Oxford Mathematical Institute **Spring 2010, Number 8**

Newsletter

We hope that you enjoy receiving this annual Newsletter. We are interested to receive your comments, and also contributions for future Newsletters.

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A year of achievement

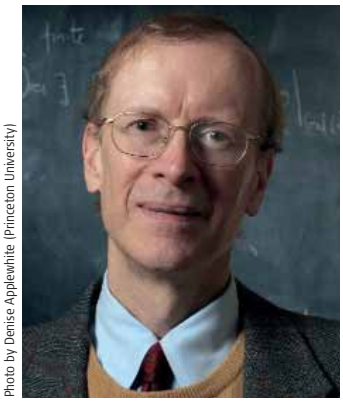


Photo by Rob Judges

Photo by Denise Applewhite (Princeton University)

Three mathematical knights: Sir John Ball, Sir Martin Taylor and Sir Andrew Wiles

Although Oxford mathematicians regularly receive national and international recognition for their wide-ranging achievements, this past year has been particularly successful. Among those most worthy of note are the following.

- Two distinguished number theorists are returning to Oxford, both to Merton College: **Sir Martin Taylor**, FRS, Vice-President of the Royal Society, has been appointed Warden of Merton from October 2010, and **Sir Andrew Wiles** has been appointed as a Royal Society 2010 Anniversary Research Professor at the Mathematical Institute from July 2011.

- The Royal Society has awarded its prestigious Sylvester Medal to **Sir John Ball**, Oxford's Sedleian Professor of Natural Philosophy, and its Michael Faraday Prize, the premier award for science communication in the UK, to **Marcus du Sautoy**, Simonyi Professor for the Public Understanding of Science.

- **Marcus du Sautoy** was also awarded an OBE in the New Year honours list, and received the 2010 Communications Award by the American Joint Policy Board for Mathematics for his contributions to the public understanding of mathematics.

- **Nick Trefethen**, Professor of Numerical Analysis, has been appointed President-elect of SIAM, the international Society for Industrial and Applied Mathematics.

- **Raphaël Rouquier**, Waynflete Professor of Pure Mathematics, has been awarded the Elie Cartan Prize by the French Academy of Sciences.

- **Sir Roger Penrose**, former Rouse Ball Professor of Applied Mathematics, shared this year's Trotter Prize at Texas A&M University, USA.

- **Endre Süli**, Professor of Numerical Analysis, has been elected a Foreign Member of the Serbian Academy of Sciences and Arts.

- This year the London Mathematical Society has awarded several of its prizes to Oxford mathematicians. **Roger Heath-Brown** (number theory) won the prestigious Pólya Prize, **Philip Maini** (mathematical biology) was awarded the Naylor Prize and Lectureship in Applied Mathematics, and a Whitehead Prize was presented to **Cornelia Drutu**.

- No fewer than six members of the Institute (**Roger Heath-Brown**, **Marc Lackenby**, **Philip Maini**, **Oliver Riordan**, **Gregory Seregin**, and **Xunyu Zhou**) have accepted invitations to speak at this summer's International Congress of Mathematicians in Hyderabad, India.

OCIAM comes of age

Hilary Ockendon
Emeritus Fellow of Somerville College

OCIAM members led by Alan Tayler (wearing tie) outside the Dartington House Common Room, Summer 1992.

Twenty-one years ago, in April 1989, a small group of applied mathematicians moved out of the Mathematical Institute and into Dartington House and OCIAM (Oxford Centre for Industrial & Applied Mathematics) was born. Alan Tayler was its first Director and he made a virtue out of this move by creating a centre with a great sense of identity and an unreasonably high worldwide reputation.

Mathematicians are traditionally fuelled by coffee, and coffee-time was, and still is, the pivotal daily event which cements the OCIAM spirit. Faculty (both current and emeritus), postdocs, visitors, and students all meet there to discuss an amazing range of topics from the most esoteric mathematics to when to hold the next party. Other regular events are the Friday Workshops (where problems from industry or other departments are subject to intense discussion), the Thursday seminar on 'Differential Equations and Applications' and the Junior Applied Mathematics Seminars (to which no faculty are allowed) which have been held fortnightly in term time since at least 1992.

OCIAM was created on the back of the success of the Study Groups with Industry that were started in Oxford in 1968; these meetings now happen annually in at least eleven countries and a deputation from OCIAM will attend many of them. The stream of problems from industry that require mathematical attention shows no sign of drying up, but there are now many more areas where maths is being applied.

Perhaps the most dramatic story is the growth of mathematical finance which developed gradually within OCIAM and is now an independent research group in Mathematical and Computational Finance. This Centre, which was originally set up by Sam Howison (see page 5), now contains eleven faculty members and is comparable in size to OCIAM. If OCIAM is the 'parent' centre which nurtures new applications in their youth, then Mathematical Finance is the first child to have grown up and left home – but there are others, such as the Mathematical Geoscience Group and the Applied Dynamical Systems Group, which are growing up fast and may soon want to spread their wings. Mathematics for Medicine has become a big part of what OCIAM does and much of this work is in collaboration with its older sister, the Centre for Mathematical Biology. Both Centres are now based in Dartington House and postdocs regularly move from one to the other. And then there is the precocious child OCCAM (Oxford Collaborative Centre for Applied Mathematics) which found a generous benefactor in the King Abdullah University of Science and Technology in Saudi Arabia and left home rather abruptly. Fortunately, OCCAM is based just up the road and a new grown-up relationship between it and its parent is developing.

Photo by Peter Hudston

OCIAM members today.

OCIAM has had 4 Directors – or 5, if you count John Ockendon's tenure of the post for 25 minutes before he resigned over a room allocation issue! (The issue was subsequently resolved and Hilary Ockendon stepped into the Director's shoes while John became Research Director). The current Director, Jon Chapman, was one of the first students in OCIAM and also held a Research Fellowship there, so he is well imbued with the OCIAM spirit. However, OCIAM has recently gained five new faculty appointments, and benign influences from Caltech, Munich, Nottingham, and Cambridge are beginning to be felt.

Alan Tayler died in 1995, but he would have been pleased to see how OCIAM has developed since then. The basic principles that he laid down – to do collaborative research, to train students, and to act as a global focus for industrial mathematics – still hold good and the future of OCIAM seems assured. ■

Mathematical Institute news

Nick Woodhouse *Chairman of the Mathematical Institute*

Where is the new building? More has happened over the past year or so than is apparent from a casual glance at the now empty space between the old Radcliffe infirmary building and the Tower of the Winds. As work on the design has continued, there have been detailed discussions with the City of Oxford and with English Heritage. The latter have a strong interest in the project because of the site's very sensitive location between two listed buildings. The process has been frustrating at times, but we all recognise the need to satisfy the intricate constraints on a building that must meet the needs of the Oxford mathematics community, and also be conspicuous to visitors to Oxford in marking the gateway to University territory as they travel down the Woodstock Road towards St Giles. The Institute has been given a fantastic site, but it is one on which many eyes are focussed.

It has been a long process with some false starts, but we are now optimistic that the project is moving forward. The site has been cleared and levelled ready for construction to begin. In November, a formal planning application was submitted that seems likely to be supported by the City's officers; we hope to have a positive outcome soon. Then we move to RIBA 'stage F', which involves detailed technical design work and negotiations with contractors.

All this is happening in the context of an increasingly chilly climate for the funding of higher education, and concern about what may happen after the election. Oxford is in a stronger financial position than many UK universities, not least because of its income from the University Press. But it is not immune. While the new Mathematical Institute building heads the University's list of capital priorities (along with the New Bodleian), it has become more important than ever to raise external funding for the project to

match the University's own contribution. We've had some generous gifts already and the development campaign will gather pace over the coming months. Your support will be important in helping us to achieve our goals. You can find out more by visiting *www.maths.ox.ac.uk/giving* or the University's *Oxford Thinking* page at *www.ox.ac.uk/campaign*.

That aside, much else has happened over the past year, as outlined on page 1. These achievements represent an extraordinary recognition of the strength and breadth of mathematical research in Oxford. ■

Numerical Analysis on the move

Andy Wathen *Reader in Numerical Analysis*

There are plans and then there's planning! For several years it was planned to move the Numerical Analysis research group from the Computing Lab to the Maths Institute; the natural time for this move would have been the opening of the planned new Mathematics building on the Radcliffe site, but even the best laid plans...

So, with the Division and the University wanting us to move, the Mathematics Department keen to welcome us, and the Computing Laboratory expecting to take over our accommodation on Keble Road for their ever-expanding IT research, plans were hatched for a temporary move of offices to coincide with the group's permanent move to the Mathematics Department. There being no available space in any existing Maths building, new locations were considered: above the 24-hour chemist was too small, and the bottom floor of the Gibson Building was still occupied by temporarily displaced Ashmolean staff, but the 'bus stop' was big enough and available!

So in 0th week of Michaelmas term the research group bade farewell to the Computing Lab and moved administratively to the Maths Department and physically to 3 Worcester Street, right next to the Gloucester Green bus station – hence the 'bus stop'. The move went remarkably smoothly and we were up and running again very quickly. It's still variable as to whether you're offered 'Cityline' or 'London Tube' as well as 'maths' when connecting to the wifi – it depends which buses have pulled up at the back – but most aspects of our environment are positive!

Photo by Jo Leggett

Alas, having taken over this space from the University's Refugee Studies unit – now in a purpose-built permanent home – we're contemplating a further physical move at the end of this academic year to the recently vacated ground floor of the Gibson Building (where we will at least be nearer to some of our mathematical colleagues). Eventually our nomadic status should end and we'll be part of the great Mathematics unification on the Radcliffe site – we look forward to this as much as any! ■

Professor Bryan Birch, FRS

interviewed by Helen Carasso

Bryan Birch, Emeritus Fellow of Brasenose College, taught at Oxford from 1966 to 1998 and was appointed Professor of Arithmetic in 1978. A distinguished number theorist, he was awarded the London Mathematical Society's De Morgan Medal in 2007.

Not only is Bryan Birch a Pure Mathematician, but he is also a pure mathematician – someone so inspired by the subject that it has been the focus of his interest for over 60 years. And that interest is about much more than simply studying what others have done before:
I realised quite quickly that it is inappropriate to 'learn' mathematics; mathematics is about proof, which means a proper understanding of reasons for its propositions to be true.

When it came to applying to university, Trinity College Cambridge was the natural choice. At age 8, by which time he already aspired to be a mathematician, he had sought advice on what he needed to do in order to follow this career, and was told that he must 'become a Fellow of Trinity'. Although the young schoolboy was not entirely sure what this meant, he gradually found out and went on to win an undergraduate scholarship there.

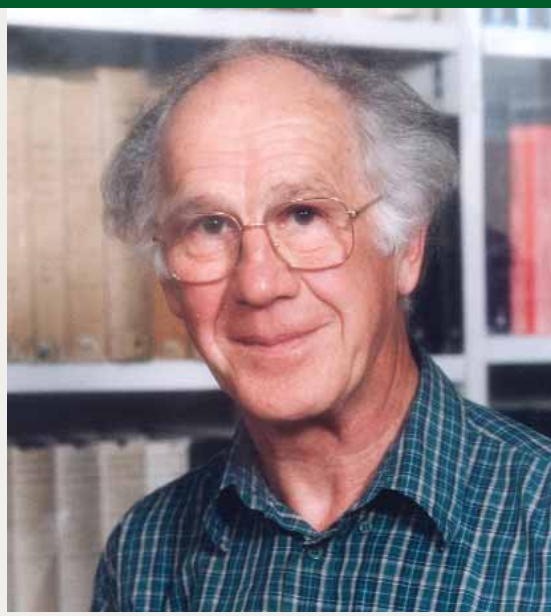
Bryan quickly identified a passion for number theory, completing his doctorate on the geometry of numbers under the supervision of J. W. S. Cassels, three years after completing his BA. On the strength of this he was elected to a Trinity Prize Fellowship, thus achieving his childhood ambition at the age of just 25. A year's postdoc at Princeton followed, before he returned to Cambridge as a Fellow of Churchill College.

From Cambridge, Bryan moved to Manchester, where he remained until joining Oxford as a Reader at Brasenose College in 1966. Of the two collegiate universities he notes:
It has been traditional in Cambridge for the applied mathematicians and the pure mathematicians not to talk to one another... in Oxford the Institute is a single department of mathematics, and it is important to us that there are no clear divisions between different branches of the subject.

Twelve years after his move to Oxford, his work was recognised by an *ad hominem* professorship – for which he chose the title 'Professor of Arithmetic', partly in homage to Cassels who'd chosen the title 'Reader in Arithmetic' years earlier. It was a particular pleasure to Bryan that on his retirement his post was replaced by an established chair in mathematics to which Roger Heath-Brown was elected.

It was in his student years in Cambridge, though, that Bryan Birch met and collaborated with the colleague with whom he was to conduct the work for which he is best known today. Peter Swinnerton-Dyer had been involved in the Computing Laboratory in Cambridge from its earliest days, and the two mathematicians realised that they could put this new resource to work to increase their understanding of elliptic curves – testing for any correlation between the local behaviour (over finite fields) and the global behaviour (over the rational numbers).

They found a precise correspondence that could be formulated in terms of the zeta functions of the curves, and from these results went on to formulate the *Birch–Swinnerton-Dyer* conjecture, which remains his proudest career achievement; although it is known to hold true in many specific cases, it remains unproved, 45 years after it was first formally stated. (In 2000, the Clay Mathematics Institute



in Cambridge, USA, selected this conjecture as one of its seven 'millennium problems', offering a $1m prize for its solution.) This important work also symbolises the role that computers were increasingly to play in enabling number theorists to address new types of problems that were, according to Bryan, 'inconceivable' to earlier generations of mathematicians.

There's no doubt that Bryan Birch takes great delight in this work for its own sake, but he was also aware of a wider significance:
At that time, there was practically nothing known about the analytic theory of such functions, so we had to find out everything for ourselves. There turned out to be an incredibly beautiful theory that is still incomplete. We had the joy of working in a completely fresh area of beautiful mathematics, so beautiful that it was certain to be important.

Over the half-century in which he has worked in this field, its applications have become increasingly significant in our everyday lives – whether incorporating security into on-line banking systems or protecting the digital signals on which mobile phones depend. But we have access to such developments only because, for decades, number theorists such as Bryan Birch pursued their subject for its interest and beauty alone, relishing the challenges of the tough mathematical problems involved. ■

Interview with/by Professor Sam Howison

The Editor asked Sam Howison, Vice-Chairman of the Mathematical Institute, to arrange to be interviewed for the *Newsletter*. One thing intervened, then another, so that he (SH) ended up interviewing himself (SDH):

SH: Thank you for talking with me today...

SDH: Sorry to interrupt, but do you often talk to yourself?

SH: As a matter of fact I do sometimes, when I'm working. If I'm trying to pin down an elusive mathematical argument it sometimes helps to ask myself questions out loud. There's something about the physicality of speaking aloud, perhaps that it is a single voice demanding answers, that makes me focus. Anyway, *I'm* asking the questions. While we're on the subject, what else do you find helps your research?

SDH: Walking definitely does something to loosen the brain – and sleeping on a problem often helps. I don't think you can just dip into a problem and expect to make progress: you won't get anywhere unless you live with it and worry about it. Walking is perfect for the conscious part of that process and sleeping for the unconscious part. The other thing that really helps is to discuss things with another person, and I am very lucky to have such an open-minded and talented set of colleagues to do this with.

SH: What are you working on at the moment?

SDH: Various things. One's a game theory problem from economics, a simple model for competition between two agents who produce a good and sell it into a market. The mathematical upshot is a pair of horrible nonlinear partial differential equations which are resisting most attempts to solve them. It's a struggle, but my economist co-author thinks it's worth it. I'm also working on a model for carbon emissions markets.

SH: Sounds interesting. What's the punchline?

SDH: Most models in finance assume that your own trading doesn't affect the price, or if it does then the impact is small. The whole point of the cap-and-trade approach is that the cost of carbon is meant to affect what people do, through the price of permits to produce CO_2. This feedback makes the problem nonlinear, and more difficult to solve.

SH: Speaking of research, you were on the RAE panel. What was that like?

SDH: The Research Assessment Exercise was the process whereby panels of experts were asked to assess research submitted by all the universities in Britain. I was on the applied maths panel and it involved many meetings and a hell of a lot of reading: the photo shows it all before it went to the shredder when I'd finished. The process was interesting but exhausting as it all had to be done quite quickly. I learned a lot but I signed such fierce confidentiality agreements that I can't tell you anything about it, or HEFCE will send the Dementors after me!

SH: What do you like best about your job?

SDH: It's a brilliant job, working in one of the best maths departments in the world. We have wonderful students and colleagues, and a fantastic support staff. When I'm doing research, that's the best thing; when I'm teaching, that becomes the best; and when I'm administrating, research and teaching are both the best.

SH: Do you think mathematics has a future as well as a past?

Photo by Ruth Preston

Sam Howison with papers for the 2008 Research Assessment Exercise.

SDH: Glib answer: yes, or I wouldn't be doing it. (I have to say that!) We certainly have a glorious past: tell me another discipline where work done nearly 2500 years ago is still fresh and alive and taught to undergraduates. Oh, all right then, philosophy. But as for the future, the computer has changed everything. All sorts of scientists can formulate problems in mathematical terms and hope to make progress. So I see openings for mathematics everywhere, from engineering to criminology and from finance to geology. Some of these areas will need mathematics that hasn't yet been developed. There's a lot more to come yet.

SH: Sam Howison, thank you very much. ■

Appointments...

Gui-Qiang G. Chen (*Northwestern University, USA*) to a University Professorship in the Analysis of Partial Differential Equations and a Fellowship at Keble College. *Research interests:* PDEs, non-linear analysis, and their connections with other areas of mathematics and the sciences.

Alain Goriely (*University of Arizona*) to the Professorship of Mathematical Modelling and a Fellowship at St Catherine's College. *Research interests:* mathematical modelling of physical, biological, and engineering systems, non-linear dynamics, integrability theory, and solid mechanics.

Colin Macdonald (*UCLA, USA*) to a University Lecturership in Numerical Methodologies and a Fellowship at Oriel College. *Research interests:* numerical analysis, scientific computing, numerical solutions of PDEs on general surfaces, and time stepping.

Jonathan Pila (*University of Bristol*) to a Readership in Mathematical Logic and a Fellowship at Wolfson College. *Research interests:* model-theoretic methods in diophantine problems.

Holger Wendland (*University of Sussex*) to a University Lecturership in Numerical Analysis and a Fellowship at Exeter College. *Research interests:* numerical analysis and scientific computing, mesh-free methods for PDEs, radial basis functions, and fluid-structure-interaction.

Thaleia Zariphopoulou (*University of Texas, USA*) to the Man Professorship of Quantitative Finance and a Studentship at Christ Church. *Research interests:* quantitative finance, portfolio management, and stochastic optimisation.

...and farewells

We're sorry to say goodbye to **Brian Stewart** (Exeter), former Chairman of the Maths Faculty and Faculty Teaching Adviser, and **Robin Wilson** (Keble), Editor of this *Newsletter*, who 'retired' last summer; Brian continues to give lectures in the Institute and Robin is now teaching for Pembroke College. We're also sorry to say goodbye to **Piotr Chruściel**, who has left to take up a Chair in Vienna.

MSc in Mathematical Finance

The MSc in Mathematical Finance programme is structured to allow those working full-time to develop expertise in mathematical finance without compromising their professional work. The course covers all the areas of mathematical finance currently deployed in financial institutions, and also enables students to focus on topics most relevant to them. The course has been revised and restructured in the wake of the global financial crisis, and there is a new module specifically on quantitative risk management. In addition to presenting classical risk management tools, it scrutinises currently employed methodologies on the backdrop of recent risk management failures, and proposes new directions.

Being a Postgraduate and a Junior Research Fellow

David Craven, *Junior Research Fellow at Christ Church, and formerly a graduate student at St John's College*

The life of an Oxford postgraduate consists of being snowed under with work during term, and having long weeks with nothing very important to do in the vacations. During term there are seminars to attend, tutorials to give, work to mark, and supervisions with your doctoral adviser, as well as the social side, with the myriad college events and functions that mark Oxbridge out from other universities. Outside term, nothing.

When you start a D.Phil., the numbers involved are too large to understand fully: you have 36 or more months to write a thesis of 100–200 pages, and you'll have to read many hundreds of pages of articles and books before you can even start research on a subject about which you probably understand only the title. It can become a little demoralizing at the end of your first year, having spent many hours reading and, while understanding more, feeling no closer to actually doing research – and research is what being a

postgraduate is supposed to be about. By the end of your second year, you're usually well on your way to having at least some idea what you are doing, and the title of your thesis at least might be more specific, even if there's nothing to go into the thesis itself; mine started out as *A topic in representation theory*, for example.

The third year is largely spent writing the thesis, and the fourth year rewriting it. With the Research Councils' acknowledgement that doctoral studies are taking longer (and an increase of funding to 3½ years), the time when you have to decide whether you need to eat or stay warm has been consequently pushed back.

If being a D.Phil. student is like tightrope walking, then being a Junior Research Fellow is like having the safety net removed. As a student you have a supervisor who can guide your endeavours to something more fruitful; if you don't fall off the tightrope then everything is fine. As a JRF, the elephant in the room is that you are on your own, rather than having a postdoctoral position and working on a project with others. When crossing from postgrad to JRF, which can take place in a single day, you go from not being expected to know very much to being assumed to have expert knowledge in several fields.

Apart from getting paid more, there's little difference between being a postgraduate and a JRF. You attend the same seminars – though you're expected to nod sagely more often – there are still papers to read and tutorials to give (if you want to), more travelling to present seminars and attend conferences, and college functions to attend, but these are more 'civilised'. This job is constantly varying, intensely challenging, involves 'arduous' foreign travel, allows you to set your own holidays, and be your own boss. It's an amazing experience. ■

Claire Taylor, MBE, cricketer

Photo © Getty Images

Claire Taylor studied mathematics at The Queen's College, but is now renowned as an international cricketer. Here she describes a typical day from the past exciting year.

I'm a management consultant for an organisation called SUMS Consulting, based at Reading University. We work exclusively within the higher education sector on the administrative aspects of running universities. The work is project based and could vary from looking at provision of occupational health services to optimising academic teaching timetables. Although I do a fair amount of benchmarking for my projects and those of colleagues, I wouldn't say I use any of the maths that I learnt at Oxford. What's more important to me is the ability to analyse a situation, find solutions, and appraise those solutions.

I work on a part-time basis, so depending on what sort of training commitments I have on a particular day, I'll work until 3 or 4 p.m. and then head off for training. Once a week, I go to Guildford for an indoor net session with the England Women's Cricket Coach. This is the most important hour and a half of my week. To prepare, I'll do some physical fitness work first: maybe a run alongside the Basingstoke Canal or the River Wey, or some sprint drills indoors, depending on the weather. The net session is divided into three sections. First some technical work, building on previous sessions to correct a weakness or practise a new shot. Then on to some tactical practice to fit the new skill into my game plan. The last half of the session is spent on game scenarios. This piece of the puzzle is one of the things I enjoy most about cricket. How are we going to win the game from here?

It all became real in the semi-final of the Twenty20 World Cup at the Oval in June 2009. Australia had made 164 and England were 43-2 in the 7th over. I was batting with Beth Morgan and we had a daunting run chase on our hands. The time I'd spent in the nets working on hitting 10 runs an over, the physical work I'd done to ensure that I could cope with the running, and the visualisation of fielders all came to fruition as England secured an 8-wicket victory and a place in the final at Lord's against New Zealand.

It's been an amazing year for the team and me; two World Cup wins, International Player of the Year and Wisden Cricketer of the Year accolades and, to top it all, the honour of an MBE. ■

MP40 – the 40th Anniversary of Maths and Philosophy

Helen Carasso, *St Anne's 1976*

It was a strange feeling when, in early 2008, I found myself sitting around a table with three senior academics (Hilary Priestley, Dan Isaacson and Jochen Koenigsmann) as a member of the planning committee for the 40th anniversary celebrations of Oxford's Mathematics and Philosophy degree, particularly as two of them taught on the course when I was an undergraduate in the 1970s. Although I'd been asked to join this esteemed group as I've spent most of my working life in communications and public relations, I was also there to represent the alumni contingent, so found myself wearing two metaphorical hats.

While the academic members of our small group were agreeing the briefing for the main speakers – the first two holders of the Chair of Mathematical Logic, Dana Scott and Angus Macintyre – and the programme of lectures that alumni would be giving on the second day of the reunion event, I was exploring the University archives to establish the background to the launch of the Maths Philosophy degree from a mass of microfiched committee papers, handwritten notes and extracts from the *University Gazette*.

As our MP40 celebrations on 4/5 July 2009 were planned to dovetail with the annual Mathematics Garden Party, we needed to coordinate our activities with our colleagues at the Maths Institute. Another priority was to contact as many Maths Philosophy graduates as possible and encourage them to spread the word to any colleagues no longer in touch with the University.

Photo by Daniel Drury

By the weekend itself, more than 60 Maths Philosophers – former students and current and past staff – had joined our celebrations to mark 40 years of a degree that can trace its epistemological roots back to ancient times. Every decade of our course was represented – including some of the first Maths Philosophy undergraduates and tutors from the late 1960s. There was perhaps a nostalgic feeling of slight superiority when some mathematicians with whom we shared the Saturday afternoon lectures were left puzzled by Dana Scott's explanation of some recent thinking on the role of lattices in the understanding of logical theories and Angus Macintyre's explanation of how the logic of exponentiation became understood, but we were all quickly back on the same wavelength again at the tea that followed!

By the evening our MP40 celebrations 'proper' were well under way – and we were delighted to have all three holders of the Chair of Mathematical Logic dining with early Oxford advocates for establishing the course, graduates from the academic world and beyond, and tutors whose commitment to Maths and Philosophy has enabled the course to grow over the years to the point where it is now firmly established at the University. With reminiscences to be shared and recent news to exchange over dinner, academic discussions were saved for the lectures in the Philosophy Faculty the following day. Whatever the routes each of us had taken since reading Mathematics and Philosophy, there was a strong shared tradition of reason, rationality and lively inquiry to be found among us all. Here's to MP50!

Photo by Daniel Drury

Mathematical Institute Garden Parties

Last year's Mathematical Institute Garden Party was held at St Anne's, and was preceded by lectures on *Lattices and logic* by Prof. Dana Scott, and *How the logic of exponentiation became understood* by Prof. Angus Macintyre, as part of the MP40 event (see left).

This year's event will take place on **Saturday 17th July**, with lectures at 4 pm in the Martin Wood Lecture Theatre, Clarendon Building, followed by the Garden Party at St Anne's. The lectures will be given by Professors Chris Budd on *Maths in and out of the zoo* and Paul Bressloff on *The mathematics of visual hallucinations*.

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.

O								X
N		Y				I	V	O
					X		N	
		T	I					Y
			C		T			
X					O	E		
	O		V					
Y	N	V				T		C
E								N

C E I N O T V X Y

***Solution to last year's puzzle*:**
ALGORITHM (row 3 backwards)