

THE AUSTRALIAN NATIONAL UNIVERSITY
CENTRE FOR MATHEMATICAL ANALYSIS

ANNUAL REPORT 1989

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INTRODUCTION

The year 1989 was yet another lively, fruitful and productive year in the Centre. The main highlight was the Special Programme on Mathematical Physics which drew many of the leading international mathematicians and theoretical physicists and generated spectacular new interactions and understandings. Other successful features of the year included the Conference on Automatic Continuity and Banach Algebras and many significant research discoveries which are embodied in the 64 Research Reports issued during the year, as well as three conference proceedings.

ADMINISTRATION

The Director is responsible to the Vice-Chancellor, through the Chairman of the Board of the Faculties, for the administration of the Centre. In planning and executing the academic programme he is assisted by an advisory group comprising Professor R.P. Brent, Computer Sciences Laboratory, Research School of Physical Sciences, A.N.U., Professor L.M. Simon, Mathematics Research Section, School of Mathematical Sciences, A.N.U., Dr. R.S. Anderssen and Dr. F.R. de Hoog, Division of Mathematics and Statistics, C.S.I.R.O., and Professor A.G.R. McIntosh, School of Mathematics, Physics, Computing and Electronics, Macquarie University. The advisory group was expanded in 1989 through the coopting of Professor M. Barber of the Department of Mathematics, Faculty of Science, who also served as Acting Director during the first half of the year.

From the beginning of 1989, the Centre became one of four sections of the newly established School of Mathematical Sciences. Although the administrative base of the Centre remained in the Faculties, the new arrangements permitted the reassignment of Institute staff to an "Institute component" of the Centre. During 1990, such transfers were approved for Professor L.M. Simon and Dr. G. Huisken.

STAFFING MATTERS

Professor Trudinger devoted most of the first half of the year to an outside studies programme. Professor Barber was seconded from the Department of Mathematics during the first half of 1989 to facilitate his involvement in the Mathematical Physics programme. Professor Simon continued his leave at Stanford University during 1989, but returned to the Centre as a Visiting Fellow for four months in the middle of the year. Dr. Bartnik spent a six month period of leave at the University of Bonn from April to October and was promoted to Senior Research Fellow. Dr. Huisken commenced his joint appointment with the Centre and the Department of Mathematics. Professor Kluvanek moved to a visiting post at the University of New South Wales in July. Dr. Newsam took up a position at the Defence Science and Technology Organization in January and Dr. Ecker took up a position as a Lecturer at the University of Melbourne in January. Dr. Urbas was appointed as a Research Fellow in September and Dr. Scott (from Oxford) and Dr. Latham (from Berkeley) commenced Postdoctoral Fellowships in October and November, respectively. Dr. Pearce was seconded from Melbourne University during 1989 and together with Dr. Batchelor, who was supported by a QEII Fellowship, played a major role in the Mathematical Physics programme. Professor Ohkubo returned to Japan in March and Professor Keraychian to Iran in July. They had each spent one year sabbatical leaves from their home institutions in the Centre.

A total of fifty four mathematicians and physicists were appointed as short term Visiting Fellows, for periods of less than six months, during 1989. These included six distinguished scientists from the Soviet Union. Professor Helemskii participated in the Centre's conference on "Automatic Continuity and Banach Algebras". Professors Bazhanov and Korepin participated in the Mathematical Physics programme, and Professors Ivochkina, Ladyzhenskaya and Uraltseva interacted with Centre members in nonlinear partial differential equations as well as participating in the Centre's conference on "Operators in Analysis".

RESEARCH ACTIVITIES

The research activities of the Centre in 1989 may be divided between ongoing research in theoretical, computational and applied mathematics and activities associated with the special programmes on Mathematical Physics and Automatic Continuity and Banach Algebras. Separate reports on these programmes by their organizers are provided at the end of this section.

Theoretical Mathematics: The following is a selection of pure mathematical research undertaken in 1989:

- (i) Nonlinear partial differential equations - Trudinger continued research, initiated in 1988, into the viscosity approach to prescribed curvature equations and their application to integral geometry (Reports R19, R46). Urbas exhibited non-regular viscosity solutions for such equations (Report R14) and discovered striking new regularity results for Gauss curvature (Reports R42, R61) including the smoothness of solution graphs in vertical boundary sets. Luo completed his doctoral research on second order boundary conditions for quasilinear elliptic operators (Reports R44, 45). An important and stimulating contribution to research in this areas was provided by the distinguished USSR mathematicians, Ladyzhenskaya, Uraltseva and Ivochkina (Reports R64, R66).
- (ii) Geometric variational problems and related evolution equations - Ecker and Huisken continued their collaboration in this area, constructing maximal and constant mean curvature slices in Lorentzian manifolds using mean curvature flow methods. Huisken and Yau (Harvard) proved the existence of a unique constant mean curvature foliation in asymptotically flat three manifolds of positive mass. Research in these areas was also supported strongly by Visiting Fellows, Isenberg and Simon.
- (iii) Mathematical Relativity - Bartnik continued investigation into his quasi-local mass concept [8], yielding in particular a proof of the linearized form of a long-standing conjecture of Penrose. Scott considered isotropic singularities and a new approach to space-time extension (Reports to appear 1990).
- (iv) Nonlinear systems - Fusco and Hutchinson made substantial progress in their study of partial regularity for variational systems (which originated in the Centre in 1985). In particular they extended previous research to embrace functionals that are directly motivated by nonlinear elasticity, (Report R1).

Computational and Applied Mathematics

A major thrust in the Centre's computational research is driven by the theoretical research described above. Kuo (Taiwan) and Trudinger extended their treatment of elliptic difference approximations to parabolic equations. Their earlier work (Report R43, 1988) was accepted for publication in 1990 in the leading computation journal, *Mathematics of Computation*. Finite element methods for mean curvature flow were developed by Roberts, Huisken and Hutchinson in conjunction with their ARC project on

"A Numerical and Theoretical Study of Models for the Evolution of Interfaces" (see 1988 Report). This work was carried out in association with Visiting Fellow, Dziuk and will be substantially advanced in 1990 through a special Australian-German workshop in geometric evolution. Bartnik continued numerical experiments with the spherical Einstein Yang-Mills equations.

Collaborative research on environmental systems with CRES and the CSIRO also continued (see publications [23,24,25]). Dietrich worked on a random field representation of hydraulic conductivity in groundwater system identification and derived in collaboration with Osborne (Statistics Research Section School of Mathematical Sciences) a new method for covariance estimation of a class of Gaussian random fields (Report R15).

Nair and Anderssen engaged in research on spectral approximation and approximate solution of operator equations during Nair's three month Visiting Fellowship (Reports R11, R16, R57). In addition Anderssen interacted with Engl and Andrew (Report R56).

Research on inverse eigenvalue problems carried out at the Centre, during its "Inverse Problems" programme in 1986, by Visiting Fellows Professors Hald and McLaughlin, was featured in the magazine Insight in 1988. The article included a commentary on the research by Dr. Anderssen.

SPECIAL YEAR IN MATHEMATICAL PHYSICS

(Report by R.J. Baxter and M.N. Barber, Organisers)

During 1989 the Centre for Mathematical Analysis sponsored a Special Year in Mathematical Physics. The research activities of this programme centred on:

- i. solvable models in statistical mechanics,
- ii. conformal and modular invariance in field theory and statistical mechanics,
- iii. the Yang-Baxter equations and integrability,
- iv. related mathematics including applications to knot theory, Virasoro and Kac-Moody algebras, Riemann surfaces and strings, and integrable systems.

These themes were chosen as foci for the Programme because they are all areas in which there is currently intensive interest from both physics and mathematics with significant results (for both disciplines) beginning to emerge. In hosting this year, the Centre hoped to encourage a dialogue between theoretical physicists and mathematicians - a hope that, from the comments of many visiting fellows, appears to have been realised.

In addition to Professor M. N. Barber who was seconded to the Centre on a half-time basis from the Department of Mathematics, other ANU academics associated with the Programme were Professor R.J. Baxter, Dr. G.R.W. Quispel and Dr M. K. Murray (from the Institute of Advanced Studies) and Dr B. Davies (Department of Mathematics). Twenty overseas and Australian mathematicians and physicists spent substantial periods as Visiting Fellows in the Centre as part of the Programme, including Drs Batchelor and Pearce.

Conferences and Seminars

As part of the Programme, three conferences were organised:

- i. Miniconference on Geometry and Physics (February): This conference was attended by 30 participants from throughout Australia and three from overseas. The keynote speaker was Professor Sir Michael Atiyah (Oxford), who gave three expository lectures on the geometry and physics of knots. The Proceedings of the conference were published as Volume 22 of the *Proceedings of the Centre for Mathematical Analysis*.
- ii. Conference on Yang-Baxter Equations, Conformal Invariance and Integrability in Statistical Mechanics and Field Theory (July): This conference was the major event of the year; the conference encompassed the major themes of the Programme and coincided with the period with the greatest number of Visiting Fellows simultaneously in Canberra. The conference featured 25 lecturers, 15 of whom came from overseas and attracted about 40 participants in all. Many of the lecturers were world leaders in their fields and there was considerable interaction between all the participants. As a result, the conference participants were able to appreciate the latest developments in these very active areas of research. The Proceedings of the Conference will be published as a special issue of the *International Journal of Modern Physics*.

iii. The 1989 Australian Statistical Mechanics Meeting: (November) This conference featured 21 lecturers from throughout Australia, and overseas...The talks covered a wide range of statistical mechanics; the Meeting attracting participants from chemistry and physics, as well as mathematics.

In addition to these formal conferences a working group on conformal invariance and the other fields covered by the July conference was organised from the beginning of May until November with seminars held once or twice a week. This provided an opportunity for participants (particularly Visiting Fellows) to present and discuss recent work in depth. A feature was an illuminating series of survey lectures delivered Dr. P.A. Pearce on the Lie algebraic classification of critical models. Another highlight was the seminars by V. V. Bazhanov, who arrived in July and reported significant progress (with Yu. G. Stroganov) towards a complete solution of the chiral Potts model (CMA-R34-89). These ideas were subsequently pursued at the CMA by Bazhanov, Perk and Baxter resulting in a joint paper (CMA-R38-89).

Research Activities

The Special Year in Mathematical Physics produced 32 CMA Research Reports most of which are due to be published in the mathematics or theoretical physics literature. By any standard this is a good indicator of the value of the programme and of the opportunity it gave participants to make contributions to the field. Highlights of some of the work of Centre members and Visiting Fellows associated with the Programme are summarised below.

Baxter continued his investigation of the "chiral Potts" models in lattice statistics (CMA-R12-89). These models form a new class of two-dimensional lattice models that satisfy the Yang-Baxter equations but which, unlike all previously known models, are not reflection symmetric. As a result they significantly extend the knowledge of exactly soluble statistical mechanical models. The critical "superintegrable" case turns out to have finite-size corrections that are not of the form predicted by conformal invariance. Whether this hypothesis can be generalised for models such as the chiral Potts model remains an open question. For the general model, several sets of functional relations satisfied by the transfer matrix were obtained in joint work with Bazhanov and Perk (both Visiting Fellows). These relations undoubtedly define all the eigenvalues of the transfer matrix. However, their solution remains a challenging problem. The chiral Potts model was also the major interest of McCoy. In particular, he and Perk have investigated the implications of this

model for other physical systems including a possible relevance to theories of high- T_c superconductivity.

Pearce continued his work on inversion relations and the derivation of exact results for the cyclic solid-on-solid model. In particular, with Batchelor he carried out a detailed analysis of the spectra of the row transfer matrices of the cyclic solid-on-solid models (CMA-R48-89) while with Seaton he is analysing these models as $c=1$ rational conformal field theories. Finally, he and Davies carried out a comprehensive analysis of the spectrum of the corner transfer matrix for the Ising model confirming in detail predictions of conformal invariance (CMA-R39-89). This work is being extended to the A-D-E lattice models.

Barber and Batchelor established (CMA-R07-89 and CMA-R35-89) some new exact results for an important class of quantum antiferromagnetic chains. These results resolved a number of controversies, confirmed some conjectures and established important new bench marks for the testing of approximation or numerical methods with wider application.

Batchelor and Klümper (CMA-R63-89) developed a new method to compute analytically the central charge, a key parameter in conformal field theory, from the Bethe ansatz equations for an integrable system. Previous methods work very well for 'simple' models such as the 6-vertex model or the spin-1/2 XXZ chain but run into difficulties for higher spin Hamiltonians. These difficulties can be traced back to the more complex form taken by the solutions of the Bethe ansatz equations. The new method overcomes these problems by exploiting functional relations for the eigenvalues and, to date, has yielded the only direct analytical calculation of the central charge for the integrable spin-1 Babujian/Takhtajan Hamiltonian and its anisotropic XXZ generalisation.

Jimbo and Miwa continued their work on algebraic aspects of integrable systems. In particular, they derived new results connecting the Knizhnik-Zamolodchikov equation and hypergeometric integrals (CMA-R27-89).

Jones pursued a number of different lines of research concerning the relationships between knot theory and statistical mechanics. One was what Jones termed "Baxterizations" (CMA-R23-89). This means: Start with a braid group representation: $\sigma_i \sigma_{i+1} \sigma_i = \sigma_{i+1} \sigma_i \sigma_{i+1}$, $\sigma_i \sigma_j = \sigma_j \sigma_i$, $|i-j| \geq 2$ and try to deform it to obtain a solution of the Yang-Baxter equations $R_i R'_{i+1} R''_i = R''_{i+1} R'_i R_i$, $R_i R'_j = R'_j R_i$ $|i-j| \geq 2$. Baxterization is possible in many cases and has revealed close connections between knot invariants and integrable statistical mechanical models satisfying the Yang-Baxter equations. Jones' recent work is

aimed at extending the approach to cover knot invariants obtained from homology of branched covers of S^3 . Another project involved trying to use the Alexander polynomial (from knot theory) as an inspiration to define new statistical mechanical models. To date, this approach has resulted in a simple understanding of why certain 6-vertex models are given by determinants and a vertex model on the 3-dimensional cubic lattice but unfortunately without positive Boltzmann weights and hence unphysical.

Joshi's research continues to revolve around the question of what makes a system integrable. There is a conjecture that if a partial differential equation is completely integrable then its solutions must necessarily exhibit a special singularity structure. Joshi has discovered (CMA-R08-89) strong evidence that an analogous condition holds for a discrete dynamical system to be integrable. This question is of interest because of connections between exact solvability of lattice statistical mechanics and integrability of their continuum (field theory) limits. In other work (CMA-R53-89), she obtained an explicit one-soliton solution for the (2+1)-dimensional Sine-Gordon equation.

Integrability in dynamical systems is also one of the major interests of Quispel. This year he focused on integrable ordinary difference equations showing that in certain circumstances they can be obtained as reductions of integrable partial differential equations. In other work, he extended that of Korepin on the correlation functions of the classical nonlinear Schrödinger equation (CMA-R26-89) to other equations exhibiting soliton solutions. These results strengthen the connections between solitons, linear integral equations and quantum correlation functions.

In addition to his work (CMA-R26-89 and CMA-R28-89) on the derivation and analysis of differential equations for the correlation functions of models solvable by the quantum inverse method, Korepin and Davies wrote a paper (CMA-R33-89) on conservation laws for the quantum nonlinear Schrödinger equation, which resolved a number of mathematical issues with the quantum inverse method.

Other significant contributions to the research programme were made by Pasquier, Atiyah and Murray, Evans and Carey, Carey and Mung (Report R60) and McGuire (Reports R51, R52).

CONFERENCE ON AUTOMATIC CONTINUITY AND BANACH
ALGEBRAS January 2-20

(Report by R. J. Loy, Organizer)

This was the latest in a series of approximately biennial conferences, the first in the southern hemisphere, and by all accounts the most successful to date. The timing and duration was designed to fit into the January break of many northern hemisphere universities, yet to have a workshop environment to enhance interaction between participants. The conference was hosted by the Centre with the assistance of a Special Interest Meeting grant from the Australian Mathematical Society.

In summary, 16 overseas mathematicians attended, and 8 from Australia. Two overseas people (Allan, Helemskii) came as longer term Visiting Fellows, and one (Grønbæk) was funded through the Mathematical Sciences Research Centre.

Lectures were given by all overseas visitors and most of the locals. The highlight in this regard was the series of lectures by A. Ya. Helemskii on "Topological Homology" – the application of powerful homological methods to problems in Banach algebra theory. Another series of talks were given by H. G. Dales, outlining progress on the problem of norming algebras, in particular the algebra of infinitesimal elements of an ordered field. In total, thirty-six one hour talks were presented, together with four one hour problem sessions. Almost all of this material was published as Volume 21 of the *Proceedings of the Centre for Mathematical Analysis*.

Three of the overseas visitors (Helemskii, Allan, Grønbæk), who stayed beyond the conference, were able to spend varying lengths of time visiting the School of Mathematics at the University of New South Wales. As well, these three, together with H. G. Dales and R. J. Loy spent a considerable time editing the English translation of the book of Helemskii "The homology of Banach and topological algebras". This translation has been recently published by Kluwer. Allan continued work on sheaves of non-abelian groups, with intended application to Banach algebras; Grønbæk worked on weak and cyclic amenability (CMA-R03-89), and investigated the cohomology of tensor algebras and algebras of nuclear operators. Much of the research done or initiated at the conference by participants is reflected in the published version of their talks in the proceedings, however some has since appeared in preprint or published form elsewhere (Grønbæk, Mathieu, Willis).

CONFERENCES AND TRAVEL

Members of the Centre participated in the following Australian conferences and meetings:

Bushfire Workshop, Canberra, March.

Watercomps '89', Australasian Conference on Technical Computing in the Water Industry, Melbourne, May.

Annual Meeting of the Australian Mathematical Society, Sydney, July.

Computational Techniques and Applications Conference, Brisbane, July.

Biennial Conference and Bushfire Dynamics Workshop, Int. Assoc. for Mathematics and Computers in Simulation, Canberra, September.

Australian Supercomputer Conference, Wollongong, December.

As well as providing participants the Centre also organized and largely sponsored the following conferences:

"Automatic continuity and Banach algebras", Canberra, January.

"Geometry and Physics", Canberra, February.

"Yang-Baxter Equations, Conformal Invariance and Integrability in Statistical Mechanics and Field Theory", Canberra, July.

"Operators in Analysis", Sydney, September.

"1989 Australian Statistical Mechanics Meeting", Canberra, November.

The following overseas activities were undertaken by Centre members. Neil Trudinger was based at Northwestern University during outside studies programmes from February until June. During this period he gave a series of lectures at a workshop on Partial Differential Equations held there in March, an invited lecture at the Midwest Partial Differential Equations meeting in Chicago in April, a "Distinguished Visiting Professor" series of lectures at the University of Iowa in April and an invited lecture at a conference to mark the retirement of D. Gilbarg at Stanford in June. In addition he gave colloquia at the Universities of Illinois and Indiana and Purdue Universities. In August, he gave an Invited Lecture at an International Conference on Differential Equations and Applications in Rousse, Bulgaria and in November he took up an invitation to deliver the Lipschitz Lectures at the University of Bonn.

Robert Bartnik during his sojourn at the University of Bonn visited and delivered lectures at several European universities including Warwick, Bochum, Göttingen, Heidelberg, as well as the Max Planck Institute for Physics and Astrophysics in Munich, the Polish Academy of Sciences in Warsaw, the Ecole Polytechnique and College de France in Paris. He also participated in conferences at Marseille (minimal surfaces), Oberwolfach (differential geometry) and Tihany (Hungarian Relativity

Workshop). On his return to Canberra via the United States, he gave lectures at New York, Princeton and Stanford Universities.

Gerhard Huisken undertook an Outside Studies visit to Harvard University in January and February, during which time he gave seminars at Stanford, Northwestern, Harvard and Brown Universities as well as Dortmund and Heidelberg on his return to Canberra. In July he gave an Invited Lecture at a Conference on Geometric Evolution Equations in Hawaii.

John Urbas spent the period from January to July at Northwestern University, and gave lectures at the Partial Differential Equations workshop and Iowa State University. He also participated in the Midwest Partial Differential Equations Meeting and the Conference at Stanford University in June. As well, he visited the University of Nice in July, attended the Equadiff. 7 Conference in Prague in August and visited the Chinese University in Hong Kong in September.

Susan Scott gave invited talks at the International Conference on General Relativity and Gravitation at Boulder in July and the Hungarian Relativity Workshop at Tihany in September.

Paul Pearce attended the International Conference on Statistical Mechanics in Rio de Janeiro in August.

PUBLICATIONS

The Centre produced 64 Research Reports in 1989, (with about 30 emanating from the Mathematical Physics year), and four volumes of its proceedings. Three of these volumes were devoted to conference proceedings but Volume 23 by W.A. Coppel of the Department of Theoretical Physics, Research School of Physical Sciences is the first published Chinese-English mathematics dictionary. Its essential aim is to facilitate the understanding of Chinese mathematical works by readers unfamiliar with Chinese mandarin.

Further publication details are given in attachment (iii).

OTHER ACTIVITIES

Professor Trudinger continued to serve on the editorial boards of the international journals, *Annales de L'institut Henri Poincaré-Analyse Nonlineaire* and *Proceedings of the Royal Society of Edinburgh, Series A*. Gerhard Huisken was an Associate Editor of the *Bulletin of the Australian Mathematical Society*.

Professor Trudinger accepted invitations to a Professorial Selection committee at Flinders University and as an assessor for a Professorial Appointment at Murdoch University.

Dr. Anderssen continued as Treasurer of the Federation of Australian Scientific and Technological Societies and as Chairman of the National Committee for Mathematics of the Australian Academy of Science.

FUTURE PLANNING

Planning continued for the 1990 Special Year on Application and Numerical Analysis of Partial Differential Equations under the direction of a committee consisting of R.S. Anderssen (Convenor), F.R. de Hoog, M.R. Osborne (Statistics Research Section) and V. Thomée (University of Goteborg, Sweden). This programme has already attracted the participation of many of the world's leading computational mathematicians.

VISITORS COMMENTS

The following comment, extacted from a report of a Visiting Fellow, Professor Isenberg of the University of Oregon, captures the view expressed by many Centre visitors over the years:

"I have visited a number of Mathematics Departments in the world - including Berkeley, Oxford, Princeton, Harvard, Rice and Minnesota - and have found the CMA to be about the most productive place to visit for me. There are lots of very strong PDE people here - Trudinger, Simon, Huisken, Hutchinson and Bartnik are the ones I know best - and besides being good, they are interested in talking mathematics among themselves and others..... I should add that it is a very friendly, lively bunch as well".

CENTRE FOR MATHEMATICAL ANALYSIS

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STAFF

Director and Professor	N.S. Trudinger, B.Sc.(N.E.),M.Sc.,Ph.D.(Stan.), F.A.A.
Professors	* M.N. Barber, B.Sc.(NSW),Ph.D.(Cnell) L.M. Simon, B.Sc.Ph.D.(Adel), F.A.A.
Senior Research Fellows	R. Bartnik, B.Sc.,M.Sc.(Melb.),Ph.D. (Princeton) * G. Huiskens, DiplMath, Dr.Rer.Nat.Habil (Heidel.) I. Kluvanek, Habil.Doc.Safarik Univ.RNDr CSc (Slovak Acad.Sciences)
Research Fellows	* N. Joshi, B.Sc.(Sydney),M.A.,Ph.D.(Princeton) G. Newsam, B.Sc.,M.Sc.(Cant.),A.M.,Ph.D. (Harvard) * S. Roberts, B.Sc.,M.Sc.(Flinders),Ph.D.(Berkeley) J.I.E.Urbas, B.Sc.,Ph.D.(ANU)
Postdoctoral Fellows	K. Ecker, DiplMath, Dr.Rer.Nat. (Heidel.) G. Latham, B.Eng.,B.Sc.(Qld),M.Sc.(ANU), Ph.D.(Berkeley) S.M. Scott, B.Sc.(Monash),Ph.D.(Adel.)
Australian Water Research Fellow	** C. Dietrich, B.Appl.Math. (ETH)., M.Eng.Sc.(Sydney),Ph.D.(ANU)
Visiting Fellows	M.T. Batchelor, B.Sc.(NSW),Ph.D.(ANU) A. Keraychian, B.Sc.(Tehran),M.Sc.(Southampton) Ph.D.(Colorado) T. Ohkubo, D.Sc.(Hokkaido) P.A. Pearce, B.Sc., Ph.D. (Melbourne)
Programmer	* D.R.L. Davies, B.Sc.,M.Sc. (ANU)
Secretary	M.G. Gray
Wordprocessor Operators	D.M. Nash J.M. Smith
Research Assistant	Y-S Luo, B.Sc.,M.Sc. (Jilin)

- * joint with Mathematics Department, Faculty of Science
 ** joint with Centre for Resource and Environmental Studies

ASSOCIATE MEMBERS

R.S. Anderssen	Division Mathematics & Statistics, CSIRO
R. Baxter	Mathematics Research Section, School of Mathematical Sciences
R.P. Brent	Computer Sciences Laboratory, R.S.Phys.Sciences
F.R. de Hoog	Division Mathematics & Statistics, CSIRO
J.E Hutchinson	Mathematics Department, Faculty of Science
A.G.R. McIntosh	School of Maths, Physics, Computing & Electronics, Macquarie University
M. Murray	Mathematics Research Section, School of Mathematical Sciences
R. Quispel	Mathematics Research Section, School of Mathematical Sciences

VISITING FELLOWS* (Short Term)

Albrecht, E.	University of Saarbrücken	January
Allan, G.	University of Cambridge	Jan-Feb
Andrews, A.	La Trobe University	Sept-Oct
Atiyah, Sir Michael	Oxford University	February
Bade, W.	University of California, Berkeley	January
Bazhanov, V.	Institute for High Energy Physics, Serpukhov	Jly-Aug
Brown, G.	University of New South Wales	January
Carey, A.	University of Adelaide	May-Jly
Chevreau, B.	University of Bordeaux	January
Curtis, P.	University of California, Los Angeles.	January
Dales, G.	University of Leeds	Jan-Feb
Dziuk, G.	University of Bonn	May-Jly
Engl, H.	Johannes Kepler Institute	June-Jly
Evans, D.	University College, Swansea	Jly-Sept
Fusco, N.	University of Naples	Jly-Oct.
Gale, J.	University of Zaragoza	January
Getzler, E.	Harvard University	June
Ghahramani, F.	University of Manitoba	January
Grabiner, S.	Pomona College	January
Gronbaek, N.	Kobenhavn University	Jan-March
Helemskii, A.	Moscow State University	Jan-Feb.
Isenberg, J.	University of Oregon	Jly-Sept
Ivochkina, N.	Institute of Civil Engineering, Leningrad	Sept-Nov

Jimbo, M.	Kyoto University	June-Jly
Jones, V.	University of California, Berkeley	July
Kaniuth, E.	University of Paderborn	August
Klümper, A.	University of Cologne	June-Jly
Korepin, V.	Steklov Mathematical Institute, Leningrad	June-Aug
Ladyzhenskaya, O.	Steklov Mathematical Institute, Leningrad	Sept-Nov
Laursen, K.	Kobenhavn University	Jan-Feb
Longstaff, W.	University of Western Australia	January
Matthieu, M.	University of Tübingen	January
McClure, P.	University of Manitoba	January
McCoy, B.	State University of New York at Stony Brook	Jly-August
McGuire, J.	Florida Atlantic University	Oct-Nov
Michael, J.	University of Adelaide	Jly-Sept
Miwa, T.	Kyoto University	June-Jly
Nair, A.	Goa University	March-Jne
Neumann, W.	Ohio State University	Aug-Sept
Nienhuis, B.	University of Leiden	June-Aug
Parvalham, R.	University of Madras	August
Pasquier, V.	Centre d'Etudes Nucleaires de Saclay	June-Jly
Perk, J.	Oklahoma State University	July-Aug
Rittenberg, V.	University of Bonn	July
Sarnak, P.	Stanford University	July-Aug
Tracy, C.	University of California, Davis	July-Aug
Uraltseva, N.	University of Leningrad	Sept-Oct
Willis, G.	Flinders University	January
Yu, X.	Academia Sinica, Beijing	Sept-Nov

*Visiting Fellows appointed for more than six months are listed as staff

COLLOQUIUA 1989

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|-------------|--|
| February 2 | Professor Alexander Ya. Helemskii (Moscow State University) "Categorical and Homological Method in Functional Analysis" |
| February 9 | Professor Felix Albrecht (University of Illinois at Urbana-Champaign) "Control Systems and Regularity Properties of the Minimum Time Function" |
| February 16 | Professor Sir Michael Atiyah (University of Oxford) "The Geometry and Dynamics of Magnetic Monopoles" |
| February 23 | Professor Peter J. Nyikos (University of South Carolina) "Various Smoothings of the Long Line and Their Tangent Bundles" |
| March 9 | Dr. Gerhard Huisken (Centre for Mathematical Analysis) "Constant Mean Curvature Foliations in Asymptotically Flat Manifolds" |
| March 16 | Dr. Paul Pearce (Centre for Mathematical Analysis) "Solvable Lattice Spin Models" |
| April 13 | Professor George F.D. Duff (University of Toronto) "On Energy Integrals and L_p Properties of the Navier Stokes Equations in Three Space Dimensions" |
| April 27 | Professor T.D. Paley (Institute for Nuclear Research and Nuclear Energy, Sofia) "Superalgebras and Quantum Statistics" |
| May 4 | Professor John Blake (University of Wollongong) "Boundary Integral Methods Applied to Bubble and Interface Problems" |
| May 18 | Professor Jacques C. Hurtubise (McGill University, Montreal) "Symplectic and Algebraic Quotients" |
| May 25 | Professor Miklos Mikolas (Budapest Technical University) "New Developments of the Coordinatization Problem of Abstract Spaces" |
| June 8 | Dr. Michael K. Murray (Mathematics Research Section, Australian National University) "Singularities in Yang-Mills Fields and Monopoles" |
| June 15 | Professor Leon Simon (Centre for Mathematical Analysis) "Singularities of Solutions of Geometric Variational Problems" |
| June 22 | Dr. Igor Kluvanek (Centre for Mathematical Analysis) "Summation, Integration, etc." |

- June 29 Professor Neil S. Trudinger (Centre for Mathematical Analysis) "Viscosity Approach to Curvature Problems"
- July 6 Professor Gerhard Dziuk (Bonn University) "Finite Elements on Surfaces and Applications to Flow Problems"
- July 20 Professor Vaughan Jones (University of California, Berkeley) "Hecke Algebras and Generalizations Related to Knot Theory"
- August 3 Dr. Jonathan Pila (Institute of Advanced Studies, Princeton) "The Number of Integral Points on Arcs and Ovals"
- August 10 Professor Peter Sarnak (Stanford University) "On Hearing the Shape of a Drum"
- August 17 Professor Jim Isenberg (University of Oregon) "Where do Ricci Flows Go"
- August 24 Dr. Norman J. Wildberger (University of Toronto) "Moment Maps and Representation Theory"
- August 31 Dr. Jim Michael (University of Adelaide) "Monotone Operators and Obstacle Problems"
- September 7 Dr. Walter Neumann (Ohio State University) "Topology of Complex Algebraic Plane Curves"
- September 14 Dr. Chris Meaney (Maths Research Section, School of Mathematical Sciences) "Unitary Structure for Reducible Principal Series"
- September 21 Professor Horst Simon (Boeing Computer Services and NASA Ames Research Center) "High Performance Sparse Matrix Algorithms"
- October 5 Professor Olga Ladyzhenskaya (Steklov Institute, Leningrad) "Attractors for Abstract Semigroups"
- October 12 Professor Nina Ivochkina (Institute of Civil Engineering Leningrad) "Some Remarks on the Development of Monge-Ampère Type Equations Theory"
- October 19 Dr. John Hutchinson (Mathematics, Faculty of Science) "Regularity Theory in Non-Linear Elasticity"
- October 26 Professor Nina Uraltseva (University of Leningrad) "Variational Inequalities"

- November 9 Dr. John Urbas (Centre for Mathematical Analysis)
"Regularity and Nonregularity For Solutions of Prescribed Curvature Equations"
- November 16 Dr. Stephen Hyde (Applied Mathematics, R.S.Phy.Sciences, ANU)
"The Structures Formed in Self-Assembled Systems"
- November 23 Dr. Hugh Possingham (Ecosystems Dynamic Group, RSBS, ANU)
"Modelling the Interaction Between Plant Population Biology and Optimal Plant Behaviour"
- November 30 Dr. Geoffrey Latham (Centre for Mathematical Analysis)
"Higher Rank Solutions of the KP Equation"

PROCEEDINGS

- Volume 21 Conference on Automatic Continuity and Banach Algebras
Edited by Rick Loy
- Volume 22 Conference on Geometry and Physics
(including Lectures by Sir Michael Atiyah)
Edited by Michael Barber and Michael Murray
- Volume 23 A Chinese-English Mathematics Primer
by W.A. Coppel
- Volume 24 Operators in Analysis
Edited by Brian Jefferies and Alan McIntosh
(IN PREPARATION)

RESEARCH REPORTS

- | | | |
|------------|---|---|
| CMA-R01-89 | Nicola Fusco and
John Hutchinson | Partial Regularity in Problems
Motivated by Non-Linear
Elasticity |
| CMA-R02-89 | Katherine Seaton
Paul Pearce | Partial order in the self-dual
Ashkin-Teller model. |
| CMA-R03-89 | Niels Gronbaek | Weak and cyclic amenability
for non-commutative Banach
algebras |
| CMA-R04-89 | Finbarr Holland | Variations on a theme of
Archimedes |
| CMA-R05-89 | Claus Gerhardt | Flow of Nonconvex
Hypersurfaces into Spheres |
| CMA-R06-89 | Murray Batchelor,
B. Nienhuis and
S.O. Warner | Bethe Ansatz Results for a
Solvable $O(n)$ Model of the
Square Lattice |
| CMA-R07-89 | Michael Barber
Murray Batchelor | The spectrum of the
biquadratic spin-1
antiferromagnetic chain |
| CMA-R08-89 | Nalini Joshi | Singularity analysis and
Integrability for discrete
dynamical systems I |
| CMA-R09-89 | J.H. Michael | Higher Order Obstacle
Problems |
| CMA-R10-89 | R.S. Anderssen
F.R. de Hoog and
L. Wahlbin | On pointwise stability of cubic
smoothing splines with non-
uniform sampling points |
| CMA-R11-89 | M.Thamban Nair | On Iterative Refinements for Spectral
Subspaces |

CMA-R12-89	R.J. Baxter	Superintegrable Chiral Potts Model thermodynamic properties and the "Inverse" model
CMA-R13-89	Paul Pearce Katherine Seaton	Exact Calculation of Ashkin-Teller Magnetic Exponent
CMA-R14-89	John I. E. Urbas	On the existence of nonclassical solutions for two classes for fully nonlinear elliptic equations
CMA-R15-89	Claude Dietrich M.R. Osborne	Maximum Likelihood Estimation of Covariance Parameters for Gaussian Random Fields
CMA-R16-89	Thamban Nair	A posterior error estimates for Newton's iterations for Refining invariant subspaces
CMA-R17-89	Leon Simon	Growth properties for exterior solutions of quasilinear elliptic equations
CMA-R18-89	Robert McIntosh Leon Simon	Perturbing Away Singularities of Harmonic Maps
CMA-R19-89	Neil Trudinger	The Dirichlet Problem for the prescribed curvature equations
CMA-R20-89	Ezra Getzler	Cyclic homology and the path integral of the Dirac operator
CMA-R21-89	Frank de Hoog R.M.M. Mattheij	Subset Selection for Matrices
CMA-R22-89	A. Keraychian	On a Certain Finite Difference Scheme for a Model for Diffusion of Biological Populations
CMA-R23-89	V.F.R. Jones	Baxterization
CMA-R24-89	Peter Jarvis	Supersymmetric Quantum Mechanics and the Index Theorem
CMA-R25-89	V. Dotsenko	Off the Critical point by perturbation (II): The Ising Model spin-spin Correlator in a Magnetic Field"
CMA-R26-89	A.R.Its, A.G.Izergin, V.Korepin and N.A. Slavnov	Differential Equations for Quantum Correlation Functions
CMA-R27-89	T. Miwa and M. Jimbo	Hypergeometric-type integrals and the $sl(2, \mathbb{C})$ Knizhnik-Zamolodchikov equation
CMA-R28-89	V. Korepin and N.A. Slanov	The Time dependent correlation function of an Impenetrable Bose Gas as a Fredholm Minor I

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CMA-R35-89	M.T. Batchelor and M.N. Barber	Spin-s Quantum Chains and Temperley-Lieb Algebras
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CMA-R45-89	Yousong Luo	An Aleksandrov-Bakelman type Maximum Principle and Applications
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CMA-R47-89	M.T.Batchelor L. Mezincescu R.I. Nepomechie V. Rittenberg	q-deformations of the $O(3)$ symmetric spin 1 Heisenberg chain

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CMA-R55-89	Nalini Joshi	The Painleve Connection Problem: An Asymptotic Approach II
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CMA-R62-89	Richard P. Brent	Factor: An Integer Factorization Program for the IBM PC
CMA-R63-89	A. Klumper and M.T. Batchelor	Analytic treatment of finite-size corrections in the spin-1 antiferromagnetic chain
CMA-R64-89	N. Uraltseva	Gradient estimates for solutions of non-linear parabolic oblique boundary problems

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