Oxford Mathematical Institute

Spring 2008, Number 6

Newsletter

We hope that you enjoy receiving this annual newsletter. We would be very interested to hear your views and comments and to receive contributions from any Oxford Alumni. Please write to
The Editor
Robin Wilson
MI Newsletter
Mathematical Institute
24–29 St Giles
Oxford OX1 3LB
or send e-mails to
The Editor, c/o
nims@maths.ox.ac.uk

Mathematical finance developments at Oxford

The Vice-Chancellor, John Hood (right) and Peter Clarke of the Man Group open the new Oxford-Man Institute of Quantitative Finance in September 2007. →
(Photograph © Rob Judges)

Over the past couple of years, Mathematical Finance at Oxford has undergone huge growth and has experienced much success, acknowledging the importance of the role of mathematics in the financial sector.

One of the recent developments is the MSc degree in Mathematical and Computational Finance, which was launched in 2007, with the aim of providing graduates with a strong mathematical grounding in the skills necessary to apply their expertise to the solution of real finance problems. The course provides an ideal platform for students to pursue further research or to develop a career in quantitative analysis. It has proved to be very popular and now offers teaching to a full cohort of 30 students.

The Mathematical and Computational Finance group has welcomed three new members of staff over the past two years, including Christoph Reisinger and Hanqing Jin. In January 2008, Professor Xunyu Zhou joined the Institute from the Chinese University of Hong Kong to take up the newly created position of Nomura Chair of Mathematical Finance. This represents an extension of the partnership between the University and Nomura, who already provide support for the Nomura Centre of Mathematical Finance.

The Mathematical Institute's links with financial institutions were further strengthened in September 2007 by the opening of the *Oxford-Man Institute of Quantitative Finance*. A joint venture between the Mathematical, Physical and Life Sciences and the Social Sciences Divisions and the Man Group plc, the world's largest hedge fund group, the new Institute was set up with £13.75m of funding and is intended to become the world's leading interdisciplinary academic institute for research in quantitative finance, with emphasis on alternative investments. ■

What is Marcus du Sautoy doing on a horse?
Find out on p.5

Professor Les Woods

Born 6 December 1922, died 15 April 2007; survived by 3 daughters and 3 wives

Les Woods had an extraordinary career which took him from fighter pilot to professor of applied mathematics at Oxford. His military service was as colourful as his academic life and, even when his scientific eminence had been recognised, he always relished his role as enfant terrible in matters of rank, class and dogma.

Born Leslie Woodhead, he was the son of a fearsome fisherman who lived near Auckland and his teenage years involved working in an abattoir, an abrupt conversion to atheism and the beginnings of a degree in mathematics at Auckland University College. Financial pressures and a role model led him to join the RNZAF in late 1941, which is when his bravery and irreverence were given free rein. His delight in unauthorised aerobatics led to confrontations with authority ensuring that, initially, he stayed firmly in New Zealand as an instructor. Even that was dangerous enough; once, when demoted to drogue-towing, a steep turn wrapped the tow-rope around the tailplane and only a last minute wire-cutting saved the day.

He married Gladys 'Betty' Bayley early in 1944 and, with offspring in mind, he changed his name to Woods, a decision he later regretted. Volunteering for active service, he flew nearly a hundred missions in Kittyhawks and Corsairs, many of them over the heavily defended port of Rabaul; his favourite escapade involved the realisation that a supposed Japanese submarine was a whale. Amazingly, all the while he worked, lecture-free, on his mathematics to the level of a 2nd class M.Sc. in 1944; Auckland University awarded him an honorary doctorate in 1983.

With his colourful background, Les Woods was astounded to be awarded, in 1947, a Rhodes Scholarship, for which married candidates were only eligible after military service. This enabled him to research computational aerodynamics with Alexander Thom in an engineering department then held in low regard in Oxford. Despite colossal culture shock, Les completed his D.Phil on control reversal in two years, annoyingly having to pay Merton College for the tuition he would have received had he been an ordinary undergraduate student. He almost missed his opportunity to indulge in low flying over Oxford when he firmly informed the Air Squadron's interview panel that his father's job was 'minding his own business'.

Les Woods was a justifiably proud applied mathematician whose fearlessly questioning and even impish approach made him a prophet and maverick of his times.

For Les the natural next step was a 1st class degree in mathematics in 1951, by which time he was father of five daughters, much to the astonishment of his more theoretical contemporaries. Then, after a brief but intellectually thrilling spell at the National Physical Laboratory, he took a Senior Lectureship at the University of Sydney, working under a colleague who, in Les's words 'found it hard to rise above his international status'. This led to a further move to the University of New South Wales, where he became a professor at the age of 33. This was Les's induction into high-level university politics and the battle between intellectual freedom and chains of command was one in which he passionately engaged forever after. More importantly, having published his brilliant text on the theory of subsonic planar flow in 1961, he realised well ahead of his time that the future of applied mathematics lay in its new frontiers. The modelling of ionised gases, or plasmas, was the perfect vehicle for his attentions.

The pivot of Les's career came during his sabbatical in Oxford in 1960 when he became embroiled with the plasma physics community at Harwell, shortly to move to Culham. This was a key factor in his decision to 'demote' himself to the engineering fellowship at Balliol College, where he stayed until it eventually became his home. This post provided a wonderful opportunity for Les's warmth and sense of fun to enthuse his students, graduate and undergraduate, many of whom followed glittering academic careers. However, more skirmishes with authority followed which, with the involvement of the equally bonhomous George Temple, led him to move to a Readership in the Mathematical Institute, of which he later became Chairman.

A final golden opportunity arose when the chair of Plasma Physics was willingly bequeathed to the Mathematics Faculty. Les's appointment to this post left him free as a bird, his world travels including a legendary depletion of Cornell's whisky supply and handsome reward from a so-called Institute for Advanced Salaries in Texas. Most importantly he

could throw all his modelling skills into the science behind the Tokamak with its promise of limitless clean energy.

The key question was how to confine the plasma for long enough for the fusion reaction to take place at a significant rate, when all the current experiments showed an unforeseen tendency for the ions and electrons to spread out from their initially toroidal paths. The traditional explanation blamed some kind of turbulence, a word often used to describe phenomena that are poorly understood. Les rightly believed that the confinement problem was nearly insuperable and, true to style, came up with a simple speculation which brought him head to head with an immensely powerful and wealthy scientific community. His ideas never survived peer review, and so they can only be found in his rather idiosyncratic text books. However, a layman's version appears in his wonderfully informative and entertaining autobiography, *Against the Tide*, an expurgated version of which was published in 2000 by the Institute of Physics only after two other famous publishing houses found it too cuttingly forthright. The book received a better review in *The Aeroplane* than in the physics literature, and it seems to have been ignored by the axiomatic applied mathematics community, against whom Les had also became embattled: he did not like 'rigour mortis'.

Les remained intensely active throughout his last decade, working especially on solar phenomena such as prominences and coronal heating.

Les Woods was a justifiably proud applied mathematician whose fearlessly questioning and even impish approach made him a prophet and maverick of his times. Alas, at a time when scepticism is most needed, modern scientific management in government laboratories and universities has all but exterminated it. ■

[This column was written by John Ockendon for *The Independent*, and is reproduced by kind permission.]

Mathematical Institute news

Nick Woodhouse *Chairman of the Mathematical Institute*

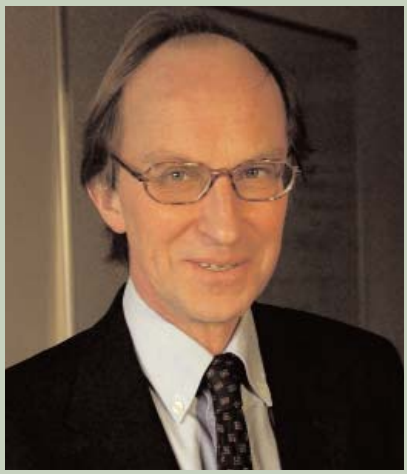
The past year has been an exciting and busy one for the Institute. Some significant new ventures have started up, and several new lecturers and professors have joined the faculty (see pages 6-7).

Oxford-Man Institute As you will see in this edition, we have received a major boost from our involvement in the new *Oxford–Man Institute of Quantitative Finance*, in close partnership with colleagues from the social sciences, engineering and computation (see p. 1).

Research Centre for PDEs We have also seen the launch of the *Oxford Centre for Nonlinear Partial Differential Equations*, led by Sir John Ball, and funded by a substantial grant under HEFCE's Science and Innovation initiative. The Centre will focus on the fundamental analysis of partial differential equations, and numerical algorithms for their solution, together with specific equations arising in areas as wide-ranging as geometry, relativity, finance, image analysis, learning processes and fluid mechanics, including geophysical, biological and polymeric flows. We were delighted to welcome back Bryce McLeod as a Visiting Professor to the Centre.

Graduate Taught Course Centre Another new departure has been the creation of the *Graduate Taught Course Centre*, which links the Institute with the mathematics departments at Bath, Bristol, Imperial and Warwick (see p. 7). The Centre delivers introductory lectures for research students, shared through access grid technology between the five departments. It allows us all to put on lectures in areas for which no one department would have the critical mass to make a course worthwhile. The lecturers can see and interact with their remote audiences, as well as with the local one.

Achievements The outstanding work of our faculty continues to be recognised through the award of numerous prizes,



Photograph © Rob Judges

Our plans for a new Mathematical Institute have progressed significantly ... We aim to begin construction of the new building early in 2009.

including the award of the London Mathematical Society's De Morgan Medal to Bryan Birch, a Friedrich Bessel Research Award to Ulrika Tillmann, an Open University honorary doctorate for Marcus du Sautoy, and the Royal Society's Hughes Medal to Artur Ekert. In the new year, we were delighted by the award of an OBE to Peter Neumann, for services to education.

New Mathematical Institute
Our plans for a new Mathematical Institute have progressed significantly in the past year with demolition on the Radcliffe Infirmary site about to begin. We aim to begin construction of the new building early in 2009. Fund-raising is progressing well, with the help of our volunteers and supporters. In particular, we were immensely grateful for the latest donation of £2m from the Wolfson Foundation. A progress report on the new building will appear in next year's *Newsletter*. ■

Marcus du Sautoy tells *The Story of Maths*

In the autumn of 2008 Marcus du Sautoy will present a landmark series for the BBC on the history of mathematics. Called '*THE STORY OF MATHS*'. The four one-hour TV programmes will take viewers from the pyramids of Egypt to the deserts of Arizona, and from the backwaters of Kerala to the suburbs of St Petersburg, in pursuit of where and how mathematics evolved over the last seven millennia.

Programme 1 covers the mathematics of the ancient world: Egypt, Mesopotamia and Greece, and shows how the Egyptians used early ideas of the calculus to calculate the volumes of pyramids. *Programme 2* takes viewers on a journey through the mathematics of the East, from China to India, and we discover that the Keralan school of mathematicians knew Leibniz's infinite series for π some centuries before its discovery in the West. *Programme 3* presents the mathematics of Europe from Descartes, via Euler, through to Riemann. *Programme 4* encompasses the mathematics of the modern era, from Hilbert and Cantor through to Perelman's proof of the Poincaré Conjecture.

The series is partly funded by the Open University and will be shown initially on BBC4. It forms part of Marcus's work as a Senior Media Fellow for the EPSRC. Combining stunning graphics with colourful locations, the series will bring alive the intellectual journey that has taken mathematicians from fractions to fractals, and from the circle to the hypersphere.

The Story of *The Story of Maths*

A personal view by Marcus du Sautoy

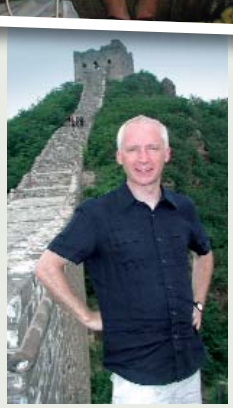
I didn't really know a lot about the history of my subject: I always believed that what matters most is the mathematics. If you know the theorems and the proofs, is it really important who created them, or in what circumstances? Certainly the way we are taught mathematics both in school and at university reinforces this ahistorical message. So you might think that, with such a mentality, I wouldn't be the ideal candidate to present a landmark series on the History of Maths for the BBC.

But in some ways I think that it's worked in my favour – the series has become a real journey of discovery for me. Uncovering quite how much the Ancient Egyptians and Mesopotamians knew about mathematics before the Ancient Greeks has been a revelation for someone brought up on the myth that it all started with Pythagoras. I was amazed to discover quite how much the Indian mathematicians of the medieval period knew about infinite series and pre-calculus. And visiting the places where Descartes, Fermat, Euler and Cantor grew up brought these characters alive for me in a way that I hope will come over on the screen.

The programmes pick up on this intellectual journey and mirror it with a real physical journey: the hope was to make something that looked like a cross between Michael Palin and *The Ascent of Man*. The programmes open with the story of the mathematics of Ancient Egypt and Babylon: Cairo and the pyramids provide an exotic location for the former. But unfortunately health and safety restrictions at the BBC stopped us from braving war-torn Iraq for the sake of mathematics. So Damascus, an outpost of the Babylonian empire, became our backdrop to talk about the mathematics hidden inside the clay tablets that have survived.

The second programme took us to the East and an exploration of Chinese and Indian

Uncovering quite how much the Ancient Egyptians and Mesopotamians knew about mathematics before the Ancient Greeks has been a revelation for someone brought up on the myth that it all started with Pythagoras.



Opposite: Marcus and film crew at the Egyptian pyramids; Marcus in Alexandria.

Left: Marcus and crew in Kerala.

Below, left to right: Marcus in Morocco, at the Great Wall of China, and at the temple in Gwalior.

...we scoured the inscriptions on the walls for the earliest known example of the number zero, one of the greatest and most revolutionary inventions made in India.

mathematics. One of the highlights for me was the pilgrimage to Gwalior to see a tiny little temple hanging off the side of a mountain fort. Big enough to fit the presenter and a cameraman inside, we scoured the inscriptions on the walls for the earliest known example of the number zero, one of the greatest and most revolutionary inventions made in India.

The mathematics of India found its way to Europe, via the spice routes through central Asia. Again health and safety denied us a trip to Iran to recreate the adventures of Omar Khayyam (the British sailors had not long before been released from captivity). So Morocco became our central Asian backdrop where we found some fantastic horses to ride across the Atlas mountains in my reincarnation of the great Persian poet and mathematician. (My director informed me afterwards that he'd decided to leave that reckless afternoon out of the health and safety report.)

Programme 3 and 4 took us to the colder climes of Europe and then on to the US: a town called Descartes; Fermat day in Beaumont-de-Lomagne, his home town; St Petersburg for the mighty Euler and the elusive Perelman; Göttingen for Gauss, Riemann and Hilbert; the Nervenklinik in Halle for the unsettled Cantor; the Paris café where Bourbaki began (now a fast-food burger joint); the Arizona desert to look for Julia Robinson's childhood haunts.

But if I had to pick out one location that excited me more than any other, it would have to be our one-day trip from St Petersburg to the grey city of Kaliningrad. This is the modern name for Königsberg, the home of the seven bridges that some see as the beginning of modern topology. The city was bombed heavily during the Second World War and today only three of the original bridges are left standing, while two of the others have been rebuilt – they now take a huge dual carriageway through the centre of the town. Despite the ugly nature of this modern city, I felt I was in a mathematical Disneyland. To be able to make the journey over the bridges to see if there is a path filled me with a childish excitement that my crew just couldn't understand. Of course with just the five existing bridges it is in fact possible to make the journey today, unlike the seven bridges that faced the earlier inhabitants of Königsberg.

My crew were only too pleased to leave behind the grim skyline of Kaliningrad, but for me it was one of the days out of the months of filming that I will always treasure. For me it encapsulated what this whole series is about, bringing alive the stories behind the amazing intellectual journey that mathematicians have made over the last seven millennia.

Leonhard Euler at 300

Last year marked the 300th anniversary of the birth of Leonhard Euler, the most prolific mathematician of all time. Euler laid the groundwork for so many areas studied by mathematicians today, ranging from the very 'pure' – the theory of numbers, the geometry of a circle and musical harmony – via such areas as infinite series, logarithms, the calculus and mechanics, to the practical – optics, astronomy, the motion of the Moon, the sailing of ships, and much else besides.

A number of anniversary events took place around the world, including a well-attended one-day meeting in the Oxford Mathematical Institute last June, organised by the British Society for the History of Mathematics and the Open University's Centre for the History of the Mathematical Sciences. Talks were given on his life and work and on his contributions to number theory, analysis, fluid dynamics, combinatorial mathematics and the popularisation of mathematics.

Appointments...

Prof Martin Bridson *(Imperial College London)* to the Whitehead Professorship of Pure Mathematics and a Fellowship at Magdalen College. *Research interests:* geometric group theory, low-dimensional topology, and the study of non-positively curved spaces.

Dr Yves Capdeboscq *(University of Versailles)* to a University Lecturership and a Fellowship at the Queen's College. *Research interests:* partial differential equations and numerical analysis, especially the characterisation of interactions between small and large scales.

Dr Paul Dellar *(Imperial College London)* to a University Lecturership in Applied Mathematics and a Fellowship at Corpus Christi College. *Research interests:* lattice Boltzmann methods.

Dr Cornelia Druțu *(Université de Lille)* to a University Lecturership in Topology and a Fellowship at Exeter College. *Research interests:* geometric group theory, topology and ergodic theory, with applications in number theory.

Dr Tamás Hausel *(University of Texas at Austin)* to a Royal Society University Research Fellowship, a University Lecturership in Pure Mathematics and a Fellowship at Wadham College. *Research interests:* the topology, geometry, global analysis and arithmetic of hyperkähler manifolds, with applications in mathematics and physics.

Dr Hanqing Jin *(National University of Singapore)* to a University Research Lecturership. *Research interests:* mathematical finance and applied stochastic analysis.

Dr Jochen Koenigsmann *(Max-Planck-Institut für Mathematik, Bonn)* to a University Lecturership in Mathematical Logic and a Fellowship at Lady Margaret Hall. *Research interests:* the arithmetic and model theory of fields, using methods from Galois cohomology, valuation theory, number theory, algebraic and arithmetic geometry, profinite group theory and representation theory.

Prof Dimitri Kramkov *(Carnegie Mellon University, Pittsburgh)* to a part-time post. *Research interests:* derivatives pricing, optimal investment and numerical and software implementations of financial algorithms.

Dr Christof Melcher *(Humboldt-University, Berlin)* to a University Lecturership in Pure Mathematics and a Fellowship at Lincoln College. *Research interests:* partial differential equations and multi-scale problems arising from questions in magnetism and materials science.

Prof Barbara Niethammer *(Institut für Mathematik, Berlin)* to a Readership in Applied Mathematics and a Fellowship at St Edmund Hall. *Research interests:* applied analysis, with a focus on the kinetics of phase transitions.

Dr James Oliver *(University of Nottingham)* to a University Research Lecturership. *Research interests:* fluid dynamics and its applications to free and moving boundary problems in industry, engineering and biology, with applications ranging in scale from ship slamming to cell mobility.

Dr Christoph Ortner *(Oxford University Computing Laboratory and Mathematical Institute)* to an RCUK Academic Fellowship in Solid Mechanics and the Mathematics of Solids and a Fellowship at Merton College. *Research interests:* the application of mathematical methods to material science, especially to atomistic models of solids and the mechanics fracture.

Dr Mason Porter *(California Institute of Technology)* to a University Lecturership in Applied Mathematics and a Fellowship at Somerville College. *Research interests:* non-linear Schrödinger equations and their application to Bose-Einstein condensation and optics.

Prof Oliver Riordan *(University of Cambridge)* to a University Lecturership in Discrete Mathematics and a Fellowship at St Edmund Hall. *Research interests:* random graphs, and in particular, 'scale-free' random graphs or 'web-graphs'.

Prof Gregory Seregin *(VA Steklov Mathematical Institute at St Petersburg)* to a University Lecturership in Pure Mathematics and a Fellowship at St Hilda's College. *Research interests:* partial differential equations, including analysis of the Navier-Stokes equations of incompressible fluid flow.

Dr James Sparks *(Harvard University, USA)* to a Royal Society University Research Fellowship. *Research interests:* mathematical and theoretical physics, in particular string theory and applications of differential geometry to physics.

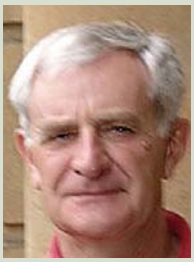
Dr Sarah Waters *(University of Nottingham)* to a University Lecturership in Applied Mathematics and a Fellowship at St Anne's College. *Research interests:* physiological fluid mechanics (cardiovascular, respiratory and urological flows) and the application of mathematics to medicine.

Dr Thomas Witelski *(Duke University, USA)* to a Readership in Applied Mathematics and a Fellowship at St Catherine's College. *Research interests:* non-linear partial differential equations associated with the free-surface flow of thin films of viscous fluids spreading on solid surfaces.

Prof Xunyu Zhou *(Chinese University of Hong Kong)* to the Nomura Professorship of Mathematical Finance and a Fellowship at St Hugh's College. *Research interests:* stochastic control, financial engineering and discrete-event manufacturing systems.

...and farewells

We are sorry to say goodbye to **Alan Day** (Hertford), **Glenys Luke** (St Hugh's) and **Hilary Ockendon** (Somerville), who retired last summer.



Alan Day

Glenys Luke

Hilary Ockendon

Alex Wilkie, FRS, Professor of Mathematical Logic, has left to take up the Fielden Chair of Pure Mathematics at the University of Manchester.

Alex Wilkie

Taught Course Centre

An innovative new project to enhance the training of Mathematics PhD students across the country

Professor Marc Lackenby led a successful bid to the EPSRC to establish a Taught Course Centre for the Mathematical Sciences, run jointly by Oxford, Warwick, Imperial, Bath and Bristol Universities. Dr Andrew Dancer has now taken over as Principal Investigator for this grant and coordinator for the Centre.

Lectures at the Centre began in October 2007, and in the autumn term approximately 120 students from the five universities took part. The Centre uses the latest interactive technology to allow advanced lectures for PhD students to be shared by all five universities. Video-link equipment in especially furnished lecture rooms allows lecturers to interact with audiences in real time. Regular event-days will also be arranged at each of the universities, the first of these (in number theory) taking place at Bristol in January. The portfolio of courses covers a broad range of mathematics, from pure to applied. Students are expected to take several courses annually, not just in their own specific subject area, but also in adjacent disciplines.

All five universities conduct outstanding research across pure and applied mathematics, and each one will contribute lectures and event-days in its particular areas of specialisation. By combining these strengths, we will be able to provide breadth of courses at the highest level, greatly enhancing existing collaborations between research groups in these universities, and inevitably creating new areas of interaction.

Our courses are open to all PhD students in the UK. Priority is given to EPSRC-funded students at the five universities, but lectures will be recorded and an electronic archive will be made available for all. The objective is to create a dramatic and lasting improvement to the training of PhD students in mathematics. Our goal is to educate the next generation of UK mathematicians, in order to maintain and enhance the UK's standing in the international mathematical community.

University of Oxford

University of Bristol

University of Bath

Imperial College London

The University of Warwick

EPSRC Engineering and Physical Sciences Research Council

Graham Higman

We regret to announce the recent death of Professor Graham Higman at the age of 91. A full obituary will appear in next year's *Newsletter*.

Stroking to victory in the Boat Race

Mathematics graduate student Will England stroked the Oxford crew to victory in this year's Boat Race. The first half of the race was tight but Oxford hit their rhythm after Hammersmith and the race was won with a beautiful piece of rowing along Chiswick Eyot. Will is in the first cohort of Oxford's new MSc in Mathematical and Computational Finance, having done his undergraduate degree at Princeton.

History of Mathematics at Oxford

Raymond Flood

In Michaelmas term 2002 a team of four, Raymond Flood, Peter Neumann, Jackie Stedall and Robin Wilson, presented a non-examinable lecture course in the history of mathematics. In the light of comments received we decided to offer an examinable course for the following academic year. This version, modified from year to year, is now in its fifth presentation, and about a dozen students take it each year. With Peter Neumann's imminent retirement, Benjamin Wardhaugh and Mark Thakkar have recently joined the teaching team.

The course is designed to provide the historical background to some of the mathematics familiar to students from A-level and the first four terms of undergraduate study, and looks at the period from 1600 to 1900. It comprises a 16-lecture course in Michaelmas Term, and a reading course of 8 extended seminars in Hilary Term. The course aims to provide an understanding of university mathematics in its historical context and an enriched understanding of the mathematical content of the topics covered, together with skills in:

Raymond Flood, Robin Wilson, Jackie Stedall and Peter Neumann

- historical analysis of primary source material;
- selective reading from a variety of secondary sources;
- efficient note-taking;
- writing well-argued essays (ranging in length from 800 to 3000 words);
- accurate referencing and construction of bibliographies;
- verbal presentation and discussion.

The mathematical topics whose history and development are covered are: the calculus up to Newton and Leibniz, mechanics, gravitation and Newton's *Principia*, the contributions of Euler, the development of probability, sequences and series, the need for rigour and the emergence of analysis, polynomial equations and groups, rings and fields, linear algebra, integration and complex analysis, foundational questions, and geometry.

While taking the lecture course students write six essays based around original mathematical extracts, and assessment is by a two-hour examination.

For the reading course students concentrate on a particular topic in much greater depth, reading original sources and analyzing their content, context, and significance. Various topics have been offered ranging from the history of number theory to the origins of group theory and from Newton's *Principia* to the history of Oxford mathematics. Each reading course is assessed by a 3000-word extended essay.

The course has been well received by the students, whose evaluation forms and comments indicate that it has given them a broader perspective and understanding of their mathematics, as well as helping them to write critically and analytically in a technical context.

Sudoku puzzle corner

Fill in the empty cells in the puzzle below, so that each of the nine letters below the puzzle appears just once in each row, column and 3 × 3 box, and a mathematical word will appear in one of the rows or columns: the hidden word may appear forwards or backwards, down or up.

I	E				A		R	
							P	
				P	L	A		
	C				I			
P				A				H
			E				S	
		L	H	E				
	R							
	S		R				E	C

A C E H I L P R S

***Solution to last year's puzzle*:**
POLYHEDRA (column 8 upwards)

Mathematical Institute Garden Parties

Nearly 200 alumni attended the Mathematical Institute Garden Party last June. The lectures were held in Lecture Room 2 of the Mathematical Institute, evoking fond memories among many of the alumni. There has recently been an explosive growth in mathematical modelling for biology and medicine, and Professors Philip Maini and Jon Chapman described several examples of current research in Oxford.

This year's event will take place on **Saturday 12 July**, with lectures at the Mathematical Institute, followed by the Garden Party at St Anne's. The theme is ***the Poincaré conjecture***, recently solved by Grigory Perelman, and accessible talks will be given by Professors **Marc Lackenby** and **John Ball**.