

# **Centre for Discrete Mathematics and Computing**

in the

Discipline of Mathematics, School of Physical Sciences

and the

School of Information Technology and Electrical Engineering

at

The University of Queensland

**2004 Report**

March 2005

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# CENTRE FOR DISCRETE MATHEMATICS AND COMPUTING

in the  
DISCIPLINE of MATHEMATICS, SCHOOL of PHYSICAL SCIENCES  
and the  
SCHOOL of INFORMATION TECHNOLOGY and ELECTRICAL ENGINEERING  
at  
THE UNIVERSITY OF QUEENSLAND

**Report for 2004**

March 2005

## 0. PREFACE

This Centre was formed at the beginning of 1998 by the merger of the Centre for Combinatorics (in the then Department of Mathematics) with the Algorithms Group (in the then Department of Computer Science and Electrical Engineering). It promotes research in combinatorics and in algorithm design, and supports the Number Theory Web. It acts as national base for an international body, the Institute of Combinatorics and its Applications (ICA), and as regional base for the Combinatorial Mathematics Society of Australasia (Incorporated) (CMSA(Inc)). In association with the Department of Mathematics, University of Auckland, it publishes an international journal, the *Australasian Journal of Combinatorics*, for CMSA(Inc). It is one of eighteen groups listed on the World Combinatorics Exchange <http://www.combinatorics.org/People/index.html>. The Centre periodically hosts conferences and workshops, the most recent being *Working Applications of Discrete Mathematics* in January 2004. This Workshop attracted support from both the Australian Mathematical Sciences Institute and the ICA.

Members of the Centre actively collaborate with overseas research groups in Austria, Belgium, Canada, China, Czech Republic, France, Germany, Iran, Italy, New Zealand, Taiwan, Thailand, Turkey, United Kingdom and United States of America. Within Australia, members of the Centre collaborate with research groups at: the Universities of Sydney, Newcastle, Adelaide, Western Australia and Wollongong; Curtin University of Technology, the University of Technology, Sydney, and the Queensland University of Technology; the Australian National University and Charles Darwin University. The Centre also hosts numerous visitors, including a number of Ethel Raybould research fellows. Postgraduate students within the Centre have the benefit of working with such visitors while they are here, and sometimes of visiting them in their home universities.

Members of the Centre have easy access to the Dorothy Hill Physical Sciences and Engineering Library of The University of Queensland, which houses one of the best collections in Australasia of combinatorial literature. They also have access to computing facilities appropriate to their needs, notably including grid computing on 128 Sun Netra X1 machines.

Although both discrete mathematics and computing are areas of much serious research, they include many problems which are easily stated and understood, and consequently of interest to people with little formal background in the area. Some of these problems are immensely difficult, the four colour theorem and Fermat's last theorem being classic examples. Some are relatively easy to solve, at least in small particular cases, and attract students into the area, and often from there into other areas of mathematics as well. Thus many combinatorial questions feature on the Queensland Association of Mathematics Teachers Problem Solving Competitions, the Australian Mathematics Competitions, and the Mathematical Olympiads. Areas where such questions arise include games and puzzles, scheduling and allocation problems, coding and cryptography, structures of woven textiles, and many problems in graph theory. Staff associated with this Centre have contributed consistently to activities for secondary students, including competitions, ExpoUni displays, Winter Schools, a biennial newsletter (Infinity) and the club allied with it (Club Infinity).

Theoretical interests within the Centre include: designs, finite geometries, networks and graphs; universal algebras and their relation to designs and graphs; number theory; finite fields; combinatorial computing, especially algorithm development relevant to these areas, to linear algebra and to parallel and distributed computing. Applications of particular interest include: experimental design; error-correcting codes and cryptography; techniques for drug design, combinatorial chemistry and DNA sequencing; and the production of scientific software now included in such large systems as MAGMA (based at the University of Sydney), GAP (Scotland), LIDIA and KANT (Germany) and PARI (France).

This report describes the research activities of staff associated with the Centre, concentrating on the year 2004.

Centre web page: <http://www.maths.uq.edu.au/cdmc/>

## 1. STAFF ASSOCIATED WITH THE CENTRE

**Centre Director to June 2004 Honorary Professor**

Anne Penfold Street, MSc *Melb*, PhD *Ill*, DMath *UW*, FTICA, (*combinatorial designs and applications*).

**Centre Director from July 2004 Associate Professor**

Elizabeth Jane Billington, MA, DipAdMaths *Oxon*, DipEd, PhD, FTICA, FAustMS, (*combinatorial designs and graph decompositions*).

**Honorary Professor**

Charles Curtis Lindner<sup>1</sup>, BS *Pres, Clinton, S.C*, MS, PhD *Emory*, FTICA, (*combinatorial designs*).

**Associate Professors**

Peter Adams, BSc (Hons), BComm, PhD, FTICA, (*combinatorial designs, combinatorial computing and applications*).

Diane Margaret Donovan, BA, DipEd *La Trobe*, PhD, FTICA, FAustMS, (*combinatorial designs and computer security schemes*).

George Havas, BA (Hons) *ANU*, PhD *Sydney*, (*algorithm design*).

**Queen Elizabeth II Principal Research Fellow (Level D)**

Darryn Edward Bryant, BSc, MScSt, PhD, FTICA, (*combinatorial designs, graph theory and DNA sequencing*).

**Lecturers**

Kevin Eugene Gates, BS *USCGA*, MS, PhD *UWa*, (*algorithm development in linear algebra*).

Victor Scharaschkin, BSc Hons *Tas*, PhD *Mich*, (*algebraic number theory, arithmetic geometry*).

**Research Fellow**

Barbara Marguerite Maenhaut, BMath *UW*, BEd *UWO*, PhD, AFTICA, (*combinatorial designs, graph theory*).

**Senior Research Officers**

Gregory Gamble<sup>2</sup>, BSc (Computing), BE (Elec), MMath *UNSW*, PhD *UWA*, (*combinatorial algorithms*).

Kenneth Raward Gray<sup>3</sup>, BA (Hons), DipEd *Macquarie*, PhD, FTICA, (*combinatorial designs and education*).

Nicholas Ahti Hamilton<sup>4</sup>, BSc (Hons), PhD *UWA*, (*finite geometry*).

Abdollah Khodkar<sup>5</sup>, MSc *Sharif*, PhD, (*combinatorial designs*).

**Research Officer**

Colin Ramsay, BCompSci, BSc (Hons) *NTU*, PhD, (*combinatorial computing and algorithm development*).

**Honorary Research Consultants**

Keith Robert Matthews, MSc, PhD, (*number theory*).

Graham Hilton Norton, BSc *Cape Town*, PhD *Cornell*, (*applied algebra, algebraic coding theory, number theory*).

Peter Arthur Barry Pleasants, MA, PhD *Cantab*, MSc *Wales*, (*number theory, combinatorics, geometry, quasicrystals*).

Sheila Williams, MA, DPhil *Oxon*, FTICA, (*universal algebra and combinatorial designs*).

**Honorary Research Adviser**

Martin James Sharry<sup>6</sup>, BSc (Hons), PhD, FTICA, (*combinatorial designs and combinatorial computing*).

<sup>1</sup>Distinguished Professor, Auburn University

<sup>2</sup>Senior Research Officer (p/t), Research Associate (Curtin University)

<sup>3</sup>Senior Research Officer (p/t); Consultant in educational assessment and testing, with clients including both Education Queensland and non-state schools.

<sup>4</sup>Senior Research Officer (level B); joint position in the Institute for Molecular Bioscience and the Advanced Computational Modelling Centre

<sup>5</sup>Resigned mid 2004; now at West Georgia University, USA.

<sup>6</sup>Manager – Infrastructure Services Unit, Information Solutions and Technology, Corporatelink, Queensland

## 2. RESEARCH STUDENTS

This list includes titles of theses and the names of the relevant research supervisors.

**Awarded 2004**

Stephen M Long, (PhD, *Combinatorial methods and applications in drug discovery*, Adams/Tran (Chemistry)/Smythe (IMB)).

**Current Research Students**

Jenna Appleton, (PhD, *Combinatorial algorithms*, Adams/Bryant).

Robert Brier, (PhD, *Topics in graph decomposition and related algebras*, Bryant/Maenhaut).

Melinda Buchanan, (PhD, *Completions of partial latin squares and related topics*, Bryant/Adams).

Sean Byrnes, (PhD, *Geometric perspectives on noncommutative algebra*, B Jones/Scharaschkin).

Matthew Dean, (PhD, *Hamilton cycle decompositions of Cayley graphs*, Bryant/Adams).

Tristan Freiberg, (MSc, *Rational points on curves of genus > 1*, Scharaschkin).

Carlo Hamalainen, (PhD, *Critical sets for latin squares and graph colourings*, Donovan/Khodkar).

Karen Grace Harris, (PhD, *Small graph designs and their various properties*, Billington/Donovan).

Daniel Horsley, (PhD, *Topics on Steiner triple systems and related combinatorial designs*, Bryant/Maenhaut).

Peter Jenkins, (PhD, *Embedding partial graph designs*, Billington/Adams/Bryant).

Andriy Kvyatkovskyy, (MSc, *Evolutionary algorithms and combinatorial algorithms*, Adams/Marcus Gallagher).

James Lefevre, (PhD, *Graph decompositions and trades*, Billington/Adams).

Radosav Pantelic, (PhD, *On image processing*, Hamilton/B. Hankamer).

Trevor Pickett, (PhD, *An investigation of combinatorial configurations and their substructures*, Donovan/Adams).

Anthony Rasmussen, (PhD, *High performance computational modelling in molecular reaction dynamics*, S C Smith/Gates).

Sheng-Ming Wang, (MSc, *Atomic Latin squares and perfect one-factorisations of complete graphs*, Maenhaut).

Mary Waterhouse\*, (PhD, *Coloured Graph Decompositions theory*, Adams/Bryant).

\* *Submitted Feb 2005*

## 3. VISITORS

**2004**

Professor Louis Caccetta (WACEIO, Curtin University of Technology), January.

Professor Charles Colbourn (Arizona State University), January.

Professor Peter Eades (NICTA/University of Sydney), January.

Professor Violet Syrotiuk (Arizona State University), January.

Mike Fox (OPCOM, Qld.), January.

Professor Jennifer Seberry (University of Wollongong), June.

Professor Roger Eggleton (Illinois State University), June.

Professor Dean Hoffman (Auburn University), July, *Raybould Fellow*.

Professor Walter Wallis (Southern Illinois University at Carbondale), July.

Dr Ian Wanless (Australian National University), July.

Professor Peter Cameron (Queen Mary London), July.

Professor Rosemary Bailey (Queen Mary London), July–September.

Professor C. Curtis Lindner (Auburn University), July–August.

Dr Bridget Webb (Open University, UK), August–September.

Professor David Pike (Memorial University, Newfoundland), October–December.

**Planned, 2005**

Professor C. Curtis Lindner (Auburn University), May – June; December.

Professor Aleš Drápal (Charles University, Prague), September.

Professor Juri Tuma (Charles University, Prague), October/November, *Raybould Fellow*.

Professor Walter Wallis (Southern Illinois University at Carbondale), December.

Professor Mike Grannell (Open University, U.K.), December.

Professor Simon Blackburn (Royal Holloway, University of London, U.K.), December.

Professor Brendan McKay (ANU), December.

Lily Khadjavi (Loyola Marymount University, U.S.A.), December.

Dr Matthew Brown (University of Adelaide), December.

## 4. RESEARCH INTERESTS

**Combinatorial Designs and Graph Theory.**

Designs as graph decompositions. Trades in graphs. Graph decompositions and colourings. Metamorphosis of designs, including  $G$ -designs. Bipartite and tripartite designs; cycle systems, Hamilton/Waterloo problems.

Triple systems, especially Steiner triple systems. Intersection problems for designs. Blocking sets in designs.

Partitioning families of blocks into collections of disjoint designs, including collections of small planes.

Defining sets of designs and critical sets of Latin squares; trades and Latin interchanges. Defining sets and trades in other combinatorial structures.

Proportionally balanced designs, constructions and properties.

**Finite Geometry.**

Construction, characterisation and embedding problems associated with geometric structures in finite projective spaces. Links between areas such as polar spaces, finite group theory, structures in projective planes, partial geometries and designs. Construction of distance regular covers of complete graphs using sets in finite projective spaces. Relations between strong Steiner trades and projective planes;  $m$ -systems of polar spaces; hyperovals in projective planes.

**Applications of discrete mathematics.**

DNA sequencing, Encoding/decoding methods for combinatorial chemistry, optimization of combinatorial chemistry techniques. Drug design. Bioinformatics.

Application of combinatorial designs to authentication schemes, to the construction of access schemes for computer security and to the construction of block ciphers. Classes of designs for the study of plant competition, of scheduling and allocation problems, and of problems in cognitive science.

**Combinatorial Designs: relationships with universal algebras.**

Relationships between quasigroups and certain types of neighbourhood designs; when the particular quasigroups involved actually form a variety. Minimal distances of group Latin squares. Universal algebra techniques applied to construct new designs. Small 2-perfect designs. Strongly 2-perfect cycle systems and associated quasigroups.

**Algebra and Number Theory.**

Ramsey varieties of finite groups, the topological group of  $p$ -adic integers, varieties of congruence lattices of groups. Homological algebra and ring theory. Cohomology rings of finite groups. Group representation theory. Formal methods for computing, symbolic computation. Homotopy theory. The Brauer Manin obstruction. The ABC conjecture. Arithmetic geometry. Rational points on varieties.

**Combinatorial Computing and Algorithm Design.**

Abstract algebraic algorithms. Perfect hashing. Fundamental algorithms for parallel and distributed systems. Finite fields and their applications. Computational combinatorics. Algorithm development for linear algebra. Computing canonical forms of matrices. Extended GCD algorithms.

## 5. WORKSHOPS/CONFERENCES

A workshop, *Working Applications of Discrete Mathematics*, was held at The University of Queensland from 14 to 16 January 2004. This was sponsored by the *Australian Mathematical Sciences Institute*, AMSI, and by the *Institute of Combinatorics and its Applications* (ICA).

The **invited speakers** and their talks were:

Professor Louis Caccetta, Western Australian Centre of Excellence in Industrial Optimisation; Curtin University, *Industrial Modelling and Optimisation: Some Real Applications of Discrete Mathematics*.

Professor Charles Colbourn, Arizona State University, *Combinatorial techniques for software interaction testing* and *Grooming in optical networks (a very challenging real application of graph designs)*.

Professor Peter Eades, National Information and Communication Technology Australia, *Graph Drawing: From Mathematical Theories to Commercial Software*.

*Ship scheduling of fertilizer products*.

Dr Jonathan Keith, The University of Queensland, *Large-scale DNA sequence alignment using anchors*.

Professor Violet Syrotiuk, Arizona State University, *Problems in Discrete Mathematics motivated by Mobile ad hoc Networks*.

The following gave **contributed talks**:

Nicholas Cavenagh, The University of Queensland, *Hamming distances of latin squares*.

Ariyanti Pratiwi, ITB, Indonesia, *One level perfect secret sharing schemes based on latin squares*.

Ken Gray, Anne Penfold Street, Karen Harris and Colin Ramsay, The University of Queensland, *Proportionally balanced designs*.

Kiki Ariyanti Sugeng and Mirka Miller, The University of Newcastle, NSW, *Secret sharing scheme with many access structure using sum labeling*.

Sanming Zhou, The University of Melbourne, *The ring routing problem*.

Liam Wagner, The University of Queensland, *Dealing with curious players in secure networks*.

There were 35 registered people at the Workshop.

The *30th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing*, 30ACCMCC, will be held at The University of Queensland from 4–9 December 2005. Sponsors include the School of Physical Sciences, the Engineering, Physical Sciences and Architecture Faculty (both at The University of Queensland), and the Institute for Combinatorics and its Applications (incorporated in Canada). A conference web page appears at <http://www.maths.uq.edu.au/cdmc/30acmcc.html>.

## 6. CURRENT RESEARCH FUNDING

### Adams

One of 14 Chief Investigators in the Australian Research Council, *Australian Centre for Complex Systems*, Director Professor Peter Lindsay, \$6 000 000, 2003–2006.

### Bryant and Adams

With Dr Keith Mitchelson (Australian Genome Research Facility), *Commercial development of a novel DNA sequencing method*, \$250 000, Biotechnology Innovation Fund Grant, 2002–2003.

With Dr Keith Mitchelson (Australian Genome Research Facility), *Mutagenesis and combinatorial algorithms for sequencing problematic genomic regions*, \$450 000, Australian Research Council Discovery Grant, 2002–2006.

### Donovan

With Associate Professor Thompson, Professor Burrage (Discipline of Mathematics) and Cronin (Tarong Energy), *Modelling, simulation and risk analysis in Australian energy markets*, \$197 000, Australian Research Council SPIRT Grant, 2001–2003.

With Dr Evgueni Jak, Professor Peter Hayes (Mining and Minerals Process Engineering) and Associate Professor Thompson, *The application of Random Graph Theory to Modelling the Thermodynamic and Physio-chemical Properties of molten Silicates*, \$59 691, UQ Research Development Grant, 2005.

### Donovan and Billington

*The fundamental structure of combinatorial configurations*, \$40 000, Australian Research Council International Linkage, 2004–2007.

### Gates

With Dr G R Hanson (Centre for Magnetic Resonance) and Professor K Burrage, *Development of an interactive computer simulation/visualisation software environment for the analysis of randomly oriented ESEEM and pulsed ENDOR spectra*, \$50 000 each year, Patent Licensing, 1999–2004.

### Havas, Bryant, Adams and Street

*Emerging applications of advanced computational methods and discrete mathematics*, \$190 000, Australian Research Council Discovery project, 2002–2003; \$416 000 ARC Centre for Complex Systems, 2004–2007.

### Scharaschkin

*Rational Points and the ABC Conjecture*, \$29 000, University of Queensland Early Career Research Grant, 2003.

### Street

With Professor J R Seberry (Centre for Computer Security Research, Department of Computer Science, University of Wollongong), *Timed-commitment schemes to smooth Internet bottlenecks, defend against denial of service attacks, and bypass some legal problems of encryption*, \$150 000, Australian Research Council Discovery Grant, 2003–2005.

## 7. INVITATIONS

The following staff associated with the Centre have given invited talks outside SPS/ITEE during late 2003 and throughout 2004.

**Adams**

Invited conference talk, *Using graph theory to sequence problematic regions of genomes*, 28ACCMCC, Melbourne, December 2003.

**Billington**

Invited plenary talk, *Multipartite graph decompositions: cycles and closed trails*, COMBINATORICS 2004, Catania, Italy, September 2004.

Conference speaker, *Multipartite gregarious 4-cycle decompositions*, 2004 NZIMA Conference in Combinatorics and its Applications/29ACCMCC, New Zealand, December 2004.

**Bryant**

Invited Speaker, The 2004 NZIMA Conference in Combinatorics and its Applications/The 29th Australasian Conference in Combinatorial Mathematics and Combinatorial Computing, Taupo, New Zealand, December 2004..

**Donovan**

Conference speaker, *On greedy critical sets in latin squares*, AWOCA, Coffs Harbour, NSW, July 2004.

Conference speaker, *Visualising energy data*, CTAC, University of Melbourne, Sept 2004.

Seminar speaker, *More on trades in graphs*, Chulalongkorn University, Bangkok.

Seminar speaker, *Latin squares and cognitive analysis*, University of Malaya, Malaysia.

**Gray**

Invited speaker, *Proportionally balanced designs*, Open University Winter Combinatorics Meeting, January 2004.

**Hamilton**

Invited speaker, *Identifying lateral gene transfer events*, Workshop on Incidence Geometry and Applications of Discrete Mathematics, Adelaide, February 2005.

**Havas**

Seminar speaker, University of St Andrews, Scotland, Nov 2003.

Invited lecturer, Università degli Studi di Trento, Italy, Nov 2003.

Seminar speaker, University of Auckland Mathematics Department, Jan 2004.

Invited Public Lecture, University of Queensland, International Centre of Excellence for Education in Mathematics and AMSI Winter School in Mathematics and Computational Biology, July 2004.

Seminar speaker, York University, Toronto, Canada, Sept 2004.

Conference speaker, Finite Geometries, groups and Computation Conference, Colorado State University, Sep 2004.

Conference speaker, Albany Group Theory Conference, The Rensselaerville Institute Conference Center, New York, Oct 2004.

Colloquium speaker, City College of the City University of New York, Oct 2004.

Colloquium speaker, Centre for Interdisciplinary Research in Computational Algebra, University of St Andrews, Scotland, Oct 2004.

**Maenhaut**

Invited seminar, *Cube factorisations of complete graphs*, Illinois State University, December 2003.

**Scharaschkin**

Seminar Speaker, *Descent on Surfaces*, Australian National University, December 2003.

Invited Speaker, *Elliptic Curves and the ABC Conjecture*, Algebra special session of the Annual meeting of the Australian Mathematical Society, RMIT, September 2004.

## 8. SEMINARS PRESENTED WITHIN THE CENTRE, 2004

The following seminar talks were presented to the Combinatorics group, by members of the Centre and national and international visitors, in 2004.

Barbara Maenhaut, University of Queensland, *Cube factorisations of complete graphs*, 18 March 2004.

Darryn Bryant, University of Queensland, *Cycle decompositions and factorisations*, 1, 8 April 2004.

Andrew Blinco, University of Queensland, *On the cyclic decomposition of complete graphs into almost-bipartite graphs*, 29 April 2004.

Graham Norton, University of Queensland, *Newman's short proof of the Prime Number Theorem*, 17 May 2004.

W D Wallis, Southern Illinois University, Carbondale, USA, *Hats*, 5 July 2004.

D G Hoffman, Auburn University, USA, *A problem of mixed differences* 9 July; *The Grundy colouring number of the  $n$ -cube* 13 July; *An  $f$ -factor theorem for signed graphs*, 16 July 2004.

Peter Cameron, Queen Mary, University of London, *The random graph and the Urysohn space*, 26 July 2004.

Ian Wanless, Australian National University, *Not all numbers were created equal*, 29 July 2004.

Curt Lindner, Auburn University, USA, *Perfect dodecagon triple systems* 2 August; *The intersection problem for maximum packings of  $K_n$  with triples, made easy* 5 August; *The Euler Officer Problem* 9 August; *Constructing quasigroups from cycle systems*, 12 August 2004.

Rosemary Bailey, Queen Mary, University of London, *Hasse diagrams to describe the structure of designed experiments* 16 August 2004; *Association Schemes*, 19, 23, 26, 30 August 2004.

Bridget Webb, Open University, UK, *Infinite Designs*, 2 September 2004.

Tony Guttmann, University of Melbourne, *A rook's tour—or walks crossing a square*, 23 September, 2004.

Nicholas Cavenagh, University of Queensland, *Latin trades: connections with permutations, geometry and topology*, 7 October 2004.

David Pike, Memorial University, Newfoundland, Canada, *Pancyclic BIBD Block-Intersection Graphs*, 28 October 2004.

Darryn Bryant, University of Queensland, *Techniques for embedding partial Steiner triple systems: Part 1*, 11 November 2004.

David Pike, Memorial University, Newfoundland, Canada, *Iterated 2-Cycle Contractions and Strong Connectivity in Random Directed Graphs* 18 November; *Colouring 4-cycle systems*, 2 December 2004.

Darryn Bryant, University of Queensland, *Techniques for embedding partial Steiner triple systems: Part 2* 24 November; *Part 3* 1 December; *Part 4*, 8 December 2004.

## 9. EDITORIAL WORK

In association with the Department of Mathematics, University of Auckland, the Centre publishes the *Australasian Journal of Combinatorics*, an international journal, for the Combinatorial Mathematics Society of Australasia (Incorporated). Billington is Editor-in-Chief, Dr C Paul Bonnington (Auckland) is Managing Editor and Adams is Financial Manager. Bryant, Donovan, Professor Peter Gibbons (Auckland), Havas, B Jones and S Williams are Associate Editors, and Street is one of two Honorary Editors. Of the 20 members of the Editorial Board, nine work within Australia and New Zealand, and the remaining 11 form an international network of combinatorialists in Canada, Germany, Greece, Sultanate of Oman, Slovakia, United Kingdom and United States of America. See also Section 9, under 'Edited journal'.

The Centre also publishes a Research Report Series, edited by Donovan.

Matthews maintains a World Wide Web site called The Number Theory Web. The site provides links to nearly 500 number theorists' home pages throughout the world, centres, book descriptions, surveys, recent theses, conference information and libraries with good holdings in the number theory field.

CMAT and CALC are exact arithmetic matrix and number theory packages developed by Matthews for use mainly in teaching. For more information see the WWW address <http://www.maths.uq.edu.au/~krm/> Hamilton maintains a web site on recent theses in geometry. See Section 9, under 'Web Sites'.

The following staff associated with the Centre have served in other editorial capacities during 2003.

Billington is an Associate Editor of the *Bulletin of the Australian Mathematical Society* and a member of the Editorial Boards of *Utilitas Mathematica* and *Journal of Combinatorial Mathematics and Combinatorial Computing*. She reviews for *Mathematical Reviews* and referees for *Journal of Combinatorial Designs*, *Ars Combinatoria*, *Discrete Mathematics*, *Bulletin of the Institute of Combinatorics and its Applications*, *Journal of Graph Theory* and *Journal of Algebraic Combinatorics*.

Bryant referees for *Ars Combinatoria*, *Bioinformatics*, *Bulletin of the Australian Mathematical Society*, *Discrete Mathematics*, *Graphs and Combinatorics*, *Journal of Combinatorial Designs*, *Journal of Combinatorial Mathematics and Combinatorial Computing*, *Journal of Combinatorial Theory series A*, *Journal of Graph Theory* and *Utilitas Mathematica*.

Donovan is a member of the Editorial Board of *Ars Combinatoria*. She referees for the *Bulletin* and the *Gazette* of the Australian Mathematical Society, and for *Discrete Mathematics*, *European Journal of Combinatorics*, *Journal of Combinatorial Mathematics and Combinatorial Computing* and *Utilitas Mathematica*.

Hamilton referees for *European Journal of Combinatorics*, *Designs, Codes and Cryptography*, *Utilitas Mathematica*, *Australasian Journal of Combinatorics* and the *Bulletin of the Australian Mathematical Society*.

B Jones is an Associate Editor of the *Bulletin of the Australian Mathematical Society*.

Khodkar referees for *Ars Combinatoria*, *Australasian Journal of Combinatorics*, *Discrete Mathematics* and *Utilitas Mathematica*.

Norton reviews for *Zentralblatt* and referees for *IEEE Transactions on Information Theory*, *Discrete Mathematics*, *Mathematica Applicandae*, *Applicable Algebra in Engineering, Computing and Communications*, *Journal of Symbolic Computation*.

Pleasant referees for *American Mathematical Monthly*, *Australasian Journal of Combinatorics*, *Bulletin of the Australian Mathematical Society* and *Theoretical Computer Science*. He is also reporting on a book for Springer-Verlag New York, who are considering it for publication.

Street is a member of the editorial boards of *Ars Combinatoria*, *Ars Textrina*, *Bulletin of the Institute of Combinatorics and its Applications* and *Scientia Iranica*. She also referees for *Discrete Mathematics*, *Journal of Combinatorial Mathematics and Combinatorial Computing* and *Utilitas Mathematica*.

S Williams reviews for *Zentralblatt* and *Mathematical Reviews*, and referees for the *Bulletin of the Australian Mathematical Society*.

## 10. COLLABORATION

The following staff members have collaborated in research with people outside the Centre for Discrete Mathematics and Computing during recent years. The list includes the names and affiliations of all collaborators. Inter-disciplinary collaboration is indicated by an asterisk.

**Adams**

Professor K Basford\*, *School of Land and Food, The University of Queensland.*

Professor Saad I El-Zanati, *Department of Mathematics, Illinois State University.*

Dr A Galbraith\*, *The Prince Charles Hospital.*

Professor D G Hoffman, *Department of Discrete and Statistical Sciences, Auburn University.*

Professor C C Lindner, *Department of Discrete and Statistical Sciences, Auburn University.*

Dr D C McGiffen\*, *The Prince Charles Hospital.*

Professor G J McLachlan, *Discipline of Mathematics, The University of Queensland.*

Professor C A Rodger, *Department of Discrete and Statistical Sciences, Auburn University.*

Professor C Vanden Eynden, *Illinois State University.*

**Billington.**

Professor Saad I El-Zanati, *Department of Mathematics, Illinois State University.*

Professor Hung-Lin Fu, *National Chiao-Tung University, Hsin-Chu, Taiwan.*

Professor D G Hoffman, *Department of Discrete and Statistical Sciences, Auburn University.*

Professor C C Lindner, *Department of Discrete and Statistical Sciences, Auburn University.*

Professor E S Mahmoodian, *Department of Mathematical Sciences, Sharif University of Technology, Tehran, Iran.*

Dr D A Pike, *Department of Mathematics, Memorial University, St Johns, Newfoundland.*

Professor Gaetano Quattrocchi, *Department of Mathematics, University of Catania, Italy.*

Professor C A Rodger, *Department of Discrete and Statistical Sciences, Auburn University.*

**Bryant**

Dr B J Battersby\*, *Department of Chemistry, The University of Queensland.*

Dr Duncan Cochrane, *Australian Genome Research Facility.*

Professor Saad I El-Zanati, *Department of Mathematics, Illinois State University, U.S.A.*

Professor Hung-Lin Fu, *National Chiao-Tung University, Hsin-Chu, Taiwan.*

Dr Heather Gavlas, *Department of Mathematics, Illinois State University, U.S.A.*

Professor Mike Grannell, *Department of Pure Mathematics, The Open University, U.K.*

Professor Terry Griggs, *Department of Pure Mathematics, The Open University, U.K.*

Professor D G Hoffman, *Department of Discrete and Statistical Sciences, Auburn University, U.S.A.*

Ms Gita Lala, *Australian Genome Research Facility.*

Dr David Leach, *Department of Mathematics, State University of West Georgia, U.S.A.*

Professor C C Lindner, *Department of Discrete and Statistical Sciences, Auburn University, U.S.A.*

Dr Alan Ling, *Department of Mathematics, University of Vermont, U.S.A.*

Dr Martin Macaj, *Department of Algebra and Number Theory, Faculty of Mathematics, Physics and Informatics, Comenius University, Slovakia.*

Dr Keith Mitchelson, *Australian Genome Research Facility.*

Dr Kathleen Quinn, *Pure Mathematics Department, The Open University, U.K.*

Professor Mark Ragan, *ARC Centre in Bioinformatics, Institute for Molecular Bioscience, The University of Queensland.*

Professor C A Rodger, *Department of Discrete and Statistical Sciences, Auburn University, U.S.A.*

Dr M Smythe\*, *Centre for Drug Design and Development, The University of Queensland.*

Dr T Tran\*, *Centre for Drug Design and Development, The University of Queensland.*

Dr M Trau\*, *Discipline of Chemistry, The University of Queensland.*

Professor C Vanden Eynden, *Department of Mathematics, Illinois State University.*

Dr Bridget Webb, *Pure Mathematics Department, The Open University, U.K.*

**Donovan**

Dr Nicholas Cavenagh, *Charles University, Czech Republic.*

Dr Joan Cooper\*, *Department of Information and Communication Technology, University of Wollongong.*

Dr E P Dawson\*, *Information Security Research Centre, Queensland University of Technology.*

Professor Aleš Drápal, *Charles University, Czech Republic.*

Dr Rebecca A H Gower, *Numbercraft, Oxford.*

Professor D G Hoffman, *Department of Discrete and Statistical Sciences, Auburn University.*

Professor Saad I El-Zanati, *Department of Mathematics, Illinois State University.*

Professor E S Mahmoodian, *Department of Mathematical Sciences, Sharif University of Technology, Tehran, Iran.*

Professor C E Praeger, *Department of Mathematics, University of Western Australia.*

Professor Jennifer Seberry\*, *Department of Computer Science, University of Wollongong.*

Dr Somporn Sutinuntopas, *Department of Mathematics, Ramkhamhaeng University, Bangkok, Thailand.*

Professor John van Rees, *Department of Computer Science, The University of Manitoba.*

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Professor C E Praeger, *Department of Mathematics, University of Western Australia.*

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Dr G R Hanson, *Centre for Magnetic Resonance, The University of Queensland.*

Mr Matthew Sullivan, *Information Technology Systems, The University of Queensland.*

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Dr H Wilbrink, *Department of Mathematics, Technische Universiteit Eindhoven.*

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Dr C M Campbell\*, *St Andrews University.*

Professor G Cooperman, *Northeastern University.*

Professor Z J Czech, *Silesia University.*

Dr X G Fang\*, *Beijing University.*

Dr S Feisel, *Paderborn University.*

Professor J von zur Gathen, *Paderborn University.*

Dr H W Gollan\*, *Essen University.*

Professor D G Hoffman\*, *Auburn University.*

Dr D F Holt\*, *University of Warwick.*

Assistant Professor Alexander Hulpke, *Department of Mathematics, Colorado State University.*

Dr W Liang, *Australian National University.*

Dr S A Linton, *St Andrews University.*

Dr B Mans, *Macquarie University.*

Dr A Nerurkar, *SUNY Buffalo.*

Professor M F Newman\*, *Australian National University.*

Dr A C Niemeyer\*, *University of Western Australia.*

Dr E A O'Brien\*, *University of Auckland.*

Professor C E Praeger, *Department of Mathematics, University of Western Australia.*

Dr S E Rees\*, *University of Newcastle (UK).*

Professor E F Robertson\*, *St Andrews University.*

Professor J-P Seifert, *Frankfurt University.*

Professor X Shen, *University of Missouri.*

Dr I Shparlinski, *Macquarie University.*

Professor C C Sims\*, *Rutgers University.*

Dr L H Soicher\*, *University of London*.  
 Professor M R Vaughan–Lee\*, *Oxford University*.  
 Dr C Wagner, *Siegen University*.  
 Professor J Wang\*, *Beijing University*.  
 Professor R A Wilson\*, *Birmingham University*.

### **Khodkar**

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 Dr M A Shahabi, *Department of Mathematics, University of Tabriz, Tabriz, Iran*.  
 Professor Saad I El-Zanati, *Department of Mathematics, Illinois State University*.  
 Professor C Vanden Eynden, *Department of Mathematics, Illinois State University*.  
 Professor D G Hoffman, *Department of Discrete and Statistical Sciences, Auburn University*.  
 Professor Hung–Lin Fu, *National Chiao–Tung University, Hsin–Chu, Taiwan*.  
 Professors Chin–Mei Fu, *Department of Mathematics, Tamkang University, Taiwan*.  
 Dr S. Sutinuntopas, *Ramkhamhaeng University, Bangkok, Thailand*.  
 Professor John van Rees, *Department of Computer Science, The University of Manitoba*.

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 Professor Saad I El-Zanati, *Department of Mathematics, Illinois State University, USA*.  
 Professor M J Grannell, *Open University, Milton Keynes, United Kingdom*.  
 Professor T S Griggs, *Open University, Milton Keynes, United Kingdom*.  
 Professor D G Hoffman, *Department of Discrete and Statistical Sciences, Auburn University, USA*.  
 Dr K A S Quinn, *Pure Mathematics Department, Open University, United Kingdom*.  
 Professor Jennifer Seberry, *Department of Computer Science, University of Wollongong*.  
 Professor R G Stanton, *Department of Computer Science, University of Manitoba, Canada*.  
 Dr I M Wanless, *Christ Church College, Oxford University, United Kingdom (now at ANU, Canberra)*.  
 Dr B S Webb, *Pure Mathematics Department, Open University, United Kingdom*.

### **Matthews**

Dr T H Jackson, *Department of Mathematics, University of York, United Kingdom*.

### **Norton**

Professor T D Blackmore, *University of Loughborough, United Kingdom*.  
 Professor A Salagean, *University of Loughborough, United Kingdom*.

### **Pleasants**

Dr H Ardal, *Department of Mathematics, Boğazici University, Istanbul*.  
 Professor M Baake, *Mathematics Institute, Greifswald University*.  
 Professor T C Brown, *Department of Mathematics, Simon Fraser University*.  
 Professor V Fournée\*, *CNRS, Ecole des Mines, Nancy*.  
 Professor C J Jenks\*, *Ames Laboratory, Iowa State University*.  
 Dr G Kasner\*, *Theoretical Physics Institute, Magdeburg University*.  
 Dr J C Lagarias, *AT&T Laboratories, Florham Park*.  
 Professor J Ledieu\*, *Surface Science Research Centre, University of Liverpool*.  
 Professor R McGrath\*, *Surface Science Research Centre, University of Liverpool*.  
 Mr H Ray, *Department of Mathematics and Statistics, Curtin University of Technology*.  
 Dr J Simpson, *Department of Mathematics and Statistics, Curtin University of Technology*.  
 Dr Z Papadopolos\*, *Theoretical Physics Institute, Tübingen University*.

### **Ramsay**

Dr I T Roberts\*, *Department of Mathematics, Northern Territory University*.

### **Scharaschkin**

Dr Lily Khadjavi, *Loyola Marymount University, Los Angeles*.  
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 Professor Hung–Lin Fu, *National Chiao–Tung University, Hsin–Chu, Taiwan*.  
 Professor D G Hoffman, *Department of Discrete and Statistical Sciences, Auburn University*.

Professor C C Lindner, *Department of Discrete and Statistical Sciences, Auburn University.*

Professor E S Mahmoodian, *Department of Mathematical Sciences, Sharif University of Technology, Tehran, Iran.*

Professor R Mathon\*, *Department of Computer Science, University of Toronto.*

Professor Jennifer Seberry\*, *Department of Computer Science, University of Wollongong.*

Professor R G Stanton\*, *Department of Computer Science, The University of Manitoba.*

Associate Professor Deborah J Street, *Department of Mathematical Sciences, University of Technology, Sydney.*

## 11. HONOURS AND AWARDS

The Institute of Combinatorics and its Applications, an international body, was set up in 1990, based in Canada, with Professor W T Tutte as president and Professor R G Stanton as Registrar. Street is one of the two Australians invited to become Founding Fellows of the ICA and served as its President from 1996–2002; Billington, Donovan and S Williams are Foundation Fellows; Adams, Bryant, K Gray, Hamilton and Sharry are Fellows; Maenhaut, Moran and Nester are Associate Fellows; B Jones is a Member.

The ICA awards Kirkman Medals, recognising outstanding achievement by combinatorialists in the early stages of their careers; Adams, Bryant and Hamilton are Kirkman Medallists.

Bryant holds a QEII Fellowship, 2002–2006.

## 12. THE CENTRE AND THE WIDER COMMUNITY

Staff associated with this Centre have been involved in the following outreach programs.

### **State, National and International Activities.**

*Australian Mathematics Olympiad for Queensland students:* Scharaschkin is involved in the training of students from Queensland for the AMO; this also includes the distribution and marking of problems. (See <http://www.maths.uq.edu.au/victors/Olympiad/>.)

*Australian Mathematics Competition Problems Committee:* S Williams served as a member of this committee, which develops questions to challenge and extend young mathematicians.

*QAMT (Queensland Association of Mathematics Teachers) Problem Solving Competition:* This is an annual competition with over 3000 students participating each year. Donovan has been involved with setting it. Scharaschkin in 2004 wrote all the problems and solutions. See <http://www.maths.uq.edu.au/qamt/>

### **University and Cross-Faculty Activities.**

*Enhanced Studies Program:* Donovan and Billington (2004) co-ordinated the delivery of MATH1061 to Enhanced Studies Students. MATH1061 is an introductory discrete mathematics course which exposes Year 12 students to both the theory and application of discrete mathematics.

*EXPO Uni:* Centre members have developed and staffed numerous exhibits which stress the importance of discrete mathematics; for example, displays on secret key distribution schemes and error detection techniques for barcodes.

*Biological and Chemical Sciences Faculty Science Days:* This recent initiative is part of the Bright Minds program. In October 2003, Year 12 students attended special sessions on campus. Donovan was the co-ordinator of the mathematics sessions, which were delivered by two talented mathematics graduate students. It is planned to run such sessions four times per year.

### **Engineering, Physical Science and Architecture Faculty Activities.**

*EPSA School Liaison Program:* A number of Centre staff and students have delivered talks on applications of discrete mathematics and on career prospects to high school students.

### **School of Physical Sciences Activities.**

*Infinity:* This is a biennial newsletter which is edited by Donovan, with two members of this department, namely, Cathy Holmes and Helen Grey. Mailed to every high school in Queensland, it provides a link between the University and the broader community and has had great success in developing strong ongoing communications between interested individuals and University staff.

*Club Infinity:* Currently this club has around 400 members. It provides a means for the University to communicate directly with mathematically-minded community members, including school students. It is also an excellent vehicle for advertising University events. Club members receive a welcome pack, copies of Infinity, and individual invitations to club events, such as public lectures. See the website <http://www.maths.uq.edu.au/~infinity/>

## 13. PUBLICATIONS AND WEB SITES

The names of authors, associated with the Centre while the work was carried out, appear in upper case.

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- Darryn E BRYANT, Barbara MAENHAUT, Kathleen Quinn and Bridget Webb, *Existence and embeddings of partial Steiner triple systems of order ten with cubic leaves*, Discrete Mathematics (Special Issue in honour of Curt Lindner on his 65th birthday) **284** (2004), 83–95.
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- Darryn E BRYANT, Mike Grannell and Terry Griggs, *Large sets of cycle systems on nine points*, Journal of Combinatorial Mathematics and Combinatorial Computing (to appear).
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- Nicholas J CAVENAGH, Diane DONOVAN and G H J van Rees, *A note on the completion of partial latin squares*, Congressus Numerantium (to appear).
- D Cochran, G Lala, J KEITH, P ADAMS, D BRYANT and K. Mitchelson, *Sequencing by aligning mutated DNA fragments*, In The Frontiers of Biochip Technologies (eds. W L Xing, J Cheng) Kluwer Publishers, in press.
- Andrew Granville and Peter PLEASANTS, *Aurifeuillian factorization*, Mathematics of Computation (to appear).
- Ken GRAY, Anne Penfold STREET, Karen HARRIS and Colin RAMSAY, *Existence of complementary pairs of proportionally balanced designs*, Utilitas Mathematica (to appear).
- N HAMILTON and J A Thas, *Maximal arcs in  $PG(2, q)$  and partial flocks of the quadratic cone*, Advances in Geometry (to appear).
- George HAVAS and M R Vaughan-Lee, *4-Engel groups are locally nilpotent*, International Journal of Algebra and Computation (to appear).
- Peter JENKINS, *Embedding partial  $G$ -designs where  $G$  is a 4-cycle with a pendent edge*, Discrete Mathematics **292** (2005), 83–93.
- Peter JENKINS, *Embedding a restricted class of partial  $K_4$ -designs*, Ars Combinatoria (to appear).
- Peter JENKINS, *Irreducible 2-fold cycle systems*, Journal of Combinatorial Designs (to appear).
- Jonathan M KEITH, Peter ADAMS, Mark A Ragan and Darryn BRYANT, *Sampling phylogenetic tree space with the generalized Gibbs sampler*, Molecular Phylogenetics and Evolution **34** (2005), 459–468.

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Centre web site: <http://www.maths.uq.edu.au/cdmc/>