Welcome to the first edition of the School of Mathematics' Alumni Newsletter, which offers us the opportunity to share with you the latest news about the School.

We hope that this newsletter will be of interest to all of our alumni and we would be very keen to hear your thoughts on how we can improve the content of these communications to ensure that they remain relevant to the needs and interests of our alumni community.

We are in the process of greatly improving our links with our alumni. Part of this was an Alumni Networking Evening on the 28th May, at which one of our most distinguished alumni, Gerry Pennell OBE, gave an excellent overview of his career; the highlight (to date) being Chief Information Officer for the London Organising Committee for the Olympic Games, where he was responsible for delivering the £500 million technology programme that underpinned the Games. This summer, Gerry will be given an Outstanding Alumnus Award by the University, and will also shortly be returning to the University as Director of IT.

Manchester has been the home of a number of ‘giants’ of mathematics over many years. Professor Sir Horace Lamb was the Beyer Professor of Mathematics from 1888 until 1920, and was one of the great founding fathers of continuum mechanics. The University has recently established the 'Sir Horace Lamb Chair', and on the evening of the 3rd June, Professor Oliver Jensen (the first holder of the Chair) gave a talk entitled 'Bringing Mechanics to Life'; this was followed by a talk on the life of Sir Horace by Professor Brian Launder, FRS. This was an interesting and excellent evening, made all the more so by the attendance of twenty members of Sir Horace Lamb’s family.

One of the main articles in this newsletter details (in overview) the history of the mathematics departments in Manchester over almost 200 years. With such a long history for the subject, we were only able to scratch the surface of many of the stories that were uncovered during the research (for which we must offer our thanks to Dr John Ballantyne, a recent PhD graduate). We shall include more in depth articles on specific periods in the history of the subject and its exponents in future issues of the newsletter, as well as many other areas that we hope will be of interest to our alumni community.

Sincerely,

Professor Peter Duck
Head of School of Mathematics
Outstanding alumnus, Edwin Broni-Mensah, aims to save you money whilst changing the lives of millions with his social enterprise Give Me Tap.

After graduating with a first-class degree in Computer Science and Mathematics, Edwin Broni-Mensah accepted a role with Goldman Sachs and a career in the banking sector beckoned. However, the opportunity to return to Manchester and undertake a PhD in Financial Mathematics was to change not only Edwin’s career path but also his outlook on life.

A keen squash player, Edwin would head to the gym on most days of the week and quickly began to notice the costs of keeping himself hydrated. Despite the fact that clean drinking water is available at the turn of a tap, we have become so accustomed to purchasing bottled water that estimates put the number of bottles sold in the UK as high as 13 billion a year (most of which end up in landfill sites). As well as the ecological and financial costs to UK consumers, Edwin was acutely aware of the plight of millions around the world, including many of his own family members in Ghana, who have severely restricted access to safe drinking water. He began to confront these issues with the same academic rigour he approached his studies and in April 2010, Give Me Tap was born.

Launched with little more than a website and a desire to change the social norm, Give Me Tap is one of those ideas that’s so simple you’ll be kicking yourself for not having thought of it. It works like this: you buy a recycled aluminium bottle from the Give Me Tap website for £12, you take this bottle into any café or restaurant that has signed up as a ‘provider’ to the scheme and they fill your bottle with free tap water. Simple, right?

And it gets a little better, not only do you save money but you also help reduce the number of plastic bottles being sent to landfill sites throughout the UK, and every 2 bottles purchased results in 1 person in Africa gaining access to clean water for life!

Impressed? Well, you’re not the only one. Since launching his enterprise, Edwin has won 13 awards, including the Most Outstanding Black Graduate in the UK in September 2010 and The Most Outstanding Student Social Entrepreneur by the Higher Education Funding Council and UnLtd in 2011. Give Me Tap and Edwin have also been profiled in numerous national publications, such as Manchester Evening News, The Observer, The Independent, The Sunday Times, The Guardian and BBC News.

Edwin says: “What we have managed to achieve so far has been amazing but there is so much more that needs to be done. I am working hard with corporate partners to change the social norms that have become part of the problem. Deloitte have recently taken delivery of 5000 bottles to distribute to their staff and have placed an order for 7500 more. We have completed 3 water projects in Africa to date, with 6 further underway, and partnerships such as this mean that we can complete many more. Give Me Tap is expanding fast and I hope to be able to make further announcements very soon.”

To find your closest provider, you can search on the Give Me Tap website or download the app and search on the go (the app is currently available for iPhone with Android launching in Q4 of 2013). The providers are currently concentrated in Manchester and London, though Edwin aims to ensure that you will never be more than 4 minutes from a refill site in urban spaces. Can’t find a tap in your area but want to support the cause? You can ask your local venue to sign up online or send Edwin an email via the website and he’ll get in touch for you.
New School Staff

Dr Simon Cotter has joined the School from The University of Oxford as a lecturer in Numerical Analysis, having completed his PhD at the University of Warwick in 2010. His interests lie in numerical methods for inverse problems and multiscale methods for biochemical networks.

Dr Marianne Johnson has been appointed as Lecturer in Pure Mathematics and her current research is in the field of tropical mathematics. Prior to taking up this position, Marianne held postdoctoral positions in Manchester and Oxford. Marianne is also an alumna of the School and was awarded her PhD in 2008.

Dr Stefan Güttel has taken up the post of Lecturer in Numerical Analysis and continues his research in this field. Stefan has held previous postdoctoral posts at the University of Geneva and the University of Oxford.

Dr Martin Lotz has joined the School from the University of Edinburgh as a Lecturer in Mathematics. His research is in foundations of numerical optimisation.

Share Your Advice and Experience

Whether you’re just beginning your career journey, or at the top of your profession, your advice, experiences and expertise could prove to be invaluable to our current students.

Alumni Networking Evening

On the 28th May, the School held its first wine reception and networking evening for former students, in the Alan Turing Building.

The evening started with a wine reception and the opportunity for alumni to catch up with some familiar faces from the School. Our Head of School, Professor Peter Duck, gave a brief welcome talk before handing over to the speaker for the evening, Gerry Pennell OBE.

Gerry is a former student of the School and delivered a very entertaining talk that covered his career from his first graduate role through to his time as the Chief Information Officer of the London Organising Committee of the Olympic Games. The University is also very pleased to announce that Gerry will be taking up the post of Director of IT in July 2013.

Alumni give guest lectures and provide career profiles to inspire both prospective and current students, and also provide practical support through mentoring, attending careers events or providing workshops and seminars. Your support and advice can make a real difference to students’ career choices, and to their experience at University. We’d love to hear from you: to register your interest in volunteering, please email: emma.packham@manchester.ac.uk
In 2004 the Victoria University of Manchester (VUM) and the University of Manchester Institute of Science and Technology (UMIST) merged to become The University of Manchester. For many staff working in the newly formed School of Mathematics, this would be their first experience of working so closely with their former neighbours. However, the history of cooperation between the two mathematics departments began many decades earlier.

On 27 April 1824, a public meeting was held in the Bridge大量文 Arms hostelry, which resulted in the establishment of the Manchester Mechanics’ Institution, with the stated aim “to enable mechanics and artisans, of whatsoever trade they be, to become acquainted with such branches of science as are of practical application in the exercise of that trade”. Building upon Manchester’s strengths as the world’s first industrialised city, the Mechanics’ Institution offered day and evening classes for apprentices in a variety of subjects. Having flourished throughout the 19th century, in 1902 it became the Manchester Municipal School of Technology, colloquially known as “Tech”. To coincide with this, the Manchester Municipal School of Mathematics was established, while the Beyer and Richardson Chairs of Applied Mathematics were founded in 1881 and 1891, respectively. The renowned physicist Arthur Schuster was the first to occupy the Beyer Chair, and did much to make Manchester a world-leading centre for the study of the subject. The University of Manchester’s physics building now bears his name.

At the beginning of the twentieth century, the histories of Owens College and Tech became inextricably linked. For in 1904 Owens College was awarded the Royal Charter and became in its own right The Victoria University of Manchester (VUM). With this change in status came the need for expansion, and one of the requirements identified was the need for a Faculty of Technology within VUM. At this point, an opportunity was recognised which could be of benefit to both VUM and Tech. The newly established University recognised the need to provide degrees in more industrial disciplines, an area in which Tech had renowned expertise; while Tech offered non-degree courses such as ONCs and HNCs to its students, but lacked the authority to award degrees. After much negotiation, it was decided that to further both these aims, Tech would provide the new Faculty for VUM. Thus, in addition to its ongoing provision of non-degree courses, highly qualified members of staff at Tech would teach degree courses for VUM.

The existing mathematics department of Owens College evolved into that of VUM, and remained separate from this newly formed Faculty. Nevertheless, mathematics played an important role within both the new VUM Faculty and the non-university side of Tech, providing foundational knowledge which could then be applied through various technological disciplines. As such a number of mathematicians were employed at Tech, engaged in the teaching of non-degree courses, along with classes for VUM degrees in subjects such as Technological Chemistry and Electrical Engineering. It was this group that would grow over the next half-century to become the fully-fledged mathematics department of UMIST.

Both VUM and Tech settled into their new roles in the early part of the 20th century. However, life at both institutions was inevitably affected by the First and Second World Wars. Staff worked for the national need, undertaking research and development specific to the demands of conflict, along with teaching specific courses aimed at servicemen and government departments. For example, during the Second World War...
The post-war period saw exciting developments in the VUM mathematics department. In 1945 Max Newman succeeded Mordell as the Fielden Chair of Pure Mathematics, and became head of the department – a position he held until 1964. Newman had been an influential figure at the Bletchley Park Government Code and Cipher School during the war, developing and working with ‘Colossus’, the world’s first electronic computer, to break German codes. Newman was determined to make VUM one of the strongest mathematics departments in the UK. Consequently he was responsible for appointing a number of high-profile academics to posts at VUM, some of whom also had links to Bletchley Park. Perhaps the most famous of these appointments was that of Alan Turing in 1948, to the post of Reader in Mathematics. Regarded by many as the father of computer science and artificial intelligence, it is difficult to overstate Turing’s contribution to his field, along with his code-breaking work during the Second World War. He remained in Manchester until his untimely and controversial death in 1954.

Around a similar period, major changes were afoot at Tech. In 1956 it was awarded the Royal Charter, essentially granting the status of an independent university. This allowed Tech to award its own degrees, in addition to those of VUM. The evolution continued, and in 1966 the remaining non-degree courses which Tech offered were transferred to various other institutions (some of which later became Manchester Metropolitan University), with yet another resulting name change: the University of Manchester Institute of Science and Technology (UMIST) was born. UMIST began offering its own Honours mathematics degrees in 1958. To provide these the mathematics department had to expand and appoint new members. One of these was the group theorist Hanna Neumann. Neumann was one half of a husband and wife team which straddled the boundaries of the UMIST and VUM mathematics departments – her husband Bernhard, also a group theorist, had been appointed a Lecturer in Mathematics at VUM in 1948. Bernhard was another of those German academics who had fled to the United Kingdom due to the threat of Nazi persecution, and had arrived in the country in 1933. Five years later, with war on the horizon, Hanna joined him, and they were married in Cardiff in 1938. Hanna Neumann was the first female academic to be appointed to the Mathematics department of UMIST. The disparity between male and female academic numbers around this time was reflected in student numbers. In 1950, for example, there were only 12 women enrolled in VUM Faculty of Technology courses, in comparison to 852 men.

Throughout the latter half of the 20th century both mathematics departments continued to flourish and expand. Following the Second World War there were less than 30 mathematics staff at VUM, while at Tech this number was in single figures. By contrast, at the turn of the 21st century both VUM and UMIST departments had over 50 members of staff. The increasing requirements of the two mathematics departments led to changes in accommodation. From the first days of Owens College up until the 1960s the offices for mathematicians had been in the University Main Building, now the John Owens Building.
Following a relatively short stay in the Williamson Building, in 1969 the department moved into the purpose built Mathematics Tower on Oxford Road. This 19-storey building was a flagship project in the redevelopment of the VUM campus in the late 1960s. Designed by architects Scherrer and Hicks, the tower contained three lecture theatres, and could accommodate over 450 undergraduates, 75 postgraduates and 60 academic staff (including those from the Department of the Mechanics of Fluids, which was also resident in the tower). Its character and unusual design features, such as a triangular spiral staircase, endeared the building to many of the mathematicians who would occupy it for the next 35 years.

Up the road at UMIST, the migration of the mathematics department in many ways mirrored that of VUM. For the first half of the twentieth century, the department was largely housed in the College of Science and Technology Main Building (now the Sackville Street Building). The growth of UMIST in the 1950s brought with it much development of the area around Sackville Street, and in 1962 Mathematics transferred to the newly constructed Renold Building, a move which brought with it a number of luxuries, such as a departmental common room, kitchen and telephones! Throughout the decade the expansion of the UMIST campus continued, and in 1970 construction was completed of the Maths and Social Sciences (MSS) Building, which the mathematicians duly moved in to. This 161ft tall tower, designed in the Brutalist style by architects Cruikshank and Seward, would house the Mathematics department for almost 40 years.

Now settled in to their respective new homes, the two mathematics departments entered a period of relative stability which would last much of the remainder of the century. VUM continued to build upon its established reputation as a world-class department, while the UMIST department, already with a rich heritage in teaching, grew into one of the United Kingdom’s leading centres for scientific research. Until the mid-nineties, there was still the somewhat confusing situation of UMIST also being the VUM Faculty of Technology. This arrangement came to an end in 1993, when UMIST formally became a completely autonomous university. As a result it was no longer possible to obtain a degree from VUM through studying at UMIST! In spite of this, the VUM and UMIST mathematics departments continued to enjoy a close working relationship. For example, this took the form of sharing seminars, collaborating in research, and combining their respective strengths to offer newly introduced MMath degrees to undergraduates of both universities.

Of course, we now know this separation was short-lived, as in 2004 VUM and UMIST merged to form a new institution, The University of Manchester. This brought inevitable change to mathematics in both former universities. The VUM Mathematics Tower, a prominent feature on the south Manchester skyline for over 30 years, was demolished in 2005 as part of a new generation of redevelopment; while the UMIST MSS Building, although still standing today, was vacated by mathematicians in 2007, and is currently unoccupied. Now unified, the University of Manchester’s School of Mathematics occupies a new, purpose-made building which bears the name of one of its most famous figures from the past, Alan Turing.

We hope that this article has given some idea of the interconnected histories of the two institutions which merged to form the University of Manchester. The School of Mathematics takes great pride in both strands of this heritage, which together have shaped the modern department. Looking forward, we’d like to emphasise that alumni of both VUM and UMIST remain very much a part of today’s School of Mathematics.

**New MSc programme focuses on industrial collaborations.**

In September 2012 the School of Mathematics in Manchester welcomed the first intake to the MSc programme in Applied Mathematics. This new MSc has a number of key objectives. Primarily it ensures that students gain excellent mathematical training for entry into either a PhD programme or research in industry.

Importantly a number of new initiatives have been incorporated, ensuring that the students engage in real-world problems, develop the skills of mathematical modelling and learn the important transferable skills required by both industry and academia. These assessed initiatives include mathematical modelling classes, presentations, poster sessions, talks by a number of industrial companies and perhaps most importantly, dissertations sponsored by industrial partners.

In the first year of the programme we received sponsorship for dissertations from six companies including Thales, Xradia and Nikon Xtech. In addition to this, the Numerical Algorithms Group (NAG) provided a prize for the best performing student. We welcomed five speakers from industry who gave a description of the company they work for and described the various scientific research projects they undertake. This provides an excellent means for company recruitment, and also enables the students to see some key industrial sectors and what is required for employment in those areas.

Applications for the 2013/14 academic year are already up on last year. This is bucking the trend for MSc applications in Mathematics in the UK.

We welcome new opportunities for industrial engagement and sponsorship and would be happy to receive requests from any new companies and industrial sectors regardless of size.

For any queries please contact the Programme Director: Dr. William J. Parnell (William.Parnell@manchester.ac.uk) or see the MSc webpage.
Your Manchester Fund

Your Manchester Fund is an easy and effective way for alumni and friends of The University of Manchester to make a significant difference to the lives of thousands of Manchester students every day. Philanthropic support plays a crucial role in helping the University achieve its strategic aims by providing vital scholarships for students from backgrounds under-represented in higher education, funding for projects that enrich the Manchester student experience and scholarships for outstanding young researchers whose work in areas like cancer and global poverty will have an impact all over the world. Seven Mathematics students are currently benefiting from alumni-funded scholarships.

Alumni and friends can donate in a variety of ways, either by phone, mail or online, and many choose to make a donation as part of the annual telephone campaign. 40 students are currently employed as part of a team who call alumni of all ages, subjects and professions, to find out more about their time at and since Manchester, and to ask if they are able to support students at the University by making a donation. So far this year, over 10,000 alumni have received a call, and have donated a staggering total of £280,000. Over 1,000 alumni have also expressed an interest in supporting the University in other ways too, such as by acting as a mentor to a student or providing a career profile. The response to the telephone campaign this year has been overwhelming.

Luke Monaghan is an alumni-funded scholarship recipient studying for a BSc in mathematics. He said: “I am extremely grateful for my [YMF] Scholarship, as it has given me the confidence to believe I can have a great career. Thank you ever so much to all those that support me.”

To find out more about Your Manchester Fund and to make a donation, please visit our website or contact Rob Summers on 0161 275 2192.

Sir Horace Lamb Chair

On the 3rd June 2013, the School celebrated the creation of the Sir Horace Lamb Chair with a public lecture by Professor Oliver Jensen, the first holder of the Chair.

The School was particularly pleased that more than twenty members of the Lamb family were able to join us on this occasion, including three of Sir Horace’s grandchildren. As well as their famous grandfather, Felicia Palmer, Henrietta Phipps and Valentine Lamb also have a well-known father, the celebrated artist Henry Lamb; whose portrait of Sir Horace hangs in the School.

We were also delighted to learn that another member of the Lamb family, Ned Lamb (pictured left with Oliver Jensen), has just completed his BSc in the School of Social Sciences at the University.

Professor Oliver Jensen (right) pictured with (left to right), Valentine Lamb, Henrietta Phipps, Felicia Palmer and Professor Brian Launder.

Manchester Teaching Awards

The School was very pleased to learn that two members of staff, Dr Louise Walker and Miss Tracey Smith, have been recognised for their outstanding work at the recent Manchester Teaching Awards.

Louise received the award for Best Lecturer in the Faculty of Engineering and Physical Sciences. The judges noted that she was the stand-out candidate for the award and that her passion for delivering the best level of teaching and pastoral care was far beyond what was normally expected.

Tracey received the award for Best Support Staff Member and was highly praised for her dedication and knowledge. Tracey runs the reception desk in the School’s Alan Turing building and is the first point of contact for many staff, students and visitors to the School.

To find out more about Your Manchester Fund and to make a donation, please visit our website or contact Rob Summers on 0161 275 2192.
Despite much hype, the academic study of finance from a mathematical perspective has been very slow to evolve. However, I wish to convince you that significant change now needs to happen in order for the subject to survive. I claim this because the underlying nature of the subject is one which evolves as the questions asked of it become more complex, and the current crop of questions are particularly pressing: what is the optimal amount for our nation to be borrowing; what should interest rates be set at; what should the minimum capital requirements of banks be? To answer these more complex questions, one must have a suitable mathematical domain from where one can solve such problems. In short, one must consider a problem through a suitable number of dimensions.

A glance at the history of mathematical finance shows that the number of dimensions considered grew as the need for answers to more complex questions arose. The one-dimensional approach to valuations dates back several hundred years and is still widely used today: the Discounted Cash Flow (DCF), with time as the underlying dimension. The DCF allows people to take account of the time value of money of a series of known cash flows. However it does not explicitly take account of future decision making and thus cannot account for the added value that a controlled approach to management provides.

To counter this shortfall, the 20th century (particularly in the 1970’s) saw people looking for ways to actually value a company’s options, which by nature would account for uncertain future cash flows. To achieve this a two dimensional approach to valuations was needed, and I shall (crudely) refer to these as Black-Scholes (BS) valuations, with underlying dimensions of future price uncertainty and time. This approach allows an option valuation to account for all manner of potential future cash flow scenarios and decision-making, which the DCF was not able to do. This two dimensional BS world is the space where most mathematical finance practice currently remains. Yet whilst benefits have risen from this two-dimensional world (and some major errors), it is not a world capable of quantifying how much optionality one might actually have in the future. This is due to the BS’s lack of consideration of a firm’s liquid asset dynamics, such as the potential growth (and decline) of retained earnings. It is these path dependent assets that I believe requires the new dimension we must urgently explore.

Let me present an example to expound my claim that path dependent assets (e.g. cash) is the next dimension of financial exploration: let us try to value the intrinsic worth of a very simplistic grocery shop. In the one dimensional world, one would value the shop using a DCF, where all profits are assumed as given. However this valuation would not be able to take account of the added value provided by the shop owners’ flexibility to close the shop down; they would choose to close the shop down should profits move too far negative, thereby eliminating the value-reducing possibility of heavy losses. And so, to capture the added value that is provided by this flexibility, a two dimensional BS-type option valuation approach could be used, which, in effect, models the value of the shop as a financial option. However, the inclusion of this closure option does not take account of the size of the cash reserves held by the shop. For example, if the shop had plenty of cash in the bank, then it could easily absorb a couple of weeks of negative profits in the hope that it would shortly resume positive profitability. But if the shop had no cash reserves, then it would have to close down as soon as the profits reached zero. In other words, the degree of optionality (and therefore the valuation) is limited by the size of the cash reserves. The previous BS model is unable to explicitly take account of the firm’s current cash level, as it assumes the shop has infinite flexibility for their decision to close down. Consequently it is incapable of taking account of the variability in cash holdings at all time points in the future, and thus will not be able to consider how the size of optionality may evolve: if the shop has no cash reserves but is currently profitable, then it will be able to grow their cash reserves, possibly to a size that will help them in the future should profits turn negative. In other words, it’s where you will have been that matters. This leads to the fact that one must consider cash reserves as a new dimension; at any point in time, the size of the cash reserves will be given by where the profits have been (hence ‘path dependent’), which is a quantity independent of where the profits might go. As such, this more realistic valuation is made in three dimensions: time, future profit uncertainty, and path dependent assets. Clearly this is a very simple example, but one from where we can begin to consider optimal borrowing levels (bringing cash in), optimal dividend policies (paying cash out) and optimal capital controls for banks (bringing cash in to raise equity ratios).

Before I conclude I must introduce a caveat, for mathematicians have in fact been increasing the dimensionality of financial problems for some while. But at the risk of being ostracised, these particular increases in
dimensionality have only served to help increase the accuracy of existing solutions, and not provide the answers to fundamental economic questions. For example, since the beginning of the credit crunch in 2007, there has been much talk about outlying financial events causing market meltdown, the so-called Black Swan phenomenon. To try to counter this, vast reams of research into more accurately modelling (uncertain) parameter values has been conducted, which increases the dimensionality of the problem. Much of this is academically sound work, yet I ask you: if a bank was previously charging $1 for a financial product and now charges $1.05 to better account for ‘outlying events’, would the credit crunch really not have happened? Would all those small additions of cost really have been set aside to absorb future potential losses? And even if they could be set aside, how sure could the bank be that this amount was enough to cover say, the unforeseen PPI insurance scandal?

Hopefully the inclusion of path dependent assets sounds like a common sense approach to a valuation, one that does not simply rely upon that much debunked myth that the shop can always borrow money should they run into trouble (even if they could borrow money, the interest rate charged upon the loan should be linked to the risk-profile of the shop, which in turn is linked to the current and future potential size of their bank account – sounds rather like a country’s credit rating, doesn’t it?). Furthermore this is an approach we probably each already have an intuitive feel for. But in the same way we still seek a medical cure to the common cold despite already knowing to use a hanky when sneezing, we need to conduct much more quantitative modelling into the dimension of path dependant assets. In doing so, mathematicians will be able to show how science may surpass the political hot-air behind borrowing rates and banking accords, and help lead the way into a new and more enlightened dimension, from where the real financial problems of our time may be correctly addressed.

---

### Schools and Colleges Liaison

The School of Mathematics has a very active Schools and Colleges Liaison programme. These events range from residential courses for A-level students, such as Making Maths @ Manchester, which allow students to experience a slice of university life, to CPD Teacher Training events.

In June of each year, we run a number of A-level revision days, these sessions attract hundreds of students from across the UK, who spend the day with specialist teachers revising the key topics of pure maths modules.

Whether you are a teacher of mathematics looking to expand your network and knowledge, or the parent of a student looking to study at a higher level, the chances are that we offer an event that could help. To find out more, please visit our [SCL Website](#).

---

### The Dame Kathleen Ollerenshaw Lecture

The Dame Kathleen Ollerenshaw Lecture is a prestigious public lecture held annually in the School of Mathematics and is named in honour and recognition of Dame Kathleen Ollerenshaw (pictured below with Professors Peter Duck and Oliver Jensen).

Dame Kathleen was born in Withington in 1912 and, after completing her doctorate at Somerville College, Oxford in 1945, returned to Manchester to work as a part-time lecturer in the Mathematics Department at Manchester University. She is probably best known in the field of Mathematics for her work on magic squares, but she also has a formidable reputation as an astronomer. (The observatory at the University of Lancaster bears her name.) Deaf since the age of eight, Dame Kathleen has been an inspiring role model to many people.

Last year Dame Kathleen celebrated her 100th birthday and the Dame Kathleen Ollerenshaw lecture was given by Professor Sir Martin Taylor, Warden at Merton College, Oxford since 2010, but previously a Professor here in the School of Mathematics and, prior to merger, at UMIST. Previous years’ speakers have included Professor Ian Stewart, Professor Chris Budd and Professor Celia Hoyles (a former student of the School of Mathematics) – all of whom have worked tirelessly, like Dame Kathleen, to popularise and promote Mathematics.

This year’s lecture will be held on **8 October 2013** and will be given by **Professor Robin Wilson**, Professor of Mathematics at the Open University. Professor Wilson is an expert on Charles Dodgson’s (aka the popular children’s author, Lewis Carroll) mathematical achievements – Dodgson held the Mathematical Lectureship at Christ Church, Oxford for 26 years. The title of the lecture is: “Lewis Carroll in Numberland”.

The lecture is open to the general public and we would be particularly pleased to see members of our alumni attend. Further information, including how to register, can be found [here](#).
As a graduate of The University of Manchester, you’re part of the largest alumni community of any campus-based UK University, with more than a quarter of a million members worldwide. We deliver events, communications, services and discounts, and volunteering opportunities tailored to your degree and professional experience. Update your details and set your preferences on your dedicated online alumni portal.

### New Research Awards

**Professor Oliver Jensen**

Oliver Jensen is part of a team who have been awarded a £1.6M grant from the Engineering and Physical Sciences Research Council (EPSRC) to pursue a research project entitled “Forecasting personal health in an uncertain environment.” The other team members are Dr Tobias Galla from the School of Physics and Astronomy at the University of Manchester, Prof. Nigel Clarke (a physicist) and Dr Richard Clayton (a computer scientist) from the University of Sheffield and Dr Julie Eatock (an expert in healthcare information systems) from Brunel University.

The project will develop new mathematical tools for characterising uncertainty and variability in multiscale computational models of human organ systems, with the aim of informing the clinical decisions that determine the trajectory of an individual patient through the healthcare system. The project will focus on two primary applications, namely the response of the respiratory system to challenge by an influenza virus, and the response of the heart to episodes of atrial fibrillation.

**Professor Mike Prest**

A representation of an algebra is a linear action of it on another mathematical object. For some algebras, all the actions can be described in a fairly explicit way but most have a much more complex representation theory. Professor Mike Prest has been awarded a £600k EPSRC research grant to employ two postdoctoral researchers on a project, which links algebra and model theory, aimed at understanding the possible complexities of the representation theories of certain algebras.

Professor Prest hopes to answer some long-standing questions about these representation types. Model theory comes into the picture because it provides some measures of complexity, yet the relationships between these and various algebraic measures are far from clear. When the project is finished we should have a better understanding of these measures.

**Dr. John Moriarty**

As we connect increasing amounts of unpredictable renewable electricity generation (mainly wind power in the UK), balancing supply and demand becomes more difficult. Dr John Moriarty has recently been awarded a 4 year Early Career Research Fellowship to look at applying mathematical techniques, including optimal stopping and optimal control, to understand how price signals can help with this balancing act. The grant also funds a specially appointed postdoctoral researcher, Tiziano De Angelis, to work on this project.

**The Alumni Association**

A recent alumni dinner at the Churchill War Rooms in London

As a graduate of The University of Manchester, you’re part of the largest alumni community of any campus-based UK University, with more than a quarter of a million members worldwide. We deliver events, communications, services and discounts, and volunteering opportunities tailored to your degree and professional experience. Update your details and set your preferences on your dedicated online alumni portal.
Suppose you are asked to behave randomly—perhaps you are asked to pick a sequence of numbers at random, or are asked how a sequence of coin-tosses should behave. Could you do it and produce a result that is indistinguishable from a truly random process? It turns out that people are, generally speaking, very bad at behaving randomly. One possibility is that people use the wrong probability distribution. Another possibility is that the correct probability distribution is used, but it does not behave quite as one might expect.

Expense pretense?
As an example, consider the (entirely fictional!) case of Barry McNarry—the less-than-scrupulously honest Member of Parliament for Chorlbury East. He is filling in his expenses claim forms and, as he has always done in the past, he is making the figures up, hoping that nobody will check too carefully or ask for receipts. He writes down the following numbers:

- £83.54
- £310.10
- £104.30
- £523.00
- £2.53
- £99.95
- £6.10
- £434.25
- £73.21

He thinks these figures look believable: there are 9 numbers, and he has carefully chosen them so that each of the 9 possible leading digits from 1 up to 9 occurs equally often. The leading digit of a number is the left-most digit—so the leading digit of 83.54 is 8, etc.) His argument is that each leading digit should, in a suitable list of random numbers, occur with equal probability. Is he right, or is he setting himself up for a fall?

Pick a number, any number
Suppose you ask a large number of people to pick a number between 1 and 10 at random. There are ten numbers, so you might expect 10% of people to pick 1, 10% to pick 2, etc; that is, you might expect people to pick numbers according to the uniform distribution, where each of the ten numbers has equal probability 1/10. In general, this does not happen. In fact, there is a strong tendency for people to pick the number 7. (1 is too small, 10 is too big, 5 is exactly in the middle, etc—none of these look ‘random’.) Figure 1 gives the result of an online poll (with 569 responses) [1] of picking a number between 1 and 10. More generally, when people are asked to pick numbers between 1 and 100, the most commonly chosen numbers are 7, 17, 37 and 73. In fact, the number 37 appears surprisingly often in the media whenever a generic number is needed (see box below).

Of course, this is psychology, not mathematics. The problem is that people do not think that round numbers look random. An example of this occurred during the Great Trigonometric Survey to map India, which included the first official calculation of the height of Mt Everest. The mountain was surveyed in 1852. After many detailed calculations, the Indian mathematician Radhanath Sikdar calculated that Peak XV (as it was then referred to) was the highest mountain in the world at 29,000ft. In 1856 this was confirmed by Andrew Waugh (who, as Surveyor General of India named Peak XV after his predecessor, George Everest). However, concerned that this looked to be a suspiciously round number, it was recorded as 29,000ft [2]. (The currently accepted height is 29,029ft.).

Naively, one expects people to pick numbers according to a uniform distribution—where each number is equally likely—but, as we have seen, people have an in-built tendency to use a different probability distribution. However, even when we know which distribution one should be using, there are often hidden patterns that can lead the unwary astray.

Going for a run
Without thinking about it—and (crucially!) without doing it for real—pretend that you have tossed a coin ten times and write down the sequence of ‘Heads’ (H) and ‘Tails’ (T) that you think you might have obtained. Now count the largest number of consecutive heads you have and call this the length of the longest run. It is highly likely that you picked a sequence of Hs and Ts for which the longest run is no more than 3. (I have tried this experiment with large groups of school-children on many occasions. Usually no more than 15% of people pick a sequence of 10 Hs and Ts that have a run over at least 4 heads. Of those who do have a longest run of 4 or more heads, a significant proportion—and usually the ones who are trying to catch me out!—have picked a run of 10 heads.) What length of longest run should people be picking if they really are behaving randomly?

Let us start by calculating the probability of tossing $n$ coins and having a longest run of $k$ or more heads. Actually, it turns out to be easier to calculate the probability of not having a run of $k$ or more heads; we can then subtract this probability from 1 to find the answer we want.

**Figure 1:** Experimental results of picking a number between 1 and 10.

**Figure 2:** Is Everest 29,000ft, 29,002ft or 29,029ft high?
Suppose we perform $n$ independent trials of tossing a fair coin; then there are $2^n$ possible outcomes. Let $A_n(k)$ denote the number of outcomes of $n$ trials for which the length of the longest run is less than or equal to $k$. To illustrate what is going on, consider the case of a longest run of length less than or equal to $k=3$. Then $A_n(3) = 2^n$ if $n \leq 3$ (as clearly every sequence of $n$ trials has a run of at most 3 heads if $n \leq 3$). For $n > 3$, if we have less than or equal to 3 heads in a run then we must have one of the following:

- T, followed by a further $n-1$ tosses with less than or equal to 3 heads in a run,
- HT, followed by a further $n-2$ tosses with less than or equal to 3 heads in a run,
- HHT, followed by a further $n-3$ tosses, with less than or equal to 3 heads in a run,
- HHHT, followed by a further $n-4$ tosses, with less than or equal to 3 heads in a run.

Hence $A_n(3) = A_{n-1}(3) + A_{n-2}(3) + A_{n-3}(3) + A_{n-4}(3)$. More generally, we have the following recurrence relation

$$A_n(k) = \begin{cases} 2^n & \text{if } n \leq k, \\ \sum_{j=0}^{k} A_{n-1-j}(k) & \text{if } n > k, \end{cases}$$

with $A_n(1) = 1$. (As an aside, it follows that the number of sequences $H$s and $T$s of length $n$ with no two consecutive $H$s is $A_n(1)$, the $(n+2)$nd Fibonacci number.)

Using this recurrence relation, we can calculate that $A_{10}(3) = 773$. Hence there are $2^{10} - A_{10}(3) = 1024 - 773 = 251$ outcomes of 10 coin tosses where the longest run of heads has length greater than or equal to 4. The probability of having a run of at least 4 heads is thus $\frac{251}{1024} = 0.245$. In other words, whenever you pretend to have tossed a coin 10 times, you should make sure that you have a run of at least 4 heads about a quarter of the time.

If we toss a coin $n$ times, what would we expect the length of the longest run to be? We can estimate this as follows; in fact, the explanation is easier to understand with a biased coin where the probability of $H$ is $p$ and the probability of $T$ is $q = 1-p$. A run of $H$s starts as soon as we have a $T$ (we can think of two consecutive tails $TT$ as a $T$, followed by a run of $H$s of length 0, followed by a $T$). In $n$ trials, there will be about $nq$ $T$s, hence about $nq$ runs of $H$s. Around $nqp^2$ of these will contain a run of at least one head, around $nqp^3$ will contain a run of at least two heads, and so on. We can expect a run of at least $k$ heads provided $nqp^k$ is greater than 1.

Solving $nqp^k = 1$ for $k$ gives us $k = \frac{\log_2(\frac{n}{q})}{\log_2(p)}$. Hence, for a fair coin ($p = 1/2$) we would expect the length of the longest run of heads to be approximately $\log_2(n) - 1$. (A precise formula can be found in [3].)

When $n = 200$, the expected length of the longest run of heads is approximately 7. One can also [3] calculate that the standard deviation is approximately 1.873 - a surprisingly small number. This means that in ‘most’ sequences of 200 coin tosses, the longest run of heads will have length between 5 and 9. This fact was used in the following experiment of T. Varga [4]. He separated a class of school-children into two sections. Each child in one section was given a coin and asked to toss it 200 times, writing down the outcomes on a slip of paper. Each child in the other section was asked to write down a ‘random’ sequence of heads and tails on a slip of paper. Varga then collected the papers in, and—to a surprising degree of accuracy—predicted which section each one originated from. His trick was that any outcome with a run of 5 of more heads probably originated from a real coin-tossing experiment, whereas children when asked to pretend to behave randomly rarely picked an outcome with a run of length longer than 4.

**Taking the lead**

There are many situations where you might expect one probability distribution to be at work, but in fact another one is. One such situation is when one is looking at the leading digits of a given data set. One might expect each of the nine possible leading digits 1, 2, ..., 9 to occur equally often; however, in general, they satisfy a different distribution known as Benford’s law.

Like many concepts in mathematics, Benford’s law is named after its populariser and not its original discoverer. In 1881, the astronomer and mathematician Simon Newcomb observed [5] that, in large sets of data, the frequency with which leading digit $d$ occurs is

$$P(d) = \log_{10}(1 + 1/d).$$

He did not provide any theoretical justification for this claim, but did observe that ‘the law of probability of the occurrence of numbers is such that all mantissae of their logarithms are equally probable’ (in short: in the set of data $(a_n)$, the fractional parts of $\log_{10}a_n$ appear according to the uniform distribution on [0, 1]). In 1938, the electrical engineer and physicist Ben Frank Benford collected 20,229 numbers from 20 different data sets. Whilst some data sets (numbers appearing in newspapers, street addresses listed in the 1934 edition of ‘American Men of Science’, etc) showed close agreement with (*), others (molecular weights, entries from mathematical tables of $1/n$, $\sqrt{n}$, etc) did not. (One should note that there is evidence [7] to suggest that Benford carefully rounded numbers to achieve a better fit with the predicted frequencies.) However, the totality of all 20,229 numbers showed a very close agreement with (*).

Several heuristic justifications of Benford’s law have been given (see [8] for a survey), but it was only in 1995 that a rigorous mathematical proof was given [9]. It is beyond the scope of this article to go into the full details, but the basic idea is the ‘scale-invariance’ of the distribution. Figure 3(i) illustrates the frequency with which each leading digit occurs in the price of 300 catnic lintels, taken from Corus’ 2008 price list, firstly, when the price is expressed in pounds and secondly, when it is converted (by multiplying by the exchange rate 1.18) into Euros; qualitatively these are very similar. Figure 3(ii) illustrates the result of creating a random set of 300 prices in pounds with each
leading digit occurring with equal probability 1/9 and then converting these prices into euros; qualitatively these are very different.

Instead of converting between pounds and euros (and so having to multiply by 1.18), let us look at how leading digits behave in pounds and a currency—let us call it the Galactic Groat $G$—with exchange rate £1 = $G_2$.

If an item costs between £10 and £19.99 then it costs between $G_20$ and $G39.98$. Thus, if the price of an item has leading digit 1 in pounds then its price has leading digit 2 or 3 when expressed in Galactic Groats.

There are many situations where one can expect Benford’s law to hold:
- Data-sets that result from mathematical combinations of two numbers (for example, quantity x price) [10];
- Large data-sets [10];
- Mathematical sequences where there is some exponential growth (for example, the leading digits of $2^n$ and the leading digits of the Fibonacci numbers both satisfy Benford’s law [11]).

(See [10] for when one should and should not expect Benford’s law to hold for real-world data.) Benford’s law has been successfully used to analyse stock market data, census statistics, accounting data, eBay bids, US politician’s campaign finances. See [10, 12] and the references cited therein.

The moral of the tale...

How should Barry McNaarry—the less-than scrupulously honest Member of Parliament for Chorlbury East—have randomly chosen his expense claims? In 2011/12 MPs made 185243 expenses claims [13], and the frequency with which each leading digit appears is displayed in Figure 4 together with Benford’s law. Qualitatively, there appears to be a reasonably close fit. However, a more detailed statistical analysis (for example, a $\chi^2$ test) leads us, in the language of hypothesis testing, to reject the hypothesis that MPs expenses conform to Benford’s law at any level of significance. (One should also note that Benford’s original data also fails these statistical tests [11].) It is important to note that this does not mathematically prove that MPs expenses are fraudulent (for example, the over-abundance of leading digit 5 could be explained by the large number of 50p cups of tea/coffee bought for interns!). However, it does suggest that further, more detailed, work should be done and that we should continue to keep an eye on our MPs! It is, however, certainly clear from Figure 4 that the distribution of leading digits of MPs expenses is very far from uniform. Barry McNarry should be spending time learning the mathematics of randomness before he ends up doing time for fraud!
Françoise Tisseur is a professor of Numerical Analysis in the School of Mathematics at the University of Manchester. She was born in Saint-Étienne, France, and attended the Université de Saint-Étienne. In 1993 she was awarded her Maitrise (Masters degree) in Mathematical Engineering, then her Diplome d'Etude Approfondie in 1994. She completed a PhD in Numerical Analysis at the same university, graduating in 1997. Since then she has worked on Numerical Linear Algebra problems in France, the USA and the UK, collaborating with many international colleagues.

She was awarded the 2010 Whitehead Prize by the London Mathematical Society for her research achievements in numerical linear algebra, including polynomial eigenvalue and structured matrix problems. In 2012 she was awarded the prestigious Adams Prize for her work on the polynomial eigenvalue problem and promoted to professor in the same year. She lives in Eccles with her husband Nick Higham (also a professor of Numerical Analysis at the University of Manchester!) and their two children.

Can you tell us about the work you were awarded the Adams prize for?

The Adams Prize is awarded jointly each year by the Faculty of Mathematics and St John's College Cambridge to a young (normally under 40 years of age), UK-based researcher doing first class international research in the Mathematical Sciences.

Last year’s topic was 'Computational Mathematics' and I was awarded the prize for my work on polynomial eigenvalue problems, including theory and numerical solution. The numerical solution of algebraic eigenvalue problems is a key technology underpinning many areas of computational science and engineering, including acoustics, control theory, fluid mechanics, and structural engineering. In all these areas, the need for fast and numerically reliable solution of eigenvalue problems arises. The problems can be large, so that time to solution can be unacceptably long, and they can be very ill conditioned, making it difficult to obtain accurate solutions. I have provided new theory, algorithms and software that allow solution of problems that could not previously be solved reliably, or for which there is no library software available.

What are the current challenges in your area of mathematics?

Practical applications often require solving very large systems of equations with millions or even billions of variables. Numerical methods struggle to provide any accuracy in the computed solution or to solve these very large systems in a reasonable time.

The trend towards extreme designs, such as in microelectromechanical devices, leads to problems with poor conditioning, which means that the solution is very sensitive to perturbations. Also, the physics of the system leads to algebraic structure that numerical methods should preserve if they are to provide physically meaningful results.

Which topics in the Manchester undergraduate degree course are relevant to research in Numerical Analysis?

All the numerical analysis courses offered in the School are relevant to my work, in particular, Numerical Analysis I and II, Matrix Analysis and the fourth year option Numerical Linear Algebra.

However these are by no means the only courses that are relevant to research in Numerical Analysis. Applications in Mathematical Physics, Science and Statistics means that topics in courses such as Continuum Mechanics, Mathematical Biology and Markov Processes are very important to research in Numerical Analysis. Many pure maths courses are also important as they provide a rigorous understanding of essential underlying theory; topics in courses such as Noncommutative Algebra, Computation and Complexity, and Combinatorics and Graph Theory are also important to research in Numerical Analysis.

What advice would you give to someone thinking of starting a PhD in mathematics?

I think it is important to choose an area of mathematics that you like, of course, but which also offers opportunities for jobs either in academia or in industry.

I would encourage anyone interested in starting a PhD in maths to attend the London Mathematical Society Prospects in Mathematics conference, which takes place every December. The conference has the goal to introduce the many and varied opportunities for research in mathematics that exist at universities in the UK. The last conference took place in Manchester in December 2012 and most presentations are available here.
Charles Frederick Beyer (1813 – 1876) donated the current equivalent of almost £10 million to the University’s predecessor institutions, including funds for an endowed professorship in Applied Mathematics, which still exists, and contributions towards the construction of the main Oxford Road site, which includes the building bearing his name.

Born in Germany to humble beginnings, Beyer won a scholarship to attend university before coming to Manchester in 1834 to work as a locomotive engineer. Twenty years later he founded the pioneering firm Beyer, Peacock & Company which produced almost 8,000 locomotives until its closure in 1966.

Beyer was heavily involved in the economic and educational development of the city, including the Mechanics Institute, later UMIST, and Owens College, later the Victoria University of Manchester. His philanthropic support of Owens College in particular was instrumental in the College making its move from its original site at Quay Street down to Oxford Road.

As well as bequeathing funds towards construction, Beyer contributed to scholarships and professorships, including the Beyer Chair in Applied Mathematics. This Professorship was first held by Arthur Schuster from 1881-1888 and has been continually held ever since – Prof David Abrahams has been the current Chair since 1998. Other notable holders of the Chair include, Sir Horace Lamb, Sydney Goldstein, James Lighthill and Fritz Ursell.

The 200th anniversary is an opportunity to celebrate both Beyer’s birth and his legacy. Beyer remains a major figure in the history of engineering and economic development in Manchester and was pioneering and far-sighted in his deep philanthropic support for education and this University.

Alumni MSc Discounts

There are loyalty bursaries of £1000 available for graduates from the University of Manchester. In addition, there will be a further 10% fee discount for University of Manchester graduates with a 1st Class Honours Degree.

The discount applies to all our MSc degree courses: MSc in Actuarial Science, MSc in Mathematical Finance, MSc in Pure Mathematics and Mathematical Logic, MSc in Statistics (including an optional pathway in Financial Statistics), MSc in Applied Mathematics, including pathways with Industrial Modelling and with Numerical Analysis.

All courses are available for full-time and part-time study except for the MSc in Mathematical Finance, which is only available as a full-time course.

The School of Mathematics is the largest in the UK with an outstanding research reputation and facilities. We currently have nearly 200 postgraduate students working in all areas of Mathematics: Pure, Applied and Statistics under the guidance of academic staff, many of whom are recognised as being international experts in their chosen field.

Further details are available on our webpage or by contacting: Lenox.Green@manchester.ac.uk

Postgraduate Students Awards

Tom Shearer (pictured below with Professor Ann Webb), who has recently completed his PhD in applied mathematics, has been nominated for the Doctoral (Research) Student of the Year Awards, 2013.

Tom has also been awarded an EPSRC Doctoral Prize Fellowship, to study the mathematical modelling of the anterior cruciate ligament at the University.

Your Manchester Extras – Services & Discounts

Don’t miss out on the services and discounts available to all University of Manchester graduates. Alumni benefit from Manchester hotels, shopping, entertainment and restaurant discounts, including our own Manchester Museum and Whitworth Art Gallery. You can also get free access to most libraries at the University and online e-journals, discounts on postgraduate courses at the University, and access (some limitations apply) to the Careers and Employability Service. If you can’t believe your eyes, there are even free eye tests. To find out more, visit Your Manchester Extras on the alumni portal - Your Manchester Online.
In Memorium - Fritz Joseph Ursell  
28 April 1923 – 11 May 2012

Fritz Ursell was a singular and influential applied mathematician who made seminal contributions to research, particularly in regards to the mathematical analysis of linear water waves. This required the development of new techniques for the asymptotic evaluation of integrals, especially uniformly valid approximations. He made numerous contributions to the field: he constructed a family of solutions for edge waves on a sloping beach, which extended Stokes’ original result, he gave detailed analysis of the Kelvin ship-wave pattern and he was the first to prove the existence of trapped modes in water wave problems.

Fritz was educated at Cambridge and then worked for Group W towards the end of World War 2, devising methods for ocean wave forecasting. After three years in Manchester as a Research Fellow with Sydney Goldstein, he returned to Cambridge in 1950 as a University Lecturer. In 1961 he was appointed to the Beyer Chair of Applied Mathematics at the University of Manchester, a position he held until his retirement in 1990. He was elected a Fellow of the Royal Society in 1972. His papers, collected and published in 1994, are exceptional for their clarity and precision.

Born in Dusseldorf, Germany, Fritz was almost ten years of age when, on 30 January 1933, there was a change of government; Hitler attained power. Life for those of Jewish decent became more and more difficult and in 1936, due to the indefatigable efforts of Jeanette Franklin Kohn, a place was found for Fritz at a preparatory school in England. In January 1937, Fritz started at Street Court School at Westgate-on-Sea, Kent. By June he had learned enough English to take the Common Entrance Examination into Clifton College Bristol.

In May 1940, after the fall of France, Fritz was given notice by the police that he would have to leave Bristol, due to its strategic coastal location and his status as an alien enemy. This action may have been the end of Fritz’s scholarship ambitions, were it not for the headmaster of Clifton, B. L. Hallward, who found him a place at Marlborough College. Fritz joined the Mathematical Upper Sixth, took the Higher School Certificate that summer and achieved a distinction in Mathematics and Physics.

The Cambridge Scholarship Examinations were due in December and Alan Robson, the Head of Mathematics at Marlborough College, advised Fritz to apply to Trinity College. He knew that Fritz had no financial means, that a scholarship would pay for half his expenses and that Trinity had the resources to pay for the rest if they so wished. This is exactly what happened.

The classes at Trinity were very small, with five students: Freeman Dyson, James Lighthill, Tony Skyrme, Alison Falconer and Fritz. With characteristic modesty, Fritz always claimed to be the weakest student. In fact, he was worried about not being able to compete against his talented peers, and so he sought the advice of A. S. Besicovitch, his Director of Studies. Fritz liked to recount the advice he received: “You will never have to compete, these talented people will not be interested in your problems but in different problems. Also, they may abandon mathematics altogether, like the famous Trinity mathematician Isaac Newton. And finally, it is not the good mathematicians that do the good mathematics”.

In December 1943, Fritz was posted to the Admiralty Research Laboratory (ARL) at Teddington. He started in Group H (electromagnetics), as an assistant to A. Craig. The head of Group H at that time was S. Butterworth and in May 1944, Fritz was informed that Butterworth would soon retire. A new research group (Group W) was to be set up and would take over the office which Fritz was sharing with several colleagues. A new, smaller, office was to be assigned to Group H, and due to the reduced space, it was decided that Fritz should remain in his old office. In this way, Fritz joined Group W (the Wave Group) in June 1944, an act which serendipitously determined his subsequent career.

The newly appointed head of Group W, George Deacon, moved all of Group W into one large room on the top floor of the ARL. There were no partitions and no obstacles to discussion. After many fruitless months and a research trip to Cornwall that brought no useful results, Fritz suggested that they should measure the variation of frequency with time in Cornwall and try to trace the waves back in space and time and see whether they did indeed originate in a region of high wind. He wrote a short ARL Report (dated March 1945) explaining these ideas.
The experiments were done: they used a submerged pressure-measuring device every two hours, to take a twenty minute record of the pressure due to the waves. Next, they needed to make a Fourier analysis of each record, extracting about 120 harmonics, before they traced the frequencies backwards from the beach using the known theoretical group velocity, and showed that they originated in a storm area. The conclusion is that, outside the storm area, waves really do propagate according to linear theory.

While the group was carrying out their analysis, the war against Japan ended. Fritz decided that he did not want to be an oceanographer, but he stayed in Group W and worked on the motion of ships in waves. Fritz next considered the heaving and rolling motions of horizontal cylinders in the free surface of a liquid and devised a new method which led to an infinite system of linear algebraic equations with explicit coefficients. Its solution was computable by the methods available in 1947 and was actually used to compute for the first time the added mass and damping as functions of frequency. This ‘multipole method’ was to be used extensively by others in the following years.

In 1947, Fritz went for an interview in Manchester and received a three-year Imperial Chemical Industries (ICI) Fellowship. Almost immediately, Fritz was also elected to a Prize Fellowship at Trinity. However, due to the better facilities in Manchester, Fritz chose to stay in the North West and was granted a leave of absence by Trinity. In this period (1947 – 1950), Fritz wrote three important papers. The first two of these were ‘Surface waves on deep water in the presence of a submerged cylinder. I and II’ and the third was the 1951 paper, ‘Trapping modes in the theory of surface waves’.

In 1950, Fritz accepted a University Lectureship in Applied Mathematics at Cambridge. This appointment coincided with a period in which Fritz began to collaborate more widely, particularly with colleagues in the U.S. Over the next few years, Fritz spent long periods visiting colleagues at Harvard, New York University, Scripps Institute of Oceanography and MIT. One of the fruits of these visits was the paper, ‘The long-wave paradox in the theory of gravity waves’, which introduced what is now known as the ‘Ursell number’, a measure of the nonlinearity of long surface gravity waves on a fluid layer.

Fritz spent the academic year 1957 – 1958 at MIT. During this period he was taught to drive by Bob Dean (“A very harrowing experience”) and met Katharina Renate Zander. Fritz and Renate were to marry on the 19 June 1959 and would have two daughters, Ruth and Susie. In 1958, Fritz obtained a D.Sc. from Cambridge. Despite having already published about 25 papers by this time, Fritz was motivated to submit for the degree by the perceived importance of holding a doctoral degree within the American academic system.

In 1961 Fritz was offered the Beyer Chair of Applied Mathematics at Manchester, to complicate matters he was also offered a professorship at MIT. After lengthy deliberations Fritz accepted the Beyer Chair and moved back to Manchester, remaining there for the rest of his career. He maintained his research productivity, perhaps because he did not take on any major administrative roles, and was always grateful to Charles Illingworth and Lesley Camm for shouldering most of the Department’s administrative burden.

Fritz’s research in Manchester took in, amongst other areas, slender-body theory, the problem of ‘head-seas’ and transient water-wave problems. The 1984 paper with M. J. Simon, ‘Uniqueness in linearized two-dimensional water-wave problems’, gave the first significant generalization of F. John’s (1950) uniqueness theorem for two-dimensional floating-body boundary-value problems. Fritz also wrote many papers on ‘integrals with a large parameter’.

Ideally, Fritz should have written a book on asymptotics, but he never did: he always claimed that he could not write a research monograph because he did not know what other people had done (when Fritz retired he had accumulated over ten-thousand papers in dusty filing cabinets; the drawers were seldom opened except by treasure-seeking students). Having reached the age of 67, Fritz retired from the University of Manchester in 1990.

Fritz was more than just a fine mathematician. He will be remembered for his wit, his humanity and for the time he was prepared to spend with colleagues, especially young researchers. A natural raconteur, Fritz was able to converse in an engaging manner on a wide range of topics, his favourites being politics and history. He had a strong sense of fairness and was not afraid to stand up for those whom he thought were being treated unjustly and we can hardly do better than to close with one of Fritz’s signature remarks: “All this is well known to those to whom it is well known”.

Mentoring Opportunities

Mentoring is a great way for alumni to give something back to The University of Manchester, whilst helping our current students to develop their employability skills.

Being able to access the advice and guidance from someone who has experienced life as a student here, made the transition from University to working life, been through the application/interview process and started on a career journey is invaluable to them.

The Careers Service has many years of experience of delivering effective mentoring initiatives and currently offers two main ways for you to provide this support:

Manchester Gold: we facilitate mentoring partnerships between an individual mentor and mentee. Over a six month period, they work together to help the mentee address specific issues, concerns or objectives in relation to career planning and decision making. Mentoring can be conducted via face to face meetings, telephone conversations, email, Skype or any combination of methods of communicating depending on geographical location and availability. We estimate that mentors need to dedicate around 10 hours of their time to a Manchester Gold partnership.

Online Q and A: by registering for this option, a mentor is offering to answer ad-hoc questions from a number of different students. Mentors can select how many questions they are willing to receive each month. This is a resource for students who have specific questions and do not require the more formal, in-depth and protracted level of support offered by Manchester Gold.

We welcome mentors from all roles, types of organisation, sector and with varied levels of experience. As long as you feel able to offer support to a student who is trying to make decisions about what to do once they graduate, we would invite you to register with us.

If you would like to know more about these opportunities, please email: mentoring@manchester.ac.uk

Cryptography CompetitionHonours the Father of Modern Computing

Launched to coincide with the Alan Turing Centenary Year in 2012, the Alan Turing Cryptography Competition is aimed at children in Years 7 to 11 (or their equivalents) throughout the UK. The competition in 2012 was so successful that we ran it again in 2013 and it will now become an annual event in the School.

The 2012 competition followed the story of two children, Mike and Ellie, who get caught up in a cryptographic adventure to discover the long-lost Turing Treasure. In 2013, Mike and Ellie returned to unravel the secrets of the Egyptian Enigma, aided by the mysterious Mr Barquith. The story featured a number of illustrious names from the history of the University, including Jess Haworth (who founded the Egyptian collection at the Manchester Museum), Ernest Rutherford and, of course, Alan Turing himself.

Children take part in the competition with up to three friends. Every two weeks a new chapter of the story is released on the competition website. Each chapter contains a code – there are six in total and they get harder as the competition progresses. The teams compete to see how fast they can solve each code – the faster they solve each code, the more points they get! A leaderboard on the competition website shows how well each team is doing, and the top three teams at the end of the competition win prizes. There are also a number of spot-prizes to be won throughout the competition.

If you are outside of the required age range, or outside of the UK, then you can still take part by registering an ‘out-of-competition’ team. You won’t be eligible for the prizes, nor will you appear on the leaderboard, but – if you like solving puzzles and cracking codes – you can pit your wits against some of the smartest students in the country! The codes come in many shapes and sizes and we have included one from the 2013 competition, on the next page, for you to try - if you think you are up for the challenge...!

The 2014 competition will be launched in January, with details being sent to schools in October of this year. You can view the details, when published, as well as all the codes, clues and solutions from the 2013 competition on our website.
The history of mathematics in Manchester

Particular thanks to Dr Francis Coghlan, Dr John Parkinson and Dr Robert Sandling.

The MacTutor History of Mathematics archive, http://www-history.mcs.st-and.ac.uk/
University of Manchester Mathematics Building, Scherrer and Hicks, 1969.

Patterns in the Unpredictable: Why can’t people behave randomly