

OCIAM NEWSLETTER

October 2006

EDITORIAL

It is good to get out and about, not least to see what other people are up to, and summer is the prime time to do that. Woods Hole on Cape Cod, where I spent four unrelentingly pleasant weeks in August, is the home of the Woods Hole Oceanographic Institution, and of a summer school on geophysical fluid dynamics which has run every year for nearly fifty years (see Rachel Zammett's account in this issue). Some of the greatest applied mathematicians and geoscientists on the planet frequent the porch of Walsh Cottage, and the conversations are eclectic and unmissable. While writing a section on tsunamis for my forthcoming book, I asked Joe Keller what he had written on the subject, and he told me (in detail, although the papers are 45 years old), along with stories of the Honolulu symposium in 1961 which followed the great Chilean earthquake and tsunami of 1960.

In Madrid, I went to a meeting on Earth Science and Mathematics. The Spanish analysts, all existence and uniqueness types, are valiantly trying to build bridges to connect with real scientific problems. It is a tough thing to do (hard problems tend to be, well, hard), but their effort is really worthwhile insofar as there is a genuine effort there to study mathematical models which arise in actual physical applications.

The University of Limerick in the west of Ireland sits in an attractive campus by the river Shannon, with views of the hills of County Clare in the distance. The Department of Mathematics and Statistics is the recent recipient of a massive grant from Science Foundation Ireland, which will enable the University to establish a strong presence in industrial applied mathematics. This development is very exciting, and potentially may allow the establishment of a really good applied mathematics group in Ireland.

Andrew Fowler

FUTURE EVENTS

The Alan Tayler Lecture

sponsored by
The Smith Institute

Henri Berestycki

*l'École des Hautes Études en Sciences Sociales
(EHESS)*

*“Modelling spatial diffusion : From flames to
social norms”*

20 November 2006 in the Burley Lecture Theatre at St Catherine's College. Tea will be available in the foyer of the theatre from 4.15pm.

58th European Study Group with Industry

29 Jan – 2 Feb 2007

Universität Utrecht

<http://www.math.uu.nl/swi2007/>

MISG (Mathematics in Industry Study Group)

5-9 February 2007

University of Wollongong, Wollongong Campus,
Australia

<http://www.misg.math.uow.edu.au/>

ESGI (European Study Group with Industry)

26-30 March 2007

Nottingham University

<http://www.maths.nottingham.ac.uk/conferences/ESGI07/>

OCIAM 07 (International Congress on Industrial and Applied Mathematics)

16-20 July 2007

Zurich, Switzerland

<http://www.iciam07.ch/poster>

Deadline for minisymposium proposals: 10 Oct 2006

Deadline for abstracts submission: 12 Nov 2006

Deadline for earlybird registration: 15 Jan 2006

VISITORS

George Mullenger (SDH) 17 September to 4

November 2006. George will visit us for a few weeks in September-November 2006 under the auspices of the Oxford-Canterbury exchange (that's Canterbury, New Zealand). He works on models for granular media.

Martin Barlow (TL/BH) 1 Oct – 30 June 07

If your carpet had as many holes as a Sierpinski carpet, then you would need a new carpet. It is obtained by taking a square, mentally dividing it into 9 components, and then deleting the central one, and then taking each of the 8 remaining squares and dividing each into 9 components.... the example allows many variations. The three dimensional analogue could be interpreted as a model for the 'space' in soil with the holes being interpreted as impermeable material. Mathematically, the simplest connected fractal set is the Sierpinski gasket.

In the late 80s Barlow, Perkins and Kusuoka created a revolution and introduced Brownian motion on the Sierpinski gasket. Later, Barlow and Bass made a highly non-trivial extension and constructed a diffusion on the carpet. In this way Barlow and his colleagues started the mathematical study of diffusion on fractals. Their examples challenge many of our most cherished methods. In particular, it seems natural, even important to describe the bulk diffusive behaviour (the Fokker-Planck equation), but the tools of classical PDE theory are inadequate for this purpose and can most easily be replaced by the technology of Dirichlet Forms introduced by Beurling and Deny in a paper in the Acta in 1958.

Over the last twenty years, many of the deepest theorems from the parabolic divergence form theory of PDEs, such as Moser's Harnack inequality, and Aronson type pointwise bounds have been transported to the context of Dirichlet spaces – however, the new results tend to be more flexible and

quantitative – with the estimates depending quite tightly on the geometry of the underlying spaces. Barlow is one of those most deeply involved – and has many results concerning PDEs; sometimes the results are specific to the fractal context, but often they have wider application.

One of the many major achievements of Barlow's work on fractals has been towards the better understanding of the regularity of harmonic functions (Harnack inequalities) in irregular domains. Recently he transported this understanding into the field of diffusions on the percolations cluster. Aside from the pretty pictures you can find at

<http://www.math.ubc.ca/~barlow/rwp/index.html> you will not be surprised to hear that Barlow, by bringing these same well-honed and deep analytic/Dirichlet form tools to bear, has made substantial and fresh inroads in this area.

Barlow has also made fundamental contributions to the theory of martingales, including what are now known as the Barlow-Yor inequalities.

Martin Barlow will be visiting the Mathematical Institute, Oxford for the Year 2006/7 as the guest of the Stochastic Analysis group, and particularly his ex-graduate student Ben Hambly. He has visiting fellowships at Magdalen College, and for the second part of the year at **All Souls College**.

Terry Lyons

Tony Ware (SDH) Jan 2007 Tony Ware plans to visit for 6 months from January 2007. Tony is from Calgary University, Alberta, Canada and works on numerical methods for mathematical finance; he is familiar to many of us, having done his D Phil in the Numerical Analysis Group.

NEWS

ECMI News

We are pleased to announce that the ECMI Conference in 2008 will be held at University College London under the auspices of the Lighthill Institute. The meeting will run from June 30-July 4. The chairman of the scientific committee is John Ockendon and the chairman of the local committee is John Norbury (UIC representative of the ECMI

council). The IMA will be in charge of the organization. We plan to make a special feature of talks on new and developing areas of application of mathematics. Watch this space for more information!

ECMI 2006 was held in Madrid from July 10-14 this year. Sam Howison gave a plenary lecture on "Challenges and Opportunities of Mathematicians in the finance industry" and in spite of being scheduled at 8am on the morning after the Conference Dinner he managed to attract a good audience. Altogether 9 members of OCIAM took part in the meeting. A Round Table discussion on European Collaboration on Mathematics in Industry was organized by Melvin Brown and Hilary Ockendon and resulted in some lively discussion; further details can be found in the ECMI Newsletter, October 2006.

Nursery Corner

Drew Michael Donnelly Hambly was born at 2.14 pm on Wednesday 24 May. He weighed 3.58 kg or 7lb 14oz, and was discharged home less than 24 hours later. Lots of congratulations to the Hambly clan.

Tiina Roose's baby boy Max just turned 6 months old. He is 9.26 kg and about 70 cm long. His list of achievements include eating puréed vegetables, giving himself his cup and being the only baby in his singing group to actually sing along.



OCIAM & CMB v. Comlab 2006 Cricket Match Report

Once again the day arrived when 160 sausages, 10 kilos of burger meat, 200 buns and around 8 kgs of strawberries were collected from the Covered Market. "What for?" I hear you all ask. The annual cricket match and eating festival that is the OCIAM & CMB v. Comlab of course!

The match this year occurred on what turned out to be a rather Antipodean style day (temperatures in the high twenties to early thirties). With everyone donning hats and our very own intrepid photographer taking some rather catching shots, none other than Dr Roman Voskoboynikov, the match kicked off with ComLab batting first shortly after 2p.m. Whilst balls were caught and the occasional one hit the boundary, Dr T, assisted by Dr Breward and many a helpful DPhil student, sought to feed the hungry hordes. One thing learnt on this particular day is that Germans make very safe charcoal, so good in fact that it takes 2.5 hours to light! However, with visiting Assoc. Prof. Mark McGuinness supervising, the cooking was soon underway and after a short break it was time for OCIAM to hit the pitch.

The Comlab total of 102 in 21 overs (an extra one added to allow Deputy Fowler to test out his knee) was always going to be a challenge but the OCIAM batting proved up to it. The runs kept flowing until a mere 3 were required from the 20th over. After 2 balls the scores were tied and the director was at the crease poised to triumph. The three dot balls that followed saw the troops getting nervous but a hastily run leg-bye called by the mainstay Prof Chapman saw OCIAM home off the last ball.

Thus OCIAM recovered the Smith Willow and Graham Sander was named man of the match. Well done to all!

As ever, we are particularly indebted to our sponsors of the match, D. E. Shaw Group, who also provided us with extra T-shirts and rubik cubes to while away the hours.

Your match reporters,
Drs Hambly and Tindall

Mathematical Geoscience Group

A small group of faintly like-minded members of OCIAM have decided to promote their activities under the auspices of the newly formed Mathematical Geoscience Group. Headed by Andrew Fowler and Chris Farmer, the group also includes OCIAM members John Norbury, Irene Moroz, Graham Sander and Peter Howell among its interested constituents, and it will aim to provide a focus for problems in geoscience in the widest sense, including geophysics, geology, meteorology, planetary science, having applications in the environment, the oil industry and weather forecasting, for example. A web page

(www.maths.ox.ac.uk/mgg) has been launched, and a new seminar series on mathematical geoscience begins this term, with seminars on alternate Fridays. It is particularly intended to nurture connections and run workshops with other departments in Oxford and elsewhere, and particular links have already been made with Earth Science, Geography, Statistics, Atmospheric, Oceanic and Planetary Physics and Archaeology.

Andrew Fowler

Prizes, awards and jobs

Max Little, a 4th year D.Phil. student supervised jointly by Irene Moroz and Patrick McSharry at OCIAM and Stephen Roberts in Engineering Science, has been awarded first prize in the student paper competition at the Institute for Electrical and Electronic Engineers (IEEE) flagship signal processing conference, the International Conference on Acoustics, Speech and Signal Processing (ICASSP) 2006 in Toulouse. The title of the paper is 'Nonlinear, Biophysically-Informed Speech Pathology Detection' and is published by the IEEE Press.

Gareth Jones managed to collect a £50 prize (thanks to SIAM UK-Ireland) for one of the best student talks at this year's British Applied Maths Colloquium, held at Keele University. The talk, entitled "Buckling of a spherical shell embedded in an elastic matrix with a uniaxial stress field at infinity", summarised part of his work carried out under the supervision of Jon Chapman and David Allwright. Gareth also got appointed as the Critical Mass "New Frontiers in Solid Mechanics" postdoc – which is to start in December.

John Ockendon awarded the 2006 IMA Gold Medal

The IMA Gold Medal is awarded in alternate years in recognition of outstanding contributions to mathematics and its applications over a period of years. This year the medal was awarded to John Ockendon. John will give the IMA 2007 Summer Lecture at the Royal Society on 27 June 2007, when he will be presented with his gold medal.

Flood warning

I'm the PI on a Natural Environmental Research Council award entitled "Quantifying Flood Risk of Extreme Events using Density Forecasts Based on a New Digital Archive and Weather Ensemble Predictions", which is part of their Forecasting Risk from Extreme Events programme. The research project will be carried out by the Systems Analysis, Modelling and Prediction (SAMP) group (www.eng.ox.ac.uk/samp) in collaboration with the [European Centre for Medium-Range Weather Forecasting \(ECMWF\)](#), the [Saïd Business School](#) and [Hydro-GIS Ltd](#). The project will combine advanced mathematical forecasting techniques, state-of-the-art probabilistic weather predictions, and the largest electronic archive of extreme rainfall events in the UK. Both probabilistic forecasting and machine-learning techniques will be used to predict and categorise the extreme rainfall events.

Patrick McSharry

WATER SPORTS

Surfing news

A celebrity, possibly Chris Carter of X-Files fame, once made a statement to the effect that the more you try to say about surfing, the sillier you end up sounding. Since I share this sentiment, I am not going to write a proper surf report at all, except to state the more-or-less obvious; that it is much better to surf in winter than in summer because the crowds are much smaller and the waves are better, as illustrated in the photo (taken at Bondi in July). So, I hope I will have your sympathy as I struggle with the tiny waves, swarms of surfers and searing sun back in Sydney for the next six months while you all enjoy the winter.

Rather, I am going to pose a meteorological/geo-fluid-mechanics question vaguely related to surfing; it's relevant, to me at least, because as a goofy footer (i.e., left footed) I like the waves generated by the northeasterlies (at Bondi they tend to break to the left, all other things being equal) but I'm not so keen on the temperature gradient established by the cold water below and hot air above, with me in the middle.

Sydney lies at, roughly, 34 degrees south and 151 east and its beaches (for the main) face eastwards. In summer the prevailing winds are northerly or northeasterly. It is well known that after a prolonged spell (of the order of a week, say) of northerly winds

the air temperature goes up while the (beach) water temperature goes down. For example, it is not unheard of for the water temperature in late December to drop from 21C to 17C after a week of stiff northerly winds. Southerly winds have more-or-less the opposite effect, the air temperature goes down but the water temperature goes up. What is the mechanism that causes this?

Jeff Dewynne



On the pronunciation of the names of hydrodynamicists

Andrough Foughlough [1] claims that Froude is pronounced "Frood". What gough [2]! Anyone can gough [3] ough [4] to the OCIAM common room and look it ough [5] in the New Oxford English Dictionary, which clearly states that it is `Fraod'. For mough [6] evidence, Google will find the poem "The Joy of English Pronunciation" (first line: "Dearest creature in creation") by George Nolst Trenité, in which Froude features in line 155. A local adaptation of the verse in question is:

I'm proud to join the crowd that ploughed along with Froude and Bryce McLeod.
Bryce twice! That's nice (not gneiss) or comely --
Which, rumly, rhymes with Cholmondeley,
Bottomley.

This, I feel, refutes Dr Fooler's argument quite comprehensively.

Sam Hauison.

- [1] "ough" as in "through", "bough" "thorough".
- [2] "rough".
- [3] "though".
- [4] "cough".

- [5] "hiccough".
- [6] "ought".

TRAVEL

The U.S. Study Group was hosted by Burt Tilley at the well-endowed but alcoholically challenged Olin College outside Boston. Several of the problems were close to ones that had been solved in literature unfamiliar to the OCIAM reps (CJB and JRO): for example, how to get the best black and white dot representation of a pixel whose original had shades of grey (Colin Please somehow managed to turn this into a backward heat equation), or how to convert the output of a downward pointing camera on a model aeroplane into a "head up" display; for the old school, Ferdie Hendricks challenged all with the amazing high Reynolds number thin film flow in a disk drive. Most telling was the problem from a medical robotics consultancy who knew they had to use quaternions to represent their camera positions but did not know how to convince their customers that they actually did the job!

Canadian Study Group

The Canadian Study Group provided a good selection of problems including one on Salamander eggs that drew my attention (and that of the oldest Study Group attendee, Ellis Cumberbatch). The Fields Institute was a good venue, with everything compact, and free Werthers Originals helped diffuse tense sparring moments with our problem presenter. Toronto provided an excellent backdrop to the meeting (very good restaurants, good cocktails, fizzy brown stuff masquerading as beer) and I managed to get to the Canadian National Exhibition – a cross between the Royal Tournament, Ideal Home Exhibition and an agricultural show – before having to face the airport for the journey home (without duty free!)

Chris Breward

Venturing into the gates of Hell

On June 23rd, fellow OCIAM member Christina Orphanidou and I joined eight others and boarded a very early flight to Reykjavik, Iceland to meet up with Geoff Evatt, who was already there for a conference on glaciology. Destination: The Gates of Hell. Seriously – I'm not joking!



Iceland's most active volcano, Hekla towers 1,491m above the surrounding area and is known by Icelanders as the Gateway to Hell. Our goal was to climb it. Having last erupted in 2000, the good thing was that it wasn't "due" to erupt again for another couple of years... the bad thing was that for miles around the base, it was a barren lava field. As we discovered when we turned up to camp there...

We arranged to be dropped off near the volcano for the weekend, stopping en-route to visit the geysers at Geysir (!) and Gullfoss, a very impressive waterfall. Having been drenched in spray at the waterfall, we couldn't have been further from drinking water as we pitched our tents in the rather intimidating shadow of Hekla on Friday night. Miles from anywhere, in true Ray Mears style we fashioned an impromptu siphon to drain meltwater from a nearby patch of snow. The boys were in their element... Geoff, however, then illustrated his true outdoor skills when trying to cook his pasta, managing instead to set the entire surrounding rock alight.

After the excitement of setting up camp, climbing the volcano on Saturday was easy – a few hours slog, mainly through snow, and we were on the summit with a view for miles. The surface of the top of the volcano was pleasantly warm, great for sitting and dozing, but also a gentle reminder of the ferocious volcanic activity going on below us... Descending we found was best achieved by tobogganing at great speeds on a survival bag – fantastic fun provided you managed to avoid spearing yourself on random outcrops of razor-sharp lava...



A celebratory mug or two of port and a few games of "pétanque à la lava" and too soon it was Sunday morning and time to say goodbye to Hekla. It was a short, but wonderful trip, and fortunately for me, the start of an incredible five day hike. As the others got on the minibus back to Reykjavik and a shower, my brother, sister and I shouldered our packs, pointed our compasses south and set off for the coast.

Helen Haworth

Geophysical Fluid Dynamics summer school

In the summer I attended the 47th Geophysical Fluid Dynamics summer school at the Woods Hole Oceanographic Institution. This year the theme was 'Ice', and the principal lectures were delivered by Grae Worster (University of Cambridge). During this first two weeks of lectures we studied solidification problems, with special emphasis on the formation of sea ice, before moving on to look at mushy layers and interfacial premelting. This was followed by eight weeks of seminars on a variety of topics, ranging from glaciology to cosmology to the swinging of ponytails. During this eight week period, we also worked on an individual project; in my case, the breaking of natural dams with Neil Balmforth (UBC), which combined theory and numerics with experiments in the GFD lab. At the end of the summer, the students each gave an hour-long presentation to the staff on their project and produced a written report - these can be found online at <http://gfd.whoi.edu/proceedings.htm>

Rachel Zammett

MEDICAL NEWS

There may be a calm, relaxed academic atmosphere in the outside world, but the stress of the steaming hothouse that is OCIAM takes its toll. Most recently, Chris Breward succumbed to a bout of atrial

fibrillation, which landed him in hospital for two days while his heart rate fluttered round an alarming 170 beats per minute. He is off caffeine and on flecainide, which as well as a medicine is a mediaeval Irish swear word. To quote Levick's book, atrial fibrillation "...is an uncoordinated, repetitive excitation that results in a writhing movement of the wall, incapable of expelling blood. Fibrillation in the atria is a relatively benign condition, quite common in the elderly and compatible with a sedentary life." So that's all right then.

Elsewhere, the editor had another arthroscopy to try and retrieve the remains of his knee from the gluepot. Undoubtedly the most interesting aspect of the operation was a switch in blood pressure from 140 over 119 (pre-op) to 120 over 79 (post-op), despite an apparently calm mood. In the anaesthetic room, it was interesting to watch sinus arrhythmia in action, the heart rate noticeably speeding up on inhalation and slowing down on exhalation. At 50 beats per minute, the Fowler heart beat was tending asymptotically to zero compared with the atrial Breward norm. As for the operation, it doesn't seem to have done much.

Andrew Fowler