

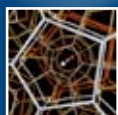
INSIDE



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New Zealand Institute of Mathematics & its Applications

## The single letter that grew

**When two statisticians met in a corridor at the University of Auckland back in 1990 they had no inkling that the initial of their first names would become the most commonly cited in mathematics. Jenny Rankine explains.**

The encounter between Ross Ihaka, of Ngati Kahungunu and Pakeha ancestry, and Canadian Robert Gentleman led to their collaboration on the statistical software system R. Their original goal was to create something with which they could teach their first year introductory statistics course. They based R on existing software called S, and developed programming techniques to reduce memory demands and performance difficulties when dealing with large problems. They called it R after their names and because single letters can't be trademarked.

Rather than take the commercial route that S had, they took out a GNU public licence. "By making the software free," says Ihaka, "we started to pick up a lot of collaborators. People aren't keen on working on commercial software, because their work gets taken over by the companies. We have the top researchers in the world involved in R, but we couldn't afford to pay them to work on it. They made R more and more useful, and more and more people started to use it. Now it's probably the most fully-featured piece of software in the world."

R can be used for linear and generalised linear models, nonlinear regression models, time series analysis, classical parametric and nonparametric tests, classification, clustering and smoothing. It also displays data in a range of well-designed charts, graphs and other diagrams.

**R gets a life of its own**

Ihaka and Gentleman's original paper about R has accumulated "a couple of thousand citations", as did another paper with the core collaborators, according to Ihaka. The software took on a life of its own; the R Foundation formed by the R Development Core Team in 2002, with Ihaka and Gentleman as presidents, is based at the Vienna University of Technology in Austria. Mathematical publisher Springer told Ihaka it is preparing about 30 books for its series on applications of R.

Gentleman now heads the Program in Computational Biology at the Fred Hutchinson Cancer Research Center in Seattle, USA. Ihaka still "dabbles" on uses for R, but this self-taught programmer is now consumed by writing another programme. "The working name is L; I hope it will be better, a thousand times faster and



**R&R:** Robert Gentleman, left, and Ross Ihaka



able to handle much bigger problems than R."

His impetus is that "our ability to process and even store data is far exceeded by the rate at which we can collect it. Twenty years ago, we used to work with 50 to 100 numbers - now we work with billions. We might be comparing fertilisers using 50 plots of wheat in a field, or analysing high-resolution images from electronic telescopes, or analysing people's purchasing habits from their supermarket transactions. We need better tools."

Ihaka is using Lisp, "which dates back to the 1950s and is used in artificial intelligence and large-scale **▶ 2**

### Welcome

We've had some great feedback on the first two issues of IMAGes. We hope you enjoy this one just as much. It features our new MathsReach initiative, with a range of items about the work and interests of New Zealand mathematicians and statisticians and one of the high-profile visitors brought to New Zealand by the NZIMA.

Find out more from [www.nzima.org](http://www.nzima.org).

**Marston Conder and Vaughan Jones**  
Co-Directors

◀ programming. R was an implementation of Lisp, but we didn't know much about it so there are fundamental limits on in speed and problem size in R as a result. The machines you needed back then to run Lisp were bigger than we could afford, but now it's available on the smallest PC."

At the moment, the project occupies Ihaka and a Masters student. "People think you should get commercial sponsors, but we can't do it like that. We need hundreds of people working on it, and you can't get the

investment to pay that many people."

Ihaka describes his work on R as "enormous fun. I get the occasional bottle of Scotch or free meal - a woman who teaches in a poor Black university in South Africa sent me a book they'd produced. A man researching tropical diseases in South America told me R was the only software they could afford. In a lot of developing countries it's the only one they use. Because it's so widely used, R has provided us with all sorts of contacts."

Ihaka is writing a book on R programming and one on statistical graphics and visualisation. He wanted to recommend a book to students about using colour and drawing graphs, but found few that were accurate about colour wavelengths and how our eyes perceive colour.

#### See also

[www.r-project.org/foundation/main.html](http://www.r-project.org/foundation/main.html)  
[www.gnu.org/](http://www.gnu.org/)

## Remote but live

In March, audience members around the country were able to participate live in Professor Marcus du Sautoy's public lecture on the Music of the Primes (see page 7).

The NZIMA and University of Auckland/BeSTGRID presented the lecture to participants at the Universities of Auckland, Canterbury and Massey - Palmerston North and Albany campuses - and the Auckland University of Technology using portable AccessGRID nodes on the Kiwi Advanced Research and Education Network (KAREN) courtesy of BeSTGRID.

Two-way video and audio meant that another 100 people watching remotely were able to ask questions and participate in the discussion after the lecture with the 250 in one of the two University of Auckland lecture theatres needed for this event. In fact, the audience in other centres asked more questions than the one in Auckland.

Marston Conder, a NZIMA co-director, described the broadcast as a landmark event in New Zealand mathematics. Many remote participants had never been part of a lecture like this before, and many wanted to do similar broadcasts themselves.

Presenters can write their usual whiteboard

notes on a tablet laptop, which is then projected up onto a wall for the audience.

#### See also

[www.math.auckland.ac.nz/~bonning/video/marcus-du-sautoy.wmv](http://www.math.auckland.ac.nz/~bonning/video/marcus-du-sautoy.wmv) for a sample video of the lecture on AccessGRID

[www.bestgrid.org/index.php/Main\\_Page](http://www.bestgrid.org/index.php/Main_Page) for information about the BeSTGRID and AccessGRID technologies

Associate Professor Paul Bonnington, Director of BeSTGRID, phone 09 373 7599 x 86623 or 021 623 206, email [p.bonnington@auckland.ac.nz](mailto:p.bonnington@auckland.ac.nz)

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#### Design:

Jenny Rankine,  
Words and Pictures

It is easier to square a  
circle than to get round  
a mathematician.  
*Augustus de Morgan*

## Southern Fields

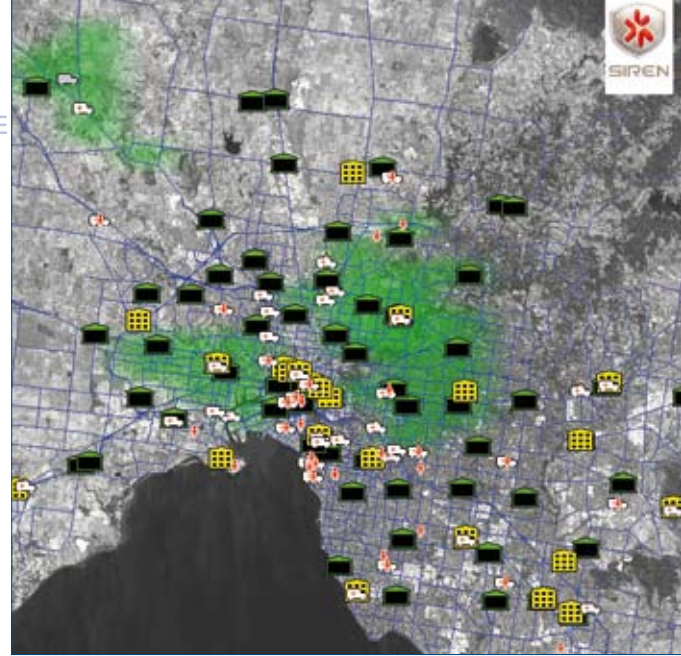
The only two Fields  
Medallists from the southern  
hemisphere, Terry Tao (2006)  
and Vaughan Jones (1990)  
now work in the same part  
of the world. Professor Tao  
was brought up in Adelaide  
and is based at the University  
of California in Los Angeles.  
Professor Jones, born in  
Gisborne and a co-director of  
the NZIMA, is based at UC  
in Berkeley.





# Emergency siren racing

**Jenny Rankine talks with an Auckland researcher who helped export New Zealand mathematics solutions around the world.**



When an ambulance passes, siren blaring, most people think of those for whom it races through suddenly still streets.

Dr Andrew Mason, in the Department of Engineering Science at the University of Auckland, also thinks of how he can improve the optimisation mathematics behind ambulance scheduling so that it gets to its destination in time to save lives. For the last five years, most of his research has been dedicated to this task. It all started with a chance meeting at a rostering conference in 1998. "St John wanted help with their rostering problems. Once I started, it became clear that we needed mathematical tools to work out how many staff were needed. With Shane Henderson I coded a simulation in C++ that we called BARTSim - Better Ambulance Rostering Technology Simulation - a pun on Bart Simpson."

"It used Geographic Information Systems-style visualisations to provide managers with a view of their problem they'd never seen before," he says. Loaded on a PC, it showed tiny flashing ambulances travelling through city streets, picking up and dropping off patients before returning to base.

"It was a real breakthrough. When we first showed St John they were impressed - they had GIS systems for dispatch but not for data analysis. Today GIS tools are commonplace." The simulation never actually answered the rostering question, but it did help St John with decisions about where to locate and how to run their bases.

In the same year Mason co-founded Optimal Decision Technologies, now called the Optima Corporation, which initially concentrated on rostering optimisations for Air New Zealand. The ambulance simulation sat on Mason's shelf until he was invited to tender for a similar project for the Melbourne Metropolitan Ambulance Service (MAS) in 2001. The University of Auckland licensed the simulation to Optima and they won the tender.

"Once we got into the guts of the Melbourne system we realised it was far more complicated than Auckland," he says. "They would often send two, three or even four vehicles to an accident; there were around five times as many calls, vehicles and roads. We made big changes to BARTSim, and it was renamed SIREN - Simulation for Improving Response-

times of Emergency Networks." Mason and Optima had found a niche for optimisation research products that no one else supplied.

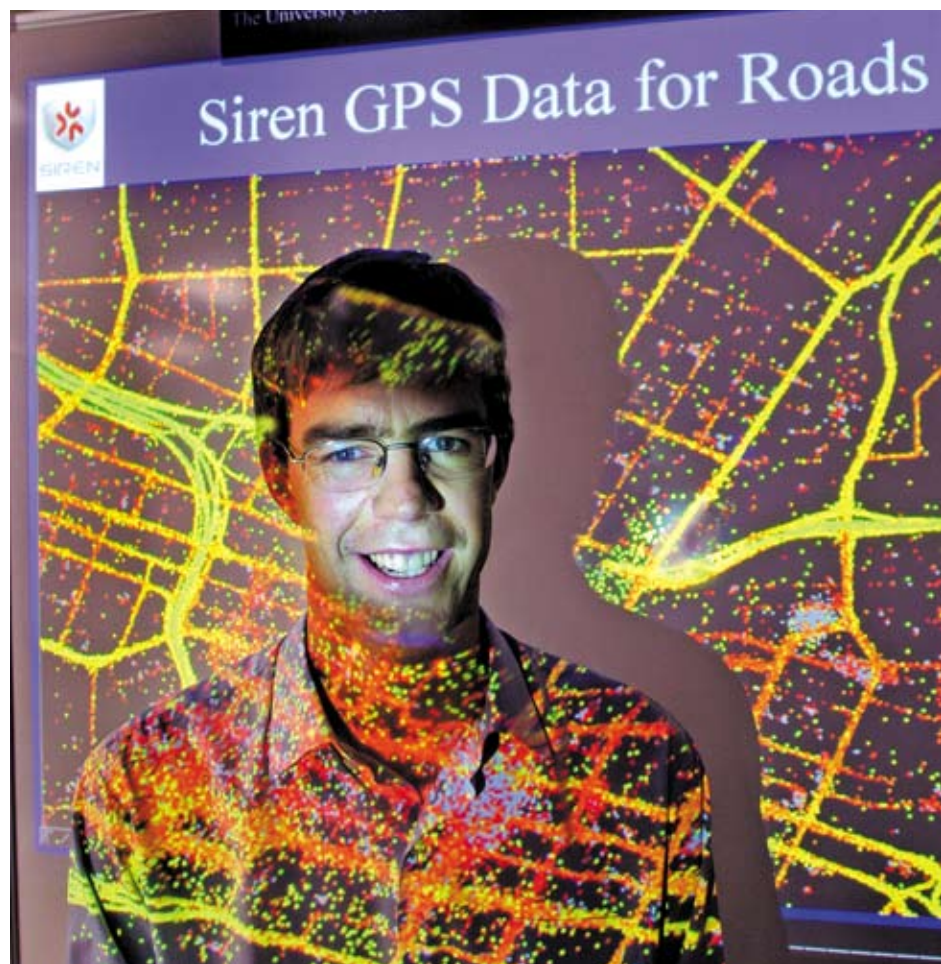
Optima developed the simulation into SIREN Predict, and sold it to emergency services in Australia, Denmark, Canada and the UK. It also developed another product, SIREN Live, which solves optimisation problems interactively in real time for dispatchers, taking into account vehicle locations, types and status, base and standby locations, staff shifts and call information.

"The beauty with tackling Melbourne's complex system first is that any other city has been relatively straightforward," says Mason. As Optima's Research Director, his goal is to reduce the time taken to implement Siren for a new city, including the effort it takes to build and calibrate the road network.

"Twenty years ago, finding how long it took to travel from A to B was virtually impossible. Now, fully- ▶ 4

**Users can watch ambulances travelling between callouts, bases and hospitals in Siren's virtual city. Below: Andrew Mason.**

Photo by Geoff Dale, courtesy of the University of Auckland.



# Making sense of the very complex



■ Catherine McCartin

A travelling salesperson sets out on a trip around the country. Given a number of cities, and the costs of travelling, what is the cheapest round trip she can take to visit each city only once, and then return home? The most direct way for her to answer this question would be to try all the different combinations, and see which one is the cheapest. However, even with just a few different cities, there are many combinations that could be tried, and the more there are, the more complicated the problem becomes. Instead, computational techniques that somehow restrict the problem are needed, to produce a useful solution within a practical time frame.

There are many real-world problems that are similar to this, and a variety of different computational techniques have been developed to find practical ways to solve them. One of the newest ones is known as parameterised complexity, and it is in this area that Dr Catherine McCartin, a Senior Lecturer in Computer Science at Massey University, carries out her research. "Parameterised complexity techniques for designing algorithms for this kind of problem have given us efficient ways of producing exact solutions

to real-world problems that we would previously have had to approximate," she said. "Parameterised complexity also gives us the chance to view a problem from several different perspectives."

Parameterised complexity is based on the simple observation that many real-world problems have certain aspects of their input that vary only within a moderate range, at least for instances that are of practical importance. By exploiting such small parameters, many problems can be efficiently solved. There are often several different ways to 'parameterise' a problem.

Parameterised complexity has applications in many different areas, and McCartin works on both the theory and its uses. One application involves developing methods to help construct evolutionary trees. Often, she explained, "you have several phylogenetic trees from the same group of organisms – they might come from different gene markers. But you want to find the true model that reflects evolutionary history." The problem, however, is finding out what that is, and it is here that parameterised complexity methods can help.

"Parameterised complexity ideas are applied in all kinds of places. Computational biology is a major one, because it is a newish area and lots of things are happening there, and a lot of their problems seem to fit with the parameterised view," said McCartin, who enjoys the exact nature of her work. "I like the fact that you can get useful solutions for things where there were none before. Also, I like knowing that my work produces robust results. It is quite satisfying to be able to prove things."

In 2006, McCartin received the Royal Society of New Zealand's Hatherton Award, which is presented for the best scientific paper by a PhD student at any New Zealand university in physical, earth, mathematical and information sciences. McCartin received the award for her paper entitled "Parameterized Counting Problems", which was published in the *Annals of Pure and Applied Logic* in July 2005.

By Anna Meyer

## Emergency siren racing from page 3

detailed road maps are readily available in most industrialised countries." Mason is currently using Global Positioning System (GPS) data to extract the speed at which ambulances travel with and without lights and sirens at different times of the day.

"It's like laying electronic breadcrumbs every 30 seconds or every minute; we have to do a probabilistic analysis to determine the most likely routes the vehicle took. We've come up with a new algorithm for that."

Optima has developed different ways to represent the data, for example, with the dots coloured by speed. "Inside tunnels, GPS units can't reach the satellites, so maps scatter high speed dots in nearby suburban streets. I'm working out how to clean up these position errors as well as errors in the road networks that cities provide."

Fourth year and Masters students in Engineering Science also work on these problems. "My fourth year and Masters students from last year are both now working at Optima." Mason is also working with Shane Henderson, now at Cornell University in the USA, to improve the optimisation strategies built into SIREN Live.

This unique work was recognised in front of more than 700 people, including the Prime Minister, at the 2006 Price Waterhouse Coopers Hi-Tech Awards in November; when Optima accepted the Enatel NZ Hi-Tech Innovation of the Year award for Optima's SIREN products.

### See also

[www.esc.auckland.ac.nz/Mason](http://www.esc.auckland.ac.nz/Mason) or [www.TheOptimaCorporation.com](http://www.TheOptimaCorporation.com)

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**MathsReach**  
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The NZIMA's MathsReach initiative was launched by the Prime Minister, the Right Honourable Helen Clark, at Onehunga High School in February 2007.

MathsReach provides a collection of resources on the web and CD for school students, teachers, parents and careers advisors, showing what lies beyond the school curriculum.

It offers insight into the lives of mathematical scientists and inspires students to see how mathematics can open doors to all sorts of opportunities.

See [www.mathreach.org](http://www.mathreach.org)

Photos: Tiger Tiger

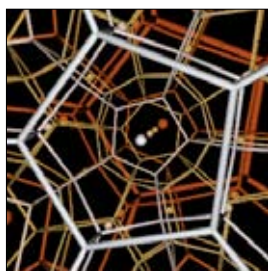
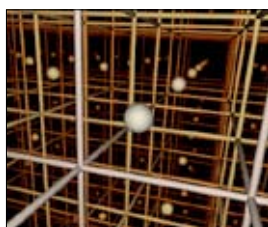
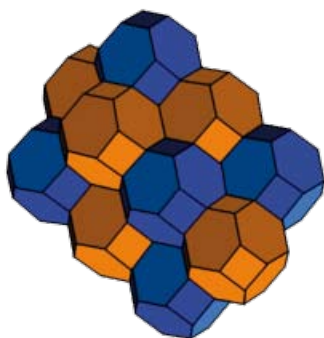


# Tiling in curved space



By Jenny Rankine

**Above: Gaven Martin;**  
photo courtesy of Massey  
University. **Immediately  
below: A bi-truncated  
cubic honeycomb**



Professor Gaven Martin is in full flight, describing how non-linear partial differential equations explain how the microstructure in a steel bar affects the macroscopic distribution of force as it is bent. If his listener doesn't understand, he takes a step back and sketches the graph of a simple function on his office whiteboard at Massey University in Albany.

He shows how finding its minima leads to a differential equation. The  $x$  and  $y$  axes no longer represent single variables, but states – which are functions in themselves. So the energy of the bar is now a function of functions. The solution of the partial differential equation (PDE) will be the particular bend that, out of all possible twists, uses the least energy.

This PDE might be solvable for a simple steel bar, but for most modern materials and structures, such as cars, bridges, tower blocks and even bars made from composite materials, other PDEs are not. "So we build models of the key energy functionals of those structures - their crystalline alignment or the interface between two different components - and then minimise them, leading often to quite complicated non-linear PDEs."

"Pure mathematicians study classes of differential equations with generic features to validate these models. Generic features include whether the equation has a solution or not," he says. "This sounds almost useless, but it's not. It's a damn sight better searching for something if you know it's there. Other important features include whether there are multiple solutions or only one and whether the solution is regular or not, because otherwise a computer has no chance of finding it. The solutions to differential equations can be very irregular."

In 1850 Joseph Liouville hypothesised that the only conformal transformations of space (the symmetries of physical theories such as relativity) are the usual Lorentz or M\"obius transformations. Liouville proved this if the symmetry was sufficiently smooth. "But this begs the question," says Martin. "Physical systems exist where solutions are highly irregular. Liouville was effectively asking if there were any physical symmetries other than the obvious ones." In 1990, with Polish mathematician Tadeusz Iwaniec, Martin completely solved this problem.

"We showed *exactly* how regular a solution would have to be for it to be a M\"obius transformation; we

also constructed solutions, functions, that weren't. But they were so irregular that they couldn't represent a physical symmetry – they blew up all over the place." This result remains the only fully non-linear system of PDEs in more than two dimensions with an exact regularity theory. The tools and ideas created in the proof (non-linear Hodge theory) opened a theoretical bottleneck and led to hundreds of mathematical papers being published.

Martin's description of a new result in hyperbolic (curved space) geometry leads to another flurry of whiteboard drawings. This time they are spheres, tori (donut shapes) and other surfaces with more holes and the two-dimensional polygons that tessellate their surfaces.

Tessellations are periodic tilings of two or more dimensions that cover a plane, like graph paper, or fill a multi-dimensional shape, like honeycomb, with no overlaps and no gaps. The result Martin is describing is the formula for the smallest possible three-dimensional tessellation of hyperbolic space – solving a problem first posed by Carl Siegel in 1945 after he had solved the 2D problem.

Every surface can be identified with a hyperbolic tessellation and recently results of Grisha Perelman (of Poincaré conjecture fame) show the same is more or less true in three dimensions. Martin, with Fred Gehring and former PhD student Tim Marshall, showed that tetrahedrons with internal angles  $\pi/2$ ,  $\pi/3$  and  $\pi/5$  gave the smallest possible 3-D hyperbolic tessellation, and found deep connections with number theory.

"Sometimes these simple problems take decades." Martin worked on the 3-D tessellation problem for nearly 20 years, getting partial results in small steps. "You get the occasional blinding flashes of insight, but they often come when you're younger."

Martin met his future wife Dianne, a biology professor at Massey University, when they attended Auckland's Henderson Intermediate. He did his PhD at the University of Michigan and has worked in the USA, Finland, Sweden, France and Australia. He has recently become director of the new NZ Institute for Advanced Study. Martin was one of the NZIMA's original principal investigators, and represents the New Zealand Mathematics Research Institute (Inc.) on the NZIMA board.

# Prime promoter



**Soccer player, musician and mathematician Marcus du Sautoy, a 2007 NZIMA Maclaurin Fellow, spoke with Jenny Rankine.**

Marcus du Sautoy is 41 and bought a house at number 53 in a North London street. He can take the 19 or 73 bus to get there or drive his Primera 47. In 2003 when he was 37 he wrote a bestselling book which has been translated into 11 languages. All these numbers might tell you the subject - prime numbers - which he calls "the atoms of mathematics".

Despite buying his Sunday soccer team prime number t-shirts, he found it "freaky" that his subconscious had filled his life with so many primes.

Du Sautoy is that walking contradiction, a popular mathematician. He is a professor of mathematics at Oxford, and enjoys a media fellowship which enables him to spend half his time in the abstruse world of theoretical symmetry in infinite dimensions, and the other half popularising mathematics. This involves him in a bewildering array of media and collaborations.

He presents the BBC television program, Mind Games, where contestants solve mathematical and language problems. He has made short videos for school students; his four one-hour BBC maths history documentaries will go to air next year; he has a radio series and newspaper columns.

## Num8er My5teries

In 2006 he scored the ultimate TV scientist slot - the Royal Institution Christmas Lectures - which drew over a million viewers. He called them The Num8er My5teries, about five of the Clay Mathematics Institute's Millenium Problems, and will repeat them in Australia in the near future. He collaborated on the play A Disappearing Number, about mathematicians Srinivasa Ramanujan and GH Hardy, which is touring the UK.

Du Sautoy has also worked with New Zealand dance choreographer Carol Brown and composer Dorothy Ker as part of the UK's burgeoning sci-art movement. "We combined maths, music, sculpture

and choreography to explore ideas of infinity and space." He finds these collaborations very stimulating: "they help me look at things in new ways."

He's enthusiastic about the drama behind his supposedly dry subject - his book *The Music of the Primes* is full of near escapes from death, love, betrayal and mad genius, proofs scribbled in margins and published from prison. When I meet him, he's wearing a purple soccer t-shirt with a prime number on the back and the equation describing the trajectory of a ball on the front. "Every time you catch or kick a ball, you're solving this quadratic equation," he says.

Du Sautoy describes the elation of discovering something first, which mathematicians crave for the rest of their careers. His discovery was a symmetry group. "Before I found it, it didn't seem to exist at all. Like an alchemist, I put things together in unexpected ways and pushed the subject in a new direction. Afterwards it felt like it had been lying there like a piece of gold waiting to be discovered."

His talent with metaphor is used to the full in his book *The Music of the Primes*, which describes the fiendishly complicated Riemann hypothesis in terms of harmony and landscape. Both the book and du Sautoy have fun websites. He has a new book coming out in early 2008 called *Finding Moonshine*, which tells the story of symmetry.

During his visit earlier this year, he spent a week with Ben Martin, a group theorist at the University of Canterbury. "A week's a short time, but we were able to connect very quickly." In the competitive world of elite mathematics, good collaborations are precious.

**2** Du Sautoy works regularly with a German mathematician, Fritz Grunewald. "It feels like having two ladders, each with rungs missing so we can't climb further alone. As soon as we meet, everything fizzes. Often I'll be standing at a white board, grumbling, and he runs with it. Teasing out what's going on in non-verbal moments is as important as talking." In Auckland du Sautoy lectured on the primes and made use of the computer skill of Auckland mathematicians on infinite groups. "It was fun doing computer experiments, it felt like being a scientist - I understood the groups a lot better."

**53** He loves to overturn the popular misconception that maths research is long division to a lot of decimal places and that computers must have worked it all out by now. "Computers can help mathematicians generate data in their search for patterns; mathematicians have to try to show why the patterns will always work," he says.

**1447**

**19**

**2677**

**73**

**307**

**23**

**41**

**89**

**53**

**2003**

**111**

**101**

**1117**

**5**

**43**

**191**

## See also

[www.musicofthepimes.com/](http://www.musicofthepimes.com/) and [www.maths.ox.ac.uk/~dusautoy/](http://www.maths.ox.ac.uk/~dusautoy/)

For a free DVD of the Christmas Lectures: [www.rigb.org/rmain/news/newsdetail.jsp?&comp=1&id=122&lang=EN](http://www.rigb.org/rmain/news/newsdetail.jsp?&comp=1&id=122&lang=EN)

Videos on Teachers TV: [www.teachers.tv/search/node/du+Sautoy](http://www.teachers.tv/search/node/du+Sautoy)

[www.lms.ac.uk/activities/education\\_com/videos\\_purchase.html](http://www.lms.ac.uk/activities/education_com/videos_purchase.html)

A DVD of a BBC documentary presented by du Sautoy based on *The Music of the Primes* is available at [www.ouw.co.uk/products/XM002\\_DVDSERIES.shtm](http://www.ouw.co.uk/products/XM002_DVDSERIES.shtm)

## NOTABLE MATHS PROBLEMS

### IS P = NP?

**Are complexity classes P and NP equivalent?**

**Simply:** If positive solutions to a yes/no problem can be verified quickly, can they also be computed quickly?

**Example:** Does some subset of the set  $\{-2, -3, 15, 14, 7, -10\}$  add up to zero? Yes, and it's easy to check that  $\{-2, -3, -10, 15\}$  does, with simple addition. Verifying that a subset adds up to zero can be much faster than finding the subset in the first place. How to find such a subset when the set itself is large is called the subset-sum problem. This is an example of a problem in the class NP (non-deterministic polynomial time). Verifying the answer is an example of a problem in the class P (polynomial time).

**Discipline:** Computational complexity theory, which deals with the resources, such as time (expressed in the number of steps) and space (expressed as memory), needed to solve a given problem.

**Incentive:** \$US1million, one of the seven Millennium Prize Problems of the USA-based Clay Mathematics Institute.

**Unusual aspect:** Involves a computer that has never been built. Turing machines, first described by English mathematician and cryptographer Alan Turing in 1936, were a thought experiment to simulate the logic of any computer that could possibly be constructed.

**Consequences:** Remarkably, a polynomial-time solution to a problem in NP would provide polynomial-time solutions to *all* problems in NP. If  $P=NP$ , then this would simplify many currently intractable mathematical problems in fields as varied as operations research, logistics and biology. On the other hand, a proof that  $P \neq NP$  would show that many common problems cannot be solved efficiently, moving the attention of researchers to partial solutions or other problems. As experts believe that  $P \neq NP$ , this is happening already.

**NZIMA link:** 2004 Logic and Computation programme.

## Awards and honours

**HYMAN BASS**, a visiting Maclaurin Fellow last year, was presented with a National Medal of Science by the President of the USA in July. He was one of eight winners of this award for 2006.

In June, NZIMA Co-Director **VAUGHAN JONES** was awarded the 2007 Prix Mondial Nessim Habib by the University of Geneva, for his achievements in mathematics. This an annual prize awarded to prominent researchers from all disciplines.

**ROBERT MCLACHLAN** (one of the NZIMA's principal researchers) was awarded the Dahlquist Prize at the SciCADE meeting in St Malo in July 2007, for his outstanding contributions to geometric integration and composition methods for solving differential equations.

**CHERYL PRAEGER**, a member of the NZIMA's International Scientific Advisory Board, has been awarded a prestigious Federation Fellowship by the Australian Research Council.

**JAMES SNEYD**, one of the NZIMA's principal researchers, has been awarded a James Cook Fellowship for 2007-2009.

Every mathematician worthy of the name has experienced ... the state of lucid exaltation in which one thought succeeds another as if miraculously ... Once you have experienced it, you are eager to repeat it but unable to do it at will, unless perhaps by dogged work ...

André Weil, 1991

## MATHEMATICAL EVENTS

5-7 November 2007, Long Bay, Auckland  
**Workshop for Women in the Mathematical Sciences in NZ** Contact Dr Vivien Kirk, v.kirk@auckland.ac.nz

22-23 November, Queenstown  
**NZ Mathematics and Statistics Postgraduate (NZMASP) Conference** www.math.canterbury.ac.nz/bio/NZMASP/ or contact Scott Graybill, sjgl46@student.canterbury.ac.nz

30 November - 1 December, Christchurch  
**41st Annual ORSNZ Conference** https://secure.orsnz.org.nz/conf/

3-7 December, Dunedin  
**32nd ACCMCC (Australasian Conference on Combinatorial Mathematics and Combinatorial Computing)** www.cs.otago.ac.nz/staffpriv/mike/ACCMCC32/32ACCMCC.html

9-11 December, Victoria University of Wellington  
**Mathematical & Computational Nanoscience 2007** (sponsored jointly by the NZIMA and the MacDiarmid Institute) www.macdiarmid.ac.nz/mcn/

12-15 December, Victoria University of Wellington  
**1st Joint Meeting of the American and New Zealand Mathematical Societies** www.mcs.vuw.ac.nz/

~mathmeet/amsnzms2007/

6-12 January 2008, Nelson  
**2008 NZMRI Conference on Conformal Geometry** www.math.auckland.ac.nz/wiki/2008\_NZMRI\_Conference\_on\_Conformal\_Geometry

14-18 January, Kaikoura  
**Conference on Finite Groups and Representations** www.math.canterbury.ac.nz/bio/Finite\_Groups/

28 January - 1 February, Woollongong, Australia  
**Mathematics in Industry Study Group 2008** www.uow.edu.au/informatics/math/research/misg/index.html

3-7 February, Katoomba, Australia  
**ANZIAM 2008** www.maths.usyd.edu.au/ANZIAM2008/

18-22 February, Napier  
**Conference on Algorithms** www.cs.otago.ac.nz/algorithms/activities/febmeeting.html

19-22 February, Auckland  
**Workshop on Multi-scale Modelling of the Respiratory System** www.bioeng.auckland.ac.nz/events/msmrs/index.php