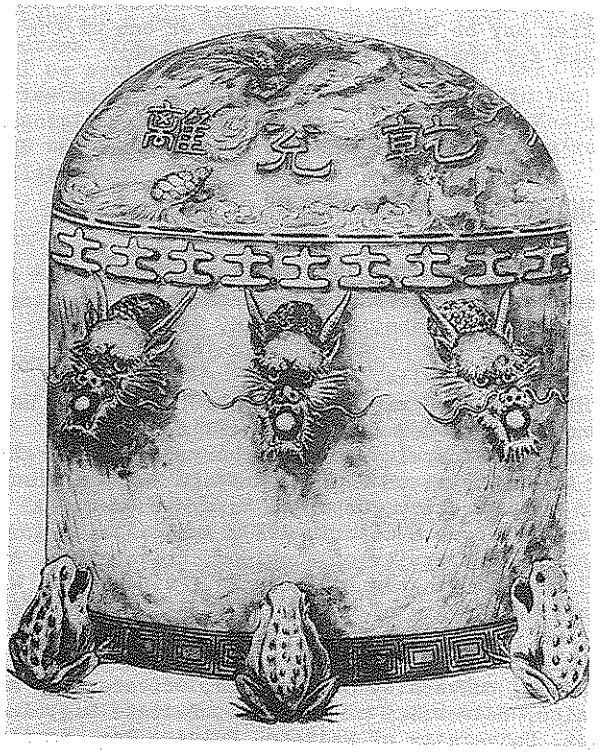
THE NEW ZEALAND MATHEMATICAL SOCIETY

NEWSLETTER



SEISMOLOGY

Seismoscope of Chang Hêng AD 132

CENTREFOLD

PROFESSOR DAVID SPENCE

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Editorial

As readers may know the production of the Newsletter has moved south to Otago University but hopefully the high standard set by Canterbury will be maintained. I am very grateful to the former editor, Ian Coope, for smoothing the transition, to Matt Varnish for continuing to provide challenging crosswords, and to the secretaries of the Mathematics Department at Otago, particularly Karen Smeets, for typing this edition during a period which saw the Department shift from one side of the Otago Campus to the other.

I am also very pleased to announce that Professor A. Zulauf of the Department of Mathematics at the University of Waikato has agreed to sub-edit the Problem Section of the Newsletter. Proposals of problems together with solutions and/or relevant references etc. should be sent directly to Professor Zulauf.

This issue features the New Zealand Mathematical Society Lecture delivered by Dr J.H. Ansell at the Massey Colloquium in May. Coverage of invited addresses at the Colloquium will continue in the next issue of the Newsletter. News items, notices and any other articles for publication in the Newsletter may be sent to the editor or one of the Honorary Correspondents listed below. Copy date for the next issue is 15 November.

John Curran
Editor

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OFFICERS OF THE SOCIETY, JUNE 1983 - MAY 1984

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	Dr J.A. Shanks,	University of Otago (to 1986)
	Dr D.J. Smith,	University of Auckland (to 1984)
Editor:	Dr M.J. Curran,	University of Otago

PRESIDENT'S ANNUAL REPORT 1982/83

On behalf of the Council of the New Zealand Mathematical Society, I have pleasure to present the ninth Annual Report of the Society.

The past year has seen a high level of support for the activities of the Society, with a continuation of the Society's previously successful activities as well as the introduction of new ones.

The Newsletter continues to flourish as one of the Society's most visible activities. The high standard in content and appearance has been due to the work of the Editor, Dr Ian Coope, to whom the Council has expressed its appreciation.

The Publications Committee, under the convenership of Dr Ivan Reilly, has sponsored the writing of a new first year Calculus text for New Zealand Universities. The writing team is drawn from four universities and has had feed-back from others. It is hoped that the text will be available for the 1984 academic year. The seventh form applied mathematics syllabus series has sold well - over 2,000 copies in the past year. The Council has agreed in principle with the suggestion from the New Zealand Association of Mathematics Teachers that NZMS and NZAMT should cooperate in publishing ventures aimed at the new Form 6 and Form 7 syllabi.

The Society now has a Common Seal featuring the NZMS kiwi in the centre.

A very successful Coordinating Service for Mathematical Visitors has been launched for the Society by Dr Dean Halford. The service is of considerable value and it is hoped that members will readily provide the necessary information.

A mathematics project competition for teachers is being run jointly by the Society and NZAMT. The closing date for entries is 1st June and considerable interest has been shown so far.

The Council has accepted the offer of the Australian Mathematical Society to conduct the 1985 Australasian Mathematics Convention at the University of N.S.W. and the 1988 Convention at the Australian National University (as part of Australia's bicentennial celebrations). It is hoped to hold a Summer Research Institute in New Zealand in January, 1985. This is being organised by Professor D. Gauld.

The Council expressed its concern to the Minister of Education on the cutbacks in university teaching fellowships for secondary teachers. The Minister's general reply was not encouraging and did not relate directly to the issues raised.

The Royal Society award scheme, known as the Prince and Princess of Wales Award Scheme, has now been officially launched and the details announced. It is to be hoped that this Society will financially support the scheme.

The President of NZMS was nominated by the National Committee on Mathematics to attend the General Assembly of the International Mathematical Union in Warsaw, August 1982, but declined to do so when the associated International Congress of Mathematicians was cancelled.

At its December 1982 meeting, the Council coopted Dr John Shanks to the Council to act in the role of incoming Secretary until the 1983 AGM. The 1982 NZMS Visiting Lecturer was Dr Graham Read of the Open University, U.K.

The Council has clarified the position of the New Zealand Vice-Chancellor's Committee on New Zealand academics who wish to teach at the University of the South Pacific. The Council is also setting up a fund to assist mathematics students from the U.S.P. to undertake graduate studies in New Zealand.

It is with regret that we record the death of Dr Gopi Jain of Otago University in June 1982. The Council has supported the memorial appeal.

The Council had three full meetings during the year. The first at the Otago Colloquium, on 16 May 1982, the second at Victoria University on 7th December 1982 and the third at the Massey Colloquium on 22nd May 1983.

On behalf of the Society, I wish to thank all members of the Council for their work for the Society during the past year. Particularly, I would thank the Secretary Dr Ken Russell, the Treasurer Dr Joel Schiff and the Newsletter editor Dr Ian Coope.

J.H. Ansell
PRESIDENT

Local News

AUCKLAND UNIVERSITY

DEPARTMENT OF MATHEMATICS & STATISTICS

Dr Chao P. Chang retired at the end of March after serving 16 years with the department.

On Saturday, 30 April, Mr Chris King organised a very successful Centennial Open Day in the department.

On Saturday, 7 May, a re-union of departmental staff, old and new was held. The success of many weeks of preparation which Dr Bruce Calvert had spent in bringing this event to fruition, was proved by the large number of staff who attended.

Our congratulations go to Professor Alastair Scott on being elected a Fellow of the American Statistical Association. He is the first resident New Zealander to receive this honour.

Seminars:

Dr J.A. John (University of Southampton), *'Block Designs and Graph Theory'.*
Dr J. Waller (Raukaru Agricultural Research Centre), *'Factorial Designs for Experiments with Mixtures'.*
Dr David Robinson (King's College, University of London), *'Some modern aspects of General Relativity Theory'.*
Professor Kurt Hirsch (Queen Mary College, London), *'Groups with finitely many automorphisms'.*
Professor P.L. Kannappan (University of Waterloo, Canada), *'Applications of Functional Equations in Economics'*, and *'On Trigonometric Functional Equations'.*
Dr N.I. Fisher (Division of Mathematics & Statistics, C.S.I.R.O., Sydney), *'Statistical Aspects of Apparent Polar Wander Path Problems'* and *'Some New Techniques for the Statistical Analysis of Spherical Data'.*
Professor T. Hussain (McMaster University, Canada), *'On Fixed Point Theorems.'*
Professor G. Kalton (Institute of Social Research, University of Michigan), *'Imputing for Missing Responses in Surveys'.*
Dr Robert Davies (Director of Applied Mathematics Division, D.S.I.R. Auckland), *'Asymptotic Inference'.*
Dr Peter Thomson (Institute of O.R. & Statistics, Victoria University of Wellington), *'Delay Estimation'.*
Dr T.P. Speed (Chief of the Division of Mathematics & Statistics, C.S.I.R.O., Australia), *'The Analysis of Means and Variances'.*
Professor Erwin Kreyszig (University of Windsor, Canada), *'On the Historical Evolution of Functional Analysis'.*

I.L.R.

DEPARTMENT OF COMPUTER SCIENCE

During the celebrations for the centenary of the University of Auckland in May 1983, the Departmental display for Open Day included a fragment of Charles Babbage's Difference Engine, loaned by the Babbage family in Auckland. An Engineering student came to that display, to inspect the work of his great-great-great-great-grandfather.

The foundation Professor of Mathematics at Auckland University College, Professor George Francis Walker, M.A., arrived in Auckland at the end of April 1883. A few days later, on 1 May 1883, he went sailing with Professor Tucker and was drowned off Herne Bay. In 1980, a Memorial Wall was erected at Symonds Street cemetery, to record the names of people whose graves had been removed for motorway construction - that Memorial Wall contains the name of George Francis Walker, M.A. On 2 May 1983, 28 mathematicians and computer scientists of the University of Auckland assembled at that Memorial Wall, where Don Nield gave a speech to commemorate the first person appointed as Professor of Mathematics at Auckland University College.

Professor Fred Chipman has returned to Acadia University in Nova Scotia, after spending a sabbatical year in the Department.

During the second term, a weekly series of seminars on the Numerical Solution of Ordinary Differential Equations has been attended by members of the Departments of Computer Science and Mathematics & Statistics.

The Department has recently acquired a further 8 Z89 micro-computers, bringing our collection up to 35 Z89s.

G.J.T.

DEPARTMENT OF COMMUNITY HEALTH

The biostatisticians in the Department of Community Health have been busy lately, with both Alistair Stewart and Peter Mullins presenting papers at the recent joint ANZSERCH/APHA and Biometric Society in Brisbane. The papers presented were, respectively, *'Trends in Survival after Myocardial Infarction in Auckland'* and *'The Robust Approach to Outlier Detection'*. Alastair Anderson and Peter Mullins also attended the annual conference of the NZ Statistical Association in Wellington at the end of June.

WAIKATO UNIVERSITY

After prolonged, sometimes heated and sometimes tedious debate, we agreed to rationalize our courses for 1984, by (i) making no significant change at parts I or III, (ii) deleting the part II specialties of analysis and mathematical physics, (iii) collecting a part II core of calculus, matrix algebra and differential equations into two courses, and (iv) setting up a mathematical precursor for operations research.

Otherwise, wait for the next instalment ... something might happen!

M.S.

MASSEY UNIVERSITY

Greg Arnold and Hugh Morton both took short periods of sabbatical leave in May. Greg visited Australia, attending both the Australian Mathematical Society and the Biometrics conferences in Brisbane. An issue that aroused interest at the Biometrics conference was the allocation of resources to health care - it seems N.Z. is not the only country to have problems in this area. Greg also visited several C.S.I.R.O. establishments and universities. One thing that surprised him was the wide variety of attitudes in university statistics departments towards the teaching of service statistics courses - ranging from departments with huge service courses (enrolment 1500 or thereabouts) to departments that regard the teaching of service statistics as no business of theirs.

Hugh Morton spent his leave at the Princess Margaret Hospital in Christchurch, gathering data for his research into the mathematical modelling of athletic activity. With the enthusiastic help of the staff of the respiratory laboratory, he monitored respiration, blood lactic acid level and cardiac activity of athletes undergoing exercise. His aim is to relate this physiological data to the energy output requirements of athletes as measured, for example, by the acceleration of a sprinter.

Tom and Kay Hassard added a daughter to their family towards the end of June.

Dean Halford left late in June for a two-month sabbatical in Britain and Europe.

Seminars:

Carles Little, *'The Hadamard Conjecture and Embeddings of* $K_{4s,4s}$*'*.
Mike Hendy, *'Evolutionary Trees from Dissimilarity Data'*.
Bruce Aubertin, *'On the Uniqueness of Walsh Series Expansions'*.

M.R.C.

VICTORIA UNIVERSITY

Dr John Harper, previously the local columnist, departed on leave in late June to spend 7 months leave at Cambridge University, U.K. The Harper family are travelling to and from U.K. via North America.

With the creation of a new Department of Computer Science in 1984, the two O.R. experts (Professor Tony Vignaux and Dr Tapos Sarkar) will join the Department of Mathematics later this year. This will coincide with the launching of a new series in 1984 of under-graduate courses in O.R. in the Mathematics Department and the inauguration of honours/masters programs in O.R. and Statistics.

Professor David Spence concluded his N.Z. visit by a months tenure as Visiting Fellow at Victoria University of Wellington (see the Centrefold Article). Other recent visitors have included Professor Franco Einaudi from Georgia Institute of Technology who gave a lecture in our Geophysics series entitled *'Interaction between gravity waves and convective storms'*;

Dr Ross Urwin (a graduate of VUW), now at Pennsylvania State University, who gave a lecture on the *'Lie Algebra of Classical Observables and Classical Dynamics'*; Dr John Eccleston, of the University of New South Wales and Dr Terry Speed, Chief of D.M.S, C.S.I.R.O., Canberra who presented papers at the Experimental Design Day held directly after the annual conference of the N.Z. Statistical Association.

During late July Dr Ken Russell, ex-Secretary of the Society, will be visiting for two weeks the University of N.S.W. (his alma mater) as a Visiting Fellow to further research in experimental design. Dr Peter Thomson was in Sydney in May furthering his research in time-series related research with Dr Murray Cameron, D.M.S. He also assisted colleagues at D.M.S. with the analysis of cloud-seeding data.

Most VUW statisticians were involved in the annual N.Z. Statistical Association conference which was a great success. Planning is underway for the 1984 mathematics colloquium to be held at Victoria in May. It is expected that the standard of accommodation will be improved over the poor experience of some visitors in 1977.

A new series of research seminars on "current research" has been launched to stimulate interaction between applied mathematicians and theoretical physicists. A lively series of talks is being given. Topics have included (elasticity in rocks, geophysics, liquid surfaces, coupled diffusion processes, mathematical biology).

During the mid-term break in late June a "seventh form maths day" was held by the Department for local students. It was organised by secondary-school teachers fellow, John Powell. Sessions on the history of calculus and problem-solving were supplemented by workshops in small groups. About 350 seventh form pupils and 15 secondary teachers participated.

Sharleen Forbes produced a healthy baby boy named Joss Anthony, in May, and latest reports are that baby and parents are surviving well.

G.C.W.

DSIR

APPLIED MATHEMATICS DIVISION, WELLINGTON

Robert Davies has attended a conference in Berkeley in honour of Professors Neyman and Kiefer who died in 1981. Professor Neyman was Robert's supervisor.

Selwyn Gallot is attending the 4th International Conference of Applications of Statistics and Probability in Engineering in Florence, and the Conference in Applied Engineering and Biology in Lexington, Kentucky.

Alex Neil is visiting the U.S. and U.K. on L.W.o.P., and will attend the A.S.A. Conference in Toronto.

David Iles, a former staff member, has been awarded a Dean's Fellowship at U.S.C.

The N.Z. Statistical Conference was held at Victoria on June 28-29. Specialist sessions on design and analysis of experiments, and medical statistics were held on June 30. A display of microcomputers and software was arranged in conjunction with the conference. Terry Speed, head of C.S.I.R.O. Division Mathematics and Statistics, and John Eccleston, Department of Statistics, N.S.W., spoke at the conference, and later visited A.M.D. and Victoria.

G.J.W.

MT. ALBERT RESEARCH CENTRE, AUCKLAND

Mr John Gibbs, who is a senior staff member in the Department of Computer Studies and Applied Mathematics at Auckland Technical Institute, is spending five weeks' Technical Refresher Leave (starting from July 18) with the Auckland A.M.D. substation. His purpose is to widen his experience of practical statistical analysis and to gain experience in using statistical computer packages.

Jocelyn Dale (nee Hopkins) is expected back in N.Z. from Imperial College (in London) around September 14. Her Ph.D. thesis, with the dual themes *'Statistical Methods for Ordered Categorical Responses'* and *'Goodness of Fit Tests for Sparse Contingency Tables'*, was submitted on June 16.

John Maindonald leaves on August 9 for travel abroad. He will attend the American Statistical Association conference in Toronto, investigate developments in statistical computing in the U.S.A. and in the U.K., and attend the International Statistical Institute conference in Madrid over September 12-22.

J.H.M.

CANTERBURY UNIVERSITY

Graham Wood has returned from leave, spent mainly at the University of Washington, Seattle.

Brian Woods will depart at the end of August for one year's study leave. He will divide his time between the Centre for Vulcanology at the University of Oregon, and the department of applied mathematics at the University of British Columbia.

Derrick Breach also goes on study leave for one year at the end of September, with plans to visit universities in several countries.

Simon Bernau, a former student and staff member of the department, and now at the University of Texas, Austin, called in last month. This was a private visit, but he agreed to give us a seminar.

As well as seminars by short term visitors, there have been regular weekly seminars by the staff on aspects of computational mathematics, organized by Allan McInnes.

From 29 August to 2 September the Combinatorial Mathematics Society of Australasia will hold its 11th conference at the University, Derrick Breach being the organizer.

Seminars:

Professor L.C. Woods (University of Oxford), *'Some misconceptions commonly found in continuum thermodynamics'* and *'Methods of applied mathematics'*.

Dr Hugh Morton (Massey University), *'Modelling the exercising athlete'*.

Professor A.M. Odlyzko (Bell Laboratories, New Jersey), *'New algorithms for computing* $\Pi(x)$ *'*.

Professor Simon Bernau (University of Texas, Austin), *'Projections: some classical results'*.

R.S.L.

OTAGO UNIVERSITY

Dr Peter Fenton and Dr Gerrard Liddell have returned from their study leaves. Peter spent his time (one term) at the Mathematics Department at Imperial College London. Gerrard spent his year's leave at both Oxford and Queen's University (Canada); and visited various universities in the U.K., Germany, Italy, North America, Singapore, Kuala Lumpur, New Delhi, and Cairo.

Visitors have included Professor K. Hirsch from Queen Mary College, London, and Professor Simon Bernau of the University of Texas. Professor Hirsch gave a talk on *'Groups having Finite Automorphism Groups'* and Professor Bernau spoke on *'Projections - Some Classical Results'*.

A series of lectures on *'Theory of correctness proofs for computer programs'* is being given by Dr John Harris and Dr Gerrard Liddell.

A series of tutorial classes has been organised by Otago University Extension in association with the Mathematics Department for people who do not have ready access to a microcomputer but who would like to teach themselves some BASIC. The facilities of the Mathematics Department's Microcomputer Laboratory has been made available to members of the general public for two evenings per week. This laboratory is equipped with twelve Casio FX 9000P microcomputers with cassette recorders and printers. No previous acquaintance with these machines or with BASIC language has been assumed and Mathematics Department staff have been present at all times to give help when needed. In general, participants have been encouraged to work on their own projects.

G.O.

AUSTRALIA

Professor Leon Simon of the Department of Mathematics, Institute of Advanced Studies, The Australian National University has been awarded the 1983 Australian Mathematical Society medal.

S.A.M

Feature Article

FROM SEISMOLOGY TO SINGULAR VALUE DECOMPOSITION

Jim Ansell

The New Zealand Mathematical Society Lecture at the Mathematics Colloquium, Massey, 1983

Earthquakes, as they say, are as old as the hills and the application of physical principles to the study of them goes back at least as far as the ancient Chinese. They are both a global problem and a local problem. In maori legend it was the god Rūaumoko, son of the earth-mother Papa (and Rangi), who caused earthquakes after being carried under when Papa was turned over while he was still at the breast. (Te Rangi Hiroa, 1949).

Seismology then is the study of earthquakes and earthquake waves and has a long history, while singular value decomposition and the extensive use of large matrices is only as old as the computer.

This paper has two themes; firstly, the historical development of aspects of seismology from the point of view of the applied mathematician; and secondly, the nature of applied mathematics and mathematical modelling. I say seismology from the point of view of the applied mathematician because there are two types of seismologist, not as Professor George Batchelor of Cambridge once informed me, large seismologists and small seismologists, but mathematical seismologists and physical seismologists.

Historical

The brilliant Chinese mathematician, astronomer and geographer Chang Hêng is reputed to have been the first seismologist to observe earthquakes instrumentally in the second century A.D.

> "In the first year of the Yang-Chia period (132 A.D.) Chang Hêng also invented an 'earthquake weathercock' (i.e., a seismograph). It consisted of a vessel of fine caste bronze, resembling a wine-jar, and having a diameter of eight chhih (six feet). It had a domed cover, and the outer surface was ornamented with antique seal-characters and designs of mountains, tortoises, birds and animals. Inside there was a central column capable of lateral displacement along tracks in eight directions, and so arranged (that it would operate) a closing and opening mechanism. Outside the vessel there were eight dragon heads, each one holding a bronze ball in its mouth, while round the base there sat eight toads with their mouths open, ready to receive any ball which the dragons might drop."
>
> "When an earthquake occurred the dragon mechanism of the vessel was caused to vibrate so that a ball was vomited out of a dragon-mouth and caught by the toad underneath. At the same instant a sharp sound was made which called the attention of the observers. Now although the mechanism of one dragon was released, the seven (other) heads did not move, and by following the direction, one knew (the direction) from which the earthquake had come. When this was verified by the facts there was an almost miraculous agreement."
>
> "... it became the duty of the officials of the Bureau of Astronomy and Calendar to record the directions from which earthquakes came."
>
> (Needham, 1959)

A working knowledge of Chang Hêng's instrument remained for four centuries, with several books being written by able Chinese mathematicians describing the workings of the 'earthquake weathercock'. In later years the instrument disappeared and its earlier existence was even questioned, but the instrument was not improved upon until the eighteenth century, some 1600 years later!

In ancient China then, there were competent mathematicians with seismic data available, but to our knowledge no mathematical theory was developed.

The beginnings of the mathematical theory of the propagation of seismic waves came in the nineteenth century in France when in 1821 the mathematician Navier read a paper to the Paris Academy of Sciences on the equation of motion of a point in an elastic solid. (This equation may be derived from Newton's laws of motion, relating the force on a small element to its acceleration, and Hooke's Law, stress is proportional to strain. Stress is force/unit area and strain is relative deformation.)

Later in 1828 Poisson, in a paper read to the Academy, demonstrated the existence of two types of elastic wave with different wave speeds; now called P and S waves. Poisson like Navier used a restrictive molecular theory. The result was derived more generally by George Green in the Transactions of the Cambridge Philosophical Society in 1839 and by Cauchy in his Exercises Mathématique. Thus in 1847 William Hopkins gave a paper to the British Association for the Advancement of Science, "Report on the geological theories of Elevation and Earthquakes", in a section of which he summarised the mathematical seismology of his day. He described the linear relation between stress and strain, the differential equation of motion for the displacement of a point, and various aspects of the nature of the P and S waves, including their interaction, refelction and refraction at plane interfaces - including Snell's law. (The amplitudes of the reflected and refracted waves were calculated much later in the early 1900's by C.G. Knott, Reader in Applied Mathematics in Edinburgh.)

In today's vector notation we write the equation for the displacement $\underline{u}$, in an isotropic homogeneous elastic medium, in the form

$$\frac{\partial^2 \underline{u}}{\partial t^2} = \nabla(\alpha^2 \nabla \cdot \underline{u}) - \nabla \times (\beta^2 \nabla \times \underline{u})$$

where α and β are the constant P and S wave speeds; $\alpha > \beta$.
For a sinusoidal wave of the form $\underline{u}(x,y,z)\exp(-i\omega t)$, we find

$$\underline{u} = \nabla(-(\alpha^2/\omega^2)\nabla \cdot \underline{u}) + \nabla \times ((\beta^2/\omega^2)\nabla \times \underline{u})$$

$$= \underline{u}_p + \underline{u}_s .$$

This equation for $\underline{u}$ is of the form of the Helmholtz representation theorem (sometimes called the fundamental theorem of vector calculus)

$$u = \nabla\phi + \nabla \times \underline{A} \quad \text{with} \quad \nabla \cdot \underline{A} = 0 .$$

Also, $\underline{u}_p$, $\underline{u}_s$, ϕ, $\underline{A}$ satisfy Helmholtz's equations.

$$\nabla^2 \underline{u}_p + (\omega^2/\alpha^2)\underline{u}_p = \underline{0}, \quad \nabla^2\phi + (\omega^2/\alpha^2)\phi = 0$$

$$\nabla^2 \underline{u}_s + (\omega^2/\beta^2)\underline{u}_s = \underline{0}, \quad \nabla^2 \underline{A} + (\omega^2/\beta^2)\underline{A} = \underline{0},$$

where $\underline{u}_p$ is the P wave with scalar potential ϕ and wave speed α, while $\underline{u}_s$ is the S wave with vector potential $\underline{A}$ and wave speed β. This formulation devised by Richards (1974), demonstrates results originally produced by George Stokes and Lord Kelvin in the nineteenth century. More recently I have generalised these results for an inhomogeneous elastic solid (Ansell, 1979).

The P wave displacement is irrotational and compressional, and is in the same direction as the wave is propagating. The S wave wave displacement is equivoluminal and involves shear, and is transverse to the direction of wave propagation. These two wave types can sometimes be felt in local earthquakes, with a change in the nature of the motion coming with the S wave. The time between the P and S waves in seconds multiplied by nine gives approximately the distance of the earthquake in kilometres.

Besides the waves described above there are also surface (and interface) waves. In the Proceedings of the London Mathematical Society for 1885, Lord Rayleigh described a surface wave which propagated along a free surface and consisted of P and S waves coupled by the boundary conditions - the Rayleigh wave. Twenty-five years later A.E.H. Love theoretically derived another type of surface wave which was of S type only and propagated in layered structures. Up until John Milne and others in Japan in the 1880's initiated a rapid development of the design of seismometers and began routine instrumental observation of seismic waves, the theory outstripped observation.

But what of New Zealand? Chang Hêng's counterpart was Sir James Hector, a polymath and chief government scientist from 1867 to 1903. He had many responsibilities from being director of the Geological Survey and the meteorological department to being Chancellor of the University of New Zealand. In 1884 he had built in Wellington a modification of a seismograph used by John Milne in Japan. Hector's seismograph was one of the earliest observatory seismographs in the world and was operated in the Colonial Museum for eighteen years. Apart from occasional reports in the newspapers, however, no scientific reports were made. (Presumably for his efforts in the collection of statistical data, Hector was elected an honorary member of the Statistical Society of London in 1876.)

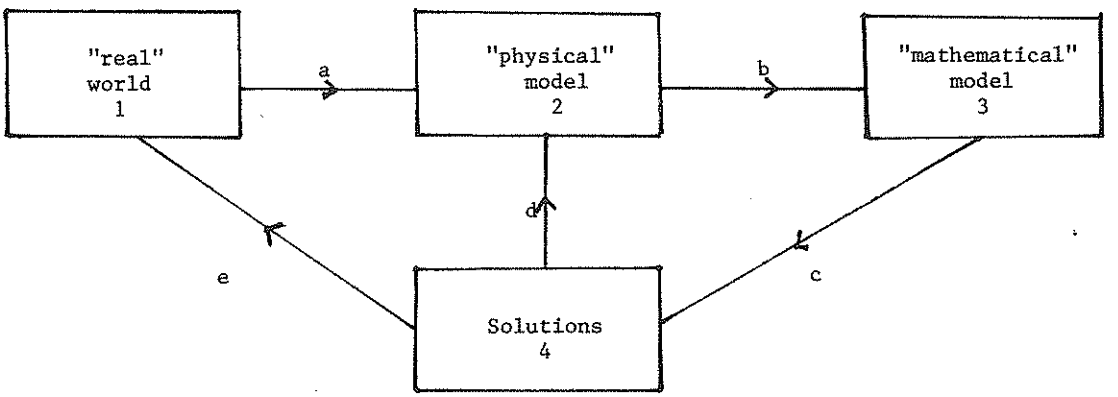
However New Zealands' first mathematical seismologist was George Hogben, a non-conformist radical Cambridge mathematician who is best known for the reform of New Zealand education carried out when he was Inspector General of Schools from 1899 to 1915. In the 1880's and 1890'2 Hogben, stimulated by some strong Canterbury earthquakes, applied himself to the problem of location of the focus of the earthquakes and the determination of the velocity of propagation of seismic waves (two problems still under attack today). He used felt reports from various parts of New Zealand. These reports gave the direction of felt motion and sometimes its time of onset, both of which may be used to locate the earthquake. Hogben used several methods including Milne's "Method of Coordinates" in which the Earth is locally modelled by a homogeneous elastic half-space and the unknowns are the latitude, longitude, depth and time of occurrence of the earthquake plus the velocity of the appropriate wave in the half space.

Using the equation for each observation, (distance from observation point to the focus)^2 = (velocity)^2 × (travel time)^2, Hogben (1890) formed a system of linear equations which he solved by forming the normal equations. He quoted as a reference a popular book on the least squares method by Merriman. Hogben's theory was sound but he had difficulty because the timing by observers was not sufficiently accurate. (Today the Time Service is run by the Seismological Observatory.)

The most eminent New Zealand mathematical seismologist since Hogben was Keith Bullen who lectured in mathematics at the University of Auckland and was later Professor of Applied Mathematics at Sydney University. He worked with Harold Jeffreys at Cambridge and in 1940 they published global average travel time tables for P and S waves. These tables have yet to be superseded. (Hogben and Bullen failed to get professorships of mathematics in Wellington and Auckland respectively!)

Mathematical Modelling

Clearly, mathematicians have been active in seismology, but let us now focus on the process of mathematical modelling, in which applied mathematicians are involved.



Step (a) - In the "real" world we focus on some particular area, which we identify as the "physical" model and which we attempt to quantify and describe.

Step (b) - We simplify and distil this model into a mathematical model - a deterministic or statistical model or a combination of both. The model is expressed in terms of known mathematical structures and in a form that is potentially solvable.

Step (c) - We solve problems associated with the mathematical model, using analytical or numerical techniques.

Steps (d) and (e) - We compare the solutions with the physical model and the real world, using additional data or through prediction.

This model of modelling is valid for both small problems and the development of a subject area. Chang Hêng made Step (a). Navier, Poisson etc. derived mathematical models and obtained some solutions but there was little data with which to compare these solutions. Milne and Hogben completed a cycle by comparing their solutions with the data. The process of establishing simple canonical models and gaining a full understanding of them, i.e., being able to accomplish Step (c), is an important and necessary part of the cycle. But, for full problem solving it is necessary to be able to cycle and recycle. In seismology, this process means improving the models and improving the data.

Modern Location and Parameter Estimation

One of the currently active areas of theoretical seismology in New Zealand, and elsewhere, is the problem of precise earthquake location and estimation of the seismic velocity structure. The problem is as follows.

Given (a) a set of measured arrival times t_i of various seismic phases at a set of seismograph stations, and

(b) a method of calculating travel times for a velocity model, with possibly unknown parameters $\underline{v}$, usually from travel time tables or ray tracing (bending or shooting) through a given structure;

then (1) locate the earthquake (or earthquakes), i.e., determine $\underline{h}$
$\underline{h}$ = (origin time, latitude, longitude, depth) = (t, x, y, z),

and (2) determine the velocity parameters $\underline{v}$.

For the ith seismic phase, with estimates $\underline{h}_0$ and $\underline{v}_0$ of the location and velocity parameters, we can calculate the expected arrival time $T_i(\underline{h}_0, \underline{v}_0)$. The true parameters are estimated by minimising

$$\sum_i \omega_i (t_i - T_i(\underline{h}, \underline{v}))^2 = \sum_i \omega_i (\text{obs.} - \text{calc. times})^2 ,$$

where ω_i are a set of weights (possibly Jeffreys' weights).

We solve this by linearisation and iteration. For initial estimates, $\underline{h}_0$ and $\underline{v}_0$,

$$\underline{h} = \underline{h}_0 + \delta\underline{h} \quad \text{and} \quad \underline{v} = \underline{v}_0 + \delta\underline{v} ,$$

and by using a Taylor expansion of $T_i(\underline{h}, \underline{v})$ about $\underline{h}_0$, $\underline{v}_0$ we find

$$A\delta\underline{v} + B\delta\underline{h} = \underline{y} + \underline{\underline{\in}}$$

where $$A_{ij} = \frac{\partial T_i}{\partial v_j} \quad \text{and} \quad B_{ij} = \frac{\partial T_i}{\partial h_j} \quad \text{at} \quad \underline{h}_0, \underline{v}_0 ,$$

$$\underline{y} = (\text{obs.} - \text{calculated times}) = \underline{t} - T(h_0, v_0)$$

and $\underline{\underline{\in}}$ is the vector of linearisation, model and measurement errors.

Hence $G\underline{r} = \underline{y} + \underline{\underline{\in}}$, with $G = (A|B)$ and $\underline{r}^T = (\delta\underline{v}^T | \delta\underline{h}^T)$, and least squares solution $\underline{r} = (G^TG)^{-1}G^T\underline{y}$ if $(G^TG)^{-1}$ exists.

We can find $\underline{r}$, i.e. $\delta\underline{v}$ and $\delta\underline{h}$, by forming the normal equations and using Choleski's method or by using Householder Decomposition or singular value decomposition. We then iterate until $\underline{r}$ is small.

For the routine location of earthquakes we fix the model and hence $\underline{v}$. At other times we fix the location, for example when using an explosion. We can also locate several earthquakes at a time and then $\delta\underline{h}$ has dimensions of 4 times the number of earthquakes. In one recent overseas study 26,000 earthquakes were used, but more typically a recent Ph.D. study (Felix Chong, VUW) of Hawke's Bay earthquakes used twenty earthquakes and twelve velocity parameters. In this case some of the results could be checked by the use of an independent method and independent data.

In solving the linear systems three difficulties arise:

1. the numerical stability and ill conditioning of the system;
2. the computation time needed for large systems and multiple iterations; and
3. the interpretation of the solutions obtained.

The questions that arise are: what are the properties of the solution? What is the interaction of the hypocentral (location) parameters and the velocity parameters? What happens if we try "too many" or "too few" parameters, and is there a unique answer?

The answers to these questions can be considered in terms of the generalised inverses of the matrices and their singular value decompositions (see Ben-Israel and Greville, 1980, for references). E.H. Moore in 1920 defined a unique inverse for every finite matrix (square or

rectangular) in a talk given at a meeting of the American Mathematical Society. The Swedish mathematical geodesist A. Bjerhammer rediscovered Moore's inverse in 1951 and recognised its relation to the least squares solution of linear systems. R. Penrose, sharpened and extended Bjerhammer's results in 1955. He formulated the Moore-Penrose conditions, which are for real matrix G,

$$GXG = G \quad (1) \qquad XGX = X \quad (2)$$
$$(GX)^T = GX \quad (3) \qquad (XG)^T = XG \quad (4)$$

and showed there exists a unique matrix X satisfying these conditions. We write $X = G^\dagger$ and $G^\dagger = (G^TG)^{-1}\,G^T$ if $(G^TG)^{-1}$ exists. We may also study G through its singular value decomposition, developed for rectangular matrices by Eckart and Young in 1936.

$$G = UDV^T,$$

where the columns of U are the eigenvalues of GG^T, the columns of V are the eigenvectors of G^TG and D is a diagonal matrix.

$D = \left(\begin{array}{c|c} S & 0 \\ \hline 0 & 0 \end{array}\right)$, where S is a diagonal matrix whose diagonal elements are s_{ii}. s_{ii}^2 are the (positive) eigenvalues of G^TG (and GG^T) and $s_{11} \geq s_{22} \geq \ldots > 0$.

The generalised inverse of G, $G^\dagger$, is given by

$$G^\dagger = VD^\dagger U^T \quad \text{where} \quad D^\dagger = \left(\begin{array}{c|c} S^{-1} & 0 \\ \hline 0 & 0 \end{array}\right).$$

Now all matrices X of appropriate dimension can be written in the form, with K of the dimensions of S,

$$X = V \left(\begin{array}{c|c} K & L \\ \hline M & N \end{array}\right) U^T$$

and if X satisfies various of the Moore-Penrose conditions for G, then the submatrices K, L, M and N are determined. For example condition (1) $\Rightarrow K = S^{-1}$; (1) and (2) $\Rightarrow K = S^{-1}$ and $N = MSL$; (1) and (3) $\Rightarrow K = S^{-1}$ and $L = 0$; (1) and (4) $\Rightarrow K = S^{-1}$ and $M = 0$.

In general, the solution of $G\underline{r} = \underline{y} + \underline{\in}$ given by $\underline{r} = G^\dagger\underline{y}$ is the least squares solution which minimises $\|\underline{r}\|_2$. To consider the interaction of the velocity and location parameters however we can proceed differently. The equation is

$$G\underline{r} = A\delta\underline{v} + B\delta\underline{h} = \underline{y} + \underline{\in},$$

and we can use a matrix Q to eliminate $\delta\underline{h}$ from the equation.

$$Q = (I - BB^\dagger), \quad QB = 0, \quad Q^2 = Q,$$
$$Q \text{ is symmetric and } (QA)^\dagger Q = (QA)^\dagger.$$

Pre-multiplying the above equation by Q, we find

$$\delta\underline{v} = (QA)^\dagger\underline{y}$$

and use of the equation again gives

$$\delta\underline{h} = (B^\dagger - B^\dagger A\,(QA)^\dagger)\underline{y}.$$

Hence

$$\underline{r} = \begin{pmatrix} \delta\underline{v} \\ \delta\underline{h} \end{pmatrix} = \begin{bmatrix} (QA)^\dagger \\ B^\dagger - B^\dagger A\,(QA)^\dagger \end{bmatrix} \underline{y} = G^I\underline{y},$$

where G^I satisfies the Moore-Penrose conditions (1), (2) and (3) and gives a least squares solution. If G is of full column rank then G^I is also $G^\dagger$ and the interaction between the velocity structure and hypocentres can be deduced. In general however $G^\dagger$ is far more complex than G^I (Cline, 1964), with $(QA)^\dagger$ being replaced by $(QA)^\dagger + H$. Writing $0 = QA$,

$$H = (I - 00^\dagger)\,\tilde{K}\,A^TB^{\dagger T}B^\dagger\,(I - A0^\dagger)$$

with

$$\tilde{K} = [I + (I - 0^\dagger 0)\,A^TB^{\dagger T}B^\dagger A\,(I - 0^\dagger 0)]^{-1} \quad !!!$$

The interaction now is far more complex and can only be resolved for the simpler problems. Again, the adequacy of the data is becoming crucial.

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Notices

BACK COPIES OF NEWSLETTER

Dean Halford, Massey University, advises that back issues of the NZMS Newsletter (and Supplements) prior to 1981 are available from him but will be destroyed at the end of September this year.

AID FUND FOR U.S.P. STUDENTS

Readers are reminded of the NZMS fund to aid students from the University of the South Pacific undertaking graduate studies in mathematics in New Zealand. Enquiries and applications should be directed to Dr D.J. Smith, Department of Mathematics and Statistics, Auckland University.

SUMMER RESEARCH INSTITUTE

The Australian Mathematical Society has agreed to the holding of the 1985 Summer Research Institute in New Zealand. It is tentatively scheduled for the period 14 January to 1 February 1985 in Auckland. It is expected that fields covered by the Institute will include Algebra, Analysis, Numerical Analysis, Topology, Statistics and some aspect of Applied Mathematics. Any suggestions or offers of assistance would be gratefully accepted by Professor D.B. Gauld, Auckland University.

JOURNAL OF THE ROYAL SOCIETY OF NEW ZEALAND

Under its new editor, Dr C.M. King, the Journal's policy for possible contributions includes:

1. Original research papers, presenting new data on any aspect of science relevant to New Zealand.
2. Occasional lectures e.g. to branch meetings, of a high standard and broad interest.
3. State-of-the-art reviews on subjects of particular interest to the Pacific region. Particularly encouraged are reviews of subjects of current concern or interest to any of the Society's member bodies.
4. Notes and comments.
5. Reviews and publications.

It is recommended that anyone contemplating a submission under heading 3. should negotiate through the NZMS Secretary in the first instance.

The Publications Committee of the RSNZ suggests that conference organisers and participants might consider using the Journal to record and publicise important aspects discussed, and the RSNZ is prepared to collect such suitable material including scientific papers (subject to refereeing) for reprinting and issue as a mini-proceedings.

Centrefold

PROFESSOR DAVID SPENCE

David Spence, Professor of Mathematics at Imperial College, London and a graduate of the University of New Zealand (Auckland University College) has been visiting New Zealand recently renewing old, and making new, acquaintances. For the months of February-May 1983 he was the holder of a Visiting Erskine Fellowship at the University of Canterbury and in May-June 1983 he was the holder of a Visiting Fellowship at the Victoria University of Wellington. As a New Zealander with an impressive international record it is indeed appropriate that the Newsletter should acknowledge his contributions at this time.

David Spence was born in 1926 in Auckland and his early education took place there, culminating in his attaining top place in the Junior Scholarship examinations of 1942 while a sixth form student at Kings College. After a brief period of flirtation with medical studies at Otago, he found the lure of mathematics too much and embarked on the trail that led him to his present position. His undergraduate performance was capped by the award of the Cook Memorial prize as top Masters student in New Zealand in 1947. After a brief stint at Auckland as a Junior Lecturer in Mathematics, he left for Cambridge in 1948 to pursue further studies. He took there his B.A., then his M.A. in Mathematics, closely followed by a Ph.D. in Aeronautical Engineering in 1952; the latter under the supervision of Dr J.H. Preston, (later Professor Preston). This represented his first real excursion into Aeronautical Engineering, though it is clear that he always intended to pursue studies in Applied Mathematics and Fluid Dynamics as witnessed by his chosen books purchased for the Cook prize (Whittaker; "Analytical Dynamics": Lamb; "Hydrodynamics": Jeffreys and Jeffreys; "Methods of Applied Mathematics").

His Ph.D. work, on the boundary layers in flow past aerofoils, set the scene for his later work in the Aerodynamics Department, Royal Aircraft Establishment, Farnborough, where he worked from 1952 until 1964, rising to Senior Principal Scientific Officer (Individual Merit) in 1963. This period saw him take the first of many visiting appointments (MIT 1952, Cornell 1959-60, Caltech 1960-61). During this time he married Isobel Ramsay (in 1955) and they have produced a family of four children. David's work at Farnborough, almost inevitably of course, was also in aerodynamics and included his significant work on the modelling of jet-flapped wings - infinitely thin jets with finite momentum.

After leaving Farnborough in 1964 he took up an appointment at the University of Oxford, as a Tutorial Fellow in Engineering Science at Lincoln College; where his position was later designated as a Fellow in Applied Mathematics. Concurrently with the Fellowship at Lincoln, he held appointments in the University successively as Lecturer, then Reader, in Engineering Science. David spent some sixteen years at Oxford and it was during this time that his work greatly increased in range and scope to include the theory of elastic contact especially with friction. This work in elasticity was of great importance in many technical applications such as that which arose in the Oxford study groups in mathematical problems in industry. It was during this time that the writer first met David (and family) while holding a visiting appointment at Oxford. As a member of an allied Faculty, an adjacent college (Brasenose College), and as a resident of the same Oxford suburb (Headington), I owe considerable gratitude to the advice and support received from David and Isobel Spence.

David's work has many related aspects not previously mentioned: his work in aerodynamics and elasticity included significant contributions to the theory of boundary value problems in general and to the theory of singular integral equations in particular. It is in these areas where the writer had a great deal of interaction with his work and indeed two of us at Victoria University have just completed some work on the solutions of the biharmonic equation in an infinite strip - a problem to which David himself has made significant contributions.

His work at Oxford led to further recognition: he was a frequent visitor to North America (Wisconsin, Mexico) during this time and was awarded a D.Sc. degree in Mathematics by Oxford University in 1967. Numerous opportunities to accept appointment to a Chair in (Applied) Mathematics never quite succeeded in luring David and Isobel permanently away from Oxford until, in 1981, he accepted a Chair of Mathematics at Imperial College. This has enabled him to keep his home in Oxford and to pursue there his recreational activities of gardening and walking.

David's contribution to British applied mathematics is considerable and will of course, continue. He has served the international mathematical and scientific community well and special mention must be made of his continuing contribution as Editor of the Journal of the Institute of Mathematics and its Applications - now the IMA Journal of Applied Mathematics - since 1975.

It is fitting that these remarks are made during the year when David and Isobel have been able to enjoy an extensive visit to New Zealand while on leave from Imperial College. They have obviously enjoyed visiting David's early, and more recent, acquaintances here in New Zealand, from all walks of life - not just the world of mathematics.

G.C. Wake

Conferences

1983

September 4-9 (Bad Patzmannsdorf, Austria)
Fourth Pannonische Symposium über Mathematische Statistik
Details from W. Wertz, Institut für Statistik-TU, Argentinierstrasse 8/7, A-1040 Wien, Austria.

September 4-10 (Warsaw)
XVI Biennial Fluid Dynamics Symposium
Details from W. Fiszdon, Inst. of Fund. Techn. Res., Dept. of Mech., Polish Academy of Sciences, 21 Swietokrzyska, Warszawa, Poland.

September 5-10 (Miramare-Trieste, Italy)
Twelfth International Colloquium on Group Theoretical Methods in Physics
Details from Intern. Centre for Theor. Phys., XII Intern. Coll., P.O. Box 586, I-34100 Trieste, Italy.

September 6-10 (Valencia, Spain)
Second International Meeting on Bayesian Statistical Methods
Details from J.M. Bernardo, Department of Biostatistics, ave. Blasco Ibáñez 17, Valencia-10, Spain.

September 11-15 (Paris)
Fourth Meeting of the International Society for Clinical Biostatistics
Details of both meeting and society from ICSB-4 secretariat, Département de Statistique Médicale (+ 10), Institut Gustave-Roussy, rue Camille Desmoulins, 94805 Villejuif Cedex, France.

September 12-16 (Aachen, West Germany)
First European Simulation Congress
Details from Lehrstul für Allgemeine Elektrotechnik und Datenverarbeitungssysteme, RWTH Aachen, Schinkelstrasse 2, D-5100 Aachen, Federal Republic of Germany.

September 12-22 (Madrid)
Forty-fourth Biennial Session of the International Statistical Institute
Details from ISI Permanent Office, 428 Prinses Beatrixlaan, NL-2270 A2 Voorburg, The Netherlands.

September 13-16 (Nottingham)
Undergraduate Mathematics Teaching Conference
Details from Secretary, Shell Centre for Mathematics Education, The University, Nottingham, U.K.

September 25 - October 2 (Leipzig, East Germany)
International Conference on Operator Algebras, Ideals and their Applications in Theoretical Physics
Details from Karl-Marx-Universität, Naturwissenshaftlich-Theoretisches Centrum, International Conference 1983, DDR-7010 Leipzig, Karl-Marx-Platz, PF920, German Democratic Republic.

September 26-29 (Austin, Texas)
Fifth International Symposium on Finite Elements in Flow Problems
Details from G.F. Carey, Cockrell Hall 2, 102, University of Texas, Austin, Texas 78712, U.S.A.

September 26-30 (Pisa, Italy)
International Workshop on Applied Mathematics and Performance, Reliability Models of Computer, Communication Systems
Details from S. Tucci, Dipart. Inform., 40 Corso Italia, I-56100 Pisa, Italy.

September 26-30 (Lisbon)
Second International Meeting on Statistical Climatology
Details from A.H. Murphy, Oregon State University, Corvallis, Oregon 97331, U.S.A.

October 5-10 (Rome)
Fifth CAMM Conference on Numerical Methods in Fluid Mechanics
Details from R. Piva, Inst. Mecc. Apl., Fac. Ing., 18 Via Eudossiana, I-00184 Rome, Italy.

October 5-12 (Barcelona)
Week of Algebraic Geometry
Details from G. Welters, Descamps, Matematicas Universidad de Barcelona, Plaza Universidad, Barcelona - 7, Spain.

October 6-10 (Los Altos Hills, California)
Twentieth Anniversary Meeting of the American Society of Cybernetics
Details from William J. Reckmeyer, Chair, ASC 20th Anniversary Meeting, Cybernetic Systems Program, San Jose State University, San Jose, California 95192, U.S.A.

October 10-14 (Tokyo)
ICMI-JSME Regional Conference on Mathematical Education
Details from T. Sawada, Conference Secretary, National Institute for Educational Research, 5-22 Shimomeguro 6-Chome, Meguro-ku, Tokyo 153, Japan.

October 11-13 (Madison, Wisconsin)
Conference on Phase Transformations and Material Instabilities in Solids
Details from Mrs Gladys Moran, Conference Secretary, Mathematics Research Centre, University of Wisconsin, 610 Walnut St., Madison, Wisconsin 53705, U.S.A.

October 17-21 (Corvallis, Oregon)	*NSF Conference on Asymptotic Behaviour of Mass and Space-Time Geometry* Details from F.J. Flaherty, Department of Mathematics, Oregon State University, Corvallis, Oregon 97331, U.S.A.
October 18-21 (Budapest)	*Third Symposium on Microcomputer and Microprocessor Applications* Details from I. Baba, Scientific Society for Telecommunications, P.O. Box 451, H-1372, Budapest, Hungary.
October 24-29 (Sofia, Bulgaria)	*International Conference on Mathematical Models in Operations Research* Details from A.L. Dontchev, Institute of Mathematics, 1090 Sofia, P.O. Box 373, Bulgaria.
November 1-9 (Sellin, East Germany)	*Sixth International Summer School on Problems of Model Choice and Parameter Estimation in Regression Analysis* Details from R. Bellach, Humboldt University Sekt. Math., DDR-1086, Berlin, PSF 1297, German Democratic Republic.
November 7-9 (Tucson, Arizona)	*Twenty-Fourth Annual IEEE Symposium on Foundations of Computer Science* Details from Lawrence Snyder, Program Committee Chairman, Department of Computer Sciences, Mathematical Sciences Building, Purdue University, West Lafayette, Indiana 47907, U.S.A.
November 8-11 (Hiroshima, Japan)	*Fifth International Seminar on Boundary Elements* Details from C.A. Brebbia, Department of Mathematics, The University of Southampton, Southampton S09 5NH, U.K.
November 13-18 (Boston, Massachusetts)	*Symposium on Measurements in Fluid Transients* Details from L.D. Koffman, School of Mechanical Engineering, Georgia Institute of Technology, Atlanta, Georgia 30332, U.S.A.
November 16-18 (Hot Springs, Arkansas)	*Eighth Conference on Probability and Statistics in the Atmospheric Sciences* Details from R.W. Katz, Department of Atmospheric Sciences, Oregon State University, Corvallis, Oregon 97331, U.S.A.
November 20-24 (Meerut, India)	*International Seminar on Jain Mathematics and Cosmology* Details from Anupam Jain, Digamber Jain Institute of Cosmographic Research, Hastinapur (Meerut), Pin-250-404, India.
November 24-27 (Leuven, Belgium)	*International Congress on Computational and Applied Mathematics* Details from F. Broeckx, University of Antwerp (RUCA), Faculteit Toegepaste Economische Wetenschappen, Middelheimlaan 1, B-2020 Antwerpen, Belgium.
November 28 - December 2 (Newcastle, Australia)	*Eighth Australasian Fluid Mechanics Conference* Details from Professor R.A. Antonia, Department of Mechanical Engineering, University of Newcastle, New South Wales 2308, Australia.
December 5-7 (Rio de Janeiro)	*Second Latin American Conference on Applied Mathematics* Details from Andrew M. Olson, Coordinator, Puerto Rico-U.S. National Organizing Committee, Mathematics Department, University of Puerto Rico, Box BF, Rio Piedras, Puerto Rico 00931.
December 5-16 (Miramare-Trieste, Italy)	*Workshop on Pattern Recognition and Analysis of Seismicity* Details from International Centre for Theoretical Physics, Workshop on Pattern Recognition, P.O. Box 586, I-34100, Trieste, Italy.
1984	
January 6-10 (New York)	*NSF-CBMS Regional Conference on some Global Problems concerning Curvature of Riemannian Manifolds* Details from L.M. Sibner, Polytechnic Institute of New York, 333 Jay Street, Brooklyn, New York 11201, U.S.A.
February 5-9 (Merimbula, New South Wales)	*Australian Applied Mathematics Conference* Details from Ashley Plank, AMC Conference Secretary, School of Information Sciences, Canberra College of Advanced Education, Box 1, Belconnen, ACT 2616, Australia.
June 4-8 (Kalamazoo, Michigan)	*Fifth International Conference on the Theory and Applications of Graphs, with special emphasis on Computer Science Applications* Details from Directors, Graph Theory Conference, Dept. of Maths., Western Michigan University, Kalamazoo, Michigan 49008, U.S.A.
August 24-30 (Adelaide)	*Fifth International Congress on Mathematical Education* Details from ICME5, GPO Box 1729, Adelaide 5001, Australia.

MINUTES OF THE THIRTEENTH COUNCIL MEETING

Held at Massey University on 22nd May, 1983.

PRESENT: J.H. Ansell (President; in the Chair), D.B. Gauld, W. Davidson (Vice-Presidents), J.L. Schiff (Treasurer), K.G. Russell (Secretary), M.R. Carter, I.D. Coope, P.D. Hill, A. McNabb, D.J. Smith.
In attendance: I.L. Reilly (convener, Publications Committee), J.A. Shanks (by invitation).

1. APOLOGIES: Nil.

2. MINUTES OF THE PREVIOUS COUNCIL MEETING:

Moved WD/MRC that the minutes of the 12th meeting of the Council held on 7.12.1982 be taken as read. CARRIED

Moved MRC/WD that the minutes of the 12th meeting of the Council held on 7.12.1982 be adopted as a true and correct record of that meeting's proceedings. CARRIED

3. MATTERS ARISING FROM THE MINUTES:

Several matters were deferred until later sections of the agenda.

(A) A.C. Aitken Trust - JLS reported that an account in the Trust's name had been opened with the Bank of New Zealand in Auckland, and a cheque from Scotland had been deposited in the account. It was later reported by ILR that a copy of the Trust deed had been given to G.J. Tee.

(B) AMS Summer Research Institute in NZ - DBG advised that, as the University of Auckland had seemed at the last meeting to be the only organisation interested in hosting the SRI, he had sent to the AMS a proposal that the 1985 SRI be held in Auckland. This was to have been discussed at the AMS's Annual General Meeting several days earlier, and he was expecting a reply shortly.

(C) Graduate Information - MRC reported that the scheme to collect information on Mathematics graduates had started. Local co-ordinators had been appointed. Some co-ordinators were seeking information from students whose final year had been 1982; others would start with the 1983 year. The number of students to be approached each year was at the discretion of the various co-ordinators. The information will be published in the Newsletter.

(D) Australasian Mathematics Convention in NZ - It was reported that the Australian Mathematical Society had been advised of the NZMS's hope that the Fifth Australasian Mathematics Convention would be held in New Zealand.

(E) Selection of Visiting Lecturer - DBG advised that, to date, he had made little progress in selecting the NZMS's Lecturer for 1983. Various people were suggested. Discussion took place on a selector for 1984.

Moved IDC/DBG that the Council approach W.D. Halford to act as selector of the 1984 NZMS Lecturer. CARRIED

(F) Teacher's Competition - JHA told the meeting that the competition was under way. It had been advertised in various publications. Several entries had already been received, and more were expected before the competition closed on 31.5.1983.

Moved IRC/JLS that P. Lorimer be appointed the official NZMS judge in the competition, and that it be recommended that he consult with G. Olive as appropriate. CARRIED

(G) Two-year Term for President - DJS outlined recommendations he had prepared concerning the extension of the Presidential term of office from one year to two years. Extensive discussion took place, and it was ultimately decided that DJS should put his suggestions to the A.G.M.

(H) RSNZ Unsecured Debentures - As decided at the previous meeting, the sum of $2,000 had been invested in unsecured debentures of the Royal Society of NZ. The debenture certificate was passed to the Treasurer.

(I) Nominations to RSNZ for Honours Awards - No action had been taken as yet (see Item 14).

(J) Newsletter Editor: Moved WD/IDC that Dr John Curran be appointed Editor of the "Newsletter". CARRIED

Moved IDC/WD that W. Davidson, J. Shanks and J. Curran be appointed as signatories to a Newsletter account. CARRIED

Moved KGR that Ian Coope be thanked for his past work as Editor of the "Newsletter". SECONDED AND CARRIED BY ACCLAMATION

4. CORRESPONDENCE:

Moved PDH/DBG that the inwards correspondence be received and the outwards correspondence be approved. CARRIED

5. BUSINESS ARISING FROM THE CORRESPONDENCE:

(A) 11th Conference of Combinatorial Mathematics Society of Australasia - Moved WD/IDC that the NZMS donate $100 to the Combinatorial Mathematics Society of Australasia to assist in the administration of its 11th Conference. CARRIED

(B) RSNZ Elections - The Council was informed of the nominations which had been made by the Society for positions on the National Committees for Mathematics (IMU) and for Theoretical & Applied Mechanics (IUTAM), and also of the votes which had been cast for the Member Bodies Management Committee.

(C) New Publication Policy for RSNZ Journal - The Journal's Editor is seeking reviews of areas of science connected with the various Member Bodies' interests. WD thought that this was a good idea which would broaden the scope of the Journal. DBG suggested that several reviews should be submitted. It was agreed that the incoming Council should be asked to approach appropriate people. D. Vere-Jones, G. Seber and A. McNabb were suggested as possibilities.

(D) Prince & Princess of Wales Award Scheme - JHA outlined the background to this scheme. The government had committed $25,000 p.a. to it; a similar amount was expected from commercial sources, and the RSNZ was hoping to raise about $15,000 p.a. from Member Bodies. The last A.G.M. of the NZMS had decided that the scheme should be supported.

Moved DBG/MRC that $300 be donated to the Prince & Princess of Wales Award Scheme for 1983-84. CARRIED

6. TREASURER'S REPORT:

JLS distributed copies of the report to be presented to the A.G.M. He said that a notice had been sent to all members whose subscriptions were in arrears. This had brought in a fair sum of money, and there were now 162 financial members. JLS said that the Auditor had stated that the book stock should be counted at (approximately) 31st December each year to be listed under "Assets" in the Society's Financial Report.

Moved IDC/DBG that the Treasurer's Report be well received. CARRIED

Moved MRC/WD that $150 be paid to the Eighteenth Mathematics Colloquium towards administration expenses. CARRIED

(The meeting adjourned for lunch.)

7. ILR joined the meeting at this point. He reported that about 2000 copies of the Seventh Form Syllabus Series had been sold in the past year. Copies of the first draft of the Calculus textbook would be on display during the Colloquium for comment (required not later than 30th June). It was hoped to have it available in book form for 1984. The likely cost to the NZMS was about $12 - $13, and it was intended that the price to students would be less than $20.
The marketing of the Calculus text was under discussion, and consideration was being given to the questions of copyright and royalties.

Moved DBG/JHA that W. Davidson, G. Wake and J. Ansell be delegated to negotiate with the authors in the Calculus project the questions of copyright and royalties, and to possibly re-negotiate with authors of the Syllabus series. CARRIED

Moved ILR/KGR that the Society express its appreciation of the assistance of the Department of Mathematics & Statistics of Auckland University in the preparatory work for the Calculus project. CARRIED

ILR said that the Calculus text could be regarded as the first of a new series of publications (a title for the series was needed). He was interested in hearing of any other ideas for publication.
ILR reported that, in view of proposed changes to the 6th and 7th Form Mathematics syllabi, NZMS and NZAMT were proposing to co-operate in the writing of new textbooks. ILR would have discussions with L.C. Johnston in Wellington after the Colloquium. It was hoped to have high school and University mathematicians in the writing teams.

Moved JHA/KGR that the Publications Report be received and Dr Reilly be thanked for his work as convener. CARRIED BY ACCLAMATION

(At this point, ILR and AMcN left the meeting.)

8. HUMAN RIGHTS:

There was no report this year.

9. NEWSLETTER EDITOR'S REPORT:

IDC presented a verbal report, which will be followed by a written report later. He thanked those people who had assisted him as Editor, and recommended the appointment of a Problems Editor, preferably outside the immediate editorial team. (PDH suggested Professor Zulauf.)
The printing and postage of the Newsletters costs about $1000 per annum.
It was reported that W.D. Halford had a number of copies of back issues of the Newsletter. IDC and MRC would check on what Newsletters were missing from the archives before destroying WDH's extra copies.

10. SUBSCRIPTIONS:

Moved IDC/JLS that the subscription rates for 1983-1984 be the same as for 1982-1983. CARRIED

Moved IDC/JLS that members who have been unfinancial for more than two years be advised that their names will be removed from the NZMS's membership list unless overdue subscription fees are paid promptly. CARRIED

11. NZMS JOURNAL:

IDC raised the question of the possible establishment of a NZMS Journal as a matter for the attention of the Publications Committee. Other Councillors wondered whether such a journal might be published in association with the Australian Mathematical Society, and whether the Newsletter should carry refereed articles (so indicated). DJS was asked to enquire about a possible association of the Newsletter and the Chronicle.

12. PUBLICATION OF COLLOQUIUM'S INVITED ADDRESSES:

Discussion took place as to where the Colloquium's invited talks should be published.

Moved from the Chair that the incoming President, acting in consultation with the outgoing President, confer with the Colloquium organisers and representatives of the "Chronicle" concerning the publication of the Colloquium's invited addresses. CARRIED

13. ANNUAL GENERAL MEETING:

JHA informed the meeting that he would nominate MRC for the position of incoming Vice-President.

14. GENERAL BUSINESS:

A nomination by the Society for Fellowship of the RSNZ had been unsuccessful in 1983. The incoming Council would be asked to support the nomination. It would also be asked to make certain agreed nominations to the RSNZ for possible honours (as per Section 8 of the minutes of the meeting of 7.12.1982).

Moved DBG/WD that the President, Treasurer and Secretary be thanked for their work during the past year. CARRIED BY ACCLAMATION

As there was no further General Business, JHA declared the meeting closed at 5.00 p.m.

K.G. Russell
Secretary

MINUTES OF BRIEF COUNCIL MEETING

Held at Massey University, 24th May 1983

The meeting was declared open at 12.50 p.m.

PRESENT: W. Davidson (President; in the Chair), M.R. Carter, J.H. Ansell (Vice-Presidents), I.D. Coope, A. McNabb, J.L. Schiff, J.A. Shanks, D.J. Smith.
In attendance: M.J. Curran.

1. APOLOGIES: D.B. Gauld, P.D. Hill. SUSTAINED

2. APPOINTMENTS:

Secretary: Moved from the Chair that Dr J.A. Shanks be appointed. CARRIED

Treasurer: Moved from the Chair that Dr J.L. Schiff be re-appointed. CARRIED

Newsletter Editor: Moved from the Chair that Dr M.J. Curran be appointed. CARRIED

Publication Committee: IDC/DJS moved that Dr M.J. Curran replace Dr I.D. Coope. CARRIED

Visiting Lecturer Selector: Moved from the Chair that Dr W.D. Halford be appointed subject to his approval. CARRIED

RSNZ Member Bodies Representative: DJS/IDC moved that Dr J.H. Ansell continue in this capacity and that Dr A. McNabb act in his place for the next meeting in April 1984. CARRIED

Thesis Competition Organiser: Moved from the Chair that Dr I.D. Coope be appointed. CARRIED

Human Rights Representative: Moved from the Chair that Dr B. Calvert continue in this position subject to his approval. CARRIED

Co-ordinator of Visitors: MRC/AMcN moved that Dr W.D. Halford act in this capacity with his approval. CARRIED

Graduate Information Co-ordinator: Moved from the Chair that Dr M.R. Carter continue in this position. CARRIED

Auditor: Moved from the Chair that Dr D.M. Emanuel be asked to continue as Auditor. CARRIED

University of the South Pacific: JHA/MRC moved that Dr D.J. Smith act as co-ordinator for applications to draw on the fund established to support students from the University of the South Pacific. CARRIED

3. BANK ACCOUNTS

It was noted that according to the Constitution, the President, Secretary and Treasurer should be the signatories for the general and publication accounts. IDC would transfer the Newsletter account to the University of Otago branch of BNZ after all changes at Canterbury had been settled, his signature being replaced by that of John Curran.

4. CHANGE TO CONSTITUTION

In accordance with a resolution passed at the A.G.M., the Council appointed a Committee to draft a proposal to amend the Constitution so as to extend the presidential term from one year to two years. The Committee was chosen to be D.J. Smith (convener), W. Davidson (ex officio), M.R. Carter, D.B. Gauld, J.L. Schiff, J.A. Shanks.

5. NEXT MEETING

The next meeting of Council was provisionally set for 6th December 1983 to be held in Wellington.

The meeting closed at 1.25 p.m.

J.A. Shanks
Secretary

MINUTES OF THE NINTH ANNUAL GENERAL MEETING

Held at Massey University on 23rd May, 1983

PRESENT: J. Ansell (President; in the Chair), M. Schroder, G. Thornley, B. Hayman, W.D. Halford, G. Wake, W. Davidson, D. Nield, J. Schiff, C. Little, D. Robinson, B. Woods, A. McInnes, P. Hafner, D. Smith, G. Tee, D. Harvie, K. Russell, I. Coope, J. Shanks, B. Dawkins, M. Hendy, M. Carter, A. Swift, D. McCaughan, J. Curran, D. Gauld, H. Gardiner, J. Maindonald, R. Davies, M. Jorgensen, D. Vere-Jones, I. Reilly, F. Gair.

The meeting was declared open at 7.05 p.m.

1. APOLOGIES: P. Hill, M.D.E. Conder, J. Harper. J. Butcher, K. Broughan.

Moved Halford/Davidson that the apologies be accepted. CARRIED

2. MINUTES OF THE EIGHTH A.G.M.: These Minutes had been printed in the Society's "Newsletter".

Moved Smith/Gauld that the Minutes be taken as read. CARRIED

After a minor amendment had been made to the Minutes, it was

Moved Russell/Smith that the Minutes, as amended, be adopted as a true and correct record of the proceedings of the Eighth Annual General Meeting. CARRIED

3. MATTERS ARISING FROM THE MINUTES:

It was reported that the A.C. Aitken Trust had been established, and was now seeking funds.

The 1985 Australasian Mathematical Convention would now be held at The University of N.S.W., and the NZMS had accepted the AMS's offer to hold the 4th Convention at The Australian National University in 1988. The NZMS had requested that the 5th Convention be held in New Zealand.

The President commented on the Royal Society of NZ's Prince & Princess of Wales Award Scheme. He said that it would give the RSNZ discretionary money, and that awards would be made for travel or research for short periods ($\leq$ 2 months). Mathematicians were encouraged to apply for these Awards.

4. ANNUAL REPORT:

The President commented on a number of points from the Annual Report, copies of which had been distributed. Dr Coope was thanked for his work as "Newsletter" Editor (the meeting supported this by acclamation). Drs Wake, Reilly and Halford were thanked for their efforts with regard to the 7th Form Syllabus series, the Publications Committee, and the Mathematics Visitors to NZ listing respectively.

The Mathematics Teachers Competition was underway. Dr Ansell had written to the Minister of Education concerning Teaching Fellowships, but without satisfactory results being achieved. The NZMS has supported the Gopi Jain Appeal in memory of the late G.C. Jain.

The President concluded the Annual Report by thanking the Council for its work during the year.

Moved Russell/Wake that the Annual Report be adopted. CARRIED

5. TREASURER'S REPORT:

Dr Schiff commented on several aspects of the Financial Report, copies of which had been distributed to those present at the meeting. He said that the Society currently had three separate accounts (General, Publications, and Newsletter). Most of the Society's profit of the year (> \$4,000) had come from the sale of publications. The amount of the NZMS's funds in term deposits had been increased from approximately \$1,100 to over \$6,000 during the year. About \$5,000 worth of publications were stock on hand at 31st December, 1982.

Expenses had included approximately \$1,000 for travel by Council members to the mid-term Council meeting; Dr Schiff felt that this was an unavoidable expense. The "miscellaneous" expenditure included the sum of \$150 which had been paid to the organisers of the 1982 Colloquium.

Dr Wilson asked whether the Auditor had been rewarded for his work; Dr Schiff advised that it was difficult to predict future sales of the 7th Form Syllabus Series, as some schools were building up a stock.

Moved Russell/Woods that the Treasurer's Report be adopted. CARRIED BY ACCLAMATION

6. PUBLICATIONS:

Dr Reilly thanked Esme Greig of Victoria University who organised the distribution of the 7th Form Series, and he commented on the 1st Year Calculus text, the first draft of which was on display and for which comments were invited.

Professor Vere-Jones recommended that it be revised after two years, rather than after one year. He said that he felt the writers should try to get it below 300 pages in length, and that the editors should consider publishing it in two volumes.

Dr Reilly mentioned that it was hoped that a joint writing team from NZMS and NZAMT could have a good text book available when the new Mathematics syllabus is introduced (for 6th Form, this will be at the beginning of 1985).

Responding to the President's invitation to him to comment on the introduction of the new syllabi, Professor Vere-Jones said that he had doubts about the virtue of the NZMS becoming a major publisher, but he felt that it was an excellent organisation to bring out a text book for the first couple of years. He did not see such a book as being definitive.

Moved Gauld/Davidson that the Publications Report be accepted. CARRIED

Professor Vere-Jones mentioned the "Chronicle", and said that he thought that there could be a stronger relationship between it and the NZMS. Dr Smith said that he had been asked to pursue this matter at the last A.G.M., but as the Editor of the "Chronicle" had been overseas for much of the year, no discussions had yet taken place.

Dr Coope reported that five issues of the "Newsletter" had been published since he became Editor. Four had been put out in the past year to satisfy Post Office regulations concerned registration of the "Newsletter". The Council had decided that there be only three issues per annum. He mentioned Dr W.B. Wilson's role in helping the Newsletter, and extended best wishes to the incoming Editor, Dr J. Curran.

Moved Coope/Russell that at least three issues of the "Newsletter" be published each year. CARRIED

7. ELECTIONS:

Dr Ansell, as retiring President, was declared Outgoing Vice-President for 1983-84, and Professor W. Davidson (as the former Incoming Vice-President) was declared President of the NZMS for 1983-84. As Dr M. Carter was the only nominee for the position of Incoming Vice-President, he was declared elected to that position for 1983-84. After a ballot, Dr J.A. Shanks was declared elected to the position of Councillor for the period 1983-86.

Moved Russell/Schiff that Dr D.M. Emanuel be re-elected as Auditor. CARRIED

8. GENERAL BUSINESS:

Moved from the Chair that the annual subscriptions be the same as for the 1982-83 year. CARRIED

Dr Smith spoke of his belief that the NZMS had now stabilised to a sufficient extent that the President's term should be extended to a two-year period.

Moved Smith/Vere-Jones that this meeting appoint a Committee to draft a proposal to amend the Constitution so as to extend the presidential term from one year to two years, that the proposal be in the name of at least five members and be circulated in the next Newsletter, and that it be decided by postal ballot after that.

The motion was supported by Professors Vere-Jones and Gauld, and by Dr Halford. Mr Harvie asked whether it was proposed that the number of people on the Council be changed, and was advised that it was intended to keep the same number of Council members as at present.

Moved Schroder/Woods that the motion be amended by changing "this meeting appoint a Committee" to "the Council appoint a Committee". CARRIED

The amended motion was then put, and was CARRIED

Professor Gauld provided details about the proposed Summer Research Institute meeting in 1985, in response to a question.

Moved Broughan/Schroder that the NZMS wholeheartedly support the International Physicians for the Prevention of Nuclear War.

Considerable discussion followed. Dr McInnes felt that the NZMS should confine its activities to matters directly involving mathematicians, and on these grounds he opposed the motion. Several other speakers supported this statement. Others supported the motion.

Moved from the Chair that the matter be referred to Council.

Dr Jorgensen said that the Council should take the advice of the A.G.M., rather than the other way around. Professor Davidson felt that the Council should be allowed to obtain further information and then refer this to the membership. The motion from the Chair was then put to the meeting, and was LOST

Provessor Vere-Jones felt that the A.G.M. should not bind the NZMS on this matter. Mr Harvie spoke along similar lines.

Moved Harvie/Maindonald that the motion be amended by replacing "the NZMS" by "this meeting". LOST

Dr Coope said that, while he could not support the motion on the grounds that it did not relate directly to the NZMS's activities, he felt it would be regrettable if the motion was defeated.

Moved Coope/Gauld that the motion be not put. CARRIED

Dr Russell said that members should be further reminded of the decision of the previous Annual General Meeting that matters such as the previous substantive motion should be circulated in advance.

Dr Wake said that, so far, the Council, but not the President, had been thanked for the work done in the last year.

Moved Wake that the President be thanked for his work on behalf of the NZMS. SECONDED AND CARRIED BY ACCLAMATION

There being no further General Business, the meeting was declared closed at 9.20 p.m.

Ken Russell
Secretary

PUBLICATIONS COMMITTEE REPORT 1982/83

The activities of the publications committee can be reported under three heads.

1. Syllabus Series:

   The NZMS 7th form syllabus series continues to sell well. We are grateful to the Wellington officers for continuing to handle this operation so successfully.

2. Calculus Projects:

   As promised in the January NZMS Newsletter, the manuscript of the book designed for NZ first year undergraduates was available for comment at the Massey Colloquium. This book will be available for adoption for courses in the 1984 academic year.

3. New 6th and 7th form textbooks:

   At its December 1982 meeting, the NZMS Council approved in principle a proposal from the N.Z. Association of Mathematics Teachers (NZAMT) that NZMS and MZAMT should cooperate in publishing ventures aimed at the new 6th and 7th form curricula, currently being considered by the University Entrance Board and its Mathematics Steering Committee. The subject convenor for Mathematics, Professor David Vere-Jones, supports this proposal in the hope that appropriate textbooks will be available when the new syllabi are introduced. Negotiations are at present taking place between officers of NZAMT and the publications committee convenor.

Ivan L. Reilly
Convenor

PROPOSED CONSTITUTIONAL AMENDMENT

Following a resolution at the Ninth Annual General Meeting of the Society a committee has been formed to make a proposal to amend the Constitution in order to extend the term of office of President of the Society from one year to two. The committee, appointed by the Council at its meeting of 24 May 1983, consists of M. Carter, W. Davidson (ex officio), D. Gauld, J. Schiff, J. Shanks, D. Smith (convener).

The articles which it is proposed to amend are reproduced here with superscripts and underlining referring to the proposed amendment to follow.

ARTICLE V: THE COUNCIL

The Council shall be the governing body of the Society. It shall consist of the President, two Vice-Presidents (Article VI), and six elected members.[1] The elected members shall each serve for three years. These members may be available for re-election but shall not serve for longer than six years in succession. If a current Council member is elected to the office of Incoming Vice-President (Article VI) the vacancy will be filled by the election of a further Council member for a term of three years. In this event if there are insufficient nominations to Council to cover this circumstance, then extra nominations will be called for immediately at the Annual General Meeting. Editors of any journals the Society may publish, if they are not already members of the Council, shall have the right to attend meetings and vote on matters pertaining to their journals. Council may co-opt further members for limited periods for specific purposes. In addition to the above members, one Council member will be a representative appointed by the New Zealand Association of Mathematics Teachers.

The Council shall determine the policies of the Society and shall supervise the affairs of the Society according to such by-laws as the Council may adopt. A by-law or amendment or repeal thereof shall come into effect thirty days after notification to the membership in a publication of the Society or otherwise in writing, unless during this thirty day period twenty members of the Society shall so petition and the by-law or amendment or repeal thereof shall then be submitted to a vote of the membership and shall not come into effect unless approved by a majority of those voting. However, this restriction shall not apply to those by-laws adopted at the time this constitution is first ratified.

The Council may enter into working arrangements and reciprocity agreements with other societies and organizations.

The Council shall meet at least once a year, and at other times if requested by the President or at least three members of Council. Members of Council shall be notified at least two weeks before any such Council meeting. In addition, a special meeting of the Council shall be held as soon as possible after the Annual General Meeting (Article VII) to appoint a Secretary and a Treasurer (Article VI) who shall be chosen from among the six[2] elected members of Council. Five members of the Council shall constitute a quorum, provided that at least one of the members present shall be the President or a[3] Vice-President. The President, or in his absence a[3] Vice-President, shall normally preside as Chairman at each meeting of the Council. All matters at Council meetings shall be decided by a majority vote of members of Council present and voting. In the case of a deadlock, the Chairman shall have a casting vote.

Any vacancy in the Council or Offices (Article VI) occurring other than by the normal expiration of a term of office, may be filled by an appointment of the Council. Officers and members thus appointed shall hold office until the next Annual General Meeting. When the vacancy is in the office of President of the Society (Article VI) the choice shall be made from one of the Vice-Presidents.[4] In the event of the Incoming Vice-President resigning during his/her term of office, the next President shall be elected at the following Annual General Meeting.

ARTICLE VI: OFFICERS

The officers of the Society shall be as follows:

(1) The President.
(2) A Vice-President who shall normally be the person who held the office of President immediately before the President in office; which person shall be known as the "Immediate Past President".
(3) A Vice-President who shall be the person elected to succeed the President in the following year; he shall be known as the "Incoming Vice-President".
(4) The Secretary.
(5) The Treasurer.

The term of office of the President and the Vice-Presidents shall be one year. The term of office of the Secretary and Treasurer shall be one year, but these officers shall be eligible for re-election.[5]

The President shall be ex officio a member of all committees. He shall deliver the Annual Report of the Council at the Annual General Meeting (Article VII). The Secretary shall be responsible to Council for the records of meetings and correspondence of the Society. The Treasurer shall be responsible to the Council for the records of membership and the management of the financial affairs of the Society in accordance with the policies determined by the Council. He shall keep the Society's financial records and prepare the necessary financial statements.

ARTICLE VII: MEETINGS

There shall be an Annual General Meeting of the Society at such a time and in such a place as the Council may determine. The business of the Annual General Meeting shall be:

(1) To receive the Annual Report of the Council.
(2) To receive the duly audited Annual Statement of the income and expenditure and assets and liabilities of the Society.
(3) To elect the Incoming Vice-President.[6]
(4) To elect members of Council.
(5) To appoint an Auditor for the ensuing year.
(6) To transact any other business of which notice in writing has been given to the Secretary at least six weeks prior to the Meeting.

Special General Meetings may be convened at any time by the Secretary or the President under the direction of the Council or upon the requisition of a petition of not less than 20 members of the Society to discuss only those matters specified in the petition.

Four weeks' notice of any Annual General Meeting or Special General Meeting shall be given to members.

At every Annual General Meeting or Special Meeting the Chair shall be taken by the President if present or in his absence by one of the Vice-Presidents, failing one of them,[7] a Chairman to be nominated from members of the Council by the persons present at the Meeting. The quorum for General Meetings of the Society shall be twenty members. All business shall be decided by a majority vote of those present and voting. In the case of a deadlock the Chairman shall have a casting vote.

For election of officers voting shall be done by secret ballot; other matters shall be voted by voice, or by a show of hands if called for by any members of the Society present at the meeting.

****

The undersigned hereby propose an amendment to the Constitution of the New Zealand Mathematical Society, the amendment to come into force at the time of the Annual General Meeting of the Society in 1985. Our intention is that the incoming Vice-President elected in 1984 will therefore begin a two year term as President in 1985.

Proposed amendment

1. Article V paragraph 1 line 2
   Delete: "two Vice-Presidents (Article VI), and six elected members."
   Insert: "one Vice-President (Article VI) and seven elected members."

2. Article V paragraph 4 line 6
   Delete: "six"
   Insert: "seven"

3. Article V paragraph 4 lines 8 and 9
   Delete: "a"
   Insert: "the"

4. Article V paragraph 5 lines 5 and 6
   Delete: "the choice shall be made from one of the Vice-Presidents."
   Insert: "the Vice-President shall be appointed President."

5. Article VI paragraphs 1 and 2
Delete: both paragraphs
Insert: "The Officers of the Society shall be as follows:

(1) The President
(2) The Vice-President
(3) The Secretary
(4) The Treasurer

The term of office of the President shall be two years. The Vice-President shall normally be either the person who held the office of President immediately before the President in office (in which case he/she shall be known as the 'Immediate Past President') or the person elected towards the end of the first year of a President's term of office to succeed the President in the following year (in which case he/she shall be known as the 'Incoming Vice-President'). The term of office of the Vice-President shall be one year. The term of office of the Secretary and Treasurer shall be one year, but these officers shall be eligible for re-election."

6. Article VII paragraph 1 part (3)
Delete: "To elect the Incoming Vice-President."
Insert: "To elect the Incoming Vice-President in alternate years (Article VI)."

7. Article VII paragraph 4 lines 2 and 3
Delete: "one of the Vice-Presidents, failing one of them,"
Insert: "the Vice-President, failing him/her,"

Signed: D.J. Smith, D.B. Gauld, J. Schiff, M.R. Carter, W. Davidson, J.A. Shanks.

18TH NEW ZEALAND MATHEMATICS COLLOQUIUM

The Eighteenth New Zealand Mathematics Colloquium held at Massey University from May 23-25, was attended by 88 participants, from New Zealand and overseas. As the Colloquium did not coincide with secondary school vacation we had no secondary or teachers college staff present. Further, the meeting coincided with the second term teaching at Canterbury and Victoria, with a consequent reduction in attendance from those universities. The distruption of inter-island transport by the weather deterred only a few visitors, although many had delayed and sometimes circuitous journeys.

The five invited speakers and the titles of their addresses were:

Professor D. Vere-Jones FRSNZ FRSS, Victoria University
"Permanents, determinants, bosons and fermions"

Professor G. Szekeres FAA, University of NSW (Mathematical Chronicle Lecturer)
"Scales of infinity and Abel's functional equation"

Dr J.H. Ansell, President NZMS, Victoria University (N.Z. Mathematical Society Lecturer)
"From seismology to singular value decomposition"

Professor R.P. Kerr FRSNZ, University of Canterbury
"Equations of motion in general relativity"

Dr G.A. Watson FIMA, University of Dundee
"Data fitting when all variables contain errors"

These talks were all well received.

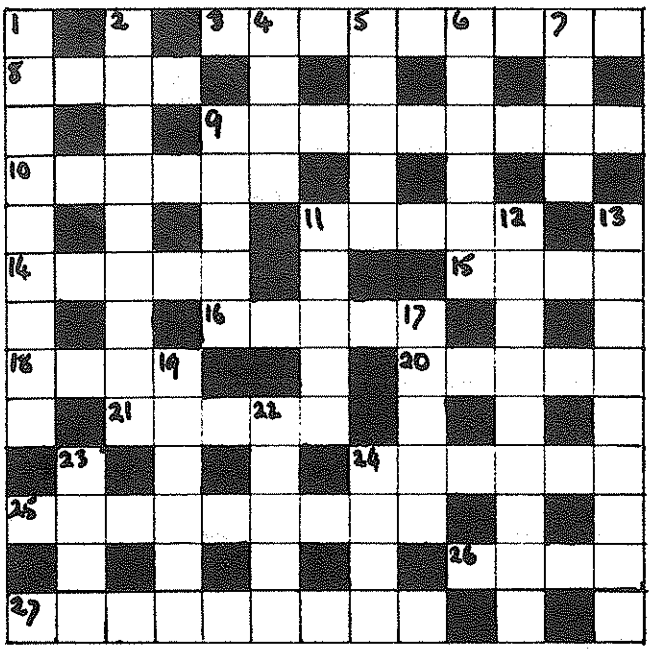
There were 46 contributed papers covering the broad spectrum of mathematical interests in pure and applied mathematics, statistics and computing. The standard of talks given was high. Abstracts will be published in the N.Z. Mathematical Chronicle.

Eighty-one people attended the annual dinner on Tuesday evening, and two bus tours were provided.

At the business meeting Mr D. Harvie formally invited the Colloquium to convene at Victoria University, probably during the week 7-12 May 1984.

Crossword

N° 11 dΨ dψ by Matt Varnish



CROSSWORD N° 10 SOLUTION

Across:

1. Algebra, 5. Peano, 8. Piers,
9. Pencils, 10. Ariosto, 11. Ormer,
12. Hungarian Cube, 15. Learn,
17. Armless, 20. Erdelyi, 21. Trump,
22. Torus, 23. Needles.

Down:

1. Alpha, 2. Grecian, 3. Bases,
4. Approximation, 5. Pontoon,
6. Axiom, 7. Observe, 12. Hilbert,
13. Annulus, 14. Unequal,
16. Adder, 18. Mitre, 19. Septs.

Across:

3. Titular sad sounds. (4,5)
8. Horsesense makes it 3 hands. (4)
9. Inset code. Has Dedekind worked on the bus-route? (9)
10. Three in the binary way in side? (6)
11. The state of one and one. (5)
14. Intersects gatherings in pinks. (5)
15. Lead of the labrythine thread. (4)
16. See as brings comfort. (5)
18. Bitter sweet? Thanks! (Right). (4)
20 and 19 down. In heaven 22 on 7. (3,2,3,3)
21. The rod has muddled 8. (5)
24. Lord in the end note proverbial pig food? (6)
25. Saltire, damn, or this. (9)
26. Animals from 1101 east. (4)
27. Multi-edged truth tester. (9)

Down:

1. Ematics consequence. (9)
2. Ancestors of Paddington, Rupert, Cookie and Pooh. (9)
4. Almost certainly not prime. (4)
5. Point to spike. (5)
6. Smooth the chief fate's mocking style. (6)
7. Take note. (4)
9. The awareness of five points. (5)
11. {IN,IN} the smaller picture. (5)
12. The method of an arabic leg. (9)
13. SESESESESESESESESESE. (9)
17. Hasten back from the deeps. (5)
19. See 20 across.
22. Of smaller cardinality. (5)
23. 3 in a riot. (4)
24. Support of public relations work. (4)

The Newsletter is the official organ of the New Zealand Mathematical Society. It is produced in the Mathematics Department of the University of Otago and printed at the University Printery. The official address of the Society is:

New Zealand Mathematical Society (Inc.)
C/- The Royal Society of New Zealand
Private Bag
WELLINGTON

However correspondence should normally be sent direct to the Secretary, Dr J.A. Shanks, Department of Mathematics, University of Otago, Dunedin.