise electronic mail systems, many of which are already in existence. It was decided that progress was being made in this direction, and that Council should reconsider the matter at its next meeting.

The meeting adjourned for lunch at 12.30 p.m., and resumed at 1.45 p.m.

## 6. FINANCIAL REPORT:

JS advised that the Society's finances were in a healthy state, although the exact position could not be gauged because of fluctuations in the amounts of incoming and outgoing funds related to publications. With the wind-up of the 7th form Applied Maths series operation, the publications account no. 1 was about to be closed; and also most of the balance of the publications account no. 2 would soon be transferred to the general account. He reported also that of the Society's membership of 183, there remained 38 unpaid subscriptions for the year. Council members were satisfied with the current financial position.

## 7. PUBLICATIONS COMMITTEE REPORT:

CL reported on the various publications activities of the Society, and brought Council's attention to matters which were considered individually under their respective headings below:

- (a) "Secondary School Mathematics": Lindsay Johnston was in attendance earlier at the meeting (see item 3), and he advised that about 4000 books had been sold, with orders received for a further 150 copies. It was agreed that another 1000 copies should be printed, and that the price of these copies be raised to cover increased printing costs.

Moved (JH/IR) that Lindsay Johnston be thanked for his efforts in making these books available to secondary schools this year

CARRIED with acclamation

- (b) "Mathematics with Calculus": At this point Dean Halford was welcomed into the meeting, and he tabled a comprehensive report on this textbook for seventh form students. He advised that about two-thirds of all New Zealand secondary schools had bought copies, with orders exceeding the 2000 copies initially printed. Council ratified the decision to print another 1000 copies, and to increase the price of the book from \$17.50 to \$19.00 to cover the increase in costs of printing.

Moved from the Chair that Council record its appreciation of Dean Halford's efforts, and especially his achievement in making this textbook available so early

CARRIED with acclamation

Dean Halford also advised that the New Zealand Education Gazette had declined to publish a further announcement about the availability of the "Mathematics with Calculus" text, as commercial book publishers had complained that they saw the Gazette as giving free advertising to its competitors. IR and MCo agreed to write to the Department of Education in an effort to make them reconsider the hardening of their editorial policy.

- (c) "Mathematics with Statistics": It was reported that this text was about six weeks behind schedule, for a number of reasons. BW agreed to liaise with the writing team in Canterbury.
- (d) "Calculus": IR advised that a further 800 copies of this university text would be printed, and it was agreed to raise the price to \$20.00 per copy in order to cover increased printing costs. He reported also that Dean Halford had been commissioned to revise the text in 1986, and that it was hoped that a revised edition would be available for the 1987 academic year.
- (e) Seventh Form Applied Mathematics Syllabus Series: A report from Graeme Wake was received, concerning the wind-up of this operation.

Moved (MCo/JH) that Graeme Wake's report be accepted with thanks, noting that over 11000 copies of the Applied Mathematics booklets were sold over the years 1981 to 1985

CARRIED

Moved from the Chair that the report of the Publications Committee be adopted

CARRIED



## 8. MEMBER BODIES COMMITTEE REPORT:

MJ advised there had been no meeting of the Member Bodies' Committee since the last Council meeting, so there was nothing to report. He agreed to obtain from the RSNZ a timetable of closing dates of applications/nominations for their various awards and committees.

## 9. VISITING LECTURER CO-ORDINATOR'S REPORT

MJ advised that Dr Terry Speed of C.S.I.R.O. had agreed to be the NZMS Visiting Lecturer for 1986, and that university departments and the D.S.I.R. had been approached in the process of organisation of his visit.

MJ advised also that Professor Saunders MacLane had been offered the Visiting Lectureship for 1987, through Gloria Olive. Although Professor MacLane had not yet accepted the offer, it seemed certain that he would visit New Zealand in any case.

Some discussion took place on the "terms and conditions" of the lectureship. It was decided that there is no necessity to set out terms and conditions, but rather that the important thing is to choose a lecturer who is a good and popular speaker, one who is able to give talks to a wide range of audiences.

## 10. U.S.P. FUND REPORT:

A report was received from EK on the lack of response to letters he had written to the universities in Tonga and Fiji, advising them of the availability of the U.S.P. fund. MCo agreed to write to individual NZMS members in the South Pacific islands to inform them of the fund and to encourage them or others to apply.

## 11. CHANGE IN TIMING OF COUNCIL MEETINGS:

It was decided to discuss this matter at the next meeting.

## 12. FINANCIAL MATTERS CONCERNING PUBLICATIONS INCOME:

Some concern was expressed about the proposed Goods and Services Tax. Council members felt that no action was required at this stage but that the NZMS Auditor might be approached for advice on this matter.

## 13. PUBLIC RELATIONS:

IR circulated copies of an article by R.G. Keats which had appeared in the Gazette of the Australian Mathematical Society. Discussion was delayed until the end of the meeting.

## 14. ELECTION/REPLACEMENT OF COUNCIL MEMBERS:

CL reported that he wished to tender his resignation from Council, with effect from the AGM in May 1986, as he would be taking sabbatical leave later that year. Also MCa and JS advised that they were coming to the end of their terms as Council members. It was decided to call for nominations for an incoming Vice-President and two ordinary Council members, to take office immediately following the next AGM. MCo agreed to place a notice to this effect in the December issue of the Newsletter.

## 15. POST-GRADUATE STUDENT TRAVEL GRANTS:

Reports had been received from Ingrid Janjic-Rinsma and Robert Chan on their attendance at respective conferences in Australia. IR reported that he was waiting for a report from the third recipient, who had recently taken up a post-doctoral fellowship at the University of Hawaii.

Because of the delay in the appearance of the August issue of the Newsletter, MCo advised that he had put back the closing date for applications for the next grants to 15 January 1986. It was resolved that IR and MCo should make the decision on the amounts to be awarded to the applicants for the 1986 grants, and report back to Council.

## Book Reviews

THE MATHEMATICS OF SONYA KOVALEVSKAYA, by Roger Cooke. Springer-Verlag, New York etc. (1984), 234 pages.

Sonya Kovalevskaya was the first woman to become a professional mathematician. Born at Moscow in 1850, she studied privately with Weierstrass in Berlin, and became his favourite disciple. In 1883 Mittag-Leffler succeeded in getting her appointed to the University of Stockholm; she became Professor of Mathematics in 1884 and also Professor of Mechanics in 1885. She produced many literary works in addition to her nine mathematical papers. In 1891 she died at the age of 41.

Even if her mathematical work had not been significant, she would still have deserved to be remembered as one of the most remarkable people of the 19th century. She was a personal friend of many of the leading scientists, writers and revolutionaries of Europe, and she was a major pioneer in advancing the status of women. She was a world celebrity in her lifetime, and yet very little was published about her in English between 1895 and 1974. In recent years there have been several studies of her published in English, including a fine nontechnical biography by Ann Hibner Koblitz (A Convergence of Lives, Birkhäuser, Boston, 1983), and a notable film about her final years was made in Sweden in 1983 (A Mountain on the Far Side of the Moon, MovieMakers Sweden, 1983). Her grave remains a place of pilgrimage for scientists and for feminists.

This book performs the useful service of examining Kovalevskaya's mathematical work. It consists of Part 1 "Childhood and Education" and Part 2 "Mature Life", each consisting of a chapter of biography and three chapters on her mathematical work, followed by Chapter 9 on the diverse evaluations which have been made of Kovalevskaya's work. Many letters from or to Kovalevskaya are published here (some for the first time), in English translation. There are six appendices giving technical surveys of relevant branches of mathematics, a detailed bibliography and an index.

Kovalevskaya's nine mathematical papers were all written on themes by Weierstrass, and he acknowledged that some of his researches had been inspired by his discussions with her. Her work of 1875 on solutions of differential equations (commonly mis-called the Cauchy-Kowalewski Theorem) went much farther than Cauchy's work of 1842, which she learnt of only after her paper was published. Cooke shows that her principal aim was to get a usable definition of analytic functions as solutions of differential equations, but she obtained very general results about conditions which ensure the existence and uniqueness of solutions of differential equations. Weierstrass was strongly impressed by a counter-example which she produced, for the heat equation  $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$  and which led him to undertake new investigations of that equation. She showed that the method of undetermined coefficients, applied to the heat equation with initial condition  $u(x,0) = \frac{1}{x-1}$ , yields a divergent series. Her paper has had much influence on later investigators of solutions of differential equations.

Kovalevskaya's paper on Abelian integrals which reduce to elliptic integrals (1884) demonstrates her mastery of the intricate subject of Abelian integrals. Cooke provides an informative introduction to that subject, which was developed enormously in the 19th century but which is familiar to few mathematicians today.

In 1799 Laplace had published a study of Saturn's rings, modelling the rings as a solid formed by rotating an ellipse around the axis of Saturn. Using the assumption that a thin film of liquid on the ring's surface would remain in equilibrium, he computed the eccentricity of the ellipse. But he also proved that a uniform homogeneous gravitating ring could not be in a stable orbit, and in 1859 Clerk Maxwell showed that no solid or liquid ring could be stable; so that Saturn's rings must consist of many discrete particles. Nonetheless, Laplace's ring model remained of some interest as a mathematical problem, and in 1885 Kovalevskaya refined Laplace's model by considering harmonics higher than the second in the cross-section of the ring. She suggested a practicable method for solving the infinite set of equations for the coefficients, and she accomplished the very laborious computation of the coefficient of the third harmonic. Since Cooke's book was published, F.H. Burkhardt and S. Smith have published their valuable reference work A Calendar of the Correspondence of Charles Darwin, 1821-1822 (Garland Publishers, New York & London, 1985). That includes abstracts of some letters

between Charles Darwin and Kovalevskaya and her husband Vladimir Onufriyevich Kovalevskii (the founder of evolutionary palaeontology). Kovalevskaya wrote to Darwin on 1870 September 1, accepting thankfully his offer to borrow books for her from the Royal Society library. When Darwin wrote to her husband on 1874 January 24, he enclosed Clerk Maxwell's treatise on Saturn's rings, as a present for her.

Kovalevskaya's paper (1885) on propagation of light in crystals was based on Lamé's theory of elasticity. Her paper is largely devoted to the solution of Lamé's partial differential equations by a method of Weierstrass, which she published for the first time. She then applied Weierstrass's method to Lamé's equation to obtain the wave surface for light in a crystal. Four months after she died, Volterra discovered an error in her solution - like Lamé she had treated a certain multivalued function (a Weber coordinate of the wave surface) as a single-valued function. That error affected the final stage of her proof, and Volterra was able to amend her result to give the correct solution.

Kovalevskaya's greatest triumph was the award of the Bordin Prize in 1888 for her work on rotation of rigid bodies around a fixed point under gravity. Indeed, the judges increased the prize from 3000 francs to 5000 francs because of the merit of the essay, before the name of the author became known (officially, at any rate). Euler had solved the case without gravity, and Lagrange had solved the case of the ellipsoid of inertia of the body (around the fixed point) with two axes equal, and with the centre of mass on that axis of symmetry of the ellipsoid. Kovalevskaya proved that, if the coordinates are to be representable by power series in (complex) time, then the only cases (other than those of Euler and Lagrange) are those in which the ellipsoid of inertia has axes in the ratio 1:2:2, with the centre of mass in the equatorial plane. In a brilliant display of virtuosity she constructed the coordinates as explicit functions of time, in terms of theta functions of two variables.

Her final paper was a note on potential theory, in which she refined the proof of Bruns's Theorem.

Chapter 9 is devoted to comments by various mathematicians about Kovalevskaya. Her scientific work was praised highly by some mathematicians, including Poincaré, Zhukovsky, Nekrasov and Mittag-Leffler; but A.A. Markov persistently criticised her work and Gino Loria denounced women mathematicians generally, and Kovalevskaya in particular. Cooke reaches the conclusion, after analysing her work, that amongst the disciples of Weierstrass she does deserve her reputation as an accomplished mathematician, whose work continues to be of interest to scientists.

The printing (and the binding) of this book is of the high standard expected from Springer-Verlag. However, there are some instances where an expression has been cramped onto a single line to the detriment of its appearance, e.g. (p.186)  $(1/i!j!)D_1^i D_2^j f(0,0)$  would look neater as  $\frac{1}{i!j!}D_1^i D_2^j f(0,0)$ . The difficult problem of notation for partial derivatives becomes evident to the reader, with diverse notations being used in passages based on various sources. Euler's equation in calculus of variations is presented in a modern form (p. 206), followed by the remark that "In classical notation it was written  $\frac{\partial f}{\partial y} = \frac{d}{dx} \left( \frac{\partial f}{\partial y'} \right)$ ": but that "classical" notation is characteristic of the period 1870-1950. A few of the definite integrals are printed in the confusing form  $\int_a^x \frac{1}{y} dx$  (e.g. pp. 46 and 198). The only significant misprints noticed were  $w+1$  printed for  $w^2+1$  (p. 194, line 33),  $\frac{d\theta}{dt}$  for  $\frac{d\phi}{dt}$  (p. 197, line 32), and "algebraic functions" for "algebraic integrals" (p. 47, line 20).

The detailed Bibliography cites original publications of papers and also their occurrence in collected editions; but the citation of a paper by A.M. Lyapunov (1894) omits a citation of the collected edition of his works. The front cover prints the title against a background of an intricate mathematical manuscript - presumably some of Kovalevskaya's work on Abelian integrals. That text could usefully be identified, in later editions of this book.

STATISTICAL COMPUTATION, by J.H. Maindonald; Wiley (1984), xviii + 370 pages.

In "Statistical Computation" (John Wiley and Sons, 1984) we have another entrant in the field of statistical computing. How does it compare with two other relatively recent entries, Chambers' "Computational Methods for Data Analysis" and Kennedy and Gentle's "Statistical Computing"?

The Maindonald book resembles the former more than the latter in that it is relatively short (370 pages, compared to 268 for Chambers and 591 for Kennedy and Gentle) and aims to be a survey rather than a definitive work of reference. For many topics the reader in search of detailed information is referred to the references. In this respect, "Statistical Computing" is a more introductory book than Kennedy and Gentle. For example, Maindonald devotes less than two pages to a discussion of generation of pseudo random numbers, compared to Kennedy and Gentle's 30.

An exception is the attention given to computations for regression analysis. No less than 156 pages (about 40% of the total) are devoted to this topic. Most of the material in this section revolves round the use of the Cholesky decomposition of the  $X^T X$  matrix, (three chapters) with one further chapter (chapter 4) discussing orthogonal decomposition methods. Champions of QR methods may question the emphasis on the Cholesky decomposition at the expense of their favourite orthogonal decomposition, but Cholesky adherents certainly get their money's worth.

Chapters One to Three discuss methods for regression analysis based on forming the  $X^T X$  matrix and using the Cholesky decomposition. A lengthy discussion of the decomposition is provided, with three separate proofs of its existence. A detailed algorithm is given for programmers. There is considerable discussion of the use of the decomposition to compute regression coefficients, covariance matrices and residuals, and how the basic calculations may be modified to allow for dependent columns, addition and subtraction of variates; all subsets regression and variable selection, and weighted least squares.

Less space is devoted to orthogonalization methods, but Householder, Givens and Modified Gram-Schmidt are all treated, as are addition and deletion of rows. There is no discussion of efficient calculation of regression diagnostics, although these are defined. Detailed comparisons between the three orthogonalization methods are not made.

Chapter Five covers analysis of variance calculations. The first part of the chapter is devoted to such standard topics as the various types of parameterization of ANOVA models, identifiability constraints, estimable functions, R-notation, testable hypotheses and orthogonal models. Only then are algorithms for performing ANOVA calculations introduced. The usual Yates-Hemmerle method for balanced data is not discussed, but a reference to Kennedy and Gentle is given. The capabilities of the common statistical packages in the ANOVA area are described. Unfortunately the author (along with his competitors) declines the challenge of making the Wilkinson algorithm (the heart of GENSTAT'S ANOVA routine) understandable to the general public. Instead he provides a brief discussion of the Kuiper-Corsten algorithm, and a more detailed discussion of the conjugate gradient algorithm popularised by McIntosh.

Chapter six on multivariate calculations once again concentrates on the Cholesky decomposition. Topics covered are Hotellings  $T^2$ , one-way MANOVA calculations, multivariate regression and the use of the Cholesky decomposition in the generalised eigenvalue problem. No discussion of algorithms for extracting eigenvalues and vectors and computing the SVD is given although references are provided.

Non-linear models are the subject of Chapter Seven. The chapter begins with the solution of non-linear equations (mostly in one variable, although a description of the Newton-Raphson method for several variables is included), and then discusses a variety of non-linear models: Bradley-Terry models, log-linear models and generalised linear models. The models are introduced and details of their fitting given.

The remainder of the book deals with a series of separate topics. These are not covered in depth, but references are given to follow up interesting paths. Topics include robust regression, splines, time series (both time and frequency domain), random number generation, approximations to distributions, and a general discussion of computers, computer languages and statistical packages. Some programs in BASIC are included to perform regression calculations, calculate the SVD of a matrix of small order, compute the solution of a non-linear equation in one unknown, and also to illustrate various approximations to different distributions.

The book is written in a pleasing style, and there are not many errors. One error that may confuse is a mistake in the definition of the Householder transformation (p.137). The discussion of storage of upper triangular arrays on p.8 has the wrong formula for the location of the  $(i,j)$  element.

In summary, this book is a readable introduction to statistical computing. With the exception of regression calculations, most topics are not treated in depth, but good references are given. A notable omission is in the area of graphics: there is no discussion of this important topic.

Compared to its competitors, Maindonald's book lacks the encyclopedic coverage of Kennedy and Gentle, and gives less of the "computer science" type of material than Chambers, such as data structures and round off error. Chambers also discusses graphics. The strengths of the present book lie in its treatment of linear regression, and its comprehensive set of more than 220 references. It is written in an individual style, and certainly deserves a place on the shelf of anyone interested in statistical computing.

Alan Lee  
University of Auckland

MAXIMUM PRINCIPLES IN DIFFERENTIAL EQUATIONS, by M. Protter and H. Weinberger; Springer-Verlag (1984), x + 261 pages.

In very general terms a weak maximum principle for a differential equation (or inequality) is an assertion that every solution of the equation (or inequality) in the closure of a domain attains its maximum somewhere on the boundary; a statement which asserts that every solution that is non-trivial in some appropriate sense attains its maximum on and only on the boundary is referred to as a strong maximum principle. Historically, the first known maximum principle for partial differential equations appears to be the one about solutions of the Laplace equation in three dimensions. Although this result was known at least as long ago as 1839, it was not until almost a century later that maximum principles attained a status of prominence in the study of partial differential equations. The impetus came in 1927 from the pioneering work of the late Professor Eberhard Hopf who established strong maximum principles for second order linear elliptic inequalities in several variables without continuity hypotheses on the coefficients and applied these principles in the treatment of associated Dirichlet and Neumann problems. The importance and versatility of Hopf's approach were soon recognised and a strong maximum principle for equations of parabolic type was proved by L. Nirenberg in 1953. A maximum principle for hyperbolic equations was also established the same year by S. Agmon, L. Nirenberg and M.H. Protter. Several extensions and modifications of these and subsequent results and their applications to classical and generalized solutions of partial differential equations have been obtained by many researchers since then.

These numerous results on maximum principles lay scattered in various journals until the first printing of the book by Protter and Weinberger appeared in 1967. This book, which by now is regarded as a classic, contains a well coordinated and comprehensive account of various maximum principles and their applications within the framework of classical solutions. The material is presented in four chapters the first of which deals with ordinary differential equations, the remaining three being devoted to partial differential equations of elliptic, parabolic and hyperbolic types respectively.

As far as known to this reviewer, there has not appeared another book on similar material before or after the appearance of this one. This 1984 reprint must therefore be quite welcome to those interested in this area although it differs from the first version only to the extent that some minor typographical errors have been corrected.

P. Ramankutty,  
University of Auckland

LECTURES ON SIEVE METHODS AND PRIME NUMBER THEORY by Y. Motohashi (Tata Institute Lectures on Mathematics); Springer-Verlag (1983), xiv + 205 pages.

Number theory is regarded as the queen of mathematics. One of the flashiest and hardest gems in her crown is the topic of this set of research lecture notes, the area of 'sieve methods'.

Often in number theory we wish to estimate the size of some interesting set of integers, for example the primes not exceeding the real number  $x$ , or perhaps the primes not exceeding  $x$  which lie in a fixed congruence class. Classical prime number theory attacks this type of counting problem from an analytical perspective, e.g. associating certain summation expressions with corresponding integrals and then trying to estimate the latter. By contrast, a sieve method attempts to get bounding inequalities for such quantities by regarding them as the number of values in a certain set that are coprime to a chosen family of primes. As a very crude prototype one has the ancient sieve of Eratosthenes which, though really not much use for estimating anything, still has some of the required flavour. Modern sieves are much more powerful but full of complexity both in setting up the sieve and in deriving the estimates.

The first major sieve method was developed by Brun during the years 1915-20. His combinatorial approach gave bounds unattainable by classical methods, in particular the famous Brun-Titchmarsh inequality. Another pretty application involves the convergence of the series of reciprocals of twin primes (see Rademacher's Lectures on Elementary Number Theory, Blaisdell, 1964, Ch. 15). There are so many applications in the literature that it is hard to quarrel with Erdős's claim that Brun's method is perhaps our most powerful elementary tool in number theory.

In the 1940s Selberg, starting from investigations of the zeros of the Riemann zeta-function, developed another sieve method which to an extent superseded Brun's. Almost simultaneously Linnik, and later Renyi, popularized a technique somewhat dual to Selberg's known as the large sieve. Both these methods have been heavily used and further refined into essential tools of modern number theory. Yet another sieve method was discovered by Rosser around 1950, but it was never published in detail. Iwaniec and Jutila in the early 70s were the first to expound the idea of Rosser, and these lecture notes amplify their work.

The first chapter of Professor Motohashi's book deals in some detail, but in a very condensed style, with the methods of Selberg and Linnik stated in very general form. Then Rosser's sieve is discussed in depth, with smooth and weighted versions due to Iwaniec. To conclude Part I, the author describes linear sieves, including recent (1980) refinements. Many of the author's own contributions to the field are woven skilfully into the treatment and results are generalized or unified wherever possible. Part II consists of three chapters of applications of these methods to prime number theory. The main areas discussed are: zero-free regions for the zeta-function, zero-density theorems, and the existence of primes in short intervals or short arithmetic progressions. The theorems deduced show very clearly the power of the sieve approach. A useful feature is that each of the six chapters ends with an extensive note outlining the history and interrelationships of the results it contains.

It must be stated at this point that the book is very much a research monograph, really heavy going and certainly the "deep end" of what is an extremely complicated subject. There is much reference to the literature and condensation of argument. The reader would need to have mastered Davenport's book on multiplicative number theory (Springer, 1980, 2nd ed.) and Halberstam and Richert's (Academic Press, 1974) on sieve methods, neither of them my idea of light reading. Nevertheless this is a very impressive exposition of a high-powered and fascinating area of number theory and is a tribute to the author's mastery of a very difficult subject. It will be essential reading for research workers in the field, while the rest of us marvel at the pyrotechnics.

Dennis McCaughan,  
University of Otago

"Graph Theory Singapore 1983"; Proceedings of the First Southeast Asian Graph Theory Colloquium, held in Singapore May 10-28, 1983; Lecture Notes in Mathematics 1073, Springer (1984).

This is a collection of 30 papers together with a set of open problems posed by the participants, who originate from a number of countries in Asia and South East Asia, as well as Australia, Canada, England, France and the U.S.A.

Most of the articles give proofs of new results (mainly structural) in graph theory, but there are also two expository papers, by E.C. Milner on the (infinite) marriage theorem of Aharoni, Nash-Williams and Shelah, and by F. Harary on connectivity-like properties of graphs. Prominent topics amongst the papers include the graph reconstruction conjecture (for the square of a tree and "almost complete r-partite" graphs), chain decompositions of finite and infinite graphs, factors of graphs ("cube factors" and graph factors with prescribed and proscribed edges), tournaments and digraphs (including a partial result on Adám's conjecture that every digraph is acyclic or has an arc whose reversal reduces the number of cycles), computational complexity, cycles in graphs and graphical colour representation of algebraic structures (groups and inverse semigroups). In addition, some articles relate to subjects outside of graph theory: an article on the mobility of a graph, by J. Rooney and R.J. Wilson, concerns the mobility of spatial systems; P.J. Slater discusses definitions of centrality which have ramifications in operations research; and Fong Wei-Wu gives an algorithm for t-immersion of a graph in the plane, which is related to planar embedding of graphs, and problems arising in the design of integrated circuits.

N.C. Wormald

SECRETARIAL - from page 25

16. HONOURS FOR DISTINGUISHED NEW ZEALAND MATHEMATICIANS:

A confidential discussion took place on support by the Council for a nominee for the Queen's honours list. Members expressed the feeling that it is always pleasing to see mathematicians honoured in this way.

17. NOMINATIONS FOR FELLOWSHIPS OF THE RSNZ:

It was agreed to give consideration to this matter and discuss it more explicitly at the next meeting.

18. GENERAL BUSINESS:

A general discussion took place on items which had been postponed from earlier in the agenda. Debate centred around the topics of Public Relations and of the development of mathematics in New Zealand as a whole. It was agreed that the proposed review under the auspices of the N.R.A.C. would be a good vehicle for the promotion of mathematics.

There being no other business, the meeting closed at 4.20 p.m.

Marston Conder  
SECRETARY

EXERCISES IN NUMBER THEORY by D.P. Parent (Problem Books in Mathematics), Springer-Verlag (1984), x + 541 pages.

This is yet another outstanding book in the excellent series "Problem Books in Mathematics" edited by Halmos. The present volume is written, à la Bourbaki, by D.P. Parent, a pseudonym for a panel of twelve young French number theorists, leaders of the renaissance of the subject in France over the last fifteen years. It is an English translation of the 1978 volume "Exercices de Théorie des Nombres".

The book is based on the idea that a senior undergraduate or beginning graduate student can best attack topics in number theory by working through exercises as a supplement to the usual theory-first approach. This is an admirable and refreshing concept, for it puts motivation ahead of detail and imitates the way most people learn - by example first. The book provides more than 160 worked examples in the theory of numbers.

The book is divided into ten chapters of varying lengths. Each of these begins with a short summary of the relevant theory, then a series of (usually interdependent) exercises, and finally an extensive set of solutions. Typically the outline takes up 15%, the exercises 20% and the solutions 65% of the chapter. The topics covered are: prime numbers, arithmetic functions, Selberg's sieve; additive theory; rational series; algebraic theory; distribution modulo 1; transcendental numbers; congruences mod  $p$ , modular forms; quadratic forms; continued fractions;  $p$ -adic analysis. Most chapters run to 50 pages or so, but there are two very brief ones of about 20 pages each: those on additive theory and on quadratic forms. There is also a giant chapter of 126 pages, the first one on primes etc., the length being possibly in proportion to the number of authors!

The separate chapters show the effect of having a large crew of authors, for as well as the variation in length there is also variation in standard. Some of the exercises, e.g. those on continued fractions, are well within the range of an undergraduate, while others, e.g. those on transcendental numbers, are very much at graduate level. Another variation occurs because in some chapters the authors have decided to divide the work into a large number of small exercises (e.g. there are 49 exercises on distribution modulo 1) while others have given less than ten exercises which are much more substantial. Nevertheless this variety is part of the book's appeal. There is no doubt that working through the exercises will give the student a solid introduction to each topic and an appreciation of up-to-date techniques in action. Instead of the formal and rather distant atmosphere of many texts, this one conveys a feeling that the subject is human, alive and dynamic.

There are a few obvious misprints and some infelicities of translation, but these do not detract significantly from the book's merit. It is a mine of interesting and stimulating material and the authors are to be congratulated for their enterprise. This book deserves a place in all mathematical libraries and should be on the bookshelf of anyone teaching number theory.

Dennis McCaughan  
University of Otago

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