



LMS 150TH ANNIVERSARY
MATHEMATICS FESTIVAL AT THE LONDON SCIENCE MUSEUM
What's your Angle? Uncovering Maths

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SOCIETY MEETINGS AND EVENTS

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- 21–25 March: LMS Invited Lectures, Loughborough
- 8 July: Graduate Student Meeting, London
- 8 July: Society Meeting, London
- 21 July: Society Meeting at the 7ECM, Berlin
- 11 November: Graduate Student Meeting, London
- 11 November: Annual General Meeting, London
- 20 December: South West & South Wales Regional Meeting, Bath

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At the end of November, the London Mathematical Society collaborated with the Science Museum, the interactive theatre company *non zero one*, and a number of UK university research groups to create an immersive mathematics Festival titled *What's Your Angle? Uncovering Maths*.

The Festival took place between 25 and 29 November 2015 in the Science Museum's Wellcome Wing Basement Gallery. The four-day event – featuring a talk by Sir Roger Penrose and a screening of a documentary by Heidi Morstang – a schools day, and two public days. Over 1,600 people in total visited.

Visitors were tasked with assuming the role of a fictional undercover NEWS-A-RAMA! jour-

nalist and navigating a range of real-world scenarios to discover the many fascinating ways in which mathematics relates to everyday modern life. The scenarios were brought to life by mathematics researchers from a variety of UK universities and actors dressed as track athletes, oceanographers, archaeologists, government intelligence officers and dairy farmers – all talking about how they use mathematics in their lines of work.

Following an induction from the NEWS-A-RAMA! boss in the 'Briefing Room', each undercover journalist was sent on four fact-finding missions, during which they had to gather as much mathematical information as they could from the actors and researchers and record it all in their notebooks. They then had to take

their notes to an editors' desk, flesh out a news story, and at the end give a news interview – in a convincingly-styled newsroom – based on what they'd learnt. The news interviews were streamed live into a media station at the centre of the room for all to see.

The Festival's principal aim was to demonstrate that mathematics is everywhere and for everyone, and therein challenge the common perception of



Simon Tavaré introducing Roger Penrose

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mathematics as esoteric. Above all, the Society and museum wanted each visitor to leave with the knowledge that mathematics is relevant, fun, and with a particular nod to the visiting school students, capable of opening doors to a wide range of fulfilling careers.

Postgraduate mathematicians from across the UK provided the content through the event in the form of eight research groups that demonstrated the mathematics behind each undercover scenario. The Society would like to extend its particular thanks and gratitude to those teams: from the University of Brighton, the University of Cambridge, University College London, the University of Essex, the University of Kent, King's College London, the University of Liverpool, the Open University and the University of Surrey.

Speaking to the LMS after the event, Mareika Haberichter, from the University of Kent, said, 'We had an amazing weekend at the immersive LMS Festival at the Science Museum. We designed interactive activities to engage the public with our research in solitons as they went undercover at Coral Beach Surf School. Solitons are a unique type of wave and a specialism of many mathematics lecturers at Kent. These waves can travel for great distances without slowing down or changing their shape.'

'We appreciated the opportunity to pitch our research to such a broad audience ranging from

school students to academics. It was fascinating to see the broad spectrum of research presented at the Festival. We were also very impressed by the smooth organisation of such a major event and the helpfulness and enthusiasm of everyone involved. The combination of art and mathematics gave it a new twist, bringing maths to life in an engaging way'.

Philip Aston, from the University of Surrey, expressed a similar view, saying, 'As a mathematician I thought that the Mathematics Festival at the Science Museum was a great opportunity to showcase some of the work that mathematicians do and how their work can have an impact on all our lives.'

'Our exhibit allowed participants to see their dynamic cardiomorph that we generated and displayed on the TV screens from their own cardiac data. The cardiomorph is a bit like a 'selfie of the heart', which uses all the data (in contrast to many other methods) and has the potential for diagnosing a range of heart conditions, including septic shock which currently results in 37,000 deaths in the UK each year.'

'There was a real buzz down in the basement and we certainly enjoyed talking about our work. It was fascinating to see some of the feedback in the TV interviews at the end as well'.

The NEWS-A-RAMA! theme was particularly popular, both with the research groups and the visitors. Anonymous comments left by members of the public were unanimously positive, including 'It was great to see how maths applies to real world situations', 'My favourite thing was seeing how maths is in everything', 'Maths gets a 10/10 from me', and 'I think I fancy becoming a mathematician now!'

Anna Lambert, of the UCL Fluid Dynamics group, also thought the theme was apt, commenting, 'The news concept really made it work – seeing kids



The NEWS-A-RAMA! briefing room, where visitors were told of their role and given their task before entering the exhibition



Fluid dynamics research was used to solve the problem of a wobbly Millennium Bridge (demonstrated here by the UCL group led by Anna Lambert)

(known as quasicrystals) in the early 1980s. It is particularly well suited for public engagement, due to the visual appeal of the subject and the possibility to explain non-trivial mathematics in terms of intuitive concepts around tilings and patterns.

'The LMS's 150th anniversary Festival at the Science Museum was a fantastic opportunity to bring this fascinating topic to the attention of the public, and give them the opportunity to engage in hands-on activities, exploring its intricate features'.

talk about difficult mathematical concepts on TV and getting it right was incredible. It was great fun working with the Science Museum and *non zero one* to develop our idea. The best bit for us was seeing the public excitedly explaining our work on TV - and getting it all right!

'We found that people were really intrigued by how mathematical ideas like resonant frequency and synchronisation help explain important phenomena like the oscillation of the Millennium and Tacoma Narrows bridges. Bringing modern mathematical research to the general public was the perfect way to celebrate the 150th birthday of the LMS'.

A number of researchers and visitors were also impressed by the breadth and quality of research presented, saying it helped both to maintain the interest of the visitors as well as get the main point across that mathematics is ubiquitous in modern life. In addition to cardio-morphs, waves and solitons, and fluid dynamics, the subjects on offer ranged from aperiodic tiling, speech modelling, fractals and pendulums, GPS and triangulation, and damaged spines and tissue development.

Uwe Grimm, a researcher from the Open University's aperiodic tiling group, said, 'The theory of aperiodic order is a relatively recent area of contemporary mathematics, which was inspired by mathematical inventions such as Roger Penrose's famous tiling in the 1970s as well as by the discovery of aperiodically ordered materials

Simon Tavaré, President of the LMS, noted that Sir Roger's fascinating talk was given on the day of the 100th anniversary of the publication of Einstein's work on general relativity.

John Hunter, from the theatre company *non zero one*, said, 'It has been great to make another Festival at the Science Museum. Once again we've enjoyed learning a lot, this time with the LMS, who have generously and enthusiastically thought about how to communicate a wide range of UK mathematics to the Science Museum audience. Can solitons be accessible to nine year-olds? The number of news broadcasts on N24 (the Festival's news channel) talking about "waves that go on and on" would suggest they can! The same goes for the work of all the groups - it was fantastic for us to see the level of engagement so high across the board'.

Will Hunter, project lead at the Science Museum, also wished to thank the Society for its involvement, adding, 'This Festival has been a fantastic experience for me and I've learnt a great deal along the way. Through my public engagement work I'd never had the opportunity to use mathematics or, in fact, work with such a broad set of research groups so it was very rewarding. Our feedback has been amazing and being able to see the public spend such extended periods of time engaging with maths was such a great experience. I want to thank the London Mathematical Society for giving us the opportunity to produce this Festival'.

RETIRING MEMBERS OF COUNCIL

TERRY LYONS (President)

After serving as President for two years, Professor Terry Lyons, FRS, handed over the badge of office at the AGM on 13 November 2015. Prior to taking up office, Professor Lyons had a long history of service with the Society. He had served as Vice-President from 2000 to 2002. Other service included being an Editor and serving as a member of both the Programme Committee and the Publications Committee. Professor Lyons is a well-respected member of the mathematical community and his drive and efforts across the Society's wide remit of activities have been enormously valuable in helping the Society to deliver its planned objectives and to develop new directions.

President Professor Lyons has been active in promoting an appreciation of mathematics and mathematicians to our culture and society and has helped the translation of that understanding into actions and support that build the mathematics for tomorrow.

Over the past two years, Professor Lyons has been instrumental in guiding the Society through a very important time in its history, namely the 150th Anniversary celebrations, which took place in 2015. During the year, Professor Lyons used the focus of the celebrations as a tool to create momentum for mathematics. The 150th Anniversary of the Society has provided many opportunities to stimulate interest and justified respect for mathematics, and with Professor Lyons' belief that mathematics has an impact on everyday life in many unexpected ways he has directed the Society, with its incredible tradition and a membership that includes so many creative mathematical scientists, with vision and foresight.

Professor Lyons has held the office of President during an incredibly busy and successful period in the Society's history, supporting research, creating awareness, influencing research and education policy and funding for mathematical sciences in the UK. He has put in place a legacy develop-

ment programme to build an influential network of supporters and to raise funds for the Society to meet its charitable aims and serve UK mathematics more generally. There continues to be challenges for mathematical sciences research policy in the UK. During his tenure, Professor Lyons has led the Society in dealing with a range of important issues, including the Dowling Review of Business and University Research collaborations and the Nurse Review of the Research Councils, and has met with Science Ministers and other government representatives to further the cause of mathematics.

Professor Lyons has represented the Society with distinction, both in the UK and abroad. During his presidency he was very active internationally. He led the LMS delegation to the 2014 International Congress of Mathematicians in South Korea and represented the Society at a number of European meetings and high-profile awards ceremonies.

He has been actively involved in a wide range of LMS business and has provided the Society with inspirational leadership and strong direction during its Anniversary year. His enthusiasm and leadership have set the Society on a path which it is hoped will provide a lasting legacy from the Anniversary, not only for the Society but for UK mathematics as a whole.

The Society would like to thank Professor Lyons for his dedicated service and wishes him well for the future. At the AGM, Professor Lyons handed over the badge of Presidential Office to Professor Simon Tavaré, FRS.

REBECCA HOYLE, ELIZABETH MANSFIELD AND MICHAEL SINGER (Members-at-Large)

Professor Rebecca Hoyle, Professor Elizabeth Mansfield and Professor Michael Singer stepped down as Members-at-Large of Council at the 2015 AGM. Council wishes to recognise and thank them for the service they have given to the Society and to the

wider mathematical community.

Professor Hoyle was elected to Council in 2014 and steps down to pursue other commitments. Professor Mansfield was elected to Council in 2011. **Professor Mansfield** has been an active member of Programme Committee since 2012 and will continue her membership of this committee. She has been a strong advocate for the increased participation of female mathematicians as speakers

at mathematics conferences in the UK and abroad. **Professor Singer** has been an active member of the Research Policy Committee since 2012 and will continue in this role. His experience has been valuable across the wide range of committee business.

The LMS thanks them all for the broad and varied support that they have given to the Society in achieving its charitable aims and supporting mathematics more generally.

LMS HONORARY MEMBERSHIP – JOHN H. CONWAY

At the General Meeting on 13 November 2015, the Society elected John Conway (Princeton) an Honorary Member of the Society.

John Horton Conway is a remarkable mathematician who has made significant contributions to many branches of Mathematics, including algebra, number theory, logic, knot theory and recreational mathematics. To al-

gebraists he is probably best known for his elegant construction of the three Conway groups acting on the 24-dimensional Leech lattice, but his many ingenious contributions to Martin Gardner's Mathematical Games column in the Scientific American, and in particular his invention of the Game of Life, have made him a mathematical celebrity to a wider public.



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LMS SPECIAL GENERAL MEETING

On 10 November 2015, the Council of the LMS received a request for a Special General Meeting from thirty members of the Society. In accordance with the Statutes of the Society, a Special General Meeting will be held.

The Special General Meeting will take place at 15:30 on 5 February 2016 in the Paget Room at BMA House, Tavistock Square, London, WC1H 9JP.

The object of the meeting, as stated in the requisition, shall be to consider the reversal of the LMS Council's decision to close down the *LMS Journal of Computation and Mathematics*.

The LMS Statutes require that 21 days' notice is given to all members of the business of the meeting. Further notice detailing the specific business will follow.

LMS EXTENDS CARING GRANTS

The LMS Women in Mathematics Committee has agreed to amend the guidelines of the Society's Childcare Supplementary Grants Scheme to allow applications to support 'caring' costs more widely. The new 'Caring Supplementary Grants Scheme' will allow mathematicians to apply for financial support for the costs of, for example, childcare or caring for elderly or disabled relatives when attending conferences, research schools, meetings or visits.

It is the LMS view that institutions and event organisers should make provision for such caring costs and the Women in Math-

ematics Committee actively encourages them to do so, but, while this is not largely the case, the Society is willing to make a supplementary grant as a contribution to the costs.

Institutions concerned about the taxability of such costs should refer to the Athena Forum's *Statement on taxes exemption for childcare costs incurred while undertaking work-related training* (athenaforum.org.uk/athena-forum-statements/).

Further information on the Caring Supplementary Grants and details on how to apply can be found on the LMS website (lms.ac.uk/grants/caring-supplementary-grants).

LMS COUNCIL DIARY

13 November 2015

A personal view

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For me the day of a Council meeting begins with an early breakfast. The train journey to Paddington usually allows enough time to read the Council papers. Though there have often been minor delays, in the end I always get to De Morgan House just in time for a coffee before the meeting begins. But not today, slippery rails, a 'platform with issues' at Swindon and the usual delays on the Circle Line, meant I arrived a few minutes late. But fortunately, and unusually, today Council began a little late too.

The President reported that a Special General Meeting would be held to reconsider the closure of the *LMS Journal of Computation and Mathematics*, following a request for such a meeting from more than 20 members of the Society. The meeting would be convened, as required under the Statutes, within 28 days of the receipt of the letter. The President presented to Council a letter that he had sent to the signatories with further details on the Council's decision. It was agreed to place this letter on the blog and to circulate it to LMS Representatives.

Council members were provided with a copy of the contract with Wiley with very recent

changes indicated in red. In addition, some minor changes had been made by our publications lawyer in order to ensure compliance with the latest data protection legislation. The Publications Secretary answered queries about the revised draft. After some discussion (and a brief pause when the sudden arrival of Storm Abigail required one of the french windows of the Hardy Room to be locked shut) the President signed the contract; copies were handed to Wiley's representatives for signing later that afternoon. This has been the culmination of a huge amount of work over the last two years, particularly on the part of the Society's Publisher Susan Hezlet and the Publication Secretary John Hunton. More work will, of course, be required in the transition until Wiley take over from OUP at the beginning of 2017.

During the year, each of the Society's committees must report to Council on its activities. This time it was the turn, amongst others, of the Women in Mathematics Committee. In presenting a written report, outgoing chair Gwyneth Stallard commented on the progress which had been made in the last 10 years. There were now four mathematics depart-

ments with Athena Silver awards and 26 with Bronze awards, eight of them being gained this year.

The Holgate Scheme, which funds lectures and workshops in schools that enrich and enhance mathematical education, was re-launched this year. Education Secretary Alice Rogers reported that it had been a great success, with more applications than the Education Committee was able to fund. Council agreed to increase the budget for this scheme by £1,350.

In winding up the last Council meeting of his term of office President Terry Lyons thanked the Society's staff, particularly during the 150th anniversary year. This had been a period of stress but of great success. He also thanked Rebecca

Hoyle, Elizabeth Mansfield and Michael Singer who were leaving Council. Incoming President, Simon Tavaré, then thanked Terry Lyons for his service to the Society during his presidency.

The meeting finished in time for the short walk up the street to the BMA for the Society's AGM at which Simon Tavaré was to take over as President, and Terry Lyons would give his Presidential Address. For those of us up for re-election we would discover whether we would be back for the next Council meeting in February. In my case it had already been agreed that, whether or not I was to be successful in the ballot, after two years it was time to pass on the diarist's pen. So this concludes my final Council Diary.

Francis Clarke

LMS GRANT SCHEMES

Please note that the deadline for Research Grant Applications has been brought forward to **22 January 2016**.

Applications are invited for the following grants:

Conferences (Scheme 1)

Grants of **up to £7,000** are available to provide partial support for conferences held in the United Kingdom. This includes a maximum of £4,000 for principal speakers, £2,000 to support the attendance of research students who are studying at universities in the UK, and £1,000 to support the attendance of participants from Scheme 5 or former Soviet Union countries.

Celebrating new appointments (Scheme 1)

Grants of **up to £600** are available to provide partial support for meetings held in the United Kingdom to celebrate the new appointment of a lecturer at a UK university.

Postgraduate Research Conferences (Scheme 8)

Grants of **up to £4,000** are available to provide partial support for conferences held in the United Kingdom, which are organised by and

are for postgraduate research students.

Visits to the UK (Scheme 2)

Grants of **up to £1,500** are available to provide partial support for a visitor to the UK, who will give lectures in at least three separate institutions. Awards are made to the host towards the travel, accommodation and subsistence costs of the visitor.

Research in Pairs (Scheme 4)

Grants of **up to £1,200** are available to support a visit for collaborative research either by the grant holder to another institution abroad, or by a named mathematician from abroad to the home base of the grant holder. Grants of **up to £600** are available to support a visit for collaborative research either by the grant holder to another institution within the UK, or by a named mathematician from within the UK to the home base of the grant holder.

International Short Visits (Scheme 5)

Grants of **up to £3,000** are available to support a visit for collaborative research by a named mathematician from a country in Africa (or countries where mathematics is in a similar position) to the home base of

the grant holder. Grants of **up to £2,000** are available to support a visit for collaborative research by the grant holder to a country in Africa (or countries where mathematics is in a similar position).

For full details of these grant schemes, and to download application forms, please visit the LMS website: www.lms.ac.uk/content/research-grants.

- Applications received by **22 January 2016** will be considered at a meeting in February.
- Applications should be submitted well in advance of the date of the event for which funding is requested.
- Normally grants are not made for events which have already happened or where insufficient time has been allowed for processing of the application.

Queries regarding applications can be addressed to the Grants Administrator (see below) who will be pleased to discuss proposals informally with potential applicants and give advice on the submission of an application.

Grants Administrators: Anthony Byrne, 0207 927 0807, email: grants@lms.ac.uk.

OTHER LMS GRANTS AND FUNDING

Research Workshop Grants

The Society offers grants to support Research Workshops held in the UK. Requests for support (for travel and subsistence of participants, and reasonable associated costs) in the range **£1,000-£10,000** will be considered. The maximum award is **£10,000**, but a typical award is in the range of **£3,000-£5,000**. Applications for partial support of workshops with other sources of support will be considered. Applications should normally be submitted 12 months in advance of the proposed workshop. For further information visit: www.lms.ac.uk/content/research-workshops-grants.

150th Anniversary Postdoctoral Mobility Grants 2016-17

Next deadline: 31 March 2016

The Society will award grants **up to £9,200**

to mathematicians of excellent promise. The purpose of the grants is to support a period of study and research in mathematics between three and six months in the academic year 2015-16 at one or more institutions other than the holder's home institution (the grant holder's home institution may be included for applicants with circumstances that make moving impractical, please see the website for the full guidelines). They are intended to support promising researchers during the transitional period between having submitted their thesis and the start of their first post-doctoral employment. The value of the grant will be calculated at £1,200 per month plus a travel allowance of up to £2,000. For more information and an application form, please visit: www.lms.ac.uk/grants/postdoc-mobility-grants.

Undergraduate Research Bursaries in Mathematics 2015

Next deadline: 4 February 2016

Open to Undergraduate Students in the intermediate years (i.e. 2/3, 2/4 or 3/4) of their undergraduate degree to undertake the project during the summer vacation. Students in the final year of their degree intending to undertake a taught Masters degree immediately following their undergraduate degree may apply. (First-year undergraduates are not eligible). The purpose of the awards is to give experience of research to undergraduates with research potential and to encourage them to consider a career in scientific research. The awards provide support for the student at a rate of £180 per week (or £190 per week in London), for a period of between six and eight weeks. For more information and an application form, please visit: www.lms.ac.uk/grants/undergraduate-research-bursaries.

Spitalfields Days

Next deadline: 31 January 2016

Grants of **up to £1,000** are available to support an LMS Spitalfields Day, which have been run since 1987 and are in honour of the Society's predecessor, the Spitalfields Math-

ematical Society (1717-1845). A Spitalfields Day is a one-day meeting, which is usually associated with a long-term symposium on a specialist topic at a UK university. Selected participants, often distinguished experts from overseas, give survey lectures (or other types of lecture accessible to a general mathematical audience) on topics in the field of the symposium. Please see the website for further details: www.lms.ac.uk/content/spitalfields-days.

Grace Chisholm Young Fellowship

Next deadline: 31 December 2016

The Society offers two fellowships of **£1,000** (consisting of £500 personal support and £500 contribution to a host institution) each year to mathematicians who need support when their mathematical career is interrupted by family responsibilities, relocation of partner, or other similar circumstance.

These fellowships, named after Grace Chisholm Young, aim to provide some support, making possible some continuous mathematical activity, so enabling the fellow to be in a position to apply for posts when circumstances allow. The Fellowship will give an endorsement of the holder's status as a mathematician, so that the break in formal employment should not prevent them from resuming a career as a mathematician at a later stage. Please see the website for further details: www.lms.ac.uk/grants/grace-chisholm-young-fellowships.

Small Grants for Education

Next deadline: 31 January 2016

Funding for grants **up to £800** is available to stimulate interest and enable involvement in mathematics from Key Stage 1 (age 5+) to Postgraduate level and beyond. Anyone working/based in the UK is eligible to apply for a grant. If the applicant is not a member then the application must be countersigned by an LMS member or another suitable person such as a Head teacher or senior colleague. Please see the website for further details: www.lms.ac.uk/content/small-grants-education.

Teacher CPD Grants

Next deadline: 31 January 2016

Funding for grants **up to £400** is available to provide opportunities for mathematics teachers to attend training which is specifically mathematical. It is intended to facilitate mathematical professional development to allow teachers in UK schools/educational institutions to:

- Develop their subject knowledge.
- Engage in a deeper understanding of how to develop mathematical thinking
- Appreciate the interconnectivity of mathematical topics
- Update themselves on mathematics curriculum reform
- Use technology when and where appropriate

Please see the website for further details: <http://www.lms.ac.uk/grants/teacher-cpd-grants>

Computer Science Small Grants (Scheme 7)

Next deadline: 15 April 2016

Funding for grants **up to £500** is available to support a visit for collaborative research at the interface of Mathematics and Computer Science either by the grant holder to another institution within the UK or abroad, or by a named mathematician from within the UK or abroad to the home base of the grant holder. Please see the website for further details: www.lms.ac.uk/content/computer-science-small-grants-scheme-7.

Caring Supplementary Grants

Next deadline: 31 January 2016

Grants of **up to £200** are available to parents and carers working in mathematics to help with the cost of childcare when attending a conference or research meeting. The Society believes that all parents working in mathematics should be able to attend conferences and research meetings without being hindered by childcare costs. Institutions are expected to make provision for childcare costs and parents are encouraged to make enquiries. However, where this is not available, the Society administers a Childcare Supplementary Grants Scheme. Please see the website for further details: www.lms.ac.uk/content/childcare-supplementary-grants.



MARY CARTWRIGHT LECTURE AND SOCIETY MEETING

Friday 26 February 2016

De Morgan House, 57-58 Russell Square, London, WC1B 4HS

3.30 Opening Lecture
Lasse Rempe-Gillen (University of
Liverpool)
Hairs, dreadlocks and Cantor bouquets

4.30 Tea

5.00 Mary Cartwright Lecture
Gwyneth Stallard (Open University)
Pits, gaps and spiders' webs

6.00 Wine reception



To register

For all event enquiries please contact Katy Henderson (womeninmaths@lms.ac.uk) by Friday 19 February. Late registrations for places may still be accepted, subject to availability.

The reception will be followed by a dinner at the Thistle Bloomsbury Park Hotel, at a cost of £35 per person, inclusive of wine.

There are limited funds available to contribute in part to the expenses of members of the Society or research students to attend the meeting.



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CHRISTOPHER ZEEMAN MEDAL 2016

CALL FOR NOMINATIONS

The Councils of the LMS and the IMA are delighted to invite nominations for the 2016 award of the Christopher Zeeman Medal, which is the UK award dedicated to recognising excellence in the communication of mathematics.

The IMA and the LMS wish to honour mathematicians who have excelled in promoting mathematics and engaging with the general public. They may be academic mathematicians based in universities, mathematics school teachers, industrial mathematicians, those working in the financial sector or indeed mathematicians from any number of other fields.

Most importantly, these mathematicians will have worked exceptionally to bring mathematics to a non-specialist audience, whether it is through giving public lectures, writing books, appearing on radio or television, organising events or through an entirely separate medium. The LMS and IMA want to celebrate the achievements of mathematicians who work to inspire others with their work.

The award is named after Professor Sir Christopher Zeeman, FRS, president of the LMS between 1986 and 1988. His notable career has been pioneering not only in the fields of topology and catastrophe theory but also because of his ground breaking work in bringing his beloved mathematics to the wider public. Sir Christopher was the first mathematician to be asked to deliver the Royal Institution Christmas Lectures in 1978, a full 160 years since they began. His Mathematics into Pictures lectures have been cited by many young UK mathematicians as their inspiration. In recognition of both his work as a mathematician and his contribution to the UK mathematics community, Sir Christopher received the LMS-IMA David Crighton Medal in 2006.

A form for nominations is available at www.ima.org.uk/zeeman2016nomination.html or from Alison Penry at: Institute of Mathematics and its Applications, Catherine Richards House, 16 Nelson Street, Southend-on-Sea, Essex, SS1 1EF; or email alison.penry@ima.org.uk.

Nominations must be received by **28 February 2016**.



Professor Simon Tavaré
President
University of Cambridge



Professor Ken Brown
Vice President
University of Glasgow



Professor John Greenlees
Vice President
University of Sheffield



Professor Rob Curtis
Treasurer
University of Birmingham



Professor Stephen Huggett
General Secretary
University of Plymouth



Professor Iain Stewart
Programme Secretary
University of Durham



Professor John Hunton
Publications Secretary
University of Durham



Professor Alice Rogers
Education Secretary
King's College, London



Professor June Barrow-Green
Librarian (Member-at-Large)
Open University



Professor David Evans
Member-at-Large
University of East Anglia



Dr Tara Brendle
Member-at-Large
University of Glasgow



Dr Francis Clarke
Member-at-Large
University of Swansea



Dr Tony Gardiner
Member-at-Large



Professor Alexandre Borovik
Member-at-Large
University of Manchester



Dr Cathy Hobbs
Member-at-Large
University of the
West of England



Professor Sam Howison
Member-at-Large
University of Oxford



Dr Diane Maclagan
Member-at-Large
University of Warwick



Professor Beatrice Pelloni
Member-at-Large
University of Reading



Professor Gwyneth Stallard
Member-at-Large
Open University



Dr Alina Vdovina
Member-at-Large
University of Newcastle

LMS COUNCIL 2015-16

As a result of the annual election in November 2015, membership of the Council is as follows (see photographs on the previous page):

President	Professor S. Tavaré (University of Cambridge)
Vice-Presidents	Professor K.A. Brown, FRSE (University of Glasgow) Professor J.P.C. Greenlees (University of Sheffield)
Treasurer	Professor R.T. Curtis (University of Birmingham)
General Secretary	Professor S.A. Huggett (University of Plymouth)
Programme Secretary	Professor I.A. Stewart (University of Durham)
Publications Secretary	Professor J.R. Hunton (University of Durham)
Education Secretary	Professor F.A. Rogers (King's College London)
Member-at-Large (Librarian)	Professor J.E. Barrow-Green (Open University)
Members-at-Large of Council	*Professor A.V. Borovik (University of Manchester) *Dr T.E. Brendle (University of Glasgow) Dr F.W. Clarke (University of Swansea) – <i>elected to a one-year term</i> Professor D.M. Evans (Imperial College London) – <i>elected to a one-year term</i> Dr A.D. Gardiner *Dr C.A. Hobbs (University of the West of England) Professor S. Howison (University of Oxford) Dr D. Maclagan (University of Warwick) *Professor B. Pelloni (University of Reading) Professor G.M. Stallard (Open University) Dr A. Vdovina (University of Newcastle)

* Members continuing the second year of their two-year election in 2014.

LMS Nominating Committee

Also at the AGM, Sarah Rees (University of Newcastle) and Ursula Martin (University of Oxford) were elected to the Nominating Committee for three year terms of office.

Continuing members of the Nominating Committee are John Toland (Chair), Martin Bridson, Stephen Donkin, Paul Glendinning and Alex Wilkie. Council will also appoint a representative.

LONGSTANDING MEMBERS

The following is a list of the one hundred and forty six members who have completed 50 years or more of membership of the London Mathematical Society.

Of these sixty five have completed more than 55 years, thirty one have completed 60 years or more and nine have completed 65 years or more.

DATE OF ELECTION	NAME
Elected more than 65 years ago	
17 Mar 1943	Dyson, F.J.
15 Jun 1944	Williams, A.E.
23 May 1946	Huppert, E.L.
20 Mar 1947	Hayman, W.K.

DATE OF ELECTION	NAME
18 Mar 1948	Isaacs, G.L.
18 Mar 1948	Reade, M.O.
13 Dec 1948	Fishel, B.
20 Jan 1949	Borwein, D.
23 Mar 1950	Ponting, F.W.

DATE OF ELECTION	NAME
Elected more than 60 years ago	
20 Dec 1951	Dowker, Y.N.
17 Jan 1952	Wilson, D.H.
15 Feb 1952	Shephard, G.C.
20 Mar 1952	Swinnerton-Dyer, H.P.F.
18 Dec 1952	Reeve, J.E.
18 Jun 1953	Marstrand, J.M.
18 Jun 1953	Rayner, M.E.
17 Dec 1953	Ringrose, J.R.
17 Dec 1953	Samet, P.A.
21 Jan 1954	Zeeman, E.C.
18 Feb 1954	Cohen, D.E.
18 Feb 1954	James, I.M.
18 Mar 1954	Gould, G.G.
17 Jun 1954	Taylor, S.J.
25 Nov 1954	Amson, J.C.
27 Jan 1955	Atiyah, M.F.
24 Feb 1955	Rayner, F.J.
24 Mar 1955	Farahat, H.K.
12 May 1955	Harrop, R.
12 May 1955	Murdoch, B.H.
12 May 1955	Wall, G.E.
15 Dec 1955	Armitage, J.V.
Elected more than 55 years ago	
19 Jan 1956	Bowers, J.F.
15 Mar 1956	Edmunds, D.E.
19 Apr 1956	Penrose, R.
14 Jun 1956	Perry, R.L.
15 Nov 1956	Edwards, D.A.
14 Mar 1957	Brown, R.
13 Jun 1957	Brown, A.L.
18 Jun 1957	Russell, D.C.
21 Nov 1957	Wallington, J.E.
19 Dec 1957	Longdon, L.W.
19 Dec 1957	Mohamed, I.J.

DATE OF ELECTION	NAME
19 Dec 1957	Monk, D.
19 Dec 1957	Newman, M.F.
20 Mar 1958	Keedwell, D.
20 Mar 1958	Wallace, D.A.R.
17 Apr 1958	Macdonald, I.G.
15 May 1958	Foster, D.M.E.
17 Dec 1958	De Barra, G.
18 Dec 1958	Birch, B.J.
15 Jan 1959	Blackburn, N.
16 Apr 1959	Burgess, D.A.
16 Apr 1959	Manogue, J.F.
21 May 1959	Ingram, G.
18 Jun 1959	Carter, R.W.
17 Dec 1959	Eames, W.P.
17 Dec 1959	Hoskins, R.F.
17 Dec 1959	West, A.
17 Mar 1960	Guy, R.K.
17 Mar 1960	Harris, D.J.
18 Mar 1960	Scourfield, E.J.
18 Mar 1960	Strauss, D.
19 May 1960	Hoare, A.H.M.
17 Nov 1960	Morris, A.O.
15 Dec 1960	Turner-Smith, R.F.
Elected more than 50 years ago	
16 Mar 1961	Rhodes, F.
18 May 1961	Sklar, A.
15 Jun 1961	Button, L.G.
15 Jun 1961	Dey, I.M.S.
15 Jun 1961	Dlab, V.
15 Jun 1961	Robertson, S.A.
16 Nov 1961	Croft, H.T.
21 Dec 1961	Barry, P.D.
21 Dec 1961	Davies, R.O.
21 Dec 1961	Rutter, J.W.
21 Dec 1961	Sands, A.D.

DATE OF ELECTION	NAME
21 Dec 1961	Wall, C.T.C.
18 Jan 1962	Ezeilo, J.O.C.
18 Jan 1962	Kingman, J.F.C.
15 Mar 1962	Baumslag, B.
26 Apr 1962	Cohn, J.H.E.
26 Apr 1962	Williams, S.O.
17 May 1962	Lue, A.S.T.
17 May 1962	Mullin, A.A
17 May 1962	Thompson, A.C.
21 Jun 1962	Peters, J.E.
15 Nov 1962	Riles, J.B.
15 Nov 1962	Gaffney, M.P.
20 Dec 1962	Douglas, A.J.
20 Dec 1962	Roberts, J.B.
20 Dec 1962	Wallace, E.W.
20 Dec 1962	Pears, A.R.
17 Jan 1963	Beardon, A.F.
17 Jan 1963	Blyth, T.S.
17 Jan 1963	Dugdale, J.K.
17 Jan 1963	Epstein, D.B.A.
17 Jan 1963	Garling, D.J.H.
17 Jan 1963	Piper, F.C.
17 Jan 1963	Robinson, W.J.
17 Jan 1963	Whittington, J.E.
18 Apr 1963	Bernau, S.J.
18 Apr 1963	Sutherland, W.A.
15 May 1963	Ault, J.C.
16 May 1963	Harte, R.E.
16 May 1963	Lee, P.
16 May 1963	Sondheimer, E.H.
16 May 1963	Weinmann, A.
16 May 1963	White, D.J.
20 Jun 1963	Duren, P.L.
20 Jun 1963	Pym, J.S.
20 Jun 1963	Rogosinski, H.P.

DATE OF ELECTION	NAME
21 Nov 1963	Bechtell, H.F.
21 Nov 1963	Curtis, C.W.
21 Nov 1963	Eggan, L.C.
21 Nov 1963	Lowe, P.G.
19 Dec 1963	Gani, J.M.
19 Dec 1963	Heywood, P.
19 Dec 1963	Knowles, J.D.
19 Dec 1963	Watters, J.F.
16 Jan 1964	Craven, B.D.
16 Jan 1964	Shawyer, B.L.R.
16 Jan 1964	Steer, B.F.
21 May 1964	Brown, W.G.
25 Jun 1964	Erdos, J.A.
19 Nov 1964	Evans, E.A.
19 Nov 1964	Roseblade, J.E.
19 Nov 1964	Vincent-Smith, G.F.
16 Dec 1964	Larman, D.G.
16 Dec 1964	Nelson, R.
16 Dec 1964	Reid, G.A.
17 Dec 1964	Ledgard, R.
17 Dec 1964	Morton, H.R.
17 Dec 1964	Neumann, P.M.
21 Jan 1965	Kegel, O.H.
21 Jan 1965	Walker, G.
10 Apr 1965	Batty, J.C.R.
20 May 1965	Hirst, K.E.
17 Jun 1965	Dodson, M.M.
17 Jun 1965	McGregor, M.T.
18 Nov 1965	Gardiner, C.F.
18 Nov 1965	Giblin, P.J.
18 Nov 1965	Harvey, W.J.
18 Nov 1965	Reade, J.B.
18 Nov 1965	Robinson, D.J.S.
18 Nov 1965	McCrudden, M.
16 Dec 1965	Evans, W.D.

LMS 150TH ANNIVERSARY DEPARTMENTAL CELEBRATIONS

These events were part of a series of receptions hosted across the UK by mathematics departments, celebrating the 150th Anniversary of the LMS.

UNIVERSITY OF OXFORD

We celebrated the 150th Anniversary of the LMS on 15 October 2015, as part of the Annual Institute Celebration. This started with a short LMS presentation (advertising for early career membership). Professor Andrew Wiles gave a talk, titled *The story of equations*. This was followed by the prize presentation for 2015 exams and departmental awards. The event concluded with a drinks reception. There were around 200 undergraduates, some parents, and many members of the department taking part.



UNIVERSITY OF NOTTINGHAM

To celebrate 150 years of the LMS the School of Mathematical Sciences hosted a colloquium on 4 November 2015. Professor Anne Taormina (Durham) gave a fascinating and wide ranging talk, *New Moonshines*, covering aspects of theoretical physics, number theory and finite simple groups. This was followed by a cheese and wine reception at which a hearty toast was raised to the continued health of mathematics and the LMS.



UNIVERSITY COLLEGE LONDON

The event took place on 12 November 2015 as a joint Women in Mathematical Sciences, Statistical Science Seminar and the 150th LMS Anniversary Celebration event. The main guest and speaker at the triple event was Alison Etheridge, Professor of Probability at Magdalen College, University of Oxford.

The event began with the Women in Math part of the activities, aimed at female 3rd and 4th year undergraduates, postgraduate students and research staff from the UCL Departments of Mathematics and Statistical Science and the Centre for Mathematics, Physics and Engineering in the Life Sciences and Experimental Biology (CoMPLEX). The main objective of the Women in Math Series is to encourage female researchers from these departments to meet and discuss over lunch in an informal environment. The Women in Math lunch was followed by the Statistical Science Seminar talk of our invited guest Professor Alison Etheridge. The talk was entitled *The pain in the torus: modelling evolution in a spatial continuum*. A wine reception for all the members of the Department of Statistical Science followed after the talk.

The official links to the events on the departmental website are www.ucl.ac.uk/statistics/research/seminars and www.ucl.ac.uk/statistics/research/women-science.



ICME-13 BURSARIES



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Thanks to the generosity of the London Mathematical Society (LMS) and the Institute of Mathematics and its Applications (IMA), the ICME-13 Bursaries Committee is able to offer competitive bursaries of up to £600 for outstanding mathematics educators, attending and presenting at ICME-13. Applications are encouraged from the full range of those working in all areas of mathematics and mathematics education in the UK, including teachers, researchers and postgraduate students who can demonstrate a benefit from attending.

The conditions for making a bursary award are

1. That the candidate will benefit academically and professionally from attending ICME-13 and needs bursary funds to attend ICME
2. That the candidate will contribute to UK presence at ICME-13 by attending and presenting
3. That the candidate will feed back into policy, practice or research in mathematics education in the UK

Full details and application forms are at www.jmc.org.uk/. Applications should be made on the application form and returned to Professor Chris Budd (mascjb@bath.ac.uk) by **31 January 2016** together with a supporting statement from a referee.



Heilbronn Institute for
Mathematical Research



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LMS-CMI RESEARCH SCHOOLS CALL FOR PROPOSALS

The London Mathematical Society and Clay Mathematics Institute invite proposals for Research Schools to be held in the UK in 2017.

Up to £31,000 is available per Research School which provides training for young researchers in a core area of mathematics. The new series of courses builds on the short courses, previously supported by the Society and EPSRC, and aims at the highest international standing by allowing for support of both international lecturers and participants. The Research Schools are also supported by the Heilbronn Institute for Mathematical Research.

Prospective organisers should send an outline proposal to Elizabeth Fisher (Research.Schools@lms.ac.uk) by **31 January 2016**.

Outline proposals should discuss:

- The general mathematical area of the proposed Research School and its importance.
- The aims of the Research School, its appropriateness to the Research School programme and the likely level of demand for the Research School.
- The names and affiliations of the lecturers, titles of their courses and brief syllabuses.
- The provision for tutorial support.

Outline proposals should be no more than two A4 sides in length.

For further details about the Research Schools, please visit the Society's website: www.lms.ac.uk/events/lms-cmi-research-schools.

A list of previously supported Research Schools and Short Courses can be found at: www.lms.ac.uk/events/past-research-schools-and-short-courses

Before submitting: Organisers are welcome to discuss informally their ideas with the Chair of the Research Meetings Committee, Professor Beatrice Pelloni (RMC, Chair@lms.ac.uk).



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Society Meeting at the BMC 2016

University of Bristol, 21-24 March

5:15pm Society Meeting (21 March)
Public Lecture: Kirsten Lauter (Microsoft Research)

This Society Meeting is part of the British Mathematical Colloquium 2016. The full conference will also include a special lecture by Hendrik Lenstra and plenaries given by Robert Adler, Luigi Ambrosio, Maria Chudnovsky, Alex Lubotzky, Peter Sarnak and Amie Wilkinson.

Workshops (Tue & Wed afternoon)

Algebra (organisers: Tim Burness, Jeremy Rickard)
Analysis (organisers: Michiel van den Berg, John Mackay)
Combinatorics (organisers: Thomas Bloom, Julia Wolf)
Ergodic Theory (organisers: Thomas Jordan, Corinna Ulcigrai)
Number Theory (organisers: Andrew Booker, Tim Browning)
Probability (organisers: Márton Balázs, Bálint Tóth)

Speed talks (Wed 5-6pm) & posters

In the spirit of Radio 4's 'Just A Minute', there will be a session of 5-minute talks, allowing early career researchers, including PhD students, to showcase some of their mathematics. If you would like to give a speed talk, please apply at <http://ow.ly/VmRkO>. If you would like to present a poster at the BMC, please apply at <http://ow.ly/VmRsD>.

Satellite meetings (Thu afternoon), Research Groups supported by LMS Scheme 3 grants

Ergodic theory, organisers Thomas Jordan, Corinna Ulcigrai
COW Algebraic Geometry, organiser Hamid Ahmadi-zhad
BLOC Representation Theory, organisers Neil Saunders, Jason Semeraro, Nicole Shashall

For further details and registration, please visit <http://www.maths.bris.ac.uk/~matyd/BMC/> Early bird registration is now open and closes on 1 February 2016. The cost of registration will be £75 and £40 for students. The venue and time of the dinner is to be confirmed.

Accommodation in Bristol is also available, but it is advised you book early to avoid disappointment. A list of hotels can be found here: <http://ow.ly/VmRA3>

THE LOST LIBRARY OF JOHN DEE

John Dee (1527-1609) was one of Tudor England's most enigmatic figures. A man for whom the word 'polymath' seems coined, he counted theology, alchemy, history and mathematics amongst his passions. The Royal College of Physicians, London holds the largest known collection of surviving books from Dee's library and more than 40 of these volumes are on show in a fascinating new exhibition.

One of the most revealing texts displayed is Andreas Alexander's *Mathemologium* (1504). Dee's marginal annotations clearly show his interest in the basic tenets of mathematics and mathematical proof, particularly the Aristotelian principles of demonstration. Other notes reflect his concerns with the applications of mathematics including astrology, prognostication and perspective.

It is, however, on the final page that the most telling inscription comes. Dee writes that he read the book at the house of his 'singular friend' Edmund Bonner, Bishop



Euclid's *Elements of Geometry*, 1570

of London, in September 1555. Dee was actually under house arrest in Bonner's palace at Fulham, having been detained on Mary I's orders on charges of 'conjuring': casting horoscopes of the royal family and using magic to undermine the queen. Dee escaped serious punishment, but the episode illustrates the suspicion with which mathematical expertise could be regarded in 17th century England.

Possibly Dee's most significant publication was his mathematical preface to the first English edition of Euclid's 'Elements of Geometry'. Dee wrote the preface in great haste in 1570. Earlier in his career he lectured on Euclid in Paris, and the preface delineates his conception of the whole structure of mathematics. Dee begins with the subjects of the medieval curriculum: arithmetic, geometry, astronomy and music. These are followed by 17 practical disciplines including Hydragogie, which 'demonstrateth the possible leading of Water, by Natures



Ptolemy's *Quadripartiti*, 1519



Arnaldus de Villanova – Opera 1527

lawe’ and thaumaturgic, ‘that Art Mathematicall, which giueth certaine order to make straunge workes, of the sense to be perceiued, and of men greatly to be wondred at’.

Elsewhere in the exhibition works illustrate Dee’s interests in applied mathematics in the forms of cryptography, astronomy and navigation. These books and the annotations within them provide a rare insight into the mind of an extraordinary Renaissance scholar.

Katie Birkwood

Rare books and special collections
librarian and exhibition curator

EXHIBITION INFORMATION

Scholar, courtier, magician: the lost library of John Dee

18 January – 29 July 2016

The Royal College of Physicians, London

Usual opening times: Monday–Friday,
9 am – 5 pm.

Opening times may vary: please check online before you visit.

Details of evening events, weekend tours and more online.

www.rcplondon.ac.uk/johndee

@RCPmuseum #JohnDee

MATHEMATICS POLICY ROUND-UP

December 2015

RESEARCH

Nurse Review of the Research Councils

The recommendations from this independent review include a new body – Research UK – which will work across the seven Research Councils. This will take the lead in shaping and driving a strategic approach to science funding, ensuring a focus on the big challenges and opportunities for UK research. There was also a recommendation to integrate Innovate UK into Research UK to strengthen collaboration between the research base and the commercialisation of discoveries in the business community. Innovate UK will retain its clear business focus and separate funding stream. The final report is available at <http://tinyurl.com/nu244n3>.

EPSRC REF analysis report

The Engineering and Physical Science Research Council (EPSRC) has reported that the 2014 Research Excellence Framework revealed ‘comprehensive evidence of the sustained economic and social impact of EPSRC’s investments in engineering and physical sciences (EPS) research’. The EPSRC has published a report and companion leaflet presenting the findings of an analysis of the REF EPS impact case studies, carried out by EPSRC. More information is available at <http://tinyurl.com/pezcoy7>.

HIGHER EDUCATION

Higher Education Green Paper

The government published its green paper titled *Fulfilling our Potential: Teaching*

Excellence, Social Mobility and Student Choice on 6 November 2015. The green paper highlighted proposals to put students at the heart of higher education. 'The reforms are designed to boost teaching standards, support more people into university from disadvantaged backgrounds, and ensure better value for money and employment prospects for students'. More information is available at <http://tinyurl.com/pbnttse>.

SCHOOLS AND COLLEGES

Education Select Committee inquiry

The Education Committee has launched an inquiry into the purpose and quality of education in England. Written evidence has been invited addressing the following points:

- what the purpose of education for children of all ages in England should be;
- what measures should be used to evaluate the quality of education against this purpose; and
- how well the current education system performs against these measures.

More information is available at <http://tinyurl.com/qzfr3cx>.

Ofqual consultation

The LMS has responded to the Ofqual consultation on Developing New GCSEs, AS and A-levels for First Teaching in 2017. The Society's response relates to Statistics (at GCSE and at AS and A-level). The consultation response is available on the LMS website at <http://tinyurl.com/oh6g6wx>.

Report on initial teacher training (ITE)

ACME has published its latest report, *Beginning teaching: best in class?* It looks at what high-quality initial teacher education (ITE) for teachers of mathematics should look like.

Among other things the report highlights that 'To get and keep high-quality teachers of mathematics it is imperative that all those involved in ITE and those supporting newly qualified teachers have a shared

understanding of what constitutes high-quality mathematics-specific ITE. A review of international jurisdictions showed an emphasis on mathematics-specific training and mathematics-specific mentoring, strong linkages between professional development and ITE and an investment in critical evaluation skills during and after ITE'. More information is available at <http://tinyurl.com/ndzcyw2>.

OTHER

Science budget inquiry

The Science and Technology Committee undertook an inquiry into the science budget, ahead of the Spending Review. The first report was published on 9 November 2015. More information is available at <http://tinyurl.com/otm49q7>.

Spending Review

The government published a joint Spending Review and Autumn Statement on the 25 November 2015. The main points are:

- protecting the £4.7 billion science resource funding in real terms for the rest of the Parliament. This includes a new £1.5 billion Global Challenges fund to ensure UK science takes the lead in addressing the problems faced by developing countries while developing our ability to deliver cutting-edge research; and
- delivering on the long term science capital commitment of £6.9 billion between 2015-2021 to support the UK's world-class research base. This includes up to £150 million (total capital and resource) to launch a competition for a Dementia Institute, to build on the UK's strengths in medical research'.

Other points of interest:

'The Spending Review and Autumn Statement provides investment of over £1.3 billion up to 2019-20 to attract new teachers into the profession, particularly into Science, Technology, Engineering and Mathematics (STEM) subjects and to deliver

the English Baccalaureate (EBacc), to raise educational standards for young people.'

'Financial support for higher education will be increased substantially to enable people to study for a degree. The government will lift the age cap on new loans to postgraduates from 2016-17 so they are available to all those under 60. Following a sharp decline in part-time students since 2008, the government will introduce new part-time maintenance loans from 2018-19 to support the cost of living while studying. The government expects 150,000 part-time students could benefit each year by the end of the Parliament. For all STEM subjects, tuition loans will be extended to students wishing to do a second degree from 2017-18'.

'The government will run a £20 million competition to set up a new Institute of Coding that will train the next generation in higher level digital skills. Support will be provided to secure launch funding to create a new university in Hereford focused on engineering in 2016 (subject to relevant approvals)'.

The government will also take forward a review of the Research Excellence Framework in order to examine how to simplify and strengthen funding on the basis of excellence, and will set out further details shortly.

The Spending Review and Autumn Statement extends the freedoms granted to Research Institutes at Budget 2015 to all

Department for Business, Innovation and Skills (BIS) Sector Research Establishments which are not public corporations, and will also grant access to accumulated reserves of commercial income, subject to a cap'.

The BIS budget will fall by a total 17%. More information is available at <http://tinyurl.com/pawf2vz>.

The Mathematical Sciences People Pipeline report

The Mathematical Sciences pervade our lives, and the complexities of the changing world could not be managed without them. In the Mathematical Sciences more than anywhere, and at all levels, the strength of the infrastructure is embodied in people. The importance to the UK of having a good supply of well qualified people cannot be overstated, but reliable quantitative information has been hard to find. Accordingly, the Council for the Mathematical Sciences (CMS) commissioned TBR to examine the higher education and career routes of students taking Mathematical Sciences courses to provide an understanding of the critical processes of the Mathematical Sciences career pipeline. This report paints a quantitative picture of the flow of people through higher education and into the workforce. The report is available on the CMS website at <http://tinyurl.com/ojqy6j6>.

Dr John Johnston
Joint Promotion of Mathematics

EUROPEAN NEWS

The following items are from the European Mathematical Society webpage www.euro-math-soc.eu/recent-news.

LERU statement on Open Access

The *League of European Research Universities* (LERU) calls upon the European Commission (EC) and the forthcoming Dutch EU Presidency to work with all stakeholders and bodies involved to bring sensible

solutions to the transition to Open Access: business models must support the transition for the benefit of research, not of publishers. It should be one of the principal objectives of Commissioner Carlos Moedas and the Dutch EU Presidency (January-June 2016) to ensure that this transition happens. Greater clarity for all stakeholders is needed both in the dissemination and archiving of the scholarly record. The statement issued

by LERU discusses current practices concerning both Gold and Green Open Access models and urges for more consistency and transparency. LERU calls upon all universities, research institutes, research funders and researchers to sign the statement and give a clear signal to the European Commission and the Dutch EU Presidency (see <http://tinyurl.com/nju8ekn>).

Oberwolfach and IMAGINARY

Snapshots of modern mathematics from Oberwolfach explain mathematical problems and ideas in an accessible and understandable way. They provide exciting insights into current topics of the mathematical community for everyone who is interested in modern mathematics. The snapshots are written by participants of each scientific program at Mathematisches Forschungsinstitut Oberwolfach, who volunteer to explain an important aspect of their research. The project is part of *Oberwolfach meets IMAGINARY* funded by the Klaus Tschira Foundation. For further information see www.mfo.de/math-in-public/snapshots.

Cédric Villani member of SAM High Level Group

Cédric Villani, Fields medal 2010 and director of the Institut Henri Poincaré, has been named member of the High Level Group of The European Commission's new *Scientific Advice Mechanism* (SAM). According to Carlos Moedas, Commissioner for Research, Science and Innovation, the seven appointed exceptional scientists 'will take the use of independent science advice in Commission policy-making to a new level. The EC will rely on their independent advice on a range of complex policy issues where high-level scientific input is needed'. For further information see <http://tinyurl.com/oqnorsy>.

Hermann Weyl Prize 2016

The purpose of the *Hermann Weyl Prize* is to provide recognition for young scien-

tists who have performed top level original work in the area of understanding physics through symmetries. The Prize, which is awarded every two years by the Standing Committee of the *International Colloquium on Group Theoretical Methods in Physics* (ICGTMP), consists of a certificate citing the accomplishments of the recipient, prize money, and an allowance towards attendance at *Group31, ICGTMP* in Rio de Janeiro from 20 to 24 June 2016, where the Prize will be awarded.

Deadline for nominations: **15 January 2016**. For further information see <http://icgtmp.blogs.uva.es/standing-committee/>.

Chevalley Prize

Geordie Williamson of the Max Planck Institute for Mathematics (Bonn) and the University of Sydney will receive the inaugural American Mathematical Society *Claude Chevalley Prize* in Lie Theory. Williamson is honoured 'for his work on the representation theory of Lie algebras and algebraic groups [which includes] proofs and reproofs of some longstanding conjectures as well as spectacular counterexamples to the expected bounds in others'. The prize will be presented on 7 January 2016 in Seattle (see www.ams.org/news?news_id=2867).

Breakthrough Prize 2016 to Ian Agol

Ian Agol (UC Berkeley and IAS) is the winner of the 2016 *Breakthrough Prize in Mathematics* (three million USD!) for 'spectacular contributions to low dimensional topology and geometric group theory, including work on the solutions of the tameness, virtually Haken and virtual fibering conjectures'.

Two *New Horizons in Mathematics* prizes - recognizing the achievements of young scientists, at US\$100,000 each - were awarded to Larry Guth (MIT) and André Arroja Neves (Imperial College London). For further information see <https://breakthroughprize.org/News/29>.

David Chillingworth
LMS/EMS Correspondent

LMS INVITED LECTURE SERIES 2017

CALL FOR PROPOSALS



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Proposals for the Invited Lecture Series 2017 are now being sought. Proposers are invited to suggest a topic and Lecturer for the lecture series, which they should be prepared to organise at their own institution or a suitable conference centre within the UK.

The annual Invited Lecturers scheme aims to bring a distinguished overseas mathematician to the United Kingdom to present a small course of about ten lectures held over five days (Monday-Friday). Each course of Invited Lectures is on a major field of current mathematical research, and is instructional in nature, being directed both at graduate students beginning research and at established mathematicians who wish to learn about a field outside their own research specialism.

The format of an annual Invited Lectures series should:

- include meetings at which a single speaker gives a course of about ten expository lectures, examining some subject in depth;
- be held over a five day period (Monday to Friday) during a University vacation;
- be residential and open to all interested.

A grant of up to £4,000 is available to the host department to support attendance at the lectures. In addition to full expenses, the lecturer is offered an honorarium of £1,250 for giving the course. It is intended that the texts of the lectures given in the series shall be published and an honorarium of £1,500 is also available upon receipt of lecture notes in a publishable form.

Enquiries about the Invited Lectures should be directed to the Programme Secretary at the Society (lmsmeetings@lms.ac.uk). The deadline for the submission of proposals is **5 February 2016**.

For more information about the scheme and how to submit a proposal, please visit: www.lms.ac.uk/events/lectures/invited-lecturer-proposals

The Invited Lecturer for 2016 is **Professor Edgar Knobloch** (UC Berkeley), who will visit Loughborough from 21-25 March 2016 to give a series of lectures on *Dynamics, Patterns and Spatially Localised Structures* (see opposite page).

Recent previous lecturers have been:

- | | |
|------|--|
| 2015 | M. Shapiro (Michigan State University)
<i>Cluster algebras and integrable systems</i> |
| 2014 | J. Väänänen (University of Helsinki and University of Amsterdam)
<i>Games, trees and models, foundations of mathematics and second order logic and The mathematical theory of dependence and independence</i> |
| 2013 | F. Bogomolov (NYU)
<i>Birational geometry and Galois groups</i> |
| 2012 | A. Borodin (MIT)
<i>Determinantal point processes and representation theory</i> |
| 2011 | E. Candes (Stanford)
<i>Compressed sensing</i> |
| 2010 | M. Bramson (University of Minnesota)
<i>Stability of queuing networks</i> |

RECORDS OF PROCEEDINGS AT LMS MEETINGS

ANNUAL GENERAL MEETING AND SOCIETY MEETING OF THE LONDON MATHEMATICAL SOCIETY

held on Friday 13 November 2015 at the British Medical Association House, London. About 150 members and visitors were present for all or part of the meeting.

The meeting began at 3:00 pm, with the President, Professor Terry Lyons, FRS, in the Chair. Members who had not yet voted were invited to hand their ballot papers to the Scrutineers, Professors Chris Lance and Rodney Sharp.

The Vice-President, Professor Ken Brown, presented a report on the Society's activities and the President invited questions.

The Vice-President, Professor John Greenlees, presented his report on the Society's finances during the 2014/15 financial year and the President invited questions.

Copies of the Trustees Report for 2014/15 were made available and the President invited members to adopt the Trustees for 2014/15 by a show of hands. The Trustees Report for 2014/15 was adopted.

The President proposed Messrs Kingston Smith be re-appointed as auditors for 2015/16 and invited members to approve the re-appointment by a show of hands. Messrs Kingston Smith were re-appointed as auditors for 2015/16.

The President, on Council's behalf, proposed that John H. Conway, of Princeton University, be elected to Honorary Membership of the Society in its 150th Anniversary year. This was approved by acclaim. The President read a short version of the citation, to be published in full in the Bulletin.

Fifty-eight people were elected to Ordinary Membership: Dominic Aku, Ahmad Alkenani, Mojtaba Ammari-Allahyari, D.M Basavarajaiah, Michael Blaylock, Robert Blincoc, Elena Boguslavskaya, David Bourne, Christopher Braun, Oleg Chalykh, Nira Chamberlain, Suhyoung Choi, Mark Costine, Stephen Coulson, Hannah Davies, Alfredo Deano, Sam Dolan, Jessica Enright, Alex Fink, Dmitri Finkelshtein, Jan Foniok, Nic Freeman, Andras Hrasko, Tyler Kelly, Eun-Jin Kim, Meena Kotecha, Anish Kumar, Irene Kyza, Kurt Langfeld, Marie-Amelie Lawn, Han Lee, Thomas Lidbetter, Yu Lu, Madhusudan Manjunath, Sandro Mattarei, Sarbari Mukherjee, Bertie Muller, Johan Martens, Loc Nguyen, Michael Nieves, Semiu Oladipupo Oladejo, Joana Oliveira Dos Santos Amorim, Olivier Menoukeu Pamen, Dmitrii Pasechnik, David Percy, Mariya Ptashnyk, Susanne Pumpluen, Mihai Putinar, Igor Rivin, Alex Roberts, Amir Saei, Sarabjit Sandhu, Travis Schedler, Bernd Schomburg, Memhet Haluk Sengun, Mahmood Shihab, Shafali Shown-Keen, Lawrence Smallman, Lutz Warnke.

Forty-three people were elected to Associate Membership: Ammad Ahmed, Sanna Ansari, Maryam Argungu, Marcel Armour, Aras Asaad, Joe Bailey, Francesca Bianchi, Martina Bohunicka, Arup Borah, Gareth Case, Dimitrios Chatzakos, Ged Corob Cook, Rebecca Cotton-Barratt, Aled Crow, Francisco de Melo Virissimo, Phil Emmott, Noel Ferrand, Carlos Fresneda-Portillo, Ming Gao, Alexander Graham, Scott Harper, James Jackaman, Fabian Jacobs, Nicholas Jamieson, Dilip Kumar, Sreekumar Kumar, Jogendra Kumar, Robert Kurinczuk, Yupeng Liu, Joseph Mahele, Emiko Okoturo, Vera Otiende, Rebecca Parkin, Caroline Peters, Ruth Reynolds, Sara Scaramuccia, Anton Solomko, Kathryn Spalding, Julia Stenberg, Stelio Anthony Stylli, John Sylvester, Thomas Windisch. Hector Zenil.

Five people were elected to Reciprocity Membership: Igor Freire, Oghenetega Stephen Irererhievwie, Santiago More, Idowu Osinuga, Robert van den Berg.

Sixty people were elected to Associate Membership for Teacher Training Scholars: Shamim Akhtar, Oona Berry, Katharine Broad, Grace Charalambous, Emma Clark, Andrew Coffey, Victoria Coome, Natalie Cummins, Ilaria D'Adamo, Paul Dean, Michael Dennett, Michael Dick, Adam Dubale, Ross Friel, Andrew Frost, Luke Garner, Jack Gavin, Emily Grayson, Aidan Gollaglee, Amelia Guinee, Ahmed Gul, Wakas Hanif, Emily Hewson, Taslima Hussain, Gautam Jain, Adam Jasko, Adam Jennings, Abeer Jeylani, Elizabeth King, Samuel Lewis, Kevin Leahy, Mike Lewry, Joseph Lucas, Siddharth Madhusudan, Sana Malik, Chloe Mason, Laura McGuinness, Alexander Milne, Lisa Mott, Miharuru Obata, Styliani Papadatou, Anushka Puri, Amanda Ridout, Jordan Roberts, Sarah Roche, Samuel Rooyen, Katie Rowlands, Miles Saunders-Priem, Jennifer Shackley, Sukhjeet Singh, Jessica Smith, Rebecca Smith, Lisa Smith, Gavin

Stewart, Julia Sturgess, Sarah Timlin, Katherine Watson, Heidi Wright, Samuel Wright, Pamela Yeh. Three members signed the book and were admitted to the Society.

The President, on Council's behalf, presented certificates to the 2015 Society Prize-winners:

Polya Prize: Professor Boris Zilber

Shepherd Prize: Professor Keith Ball, FRS

Senior Whitehead Prize: Professor Robert Mackay, FRS

Naylor Prize: Professor Steven Jonathan Chapman

Whitehead Prizes: Dr James Maynard, Professor Christoph Ortner, Professor Mason Porter, Professor Dominic Vella, Dr David Loeffler and Dr Sarah Zerbes

Anne Bennett Prize: Dr Apala Majumdar

The winners of the Berwick Prize, Pierre-Emmanuel Caprace and Nicolas Monod, and the winner of the sixth Whitehead Prize, Professor Peter Keevash, were unable to attend to collect their prizes.

The President, on Council's behalf, presented certificates to the following winners of a special prize, established for the 150th Anniversary:

Hirst Prize and Lectureship: Dr John O'Connor and Professor Edmund Robertson

Professor Christopher Budd, winner of the Communication Prize, also established for the 150th Anniversary year, was unable to attend to collect his prize.

The President announced that the next meeting of the Society would be at QMUL on 28-29 November 2015 as part of the Joint Meeting with the Institute of Physics and the Royal Astronomical Society to celebrate the centenary of the presentation of the *Theory of General Relativity* by Albert Einstein to the Prussian Academy of Sciences. The following meeting would be at the ICMS in Edinburgh as part of the Joint Meeting with the Edinburgh Mathematical Society with a Workshop on *Big Data*.

Professor Bill Cook, University of Waterloo, gave a lecture on *In pursuit of the travelling salesman: mathematics at the limits of computation*.

After tea, Professor Sharp announced the results of the ballot. The following Officers and Members of the Council were elected.

President: Simon Tavaré

Vice-Presidents: Ken Brown, John Greenlees

Treasurer: Robert Curtis

General Secretary: Stephen Huggett

Publications Secretary: John Hunton

Programme Secretary: Iain A. Stewart

Education Secretary: Alice Rogers

Members-at-Large of Council (for 2 year terms): Tony Gardiner, Sam Howison, Diane Maclagan, Gwyneth Stallard, Alina Vdovina

Members-at-Large of Council (for 1 year terms): Francis W. Clarke, David M. Evans

Member-at-Large (Librarian): June Barrow-Green

Four Members-at-Large who were elected for two years in 2014 have a year left to serve: Alexandre Borovik, Tara Brendle, Cathy Hobbs and Beatrice Pelloni.

The following were elected to the Nominating Committee: Ursula Martin and Sarah Rees. The continuing members of the Nominating Committee are: John Toland (Chair), Martin Bridson, Stephen Donkin, Paul Glendinning and Alex Wilkie.

Professor Terry Lyons handed over the Presidential badge of office to Professor Simon Tavaré. The new President thanked members for the honour and privilege of being elected as President and promised to fulfill the Charter, Statutes and By-laws of the Society.

The newly-elected President, Professor Simon Tavaré, FRS, took the Chair.

Professor Terry Lyons, FRS gave the Presidential Address on *Enveloping algebras, signatures and Chinese handwriting*.

After the meeting, a reception was held at De Morgan House, followed by the Annual Dinner, which was held at the Montague Hotel and attended by 100 people.



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Modern topics in Nonlinear PDE and Geometric Analysis

LMS-CMI Research School, Reading, 4-8 July 2016

Organisers: Stefanos Aretakis (Princeton, USA) and Nikos Katzourakis (Reading, UK).
For further information please visit: <http://ow.ly/VA0cK>. The three main lecture (6+2)-hour courses will be:

- Course 1: Nonlinear PDE and Calculus of Variations
Lawrence C. Evans (Berkeley, USA) - *Nonlinear PDE and optimisation*
Jan Kristensen (Oxford, UK) - *Convexity notions in the Calculus of Variations*
- Course 2: Geometric Hyperbolic PDE, General Relativity & Fluid Dynamics
Mihalis Dafermos (Princeton, USA - Cambridge, UK) - *The stability problem for black holes*
Gustav Holzegel (Imperial College, UK) - *The formation of shocks in three dimensional fluid dynamics*
- Course 3: Geometric Nonlinear PDE
Bernard Dacorogna (EPFL, Switzerland) - *The pull-back equation for differential forms*
Spyros Alexakis (Toronto, Canada) - *On dynamical stability of singular Ricci solitons under Ricci flow*
- The distinguished guest lecturers are **Robert Jensen** (Chicago, USA) and **Juan Manfredi** (Pittsburgh, USA)

Applications should be made by 11 April using the form at <http://ow.ly/VA0i0>. Research students, post-docs and those working in industry are invited to apply. Numbers will be limited and those interested are advised to make an early application. *All applicants will be contacted within two weeks after the deadline.

All research students will be charged a registration fee of £150 and all early career researchers will be charged a registration fee of £250. There will be no charge for subsistence costs for these groups. All other participants (e.g. those working in industry) will be charged a registration fee of £250 plus the full subsistence costs.

All UK-based participants must pay their own travel costs. For overseas participants, support will be available to contribute towards travel costs. Fees are not payable until a place on the course is offered but will be due by Friday 27 May 2016.

LMS ANNUAL GENERAL MEETING

Report

The 2015 LMS Annual General Meeting was held at the BMA House in Tavistock Square, London on Friday 13 November 2015. The meeting was preceded in the morning and early afternoon by the 2015 LMS Graduate Student Meeting.

The AGM was held in The Great Hall of the BMA House. Following the welcome, Vice-President Professor Ken Brown gave a report on the Society's activities over the last year and highlighted the notable changes since the previous year.

Vice-President John Greenlees then presented the report of the Society's Treasurer, Professor Robert Curtis, on the past year and invited questions.

This was followed by the resolutions in which the President of the Society, Professor Terry Lyons, invited questions and recommended the adoption of the Trustees' report. This was in turn followed by the official appointment of the Auditors, and the election of the new Honorary Members of the Society. Professor Terry Lyons then presented the certificates to the 2015 LMS Prize Winners, honouring the contribution made by these mathematicians.

The first of two talks presented at the



Certificates presented to John O'Connor and Professor Edmund Robertson awarded for the Hirst Prize and Lectureship

AGM was by Professor Bill Cook of the University of Waterloo. The talk was titled *In pursuit of the traveling salesman: mathematics at the limits of computation*. Professor Cook presented an overview of the traveling salesman problem and how the problem has impacted the mathematical development of algorithms during the last century. He presented current research into the problem from a theoretical as well as applied perspective, and emphasised its link with the famous P versus NP problem.

The talk of Professor Bill Cook was followed by a break with tea and coffee which gave an opportunity for everyone



Vice President Ken Brown



William Cook Lecture



LMS prize winners

to meet other attendees of the AGM and members of the Society. Shortly after the break, Professor Terry Lyons declared the official results of the election and welcomed the new President of the LMS, Professor Simon Tavaré.

The second talk of the AGM was given

by Professor Terry Lyons in his presidential address titled *Enveloping algebras, signatures and Chinese handwriting*. Professor Lyons presented a mathematical object called the path signature and emphasised its role in classical and stochastic analysis. He gave an overview of the current research

being carried out in this field and presented several currently open problems. Professor Lyons concluded with an application of signatures to a challenging machine learning problem of recognising Chinese handwritten characters in a mobile phone application.

After the conclusion of the AGM, the audience was invited to a reception at De Morgan House in Russell Square, which was followed by the Society's Annual Dinner.



LMS President and immediate Past President

Ilya Chevyrev
University of Oxford

LMS GRADUATE STUDENT MEETING

Report

The autumn London Mathematical Society Graduate Student Meeting (GSM) was held on 13 November 2015 at the statuesque BMA House in Tavistock Square, London. The meeting preceded the Annual General Meeting of the Society which included the final address of Terry Lyons' presidency as well as a lecture by Bill Cook (University of Waterloo) on the travelling salesman problem.

The GSM was an excellent opportunity for graduate students from various universities to become acquainted and exchange ideas in a friendly environment. It also encouraged many of us to attend the Annual General Meeting and to feel part of the Society's 150th anniversary celebrations.

After the essentials of coffee and pastries, we assembled in the Murrell Room to hear the first speaker of the GSM. Professor Dan Crisan (Imperial College, London) gave an historical account of the notion of a mathematical integral, finishing with an introduction to rough path integration.

François-Xavier Briol (Warwick) began the graduate student talks where Dan Crisan left off, with a brief talk on numerical and probabilistic integration – a fashionable field in today's world. This was followed by two talks on the more classical area of hyperbolic geometry by Irene Pasquinelli (Durham) and Dimitrios Chatzakos (UCL). Sam Fearn



Dan Crisan (Imperial College, London)

(Durham) then gave an exposition of *Mathieu 24*, a particular sporadic group whose representation theory has surprising links with string theory! And, Vasiliki Evdoridou (Open University) spoke about the escaping set of a certain dynamical system which is known as – and is reminiscent of – a spider's web.

After lunch, we were jovially welcomed to the first and only afternoon session of the GSM by Dr Horatio Boedihardjo (Reading). Horatio spoke about the philosophy behind rough path theory and its connections with other areas of science and Mathematics. He hinted also at various remaining open problems therein which may be of interest to graduate students.

Sina Nejad
University of Oxford



Sam Fearn (Durham)



Irene Pasquinelli (Durham)

THE SCIENCE OF BEAUTY

Report

The experience of beauty is a topic of very great interest to us all. Debates about its nature have traditionally been confined to the humanities and especially the philosophy of aesthetics. It is only relatively recently that neurobiology has addressed the topic of the neural determinants of aesthetic experience derived from different sources, from visual art to mathematics and moral beauty. While these studies have given very interesting results – in particular showing that there are specialized brain pathways for aesthetic judgment and that the “aesthetic emotion” aroused by different sources correlates with activity in the same parts of the emotional brain – they have also raised fundamental questions that are of interest to science and the humanities alike. One statistic demonstrates impressively the huge interest in a topic that combines different approaches to the study of beauty. The paper of Atiyah and Zeki on *The Experience of Mathematical Beauty and its Neural Correlates* published in February 2014 has so far been viewed around 110,000 times, a record in neuroscience and probably in mathematics as well.

The LMS was one of the sponsors of a two-day multidisciplinary conference on *The Science of Beauty* addressing these issues, which was held at the Royal Society of Edinburgh from 10 to 11 November 2015, and chaired by the RSE President Dame Jocelyn Bell Burnell. The scientific organizers were Sir Michael Atiyah (Trinity College, Cambridge and the University of Edinburgh) and the neuroscientist Semir Zeki (University College, London), who gathered a distinguished galaxy of speakers from the worlds of mathematics, neuroscience, philosophy, aesthetics, biology and physics:



© Gerardo Jaconelli, courtesy of the Royal Society of Edinburgh

Sir David Attenborough

- Sir Michael Atiyah *The Role of Beauty in Mathematics*
- Sir David Attenborough *Beauty in the Animal World*
- Angela Breitenbach *Philosophical Approaches to Beauty in Mathematics*
- Nicky Clayton and Clive Wilkins *Conversation without Words*
- Robbert Dijkgraaf *Beauty in Physics and Mathematics*
- Cinzia Di Dio *The Neurobiology of Beauty, as Related to Proportion*
- Beatrice de Gelder *The Perception of Human Beauty*



© Gerardo Jaconelli, courtesy of the Royal Society of Edinburgh

Sir Michael Atiyah, Sir David Attenborough,
Sir Roger Penrose



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Dame Jocelyn Bell Burnell, Sir Michael Atiyah

- Gordon Graham *Beauty and Excellence in Scottish Philosophical Aesthetics*
- Tomohiro Ishizu *The Neurobiology of Aesthetic Judgements*
- Winfried Menninghaus *Literature and Empirical Aesthetics*
- Sir Roger Penrose *The Role of Art in Mathematics*
- Michael Trimble *The Beauty of Tears and Tears of Beauty: Neurobiology of Sorrow*
- Semir Zeki *Neural Correlates of the Experience of Beauty, Including Mathematical Beauty*

The conference concluded with a concert at the church of St Andrew and St George *Going to Ground: Musical Magic from Pervasive Patterns* by Oscar Garcia-Prada countertenor and Din Ghani lutes.

Unfortunately, David Mumford could not attend in person, but the text of his planned lecture on *Math & Beauty & Brain Areas* was distributed at the conference.

The meeting was a great success, with many thought-provoking contributions from participants with widely differing intellectual backgrounds. The attendance was in excess of 100, including many students. The presentation by David Attenborough was a particular highlight: as he pointed out Alfred Russel Wallace believed that it was absurd to attribute aesthetic appreciation to birds, while Charles Darwin thought otherwise. Video sequences of beautiful animal behaviour persuaded the audience that Darwin was right.

The RSE website <https://www.royalsoced.org.uk/> contains detailed reports on the talks, including some videos.

Andrew Ranicki
Edinburgh



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Group photo in the Scott Room of the Royal Society of Edinburgh

UNDERGRADUATE ESSAY PRIZE

The British Society for the History of Mathematics is pleased to invite submissions for its 2015-16 undergraduate essay prize. The essay, which may be on any topic within the history of mathematics, should be no more than 2,500 words (excluding references). The competition is open to any person who is enrolled as an undergraduate in a UK or Irish university during the academic year 2015-16. The value of the prize will be £100, plus free membership of the Society for a year.



BRITISH SOCIETY
FOR THE HISTORY
OF MATHEMATICS

Details about how to enter can be found on the Society website (www.bshm.ac.uk/ug-essay). The deadline for receipt of submissions is **Friday 1 July 2016**.

RAMANUJAN PRIZE 2016

Call for Nominations

The Ramanujan Prize for young mathematicians from developing countries has been awarded annually since 2005. The Prize is funded by the Department of Science and Technology of the Government of India (DST). It is administered jointly by the Abdus Salam International Centre for Theoretical Physics (ICTP), the International Mathematical Union (IMU) and the DST.

The Ramanujan Prize is usually awarded to one person, but may be shared equally

among recipients who have contributed to the same body of work. The Prize is awarded annually to a researcher from a developing country who is less than 45 years of age on 31 December of the year of the award, and who has conducted outstanding research in a developing country.

Nominations can only be made by using the online system. See <http://tinyurl.com/ncg6nun>. The deadline for nominations is **Tuesday 1 March 2016**.

ROYAL SOCIETY MEDALS AND AWARDS 2016

The Royal Society is seeking nominations for its 2016 medals and awards. The medals, awards and prize lectures provide an opportunity to recognise and celebrate outstanding scientific achievement. They range from subject specific medals to those celebrating the communication and promotion of science and include the world's oldest scientific prize, The Copley Medal.

The full list of awards is available at <http://tinyurl.com/pebo57f>. The Royal

Society invites nominations for candidates across the disciplines and encourages consideration of women, under-represented minorities and those undertaking research in industry.

The closing date for nominations is **Monday 1 February 2016**. Full details on how to nominate and further information on all awards is available at <http://tinyurl.com/q6ogfom>. For further assistance email awards@royalsociety.org or call 020 7451 2213.



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LMS PRIZES 2016 CALL FOR NOMINATIONS

The London Mathematical Society welcomes nominations for the 2016 prizes, to recognise and celebrate achievements in and contributions to mathematics.

In 2016, the LMS Council expects to award:

De Morgan Medal

The Society's premier award; the only grounds for the award of the Medal are the candidate's contributions to mathematics.

Fröhlich Prize

Awarded for original and extremely innovative work in any branch of mathematics.

Senior Berwick Prize

Awarded in recognition of an outstanding piece of mathematical research actually published by the Society during the eight years ending on 31 December 2015.

Whitehead Prizes

Awarded for work in and influence on mathematics.

Anne Bennett Prize

Awarded for work in and influence on mathematics, particularly acting as an inspiration for women mathematicians.

For further information and nomination forms, please visit the LMS website (www.lms.ac.uk/content/nominations-lms-prizes) or contact Duncan Turton, Secretary to the Prizes Committee at the Society (tel: 020 7927 0801, email: prizes@lms.ac.uk).

The Prizes Committee is keen to increase the number of nominations it receives and, in particular, the number of nominations for women, which are disproportionately low each year. The prize regulations refer to the concept of 'academic age' — rather than date of birth — in order to take account more fully of broken career patterns.

**Closing date for nominations:
Monday 25 January 2016**



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2016 LOUIS BACHELIER PRIZE – CALL FOR NOMINATIONS

The Louis Bachelier Prize is a biennial prize jointly awarded by the London Mathematical Society (LMS), the Natixis Foundation for Quantitative Research and the Société de Mathématiques Appliquées et Industrielles (SMAI). The Prize will be awarded to a mathematician who, on the 1st January of the year of its award, has *fewer than 20* years (full time equivalent) of involvement in mathematics at postdoctoral level, allowing for breaks in continuity, or who in the opinion of the Bachelier Prize Committee is at an equivalent stage in their career.

The Prize will be awarded to the winner for his/her exceptional contribution to mathematical modelling in finance, insurance, risk management and/or scientific computing applied to finance and insurance.

Nominations are now open for the 2016 Louis Bachelier prize. A form for making nominations is available to download at <https://www.lms.ac.uk/prizes/louisbachelierprize>.

The closing date is 31st January 2016.

The prize-winner will have a list of outstanding publications in top quality academic journals in the areas of quantitative finance, risk management, or computational methods in finance and be recognised by his/her peers in academia and the industry for his/her exceptional contribution to mathematical modelling in finance. Nominees must be permanent residents in Europe (in the geographical sense).

The prize winner will receive €20,000 including £5,000 to organise a scientific workshop in Europe on their area of research interests.

The Louis Bachelier Prize, initially "Prix NATIXIS-SMAI", was instituted in 2007 by the NATIXIS Foundation for Quantitative Research and the Société de Mathématiques Appliquées et Industrielles.

The London Mathematical Society is a registered charity (Charity Commission number 252660) for the promotion of mathematical knowledge.



FROM THE GRAIN TO THE CONTINUUM: TWO PHASE DYNAMICS OF A PARTIALLY MOLTEN, POLYCRYSTALLINE AGGREGATE

11-15 April 2016

in association with the Isaac Newton Institute programme

Melt in the Mantle

(15 February – 17 June 2016)

The dynamics of partially molten rocks in Earth's interior are critical to a wide range of geodynamic phenomena. The generation and extraction of melt at mid-ocean ridges, the link between subduction and arc volcanism, the rheological behavior of the deep interior, the chemical differentiation of Earth, and the ability to image these processes with geophysical observations all fundamentally rely on the grain-scale physics of partially molten systems.

Future breakthroughs on grain-scale processes in the partially molten mantle will require collaboration and innovation among theoretical, computational, and experimental subdisciplines. Physical models of melt migration, melt-rock reaction, and textural evolution must all be integrated with models of elastic, plastic, and viscous deformation in the solid state. These models need to agree with experimental observations while stimulating future experiments to test unconstrained aspects of the models. Finally, these physical models must be encapsulated so that grain-scale dynamics, at the millimeter scale and below, can be coarsened to geologically relevant scales of kilometers. This final step is particularly challenging given that (1) the grain-scale processes inherently occur in discontinuous media while the large-scale phenomena are preferably treated as continua, (2) the grain-scale processes may, themselves, depend upon sub-grain, atomistic, modeling, and (3) the material properties relevant to the upper mantle exhibit strongly non-linear behavior.

To overcome these major hurdles requires interaction and collaboration among experimentalists, computational geodynamicists, and applied mathematicians. The aim of this workshop is to bring together leading scientists from solid-earth science, materials science, and applied mathematics to discuss the current state-of-the-art and future directions in grain-scale physical models for partially molten systems, magma dynamics in the laboratory, elasticity theory and seismic wave propagation in partially molten rocks, and upscaling and homogenisation methods for applying grain-scale models to geodynamic processes.

Further information and application forms are available from the website
www.newton.ac.uk/event/mimw02

Closing date of the receipt of applications **1 February 2016**.

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computer science meet
the next generation



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Submission Deadline: February 3, 2016

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Young researcher at HLF 2015

The Heidelberg Laureate Forum connects highly talented young researchers (undergraduates, PhD candidates, and postdocs) with the best scientists in their research fields: mathematics and computer science (Abel, Fields, Turing, and Nevanlinna Laureates).



For more information and online application, please visit:

www.heidelberg-laureate-forum.org

VISIT OF BIRGIT JACOB

Professor Birgit Jacob (University of Wuppertal, Germany) will visit the universities of Newcastle-upon-Tyne, Leeds and Oxford from 16 to 24 February 2016. Professor Jacob has made significant contributions in the areas of systems and control theory, including PDEs and operator semigroups. During her visit she will give talks as follows:

- University of Newcastle-upon-Tyne, Tuesday 16 February at 4.30 pm
Energy-based analytic methods for evolution equations
(contact Evgenios Kakariadis: Evgenios.Kakariadis@newcastle.ac.uk)
- University of Leeds, Thursday 18 February at 4 pm
Hyperbolic partial differential equations on the semiaxis
(contact Jonathan Partington: J.R.Partington@leeds.ac.uk)
- University of Oxford, Tuesday 23 February at 5 pm
Energy-based analytic methods for evolution equations
(contact Charles Batty: charles.batty@sjc.ox.ac.uk)

For further details contact Jonathan Partington (J.R.Partington@leeds.ac.uk). The visit is supported by an LMS Scheme 2 grant.

VISIT OF MIKHAIL MALYUTOV

Professor Mikhail Malyutov (Northeastern University, Boston, MA, USA) will visit the universities of Leicester, Warwick, Nottingham and Manchester from 14 February to 15 May 2016 His visit will be devoted to the mathematical problems of time series analysis. Professor Malyutov will present the results of the complexity analysis and statistical methods based on universal codes. He will describe how universal codes can be used for solving some of the most important statistical problems for time series. All problems are considered within the framework of classical mathematical statistics while, at the same

time, everyday methods of data compression (or archivers) can be used as a tool for the estimation and testing.

During his visit Professor Malyutov will give the following presentations:

- University of Leicester, 9 March
Compression based authorship attribution of literary works
- University of Nottingham, 28 April
Sparsity against exponential complexity in big data
- University of Warwick, 6 May
Context-free and grammar-free statistical testing identity of styles
- University of Manchester, 11 May
SCOT modelling, parallel training and statistical inference

Professor Malyutov will also deliver a series of lectures for MSc and PhD students about SCOT based Stock market models during February and March at the University of Leicester.

For further details contact Alexander N. Gorban (ag153@le.ac.uk). The visit is supported by an LMS Scheme 2 grant.

VISIT OF UTKIR ROZIKOV

Professor Utkir Rozikov (Institute of Mathematics, Tashkent, Uzbekistan) will be visiting the School of Mathematics at the University of Leeds from 29 January to 1 March 2016. He works in probability, mathematical physics and analysis, specializing in dynamical systems and statistical mechanics. Professor Rozikov has made significant contributions to the analysis of Gibbs states on trees, in particular with random interactions, and published an authoritative research monograph *Gibbs Measures on Cayley Trees* (World Scientific, 2013). He has promoted new tools to study Gibbs measures on graphs, such as group representation theory, information flows, node-weighted random walks, contour methods on trees, and nonlinear analysis. He has also advanced the idea of p -adic dynamics applied to statistical mechanics on Cayley graphs of non-amenable groups. His more recent research interests are focused on evolution

algebras of sex-linked populations, aiming to incorporate thermodynamics in mathematical biology models.

During his visit, Professor Rozikov will give the following seminars:

- Durham University, Department of Mathematical Sciences, Statistics seminar, Monday 1 February, 14:00, room CM221: *p-adic Gibbs measures* (www.dur.ac.uk/mathematical.sciences/events/seminars/?seminar=4489; contact Ostap Hryniv: Ostap.Hryniv@durham.ac.uk)
- Warwick University, Department of Mathematics, Statistical Mechanics seminar, Thursday 4 February, 14.00, room MS.04 (Zeeman Building): *Gibbs measures of the Ising model on Cayley trees: Modern*

results and open problems (www.ueltschi.org/seminars/index.php?date=160101; contact Daniel Ueltschi: D.Ueltschi@warwick.ac.uk)

- University of Leeds, School of Mathematics, Mathematical Biology and Medicine seminar, Wednesday 10 February, 12.00: *Stochastic dynamical systems in population biology* (www1.maths.leeds.ac.uk/research/mathbiomed/; contact Jeanine Houwing-Duistermaat: J.Duistermaat@leeds.ac.uk)

For further details contact Leonid Bogachev (L.V.Bogachev@leeds.ac.uk). The visit is supported by an LMS Scheme 2 grant and a visiting research grant from the School of Mathematics at Leeds.

SINGULARITIES AND APPLICATIONS

Victor Goryunov 60

A workshop in celebration of the 60th birthday of Victor Goryunov will be held in Liverpool from 30 March to 2 April 2016. The meeting will cover several areas of singularity theory and applications, including geometrical problems, singular spaces, differential equations and algebraic geometry. Among those who have accepted invitations to participate are:

- Jean-Paul Brasselet (Aix-Marseille)
- Alexey Davidov (Moscow)
- Andrew du Plessis (rhus)
- Eugene Gorsky (UC Davis)
- Ursula Ludwig (Duisberg-Essen)
- David Massey (North-Eastern)
- David Mond (Warwick)
- Mutsuo Oka (Tokyo)
- Patrick Popescu-Pampu (Lille)
- Maria del Carmen Romero-Fuster (Valencia)
- Maria Aparecida Soares Ruas (São Paulo)
- Inna Scherbak (Tel Aviv)

For further details see www.liv.ac.uk/~pjgiblin/VVG60/VVG60.htm. There is significant funding for UK based PhD

students to attend and there will be poster sessions and the opportunity for short presentations. The registration fee will be about £40, waived for PhD students. Any enquiries should be directed to Peter Giblin (pjgiblin@liv.ac.uk).

The workshop is supported by an LMS Conference grant and by grants from the Department of Mathematical Sciences and the Faculty of Science and Engineering at the University of Liverpool.

THE DYNAMICS OF COMPLEX SYSTEMS

Robert MacKay 60

This meeting, in honour of the 60th birthday of Robert MacKay, FRS, will be held at the University of Warwick from 18 to 20 May 2016. This meeting is to survey how the mathematics of complex systems (including dynamical chaos (dissipative and conservative), spatial-temporal chaos, and networks) is driving research in physics, biology and economics, and to celebrate the mathematical and scientific work and influence of Robert MacKay FRS on the occasion of his 60th birthday. The meeting will bring together leading researchers, establishing the current state of research at the interface of dynamical

cal systems, complex systems, and real-world applications. Current research results and future directions will be disseminated to a wide audience including PhD students and early-career researchers. We expect to welcome participants with a broad scientific background from the UK, Europe, and internationally, in particular from the complex systems and nonlinear dynamics communities and from those developing applications of mathematics to ecology, epidemiology, systems biology, statistical physics, mechanics and finance.

Only invited speakers will be allocated a time slot for oral contributions. However, all participants are welcome to present a poster. Posters will be displayed during the entire meeting, and a prize will be awarded for the best poster presented by a PhD student.

This conference is open to anyone interested. There is a registration fee of £80 to cover refreshments, three lunches (Wednesday, Thursday, Friday), dinner (Wednesday), and the conference dinner (Thursday). Register at <http://tinyurl.com/plqb792> where you can also ask to reserve accommodation.

Thanks to the LMS and others, the organisers have some funds to support travel, accommodation expenses and/or registration fee for a limited number of participants, in particular young scientists. Participants are expected to cover travel and accommodation expenses from their own grants whenever reasonable to do so. Financial support can be requested during the registration process.

WHY BE NONCOMMUTATIVE?

A one-day conference will be held on 8 February 2016, at Imperial College London to mark Travis Schedler's new appointment there. Three speakers will give broad-interest talks which help answer the titular question 'why be noncommutative?', introducing noncommutative geometry, algebra, and representation theory, and some recent applications. Graduate students and post-

doctoral researchers are especially encouraged to attend! The speakers will be:

- Iain Gordon (University of Edinburgh)
- Travis Schedler (Imperial College London)
- Toby Stafford (University of Manchester)

Everyone will be invited to a dinner afterwards, partly subsidized for PhD students. There is also limited money to support PhD students' travel to London. Contact Travis Schedler at t.schedler@imperial.ac.uk if you need assistance.

For more information see the website at <https://sites.google.com/site/whybenoncommutative/> which will be regularly updated. The conference is supported by an LMS Conference grant celebrating new appointments

MATHEMATICS EMERGING

A tribute to Jackie Stedall and her influence on the history of mathematics

The British Society for the History of Mathematics (BSHM) is holding a special two-day meeting on Saturday 9 and Sunday 10 April 2016 at The Queen's College, Oxford, to celebrate the work of Jackie Stedall. The focus will be sixteenth and seventeenth century European developments in algebra, analysis and geometry. It will be a mixture of general interest sessions and more specialised research topics; the Sunday morning session will focus on Thomas Harriot. Speakers include:

- Philip Beeley (Oxford)
- Rosie Cretney (Open University)
- Robert Goulding (University of Notre Dame)
- Niccolò Guicciardini (University of Bergamo)
- Karen Parshall (University of Virginia)
- Eleanor Robson (University College London)
- Matthias Schemmel (Max Planck Institute)
- Thomas Sonar (Technische Universität Braunschweig)
- Benjamin Wardhaugh (Oxford)

Provisional fees: BSHM members £60, (students £30); Non-members: £90 (students £60). Conference dinner £40, day rate lunch and refreshments £45, overnight B&B £50. The conference is being supported by an LMS Conference grant, the International Committee for the History of Mathematics and the Oxford University Mathematical Institute.

Further information can be found at <http://tinyurl.com/oldz8pc>.

GROUPS IN GALWAY 2016

Groups in Galway has been running on an annual basis since 1978. The two-day meeting on group theory and related topics will be held at National University of Ireland, Galway, from Friday 20 to Saturday 21 May 2016. The speakers include:

- Collin Bleak (University of St Andrews)
- John Burns (NUI Galway)
- Francesco de Giovanni (University of Naples)
- Ellen Henke (University of Aberdeen)
- Mark Lawson (Heriot-Watt University)
- Nadia Mazza (Lancaster University)
- Bob Oliver (Université Paris 13)
- Shane O'Rourke (Cork Institute of Technology)
- Said Sidki (Universidade de Brasilia)
- Peter Symonds (University of Manchester)

There will be a poster session for students, PhD students, post-doctoral research fellows and other young researchers, and research expenses prizes will be awarded to the top ranked posters. If you are not based in Galway, you can send a pdf file of your poster to Sejong Park (sejong.park@nuigalway.ie) and he will print your poster locally (free of charge for the participant), in order to avoid transport damage.

There is no conference fee. Further information can be found at the conference homepage www.maths.nuigalway.ie/conferences/gig16/. Contact the organizers Ted Hurlley (ted.hurlley@nuigalway.ie) or Sejong Park (sejong.park@nuigalway.ie) if you have more questions.

INTEGRABLE SYSTEMS

The third edition of the meeting *Integrable Systems in Newcastle* will take place over two half days, from 5 to 6 February 2016, at the Department of Mathematics and Information Sciences of Northumbria University, Newcastle upon Tyne. The workshop will focus on exploring new connections between integrability and physics and will promote interactions between leading researchers in both areas. The list of speakers will include:

- Martina Balagovic (Newcastle)
- Gennady El (Loughborough)
- Katrin Leschke (Leicester)
- Pierre-Philippe Dechant (York)
- Davide Proment (East Anglia)
- Noel Smyth (Edinburgh)
- Iain W. Stewart (Strathclyde)

There is no registration fee for this event and support for the expenses of research students may be available. For further information visit the website at <http://group28.northumbria.ac.uk/IS/> or contact Benoit Huard (benoit.huard@northumbria.ac.uk). The meeting is supported by an LMS Conference grant.

DIFFERENTIAL EQUATIONS AND POLYNOMIALS

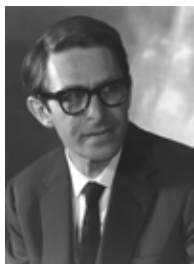
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KLAUS ROTH



Professor Klaus Friedrich Roth, FRS, FRSE, who was elected a member of the London Mathematical Society on 17 May 1951, and awarded the De Morgan Medal in 1983, died on 10 November 2015, aged 90. He was the first British winner of the Fields Medal, and

made fundamental contributions to different areas of number theory, including Diophantine approximation, the large sieve, irregularities of distribution and arithmetic combinatorics.

William Chen, David Larman, Trevor Stuart and Robert Vaughan write: Klaus Roth was born on 29 October 1925, in the German city of Breslau, in Lower Silesia, Prussia, now Wrocław in Poland. To escape from Nazism, he and his parents moved to England in 1933, with his maternal grandparents, and settled in London. He would recall that the flight from Berlin to London took eight hours and landed in Croydon. His father had suffered from gas poisoning during the First World War, and died within a few years of their arrival in England.

Roth studied at St Paul's School, and proceeded to read mathematics at the University of Cambridge, where he was a student at Peterhouse and also played first board for the university chess team. However, he had many unhappy and painful memories of his two years there as an undergraduate. Uncontrollable nerves was to seriously hamper his examination results, and he graduated with third class honours.

After this not too distinguished start to his academic career, Roth then did his war time service as an alien and became a junior master at Gordonstoun, where he divided his spare time between roaming the Scottish countryside on a powerful motorcycle and playing chess with Robert Combe. On the first day of the first British Chess Championships after the war, Klaus famously went up to Hugh Alexander, the reigning champion, to tell him that he

would not retain his title. He was of course right – the previously largely unknown Robert Combe became the new British Champion.

Peterhouse did not support Roth's return to Cambridge after war service, and his tutor J.C. Burkill had suggested instead that he pursued 'some commercial job with a statistical bias'. However, his real ability and potential, particularly his problem solving skills, had not escaped the eyes of Harold Davenport, who subsequently arranged for him to pursue mathematical research at University College London, funded by the highest leaving exhibition ever awarded by his old school. Although Theodor Estermann was officially his thesis advisor, Roth was heavily influenced by Davenport during this period, and indeed into the mid 1960s. He completed his PhD work which Estermann considered good enough for a DSc, and also joined the staff of the Department of Mathematics.

The early problems Roth studied were centred around the Hardy-Littlewood technique, the highlight being undoubtedly his novel application of the technique to sequences that are not explicitly given and resulting in his famous result on three terms in arithmetic progression, paving the way for further progress by Szemerédi, Gowers, Green, Tao and others in arithmetic combinatorics.

Davenport's influence clearly cultivated Roth's interest in Diophantine approximation. There is significant work already done by Dirichlet, Liouville, Thue, Siegel, Dyson and Gelfond. A crucial exponent was believed to depend on the degree of the algebraic number under consideration, but Siegel had conjectured that it should be 2. This is precisely what Roth showed. In a letter to Davenport, Siegel commented that this result 'will be remembered as long as mankind is interested in mathematics'. For this and his result on three terms in arithmetic progression, Roth was awarded the Fields Medal in 1958.

In speaking of Roth's work at the Opening Ceremony of the International Congress of Mathematicians in 1958, Davenport said, 'The achievement is one that speaks for itself: it closes a chapter, and a new chapter is opened. Roth's theorem settles a question which is both

of a fundamental nature and of extreme difficulty. It will stand as a landmark in mathematics for as long as mathematics is cultivated', and ended with the following words: 'The Duchess, in *Alice in Wonderland*, said that there is a moral in everything if only you can find it. It is not difficult to find the moral of Dr Roth's work. It is that the great unsolved problems may still yield to direct attack however difficult and forbidding they appear to be, and however much effort has already been spent on them.'

While most mathematicians consider Roth's result on Diophantine approximation as his most famous, it is in fact another problem that gives him the greatest satisfaction. At about the same time, he became interested in the question of the impossibility of a just distribution for any sequence in the unit interval, conjectured by van der Corput in 1935. Van Aardenne-Ehrenfest obtained the first quantitative estimate in 1949. By reformulating the problem in a geometric setting, Roth obtained in 1954 the best possible lower bound for the mean squares of the discrepancy function. This geometric setting paved the way for what is now known as geometric discrepancy theory, a subject at the crossroads of harmonic analysis, combinatorics, approximation theory, probability theory and even group theory. Once asked why he considered this his best work, Roth replied, 'But I started a subject!' He was particularly pleased that J.C. Burkill, who had remained on good terms, offered the same opinion.

Further recognition came. Roth was elected Fellow of the Royal Society in 1960 and also promoted to a professorship at the University of London in 1961. He was very proud that the Fields Medal, the Fellowship of the Royal Society and the professorship came somewhat in reverse order.

The close relationship between Roth and Davenport in those days can be illustrated by a charming incident some time in the 1950s and which Heini Halberstam recalled with great delight. Early one Sunday morning, Davenport went to his bathroom and switched on the light. The phone rang, and it was Roth. Could he possibly come over and explain the proof of

a new result? Davenport suggested that Roth came after breakfast, but as soon as he put the phone down, the door bell rang. Roth had been so eager that he had spent much of the early morning waiting in the telephone booth across the street.

It was also at this time at University College London that Roth met his wife Melek Khaïry. It was the first ever university lecture given by him and the first ever university lecture attended by her. After the lecture, Roth had asked Halberstam whether he had noticed the young lady on the front row. 'I will marry her' he claimed. By the end of that year, Roth had felt unable to mark Melek's examination script, claiming that he felt 'unable to be impartial', much to the amusement of his colleagues. Another problem at the time was that during their courtship, Melek's sister Hoda often came along. To counter that, Roth brought along his best friend at the time as a distraction for Hoda. His friend took to his assignment with great gusto, and indeed married Hoda.

In the mid 1960s, Roth produced his seminal paper on the large sieve. This is a major step towards better understanding of primes in arithmetic progressions, and the beginning of a major development in analytic number theory.

At about the same time, he had planned to emigrate to the United States to take up the offer of a position at the Massachusetts Institute of Technology where he had spent a year a decade earlier. Imperial College intervened, and agreement was reached in the middle of a reception at the Soviet Embassy in London. Roth said that Sir Patrick Linstead, then Rector of Imperial College, told him that he needed to make an application, but that there would be no other applicant. So Roth joined Imperial College in 1966 after a sabbatical at the MIT, and remained there until his retirement.

At Imperial College, Roth continued an extensive study of the irregularities of integer sequences relative to arithmetic progressions and also made substantial progress on Heilbronn's triangle problem. His famous $1/4$ -theorem of 1964 is the basis of a Fourier



De Morgan House opened on 23 October 1998 by Fields Medalist Sir Michael Atiyah (1966) in the presence of Field Medalists Klaus Roth (1958), Alan Baker (1970), Dan Quillen (1978), Timothy Gowers (1998), Simon Donaldson (1986), Richard Borcherds (1998)

transform approach to irregularities of distribution by Beck in the 1980s, leading to spectacular results. His last work concerns the introduction of probability theory into the study of upper bounds in irregularities of distribution, paving the way for many applications in numerical integration, with implications in many branches of science, engineering and finance.

Roth moved with Melek to Inverness after his retirement. Melek's death in 2002 was a great setback, and Roth never recovered from this loss.

Roth was an excellent lecturer. He explained things so clearly that a good student could often just sit there and listen, and only had to record the details afterwards in the evening. However, he occasionally would have an off day, and he warned his students at the beginning of the year that they would notice these very easily. One of us recalls that on one occasion, Roth wrote down a very complicated expression on the blackboard, then retired to the back of the room. A lot of thought was followed by an equal sign, and he retired to the back of the room again. After a long time

he came once more up to the board and wrote down the same complicated expression on the right hand side. The audience held their collective breath at this profound assertion. But the best was yet to come. He then proceeded to write down $+O(1)$, at which point all burst out laughing. Roth looked at his masterpiece again, turned to the class and protested, 'But it is correct, isn't it?'

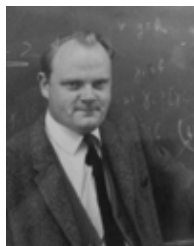
Outside mathematics, Roth enjoyed ballroom dancing, and would waltz away the evening elegantly with Melek. They took this very seriously, to the point that they had a room in their Inverness house specially fitted for dancing practice. For many years while they were in London, they had dancing lessons with Alan Fletcher, who with his wife Hazel were then world ballroom dancing champion. Indeed, Roth dedicated one of his research papers to Alan. He explained that he had been bothered by a problem which he could not solve and was therefore not dancing very well, and that Alan had annoyed him so much by asking him week after week without fail whether he had solved his problem. So when he finally managed to crack it, he needed to

acknowledge Alan for having provided the annoyance.

Roth had maintained great modesty throughout his life. He felt very privileged to have been given the opportunity to pursue what he loved, and very lucky that he had some moderate success. He had always been very generous to his colleagues, and had inspired many to achieve good results.

Roth also received the Sylvester Medal of the Royal Society in 1991. He was also elected Honorary Fellow of the Royal Society of Edinburgh in 1993, Fellow of University College London in 1979 and of Imperial College London in 1999, and an Honorary Fellow of Peterhouse in 1989.

JOHN HUMPHREYS



Dr John Francis Humphreys, who was elected a member of the London Mathematical Society on 20 June 1968, died on 13 October 2015, aged 73.

Russell Higgs writes: John Francis Humphreys was an accomplished

mathematician who made contributions to group theory and coding theory, especially to the theory of projective representations of finite groups.

John initially studied for his PhD under N. Blackburn at the University of Manchester and later under Sandy Green. John spent nearly all his working career at the University of Liverpool, becoming a Reader there in the 1980s. He also spent two years sabbatical at the University of Notre Dame from 1982 to 1984.

From 1969 onwards John published about 50 research papers, two undergraduate textbooks and one research monograph. He had a superb reputation as an expositor and lecturer, inspiring generations of undergraduates in algebra as well as his many PhD students. His book (with M.Y. Prest) *Numbers, Groups & Codes* is a standard textbook in many universities worldwide and is now in its second edition.

John's work was largely concerned with studying and constructing the irreducible projective representations of finite groups, such as the symmetric groups. This is akin to normal representation theory, but with the twist that a non-trivial 2-cocycle introduces. John also considered the more complicated topic of projective modular representations and the assignments of such representations into blocks. One of John's notable achievements was to introduce (with P.N. Hoffman) a new group construction, called the twisted central product. This construction produces (in a non-trivial manner) a central extension of the direct product of two finite groups from a central extension of each and it also enables the irreducible representations of the resulting twisted central product to be readily identified. John also investigated the Schur multiplier of various types of groups such as those of the representation groups of the irreducible finite reflection groups. He became interested in coding theory in the latter part of his career and provided an algebraic decoding for a number of quadratic residue codes over non-binary fields.

BARRY COOPER



Professor S. Barry Cooper, elected a member of the London Mathematical Society on 17 October 1974, died on 26 October 2015, aged 72.

Richard Elwes, Andy Lewis-Pye, Dugald Macpherson and Stan Wainer write: Barry

attended Chichester High School for Boys, and graduated from Oxford in 1966. He studied for a PhD, formally under R.L. Goodstein at Leicester, but worked mainly in Manchester with Mike Yates, the only established UK researcher in Barry's chosen field: the structure-theory of the Turing degrees. He was appointed Lecturer at the University of Leeds in 1969, where he remained, except for regular

sabbaticals and invited visits abroad. He was awarded his Professorship in 1996.

By this time, the study of degree structures had matured into a mathematical discipline of great technical sophistication. Known for his deep, complex constructions, Barry played a prominent international role in this growth. He defined and intensively studied the jump classes, now objects of central importance. His theorem that every degree computably enumerable in and above $0'$ is the jump of a minimal degree, is regarded as a classic. He championed the study of the enumeration degrees, establishing many of their fundamental properties. In later years, Barry also became interested in the practical and philosophical significance of the limits of computability.

The year 2012 marked the centenary of the birth of Alan Turing, a celebration which Barry led with boundless energy, and which did much to bring Turing the public recognition he deserves. Barry became the event's media spokesman and chaired a 6-month programme on Semantics and Syntax at the

Isaac Newton Institute. His edited volume with Jan van Leeuwen *Alan Turing: His Work and Impact* (2013) later won the Association of American Publishers' RR Hawkins Award.

Popular with undergraduates as an outstanding and charismatic teacher, Barry supervised many successful PhD students, and was founder and president of 'Computability in Europe', a flourishing association that now has more than 1,000 members. He was awarded an Honorary Degree from Sofia University in 2011.

Beyond mathematics, Barry played rugby for England under-16s and became a keen long distance runner, with a personal best marathon time of 2hr 48min. He co-founded the Leeds Jazz non-profit organisation in 1984, and was involved in numerous political campaigns, notably the Chile Solidarity Campaign for refugees from 1973.

Barry is survived by his wife, Kate, and their sons Evan and Mark, and by his daughters Carrie and Shirin with his former partner Sue Buckle.

CAMBRIDGE

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THE THEORY THAT WOULD NOT DIE: HOW BAYES' RULE CRACKED THE ENIGMA CODE, HUNTED DOWN RUSSIAN SUBMARINES, AND EMERGED TRIUMPHANT FROM TWO CENTURIES OF CONTROVERSY by Sharon Bertsch McGrayne, Yale University Press, 2012, pp 336, £10.99, US\$16.00, ISBN 978-0300188226.

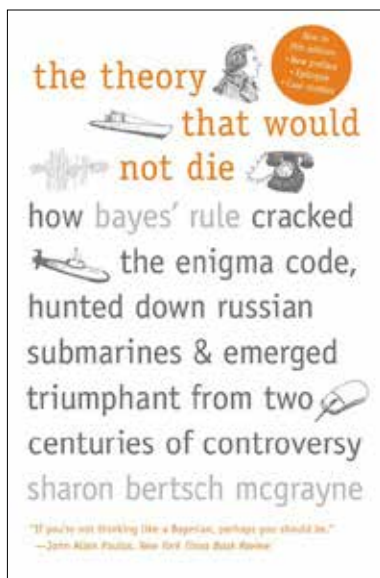
This popular science history of Bayesian arguments and the controversy associated with them first appeared in 2011 and the present edition has a new preface, epilogue and case studies. The book was received enthusiastically because it is involving, wide ranging and well researched; it has a large bibliography and the long list of experts consulted includes many of the actors in the story—they were 'there'!

'There' was principally the Anglo-American statistical community in the decades after the Second World War and a bitter controversy over the validity of Bayesian methods. These are inferential methods involving subjective or logical probabilities and based on the use of Bayes' theorem, the elementary result on conditional probability; the opposed "classical" approach is based on a frequentist concept of probability and evaluates statistical methods on the basis of their properties in repeated sampling. The atmosphere of the times is caught in a joke quoted on p. 51: "What's the collective noun for a group of statisticians? A quarrel." The author's use of the term, "Bayes' rule," conveys something of the flavour of the controversy. She uses it, not as another name for Bayes' theorem, but for something akin to the rule of a religious order—something to be "embraced" (p. 120) or "abandoned" (p. 232) and the focus of "two centuries of controversy" (title).

Parts III to V of the book take us 'there' with titles reflecting the triumphant dynamic: "Glorious Revival," "To Prove its Worth" and "Victory." At the time of writing living memory still extended back to the Second World War which is the subject of Part II. Part I, "Enlightenment and the Anti-Bayesian Reaction," prepares the ground highlighting the founding work of Bayes and Laplace in the eighteenth century and, in the twentieth, the systematising of the classical approach by Ronald Fisher and Jerzy Neyman in the inter-war period with the Bayesian response of Harold Jeffreys in 1939 with detours including the design of telephone systems and Poincaré's contribution to the Dreyfus trial. The discussion in the later parts ranges beyond the core statistical community and such players as Jimmie

Savage, Dennis Lindley and Jack Good to actuaries, business decision makers, military scientists and others in contact with the statisticians but there is no attempt at a systematic treatment of Bayesian arguments by philosophers, scientists, lawyers and others. Again, while the book brings to life the personalities of such critics as Fisher and Neyman, it does not seriously engage with their arguments.

Popular science books aim to inform and enthuse. It is hard to imagine a reader who will not pick up something of the author's (and her witnesses') enthusiasm for the



subject. The technical bar is set low—the only equation in the main text is “Prior times likelihood is proportional to the posterior”—which ensures that the book will reach a range of readers: everyone will get a sense of what it is all about and be exposed to a variety of interesting subjects, including cracking the Enigma code, hunting down Russian submarines, machine translation and risk analysis for nuclear power stations, while the expert reader will adapt to the informality and use the notes and bibliography to pursue topics in depth.

The Theory That Would Not Die is not only the first popular history of this development, it is—I believe—the first book-length history and the first attempt to synthesise materials from the Second World War and after. Fienberg’s article [2] addressed to Bayesian statisticians has similar scope but contains less lively detail while the scholarly histories of Dale [1] and Hald [3] treat only Part I of the story. *The Theory* will be a first recourse for

anybody interested in this development and, while it is a treasury of wonderful stories well-told, I am less enthusiastic about the thesis of the victory of the theory that would not die. On my reading the life and death struggle was not a matter of centuries but of decades in the twentieth century and confined to a particular scholarly community and even in that community the struggle ended where it started—with Bayesian and classical methods co-existing and with most practitioners unwilling to commit either way to *the rule*.

John Aldrich
University of Southampton

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1. A. I. Dale (1999) *A History of Inverse Probability: From Thomas Bayes to Karl Pearson*, second edition, New York: Springer.
2. S. E. Fienberg (2006) *When did Bayesian Inference become “Bayesian”?* *Bayesian Analysis*, 1, (1), 1-40.
3. A. Hald (1998) *A History of Mathematical Statistics from 1750 to 1930*, New York: Wiley.

UNDERSTANDING MATHEMATICAL PROOF

by J. Taylor and R. Garnier, Chapman & Hall, 2014, pp 414, £29.99, ISBN 978-1466514904.

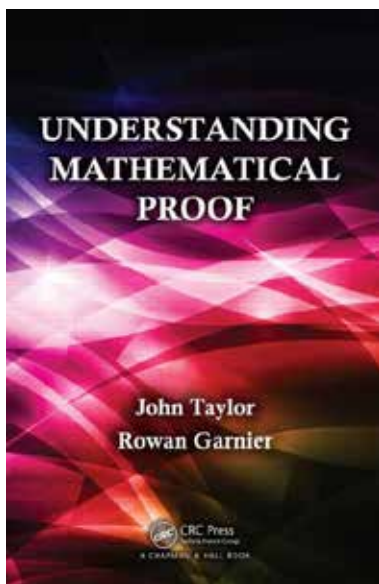
It is an unfortunate truth that mathematical proofs are often not a priority in the current school curricula. As a result of that, many students of mathematics at university level often struggle with this notion in the initial stages of their studies, sometimes even in more advanced stages. The book under review aims at helping students bridge the gap between early exposure to mathematics and a more mature involvement with this discipline by providing a well-written introduction to the notion of proof. In this respect, it is aimed at university students at beginner level of studies of mathematics or of studies in which mathematical reasoning plays an important role.

Roughly speaking, the first part of the book, comprising more or less Chapters 1 to 4, focuses on explaining what proving in mathematics is all about, whereas the second part aims at providing general

guidelines for finding proofs. The book is organized as follows. In Chapter 1 the authors introduce the general notion of proof, understood broadly speaking as a deductive discourse conducted within some precisely delimited language and according to precisely specified rules. They call the readers’ attention to the notion of proof as backbone of mathematics, the very characteristic that distinguishes mathematics from any other cognitive activities. I do not need to delve into this here, of course. Chapter 2 provides a fairly clear introduction to basic formal logic. Chapter 3 introduces the notions from set theory occurring universally within mathematics, specifically the notions of set, membership, function, the basic operations on sets, and so on. Chapter 4 provides an analysis of the logical structure of typical proofs (e.g. proofs that can be split into consideration of various possible cases). Starting

with Chapter 5, the focus shifts towards pointing at specific general strategies for finding proofs in mathematics. The introduction to Chapter 5 expresses quite nicely what the approach is going to be. The remaining chapters present variations on this approach, with the final chapter, Chapter 8, giving a particularly good treatment of the method of proof by induction.

The book is written in a precise and clear style, with lots of appropriately chosen examples and a sufficient amount of (clear) diagrams. On the down side, there are also a number of small typos, which after all should not cause much trouble to attentive readers, as well as some slight inaccuracies or comments which are beside the point. One example of this appears in the second paragraph of page 164: 'The existence of two geometries, one in which the parallel axiom is true and one in which it is false, has certain implications. In particular, it is not possible for both the parallel axiom and its negation to be true, self-evidently or otherwise.' This, of course, is correct, but one certainly does not need to know about the consistency



of any geometry in order to make that point. In my view the exposition presents also oversimplifications in the discussion of some points. This last feature is not necessarily bad in a book meant as introductory text to this topic, but perhaps

some reference to more sophisticated material could have been included. Much of the focus is in explaining specific basic techniques like that of proof by induction and, in general, on proofs of a rather constructive nature. I would have liked to see more on proofs employing more non-constructive methods, for example using the Axiom of Choice. This could have led to some discussion, at least on a marginal level, as to what axioms would be reasonable to employ in mathematics and, perhaps, other (thought--provoking) issues of foundational flavour.

To conclude, this book, although clearly not aimed at the typical reader of LMS reviews, could be useful to, and enjoyed by, students seeking a concise introduction to the notion of mathematical proof.

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INSIDE INTERESTING INTEGRALS

by Paul J. Nahin, Springer, 2015, pp 412, £31.99, €34.99, US\$49.99, ISBN 978-1493912773.

There are few things more infuriating and enjoyable than a recalcitrant integral. The fact that it is not necessarily clear whether the integral can even be evaluated analytically is always tantalising. Perhaps it can't be evaluated... or then again perhaps it can. If you could only discover the right

line of attack it might become trivial. Alternatively, you could spend a day showing that it (probably) can't be done. I vividly remember my old A level mathematics teacher saying that evaluating integrals was an *art*. It was a matter of developing an instinct for the right substitu-

tion, or having the insight to perform integration by parts multiple times. I could be then, and still can be today, waylaid by an elegant integral which I am *sure*, if I just fiddle with it a while longer, will yield to me. I have been known to browse through Gradshteyn and Ryzhik's *Table of Integrals, Series, and Products* just to wonder at the beauty of the results. It is, I suppose, a vice not uncommon amongst mathematicians.

If you share any of my weakness for integrals, then Paul Nahin's *Inside Interesting Integrals* will be a delight. This is a book of techniques and (as the author himself calls them) 'tricks' which lead the reader step-by-step through a wide range of wonderful definite integrals, from:

$$\int_0^1 \frac{1-x}{1+x+x^2} dx = \frac{1}{2} \left(\frac{\pi}{\sqrt{3}} - \ln(3) \right)$$

to:

$$\int_0^{\infty} \frac{\exp(-x^a) - \exp(-x^b)}{x} dx = \gamma \frac{a-b}{ab}$$

and many, many more. It is a volume that could almost be described as a mathematician's coffee table book. It can be opened casually and leafed through until the reader spots an integral that piques her interest with the remark 'I wonder how you would show that...?' And, one of

the beauties of the book is that Nahin shows in full detail how each result is obtained, giving the reader a clear narrative from start to finish. This coupled with the fact that the author assumes not

much more than a first course in calculus (though he still gets all the way to multiple integrals and complex contour integration), makes it an ideal book for students.

The book is written in a 'chatty' light-hearted style, with a sprinkling of historical context and, where appropriate, pointers to further reading. Sections can be read independently of each other, with each chapter concluding with a set of 'Challenge Problems' to test understanding and engage the reader actively in problem solving.

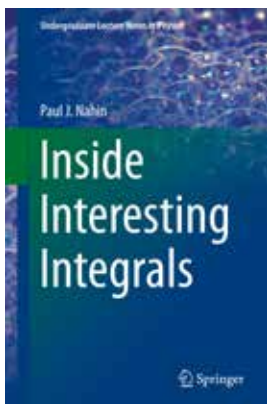
That said I must give a word of warning to pure mathematicians: Nahin is quite up front about his contentment to take an informal approach, or as he describes it the approach of the 'devil-may-care, eighteenth century mathematics of Euler's day'. As he says in the preface, 'I am not going to be terribly concerned, for example, with proving the uniform convergence of anything, and if you don't know what that means don't worry about it because I'm not going to worry about it either'. While this is probably enough to make the hair of most of the pure mathematicians I know stand on end, it made me laugh out loud, and he immediately had me (an applied mathematician) on side. It also sets the tone of the book: bright and breezy, pragmatic without being misleading, and with the author happy to check each of his results via MATLAB's numerical integrator *quad* to settle any doubts.

The moderately hefty price tag for a paperback may cause the reader to hesitate before purchasing this volume, but cast caution to the wind and buy it. It'll be one of the best

$$\int_{-1}^1 \left((x+1)^7 - x^7 \right) dx$$

pounds you will spend this year.

Mark McCartney
University of Ulster



CALENDAR OF EVENTS

This calendar lists Society meetings and other mathematical events. Further information may be obtained from the appropriate LMS Newsletter whose number is given in brackets. A fuller list is given on the Society's website (www.lms.ac.uk/content/calendar). Please send updates and corrections to calendar@lms.ac.uk.

JANUARY 2016

4-7 Classic and Stochastic Geometric Mechanics, Imperial College London (453)
 5 Algebra, Coding Theory and Cryptography Workshop, Durham (452)
 5-6 Adaptive Algorithms for Computational PDEs, Birmingham (452)
 11-12 Multi-Armed Bandit Workshop, Lancaster (453)
 20-22 British Postgraduate Model Theory Conference, Manchester (452)
 27 Well-posedness and Singularity Formation for Nonlinear Evolution Problems, King's College London (452)

FEBRUARY 2016

4-5 From Symbolic Dynamics to Approximation Methods, King's College London (453)
 5-6 Integrable Systems, Newcastle (454)
 8 Why be Noncommutative? University College London (454)
 26 Mary Cartwright Lecture, London (454)

MARCH 2016

16-20 Nordic Congress of Mathematicians, Stockholm (453)
 21 LMS Meeting at BMC 2016, Bristol (454)
 21-24 BMC 2016, Bristol (454)
 21-25 LMS Invited Lectures, Edgar Knobloch (Berkeley), Loughborough (453)
 29-1 Apr Algebraisation and Geometrisation in the Langlands Programme, Bristol (453)

30-2 Apr Singularities and Applications, Liverpool (454)

APRIL 2016

4-8 Easter Probability Meeting on Random Structures Arising in Physics and Analysis, Lancaster University (453)
 5-8 BAMC 2016, Oxford
 9-10 Mathematics Emerging, The Queen's College, Oxford (454)
 11-15 From the Grain to the Continuum, INI Workshop, Cambridge (454)

MAY 2016

18-20 The Dynamics of Complex Systems, Warwick (454)
 20-21 Groups in Galway, National University of Ireland, Galway (454)

JULY 2016

4-8 Modern Topics in Nonlinear PDE and Geometric Analysis, Reading (454)
 8 LMS Graduate Student Meeting, London
 8 LMS Meeting, London
 18-22 7ECM, TU Berlin (451)
 21 LMS Meeting at the 7ECM, Berlin

AUGUST 2016

1-4 Young Researchers in Mathematics Conference, St Andrews
 25-26 Caucasian Mathematics Conference, Turkey (453)

SEPTEMBER 2016

18-23 Heidelberg Laureate Forum (454)

NOVEMBER 2016

11 LMS Graduate Student Meeting, London
 11 LMS Annual General Meeting, London

DECEMBER 2016

20 LMS South West & South Wales Regional Meeting, Bath

LMS ANNUAL GENERAL MEETING

held on Friday 13 November 2016

(see report on page 32)



Whitehead Prize certificates presented to
Dr David Loeffler and Dr Sarah Zerbes



Whitehead Prize certificate presented to
Dr James Maynard



Whitehead Prize certificate presented to
Professor Christoph Ortner



Whitehead Prize certificate presented to
Professor Mason Porter



Whitehead Prize certificate presented to
Professor Dominic Vella



Senior Whitehead Prize certificate presented to
Professor Robert Mackay, FRS