Newsletter

A new Home for Mathematics

By **Nick Woodhouse**

Our plans for a new building have been developing behind the scenes for the past twelve months. The University has been giving thought to the overall development of the Radcliffe Infirmary site in preparation for the start of building work in 2007 when the Health Service completes its move away from the City centre.

AERIAL VIEW:
The Radcliffe Infirmary site extends from the Woodstock Road at the front of the picture to Walton Street which runs along the top of the picture. The historic buildings on the Woodstock Road will be retained but the rest of the 10-acre site will be redeveloped.

The new Mathematical Institute has a prominent place in the plans, and will be the first building to be erected. An international competition was launched by the Royal Institute of British Architects (RIBA) in December to select the architect for site masterplan. A shortlist (Dixon Jones Ltd, HOK International Ltd, Hopkins Architects, and Rafael Viñoly Architects PC) was announced in January and their plans were exhibited in April. We are now in the final stages of the competition, and it is likely that the winner will be announced very soon. We are all confident that the result will be new buildings of outstanding quality, in a setting that will make the most of the historic buildings on the Woodstock Road and of the Tower of the Winds

on the North side of the site. We shall no doubt have to get used to being part of the Oxford tourist circuit—-a new experience for mathematicians.

The masterplan architect will also take forward the detailed design of the Institute, working from the brief that we have drawn up over the last two years with the help of David Heslop of the Architects Design Partnership.

In parallel with progress on plans for the building, we have also been working on fund-raising. We are very excited about how this is going, and are delighted by how much interest there is in Mathematics at Oxford.

Access to Mathematics at Oxford

By **Richard Earl,** *Schools Liaison and Access Officer*

The word *Oxford* conjures a wide variety of images depending on the ear it finds. For those who have studied there, the word might evoke fond memories of first meetings with now life-long friends, sporting victories, or favourite tutors. Thanks to the Media's pre-occupation with Oxbridge the word might just as easily symbolise privilege and disparity. But for many gifted students country-wide, it is still simply the case that they have never thought of university, and in particular the University of Oxford, as in any way connected with themselves or their futures.

The post of Schools Liaison and Access Officer for the Mathematics, Statistics and Computer Science departments was set up in August 2003. Though the job has various responsibilities, they are all related to the promotion of Mathematics and its applications in Oxford and beyond. In the light of the Smith Report (Making Mathematics Count 2004), the promotion of mathematics generally has now been recognised as a national priority. The UK numbers taking A-level Mathematics fell from 52,000 to 42,000 following the Curriculum 2000 changes. Yet in this highly technical, information-driven age, mathematics graduates find themselves more employable than ever, and more variously so.

Several current outreach activities involving the departments have already been running for a number of years. The largest student numbers are seen at the Regional Oxbridge conferences which take place at football stadia and racecourses around the country in March. These are high-impact affairs for thousands of students at a time. The Sutton Trust Summer Schools which first ran in 1997 are another long-running programme. The one in Mathematics involves twenty five 17 year-olds, from families and schools with little or no history of university, visiting Oxford for a week-long academic programme run by members of the departments to promote the excitement and variety of university mathematics. Beyond these, many lecturers (notably Dr David Acheson, Prof Marcus du Sautoy and Dr Peter Neumann) have given generously of their time with schools and the United Kingdom Mathematics Trust.

A major access concern for us in Oxford is the low numbers taking Further Mathematics A-level; current numbers are around one third of 1980s figures, and many students do not have the opportunity to take it either to AS- or the full A2-level. Oxford does not require this second mathematics A-level, but there is a perception that it is needed to study mathematics at any university, and it is a fact that students without it find the transition to university mathematics that much harder. To this end, the first Mathematical Sciences Bridging Course ran in September 2004 in Exeter College, before the new term started. This was a week-long course picking up on the most important topics from Further Maths, and followed by support classes through the term. The course will run again in 2005 and 2006, with generous funding from The Sutton Trust.

Another recent initiative is the Undergraduate Ambassadors Scheme. This was begun by Simon Singh in 2002 and runs in several universities. The first cohort of Oxford mathematicians has just completed the course at four local schools. On this scheme, current undergraduates assist teachers in school once a week for a term as credit towards a paper in their final Examination, gaining valuable presentation and communication skills and getting a real sense of the teaching profession. The course has been a success with students and teachers alike, and the department is looking to involve more schools in the scheme next year.

Richard Earl with students on the 2004 Bridging Course.

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The gloomy view the national A-level figures portray is actually at odds with scenes witnessed at the Oxford departments' four open days, which run in May, June and September. These are proving increasingly popular, with the Institute often filled to brimming. Importantly, the fruits of these open days and other outreach efforts are seen each October with application figures now 50% higher than they were five years ago and still rising.

David Acheson awarded National Teaching Fellowship

Dr David Acheson, Fellow in Applied Mathematics at Jesus College, has been awarded a National Teaching Fellowship worth £50,000 in recognition of his outstanding contribution to learning and teaching. He was presented with his award by the Rt Hon. Alan Johnson, Minister at a celebration dinner in London on 9 September 2004.

David is well known for his innovative and inspiring teaching methods, which include playing an electric guitar in lectures to demonstrate the mathematical theory of vibrating strings. In addition to his teaching and research at Oxford, he has given a number of public lectures including: the 2003 LMS Popular Lecture, *Mathematics, Magic and the Electric Guitar;* the Alan Tayler lecture for 2004 in St Catherine's College; the St Cecilia Lecture at the St Cecilia International Music Festival in London; and the 2005 National Cipher Challenge lecture at Bletchley Park. He has also appeared on *Tomorrow's world* presenting his 'upside-down pendulums theorem', and written '*1089 and All That'*, a book that attempts to bring the job of mathematics to the general public.

David Acheson plans to use his award to establish a unique form of communication of mathematics, particularly to students who are just starting university. He plans to do this by writing an accessible and inspiring book on mathematics that is neither a conventional textbook nor a 'popular science' book, but one which draws on the best elements of both. The book will emphasise both the aesthetic and practical sides of mathematics, and will help readers to actually do maths, rather than just appreciate what it is. He will also create web-based interactive software to accompany his book, illustrating those aspects of mathematics that are best brought to life by moving images.

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David Acheson received his National Teaching Fellowship

John Hammersley

By **Dominic Welsh**

Dr John Hammersley, Mathematical Statistician; Pioneer in the Study of Percolation and Random Growth Processes, died on 2nd May 2004 aged 84. He was a remarkable and fearless problem-solver and an exceptionally inventive mathematician. One of his great strengths was an ability to pinpoint the basic mathematics underlying a scientific problem and to develop a useful theory. A notable example was his seminal paper with S.R. Broadbent on 'Percolation Processes', written in 1957 and motivated by a problem on the spread of gas molecules though a porous solid. Unlike previous studies of particles moving randomly in space, in this problem the randomness existed solely in the porous medium. Largely through his influence percolation is now a huge area of ongoing research in both mathematical probability and statistical physics with many applications in the physical and natural sciences, a typical example being the spread of blight though an orchard. Closely related was the easily stated, but

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horrendously difficult, 'self-avoiding walk' problem. This concerned the behavior of a non-intersecting random walk in a crystal lattice. It, too, has many applications, particularly in the polymer industry, but complete answers of the type Hammersley sought in the early sixties are still not known, and several of his pioneering results are now classical.

From his earliest days Hammersley had great respect for 'bare hands' numerical work in order to give some insight into how the random processes he was studying actually behaved. This could involve enormous calculations or simulations on what are today seen as primitive machines. In the early sixties the Oxford mainframe, although physically huge, had far less storage than a modern calculator. Large simulations needed to be written in machine code and a typical run could take 24 hours. These experiences in large-scale computing on relatively tiny machines provided the case studies for his ground-breaking work 'Monte Carlo Methods' (1964) written with his ex-student D.C. Handscomb. Now in its 5th edition it has been a major influence in the spread of these techniques.

John Hammersley went to school at Sedbergh and from there, with a scholarship, to Emmanuel College, Cambridge in October 1939. His undergraduate career was interrupted by military service from 1940 – 45. While in the army he developed a range of technical expertise in areas such as radar and gunnery, to the extent that he ended up being responsible for the radar installations of the gun-sites defending Scapa Flow. When he was in charge of the computations analysing the performance of anti-aircraft equipment he introduced a reform of which he was proud, replacing the 7-figure tables of trigonometric functions by 4-figure ones which were ample for the necessary approximations. By the end of the war he was a Major in the Royal Regiment of Artillery, and in 1946 resumed his undergraduate career graduating with a first class in Part 2 of the Tripos.

In 1948 Hammersley came to Oxford and after a short spell at AERE Harwell became a Senior

Research Officer in the Institute of Economics and Statistics. In 1969 he was appointed Reader in Mathematical Statistics and elected a Professorial Fellow at Trinity and he remained in this position until his retirement in 1987. He continued his research after retirement as Emeritus Fellow at Trinity attached to the Oxford Centre for Industrial and Applied Mathematics. Major achievements in this period were his papers with G. Mazzarino on the dendritic growth of crystals and the growth of Eden clusters. The Eden growth model had been of great interest to Hammersley since 1961, and it was fitting that his research career should draw to a close with an analytic and computational study of the roughness of a cluster surface.

As a research supervisor he was full of ideas and exciting problems. As an examiner he could set fiendishly difficult questions. A constant aim of his was to increase problem-solving ability in the young. This once took the form of a non-examinable course devoted solely to difficult problems. Later he visited various parts of the country lecturing on the enfeeblement of mathematical skills by 'Modern Mathematics' and by 'similar soft intellectual trash in schools and universities.'

In his distinguished career. as well as holding Doctorates of Science from both Oxford and Cambridge, he was awarded the Von Neumann Medal for Applied Mathematics by the University of Brussels (1966), elected a Fellow of the Royal Society (1976), was the Rouse Ball Lecturer of the University of Cambridge in 1980, awarded the Gold Medal of the Institute of Mathematics and its Applications (1984) and the Pólya Prize of the London Mathematical Society in 1997.

Hammersley was a gentleman of the old school, with very high standards. Curiosity and originality pervaded his whole life; he was always stimulating and wonderfully entertaining company. Away from his mathematics he was a cultured man, fond of poetry and devoted to his family. He was happily married to Gwen for 53 years, and she and his two sons, Julian and Hugo, survive him.

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Postscript
by **Hilary Ockendon**

Does anyone else remember the lectures on "Solving Problems" given for undergraduates by John Hammersley in the 1960's? I was not a very avid lecture goer but in Michaelmas Term 1960 I went to every one of these weekly lectures even though they were nothing to do with the syllabus. Hammersley started by listing a motley collection of problems; some were fairly simple brain teasers, others more complicated but they were all what he called "hard" problems that required **thought** on the part of the solver. Over the term Hammersley gave answers to all the problems he posed – some were one-liners (geometric problems solved "by symmetry"), more took a page or two of reasoning and some required a considerable amount of mathematical apparatus to be set up. At the most difficult end was a problem on self avoiding walks which I think was his current research topic. He also introduced us to the theory of quaternions and used it to show that all integers can be written as the sum of four squares. Mixed in with these problems were geometric constructions, penny weighing problems, how to divide a loaf fairly between n people etc. He delivered these lectures in his usual low key, business like way, and although I never had to learn the material for an exam these are the lectures I remember best 40 years on.

Finally, here is one of his problems (an easy one):

Given two points A and B, find the midpoint of AB using **only** a pair of compasses (no ruler). There are no prizes for the solution but maybe it will stretch a few mathematical muscles!

Congratulations

In 2004, three of Oxford's mathematicians won prizes from the London Mathematical Society.

- **Professor Roger Penrose** was awarded the **De Morgan Medal** for his wide and original contributions to mathematical physics.
- **Professor Boris Zilber** was awarded the **Senior Berwick Prize** for his paper 'Exponential sums equations and the Schanuel conjecture' which was published in the journal of the LMS in 2002.
- **Professor Ulrike Tillmann** was awarded a **Whitehead Prize** for her work on the moduli spaces of algebraic curves.

- **Marcus du Sautoy** has been awarded a **Senior Media Fellowship** from the EPSRC. The fellowship will run for three years starting in October 2005. The aim of the fellowship is to continue the Institute's outreach activity by promoting mathematics on radio, TV and through the print media.

Robin Wilson appointed Gresham Professor of Geometry

In 1597 the oldest mathematical professorship in England, the Gresham Chair of Geometry in London, was founded through the will of the financier Sir Thomas Gresham, and for over 400 years its occupants have given free public lectures for anyone who wished to turn up. The first of these was Henry Briggs, co-inventor of logarithms, who later went on to be the first Savilian Professor of Geometry in Oxford (1619) – indeed the first five Gresham Chairs had links with Oxford. Later Gresham Professors of Geometry included Isaac Barrow and Robert

A historic meeting between two Gresham professors: Sir Roger Penrose and Henry Briggs (aka Robin Wilson)

Hooke, while recent occupants with Oxford connections have been Sir Christopher Zeeman FRS and Sir Roger Penrose OM, FRS.

Robin Wilson (Keble College and the Open University) has been appointed to the Gresham Chair for the period 2004-07, and has already given his first year's lectures. Transcripts of these, and details of his future lectures can be found on the Gresham College website, www.gresham.ac.uk.

Nomura lecture 2005

The Nomura lecture this year was given by Nobel Laureate Professor Daniel Kahneman on 'The Psychology of Behavioral Finance – Past and Future'. In this talk he will describe how, researchers in behavioral finance have drawn a portrait of the individual investor as overconfident, loss averse and prone to myopic framing of problems. In the coming years the focus of research is likely to turn to institutional investors and how they trade, because they fare much better than individuals. Professor Kahneman will consider how detailed treatments of attention, emotion and intuition, are currently being developed, in addition to the existing set of conceptual tools.

Newcomer

Dr Zhongmin Qian has just arrived in Oxford as a University lecturer and Fellow of Exeter College. His research interests are in **Stochastic Analysis** and **Geometric Analysis** and he will join the group working with Professor Terry Lyons on Stochastic Analysis.

Oxford Logicians in Cambridge

The programme "M odel Theory and Applications to Algebra and Analysis" is currently taking place at the Isaac Newton Institute for Mathematical Sciences in Cambridge. The organizers are Alex Wilkie (Oxford) ,Zoe Chatzidakis (CNRS), Dugald Macpherson (Leeds) and Anand Pillay (Illinois). There are a dozen or so long term visitors, including Boris Zilber and Angus Macintyre (the present and previous Professors of Mathematical Logic at Oxford) and by the time the semester is over, on 15th July, a further sixty model theorists will have passed through on visits of between one and three weeks. The emphasis is on informal interaction, with only four or five formal lectures being given each week. Students are encouraged to attend and most of our Oxford Logic group have already taken advantage of this opportunity.

UKMT Team Maths Challenge

Pupils from 37 schools around Oxford went head-to-head in a Regional Final of the annual Team Maths Challenge, held in the beautiful setting of the Examination Schools on 21 March. The event was directed by Paul Murray (Queen's 1996--2000, now teaching at Lord Williams School, Thame), assisted by Dr Peter Neumann, his former tutor.

This is the fourth year that Oxford University has hosted the Oxford Regional Final for the UK Mathematics Trust, attracting schools from Oxfordshire, Berkshire and Buckinghamshire. In these four years, the number of teams taking part has almost doubled from 20 to nearly 40. Teams of four 12-14 year-old students from each school worked against the clock and other teams through a series of competitions including a group challenge (problems for team collaboration), a head-to-head contest (work out the next number in a sequence), a cross-number competition (like a crossword, only with numbers) and a mathematical relay race. The day was filled with energy and excitement, some exasperation, and a great deal of happiness. The winner, the Royal Latin School Bicester, will compete in the National Final in the Guildhall, London at the end of June.
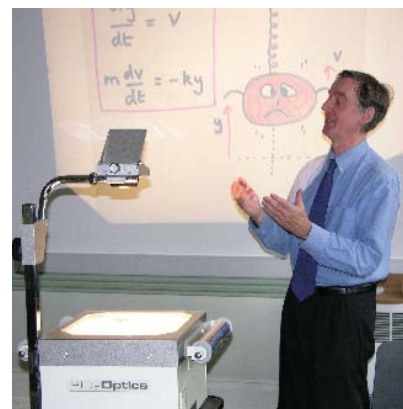
Ri Masterclasses

The famous Royal Institution master-classes for Year 9 (14-year old) students were founded by Professor Sir Christopher Zeeman after his immensely successful Christmas Lectures in 1980. The movement has been slow to come to Oxford, but an Oxfordshire master-class was founded a few years ago. In November 2004 it was hosted by Queen's College. Forty young math-ematicians from seventeen schools spent three hours on four successive Saturday mornings engaging with mathematics. They had Mathematical Challenges from Dr Peter Neumann of Queen's, Maximisation Problems from Ian Tustian and David Wheeler of Warriner School Banbury, 1089 And All That from David Acheson of Jesus College, and Gyroscopes and Boomerangs from Sir Christopher Zeeman himself. Judging by their enthusiasm and progress there should be some good young mathematicians entering universities in five years' time.

Mathematical Institute Garden Party

Over 200 mathematical alumni and their friends and relations came to Oxford last year to hear talks from Marcus du Sautoy and David Acheson followed by a reception in St Cross College,. This year we will be holding the event on June 11 in St Catherine's College. The day will start with two talks on relativity and related matters. Professor Roger Penrose who held the Rouse Ball Chair until his retirement who will give us a glimpse of the contents of his latest book 'The Road to Reality' and Philip Candelas, the current Rouse Ball Professor, will describe some recent developments in string theory. These talks will be aimed at a general audience and will be followed by a Garden Party Reception.

If you would like to attend this event please contact Laura Mildenhall, Mathematical Institute, 24-29 St Giles, Oxford, OX1 3LB. Fax 01865 270515. Email – mildenha@maths.ox.ac.uk. An invitation with a form to return is enclosed with this newsletter.There will be a charge of £10 per person.
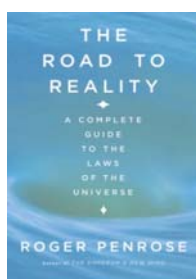

David Acheson lecturing on '1089 and all that'.

Books

Two members of the Mathematical Institute have just published books on applied mathematics. In spite of their titles these books are very different and illustrate the wide diversity of applied mathematics which is contained within the Mathematical Institute. On another tack altogether one of our visitors in the 90's has now written a book set in the Mathematical Institute…..

The Road to Reality:
A complete guide to the Laws of the Universe

The Road to Reality by Roger Penrose is a multifaceted book that provides not only a masterly overview of modern physical theory, but also an introduction and guide to the mathematics that underlies it. Its goal is a panoramic view of the great triumphs of physical theory together with a penetrating critique of the ideas that are at the forefront of modern thinking.

The book is self contained and written on many different levels. There is sufficient elementary material for a full understanding by a reader with only GCSE maths and physics and the material is explained without shortcuts or hand-waving. However, the explanations are such that the more touristically inclined reader can see the shape of the ideas without working through the details of the equations. Even in this introductory material, Roger Penrose has a great skill for bringing his subject to life, setting the ideas within bigger pictures and taking the reader off on many intriguing side trips into such subjects as computability and the nature of infinity.
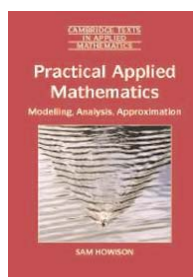
The whole book is written in Roger Penrose's very individual and thoughtful style with beautiful diagrams to help visualize basic concepts and novel insights, many of which will be new even to the experts. The critique of modern approaches to the challenges of modern physics might arouse controversy but it is undeniably profound; the ways forward highlighted by Penrose may well prove to be the mainstream of the physics of the future.

The Road to Reality by Roger Penrose, Alfred A. Knopf, Inc., New York, (2005), 0-679-45443-8
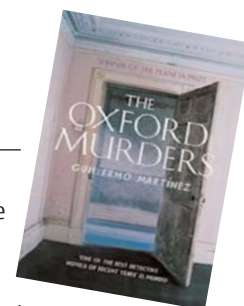
Mathematics in the real world

Sam Howison has just published the modelling book that everyone in OCIAM has been waiting for. *Practical Applied Mathematics* is a tour through all the useful techniques that we want our graduates to know interspersed with case studied from areas as diverse as modelling the dynamics of hair, electrostatic painting, piano tuning and incubating penguins eggs. Sam's delightfully personal style makes for very easy reading and his use of the wide margins to expand on the text is really an extension of the tutorial method.

Practical Applied Mathematics, Modelling, Analysis, Approximation by Sam Howison, Cambridge University Press. (2005) 0-521-84274-3.

The Oxford Murders

The Mathematical Institute in Oxford is the setting for a recent novel combining murder and mathematics in an exciting cocktail. In *The Oxford Murders*, mathematical symbols are the key to a mysterious sequence of murders. It seems that the serial killer can only be stopped if someone can crack the next symbol in the sequence. Oxford's eminent logic group plays a prominent role. The narrator, a south American mathematician, has come to Oxford to join "the famous seminars run by Angus Macintyre" (former professor of Logic in Oxford). Two other characters get their names from current mathematicians in Oxford: Inspector Wilkie and Merton's porter Brent.

It is no surprise to learn that the author of the book, Argentinean Guillermo Martínez, has a PhD in mathematics and has spent time as a visitor in the Mathematical Institute. His explanation of mathematical ideas and his evocation of the world of mathematicians have the smell of an insider. What is more surprising is how sensitively he uses the ideas. It would be all too easy to labour the connections between maths and murder but there is a lightness of touch in the way the themes are laid out in the book which made it a very easy read.

The fluidity of the narrative produced a strange tension whilst reading the book. Although the fast paced narrative compels one to gobble up the story, the mathematician in me wanted to hold back to try to crack the problem before I was told the solution. In the end the solution is of course surprising, unexpected yet perfectly logical and water-tight – just like the best bits of mathematics.
Marcus du Sautoy

The Oxford Murders by Guillermo Martínez, Abacus 2005, 0-349-11721-7