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# THE BRITISH SOCIETY OF RHEOLOGY

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**BSR BULLETIN**  
**2009, Vol. 50, No. 2**

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ISSN 1469-4999

## EDITORIAL

### SUBMISSIONS TO THE BULLETIN

Submissions to the Bulletin may be made by any practical means – post, email, disk, fax, pigeon, donkey, guide dog, *et cetera* but electronically is preferred (saves typing...). Most packages supported (Word, TeX, LaTeX, WordPerfect, ASCII, RTF) but always provide a contact name, address, e-mail, or telephone number in case of problems. The next copy date will be in June 2009 and, as always, all contributions are gratefully received. Late copy can sometimes be accommodated, however the facilities of the BSR and ESR web sites may also be appropriate. Please contact the Editor (xue-feng.yuan@manchester.ac.uk) for details.

### COVER ILLUSTRATION

The image in the cover shows Neutron Flow Mapping of an entire constriction flow of monodisperse entangled polystyrene. The scattering patterns display information on the configuration of the whole chain configurations, complementary to the stress field. Both are now computable from tube model computations. See J. Bent, L. R. Hutchings, R. W. Richards, T. Gough, R. Spares, P. D. Coates, I. Grillo, O. G. Harlen, D. J. Read, R. S. Graham, A. E. Likhtman, D. J. Groves, T. M. Nicholson, and T. C. B. McLeish, “Neutron-Mapping Polymer Flow: Scattering, Flow Visualization, and Molecular Theory”, *Science*, **301**, 1691-1695 (2003).

We are always looking for appropriate images for the front cover of the Bulletin and Rheology Abstracts (preferably of a rheological nature!). Please contact either Xue-Feng Yuan (xue-feng.yuan@manchester.ac.uk) or Nick Hudson (n.e.hudson@strath.ac.uk). Contributions are always welcome!

## **AIMS OF THE SOCIETY**

The way liquids flow and solids deform affects all aspects of life.

Extraction and processing of crude oil, moulding of plastics, use of toothpaste, spreading of margarine, painting and the lubrication of joints in the human body are all examples of processes depending upon rheological behaviour. Rheology is defined as the science of the deformation and flow of matter.

If your work is concerned with rheology in any way, then you have much to gain by joining the British Society of Rheology - publications, conferences and access to fellow members who, while working in a different discipline or industry, may be facing similar problems to yours. The Society is non-profit making and is registered as a charity.

You are warmly welcome to visit our web site <http://bsr.org.uk/> or <http://innfm.swan.ac.uk/bsr/>, and to apply for membership on-line.

## A Schoolboy Dreams of the Stars

Tom McLeish FInstP FRSC

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I was honoured and delighted to be awarded a Gold Medal from the society that has been an academic home since the first year of my PhD! I am especially happy to have received a medal alongside Mike Cates – more of Mike anon, but the reappearance here of some of the characters he wrote about in the last issue will illustrate how closely connected the international rheological community is. I will follow Mike in telling my “rheological story”: the BSR itself has been to me a continuous source of new academic friendships, and many important lessons along the way. Let the reader draw their own, if any, from the following. I recall one of my very first BSR conferences at the University of Kent, and with it a memorable encounter. On emerging into the coffee break after giving a talk on molecular rheology of branched polymers (some things never change, do they?) I was buttonholed by a rather agitated industrial participant. “We don’t want all these complicated equations!”, he protested, “we just want simple equations that we can solve and predict how our polymers will process!”. I think I mumbled something apologetic about nature just being complicated sometimes and that that was the way things were ... but the ringing criticism and appeal for simplicity I never forgot.



2009 BSR Gold Medallist –Professor Tom McLeish FInstP FRSC

But I’d like to go back and explain why I became involved in rheology in the first place, and fascinated by branched polymers in the second. My first scientific love was actually astronomy: from an early age I kept records of sunspot activity and solar rotation, took photographs of galaxies and planets, mapped Jupiter’s storms

during 5 hour observation sessions at the school telescope in bleak midwinter, got to know Patrick Moore – even managed an “O-level” in the subject (astronomy, not P. Moore that is, and a vital career move as it later turned out to be). Physics at university was clearly the route to a life spent with the stars, but I was very keen to take a “gap year” before that, ideally being paid to do something scientific. I was pointed towards companies that offered “thick sandwich” sponsorships with periods of industrial experience before and after a degree course, and finding that only two would consider physicists, did not take long to send off applications. GEC turned me down but Courtaulds offered a place. From that moment my fate was sealed: a year at their Coventry research labs polymerising acrylonitrile, extruding polyethylene fibres at high rates, wondering at the strange spiral instabilities and “spurt effects”, observing the properties of highly-filled melts in flow sent me scuttling off to the company library in the firm conviction that there *had* to be some science behind all this (no one in my research group seemed to be aware of any!). And there they were – a row of books on “Rheology” (one by a certain N. Cogswell) which I devoured happily, yet without complete satisfaction: even in the literature no-one really talked in depth about what the molecules were doing.

Then at Cambridge I set about the physics I would need to do professional astronomical research. At that point there were no undergraduate courses in the subject; only the chance to follow a final year project in the area; these often led onto a PhD. I latched on to the exciting field of X-ray astronomy and a project suggested by Andy Fabian (now a world leader in X-ray emissions from accretion disks). That was the good bit; those who know me will wince when they hear that the project itself involved writing a long and complicated Fortran code. Six weeks of frustration later I wrote a note of resignation to Fabian, opted for the problem paper instead of a project, and left astronomy for clear nights at the bottom of the garden.

I was temporarily at a loss for what to do, wistful musings about those weird polymer fluids at Courtaulds seeming to lead nowhere, until someone, I cannot recall who, asked me if I had heard about the “polymer physics” that Sam Edwards and his group were developing right under my nose in Cambridge. The words sounded right, and I was already one of the physics students totally under Sam’s spell as the magician who had lectured us (magically but fortunately unexaminably) on classical mechanics. Wouldn’t it be better to follow a PhD in this group rather than return to Courtaulds unenlightened? My suggested supervisor, Robin Ball told me about schemes called CASE awards that might satisfy both myself and the company, and a new idea called the “Doi-Edwards theory” of polymer melts that might prove a good starting point for explanations of phenomena that had puzzled me on the pilot plant. Sam even gave me a pre-print just arrived from some young turk at Bell Labs called Ron Larson. I can still remember the title page: “Fibre-Spinning with the Doi-Edwards Equation”.

Turning over, the next page had me hooked, for there was *a differential equation using tensors and describing polymer molecules!* This was what I wanted to do!

Working in the Edwards group taught us so many things that in retrospect are perhaps of more consequence than the physics we did at the time: all that contributes to the identity of a research group, the clear signal that we could and should steer our own projects as much as possible, the idea that the PhD students were valued highly for the new work we were doing (I once heard Sam reply in answer to a conference question criticising his lecture, “Well, you know, we have some very bright research students in Cambridge, and if something were really wrong with what I’ve told you, I’m sure that one of them would have spotted it.”). Added to this was the presence of external visitors – both Masao Doi and Ed Samulski were resident during my first year – all making for a quite exhilarating atmosphere.

The CASE award meant that I was reading through as much industrially related literature as physics. It was this that brought to my attention the strange vortices that formed upstream of constriction flows in branched polyethylene melts (LDPE) but not in equivalent the linear (HDPE) melts. Understanding as I did by then that Doi-Edwards theory elevated the molecular *topology* of a polymer melt to the highest physical status, I naturally started to wonder if the explanation of this topologically-determined effect might already lie implicitly within the new framework. The problem was that no one had any idea of the real molecular structures lurking in LDPE. But browsing through recent copies of *Macromolecules* in the library one afternoon I came across an extraordinary paper. A Canadian group had claimed to have synthesised, from polystyrene, a melt whose every molecule had the topology of a capital H. Not only that, but they had measured the linear rheology and shown it to be quite different from either linear or star-shaped melts. The author was Jacques Roovers, and I knew I had struck gold (and along the way might be able to finish writing a PhD). If not LDPE, then perhaps the H-polymer melt might be the next step? The conceptual problems were considerable, as illustrated by a brief conversation with Sam Edwards one day:

**SFE:** “*Well Tom, you’ve got a year left of your PhD, what are you going to do with it?*”

**TCBM:** “*I thought I’d take a look at entangled branched polymers and how they flow*”

**SFE:** ....**Pause** .... “*But why should they flow at all?*”

Although Sam and Masao had never written about it, they had clearly understood that, with reptation suppressed, the viscosities of highly branched melts would diverge exponentially (a problem that Robin Ball and I later returned to, first in the context of star polymers). Two other people were the source of encouragement to keep my sights on the ramifications of this problem. One was Mike Cates, by then back in Cambridge from Exxon and Santa Barbara. I had been reading Mike’s

beautiful thesis on the statistical physics of “polymeric fractals” (aka branched polymers!) and was impressed that once the statistics determining the ensemble were known, Mike had successfully calculated the linear rheology in the unentangled case.

“What about the non-linear rheology, Mike?”,

“No chance”.

“Because there’s no tube model?”

“Something like that”.

Perhaps the reason I have never forgotten that conversation is that, at the annual Society of Rheology conferences in the USA, I had started to hold regular conversations with Ron Larson (of “*Fibre-Spinning with the Doi-Edwards Equation*” fame and much besides by then) about the LDPE problem. Ron convinced me that the situation was much worse than the lack of a molecular theory of LDPE – there wasn’t even a phenomenological constitutive equation that came qualitatively close to describing its shear-thinning and extension-hardening behaviour in all geometries. Might Ron’s unmatched grasp of the structure of rheological models, combined with my background in molecular theory, help find the missing model? It is, however, hard to make real progress with a tough problem from a distance, especially for a post-doc looking for a job.

The job problem was solved by Sheffield University department of physics by placing quite the most extraordinary advertisement I have ever seen for a lecturer: “*Junior lecturer wanted to start a new research activity not currently followed in the department, e.g Polymer Physics / Should also be able to teach astronomy*”. There it was pinned up on the Cavendish Laboratory jobs board. They told me afterwards that it really was the astronomy “O-level” that swung it. My wife Julie was very supportive of the move north, even though it meant an interruption to the planned course of her medical qualifications (in the end a very positive one as it turned out). We saw Mike quite frequently in Sheffield (“*Nearest place to Cambridge you can go for a walk*”), giving us the chance to develop his ideas on “living” polymers made of surfactants. The other kindness I received from former Cambridge colleagues was from a thoughtful Athene Donald. Times have changed now, but at that time it was possible to walk into a lectureship without any discussion of research funding, grant proposals and the like. Athene pointed out that an application on the theory of branched polymers to the Agricultural and Food Research Council might be looked on favourably (actually I think I could have been forgiven for not having thought of that one!). I’m very grateful for that first leg up onto the research funding ladder – such kindnesses of voluntary mentoring are still needed by newly appointed academics.

The other element of very good fortune in the move to Sheffield became apparent during a visit to Exxon the summer before I started there. Talking to Lew Fetters, one of the great anionic synthetic chemists interested in branched polymers, I mentioned my new institution. “Sheffield!”, he started, “Ron Young’s there – best anionic chemist in the UK”. Indeed so it proved, and showed me how powerful,

and how pleasurable, a close collaboration between chemistry and physics could be.

I should say more about my version of the “american connection” during those years. Through sharing an office with Mike in the Cavendish I had been introduced to Scott Milner (mostly through answering the telephone to Scott’s daily calls about the problem of lamellae under shear – see Mike’s article in the last issue). Annual trips across the atlantic would take in Scott, who was also interested in polymer dynamics, as well as the matchless theory/experiment pair of Mike Rubinstein and Ralph Colby at Kodak’s Rochester labs. Mike and Ralph were enabled by Kodak to create a group as strong as any university team anywhere in the field. It also supplied them with funds for visiting fellows that, in retrospect, did a huge amount to keep the international community in polymer physics connected. There for the first time we saw how the entangled dynamics of a complex branched melt might be calculated, and Ralph set off devising a clean experiment that might test it. Both strands took several years to come to fruition.

Working with the best people in the world for a few days a year is a good start, but as noted above, cannot really substitute for sustained collaboration when the nuts you want to crack are especially hard ones. Another stroke of good fortune helped solve the impasse, again through the good offices of Mike Cates. Mike had proposed, together with Ken Walters and Anthony Pearson, a 6-month programme on the “Dynamics of Complex Fluids” at the Newton Institute, Cambridge in 1996. But then came his move to Edinburgh, and did not feel he could immediately disappear from his new responsibilities for so long. By then I had been in Leeds a couple of years, so was more mobile. I set about ensuring that two people would be able to spend extended visits to the programme – their names were Ron Larson and Scott Milner. Getting both of them to Cambridge for the 6 months might solve that problem of limited discussion time at annual visits and conferences. Indeed that time proved memorable, as those if us gathered once more in Cambridge for the 10 year review meeting recently testified. After six weeks, Ron and I had written down and started to compute with the system now known as the “Pom-Pom” constitutive theory for branched entangled polymers, and by the end of the programme has shown its inequivalence to existing theories, and its qualitative capturing of LDPE’s phenomena. In a strange twist of conceptual history, I later realised that the Pom-pom structure lay buried in the rather complicated theory of H-polymers I had worked out for my thesis, and which had caused affront to the industrialist at that early BSR meeting. Perhaps the plea for simplicity had struck home.

I’d like to say a little more about the vital role of industrial science in the UK. After the Courtaulds CASE, ICI had sponsored my post-doc in Cambridge, and a kindly soul from that company called Richard Buscall supported my first PhD student, Kevin O’Connor in Sheffield. Sam had always taught us to value (by example as in everything) the continual flux of interesting new problems that

industrial visitors brought us. One of them, the delightful and accomplished Giancarlo Cappaccio from BP Chemicals seemed to have the closest interest in the polymer rheology problems I was tackling, and promised that if the company ever had need of a deep study of long chain branching, he would contact me. Good to his word, several years later, as I was moving to Leeds, the new metallocene catalysts for olefin polymerisation were looking promising, and the possibility of designing molecular structures for processing began to look realistic. True to his word, Giancarlo did get in touch, so beginning over a decade of fruitful collaboration with BP. But more than that, it was a consortium of UK industry including BP, ICI and Courtaulds that initiated the vision that became the multidisciplinary “Microscale Polymer Processing” project. I can take no credit for the concept – I more or less did what I was told in championing the idea (at a meeting of the Polymer Engineering Group in York as matter of fact). So the chemistry-physics collaboration could be extended to chemical engineering and applied mathematics, and into industrial teams in a deeply collaborative way, assisted by some very enlightened planning at EPSRC, an organisation which we are quick to criticise but that perhaps doesn’t get enough credit when it is due.

An absolutely key collaborator during those Leeds “MuPP” years is our current BSR President, Oliver Harlen. Arriving at Leeds from Cambridge soon after me, it is no exaggeration to say that Oliver rescued me (and a very able PhD student, Graeme Bishko) from disaster. I had taken on two students, with the idea that one would work on the molecular theory of branched polymers, while the other (Graeme) would solve the consequent complex flows using a new type of finite element flow solver, the Lagrangian scheme first suggested by Ole Hassager. But it soon became apparent that this development was not a straightforward application of textbook mathematics. Oliver already knew this from personal experience and proved the ideal co-leader of the Leeds team, including the laboratory of rheologists we established (run by David Groves formerly of ICI at that time). I had long wished for such a theory-experiment mix “at home” since seeing how effective was the Colby-Rubinstein collaboration at Kodak. Graeme produced the first version of *flowSolve* in his thesis work, and, now with the Pom-Pom equations in hand, we saw for the first time *in computations* those contraction vortices form that had first alerted me to the fascination of multiscale phenomena in branched polymer melts. In Tim Nicholson’s hands, the combination went on to predict flow phenomena seen later by Malcolm Mackley’s collaborating group in Cambridge, while David Groves brought me one day the first 12-decade experimental mechanical spectrum of a highly entangled (polyisoprene) H-polymer melt. There were all the features we had predicted years before visible in a flash. It remains the only moment at which I have burst into tears over a page of experimental data!

Like Mike I know that there are many people I would like to mention and should, but two more I must. Daniel Read came to Leeds for a PhD, to work on microphase separation problems in polymer networks. He rapidly became our

expert in the theory of neutron scattering in polymeric systems, and vital to our collaborations with the groups of Julia Higgins at Imperial College and Dieter Richter in Jülich. Among other things, he carried through an enormously complex extension of the Random Phase Approximation for a stretched and quenched ensemble of partially-labelled H-polymers that was essential to the experimental and theoretical rheology programme. It was only a matter of time before Daniel would get to the molecular rheology itself, but I have to confess that it would have been sooner had I not capitulated to a temptation of supervisors of extremely clever people to keep just *something* back for themselves. It couldn't last, and after wrestling with a calculation of the linear rheological statistics of metallocene branched polymers for weeks (this was around 2000), I mentioned the problem to Daniel. I think he had the linear result after two days and the non-linear by the following week (the "seniorities" and "priorities" for the aficionados).

Alexei Likhtman has already been in Leeds, working with Sasha Semenov, before joining the MuPP team to work on molecular rheology. His lesson for me was to guard against a self-delusional satisfaction in any theoretical framework with which one is simply familiar. He has also taught me, with Scott Milner, the shortcomings of my own lack of ability for computer simulations, and the rich way these can be interleaved at different resolutions and coarse-grainings to throw light on the conceptual theories. I hope that many colleagues will enjoy using the excellent REPTATE software, developed by Alexei and colleagues and now freely downloadable, that processes and analyses rheological data and theories in a very powerful environment, enabling what used to take us weeks to be done in minutes.

Rheology knows no bounds, but did you know that it can even make your childhood dreams come true? So it was that, in a second international workshop on Complex Fluids, this time in Santa Barbara in 2002, I was drawn by irresistible and atavistic yearnings to the astrophysics conference sessions of the parallel programme. There was a poster on magnetic dynamics of the internal convection zone of the Sun – with – no mistaking it - *the ROUSE EQUATION*. No they hadn't heard of "polymer physics"; yes, this was a good approximation of "magnetohydrodynamics"; no, they had no idea of how a fluid containing such string-like magnetic objects would behave. But I did! So began one of those deeply satisfying collaborations that happen in physics when hard work over many years in one field can be carried over with minor modifications into another. The astrophysicists and I co-wrote a paper for *Astrophysical Journal*. It's even becoming moderately well cited – once by Andy Fabian (yesss!!). Gives a whole new meaning to "star polymers", doesn't it?

## BSR NEWS

### A Citation of BSR 2009 Gold Medal – Michael Cates FRS

The Gold Medal is BSR's premier award: since it was founded in 1966 only 15 have been awarded to individuals, who have been adjudged to have made an outstanding fundamental contribution to rheology, which has been influential and has stood the test of time. Recognising the honour of hosting the European Rheology Conference we have decided to award two in 2009. Both medallists are well known to the rheological community and share the common feature of having started their research careers in the Cavendish Laboratory of the University of Cambridge, in the group headed by Sir Sam Edwards (himself a recipient of the Gold Medal in 1990).



The BSR Gold Medal was awarded to Professor Michael Cates (on the left) by Professor Phil Banfill (on the right), the BSR President then, at the European Rheology Conference in Cardiff in April 2009.

Michael Cates was educated at Trinity College, Cambridge, graduating in Physics in 1982, ranked top in the University and awarded the ver Heyden de Lancey Prize,

which led to a research scholarship under Sir Sam Edwards. He completed his PhD entitled "The statistical mechanics of complex polymers" in 1985. Remaining a College Research Fellow, he spent a year at Exxon Laboratories in New Jersey and a year at the Institute for Theoretical Physics, University of California Santa Barbara, before returning to the Cavendish Laboratory at Cambridge, initially as Royal Society University Research Fellow, in 1988. In 1995 he was appointed to the Chair of Natural Philosophy (1708) at the University of Edinburgh in the School of Physics, an appointment to which was added the title of Royal Society Research Professor in 2007. He is a Fellow of the Royal Society, of the Royal Society of Edinburgh, and of the Institute of Physics, and has received several prizes, including the Maxwell Prize and Medal of the Institute of Physics in 1991 and the Prix Franco-Britannique de l'Académie des Sciences (Paris) in 1994. He has held numerous consultancies and posts on editorial boards and scientific committees both home and abroad, including membership of the Physics sub-panel of the UK Research Assessment Exercise 2008. He is much in demand as a speaker, having given nearly 100 invited talks at international conferences, and, using a measure beloved of UK university leaders, he has won and successfully led major research grants from EPSRC and EU for work on soft matter, complex fluids, surfactant systems, colloidal systems, granular media and statistical physics, leading to over 200 published papers, many of which are highly cited.

Such are the mechanical facts of Mike Cates's career, but what of his scientific impact? He lists his research interests as including (i) soft condensed matter such as surfactants, colloids, polymers, emulsions, slurries and granular media; (ii) theories of rheology, phase equilibrium, phase transition kinetics, ageing, jamming and stress propagation; (iii) hydrodynamic simulation of complex fluids, demixing, emulsification, flow of simple fluids, surfactant solutions and liquid crystals. The Doi-Edwards model predicts that in steady shear flow the stress passes through a maximum to a region of negative slope, which must cause instabilities. Extending such ideas to the case of reversibly breakable wormlike micelles, he showed that such behaviour leads to shear banding, where fluids of different viscosity coexist. Such theoretical understanding is typical of Cates' approach and has led to considerable developments in the rheology of micellar and particulate fluids, with observations of elegant structural features in response to experiments prompted by theory, and the derivation of widely applicable theories. This has led to the establishment of his group at Edinburgh University as a powerful and well-respected force in the rheological community. Mike enjoys working with experimentalists, and thrives on confronting calculations and simulations very directly with real data. Rather surprisingly as a theory professor, he conducted an elaborate experimental demonstration in his inaugural lecture in Edinburgh - showing the audience the 'spurt' effect in the flow of a solution of worm-like micelles, the theory of which was largely worked out by Mike himself. Mike's fondness for experiments combined with his sharp mind mean that he is often able to make valuable suggestions to his experimental colleagues.

Beyond science, Mike's interests and achievements are many and varied. An experienced hillwalker, he has climbed all 284 Scottish Munros (mountains over 3000 feet). Perforce, therefore, he has experienced mist, rain, hail, sleet, snow, and occasional sunshine. A keen musician, he taught himself to play the mandolin, and his group members past and present will recall fondly his singing of folk songs at his legendary annual Burns parties. He is a connoisseur of whisky, wine, and Scottish beer, an excellent and imaginative chef, as well as an accomplished painter and fine art enthusiast.

I am therefore delighted to be able to present, on behalf of the British Society of Rheology, the Gold Medal to Professor Mike Cates in recognition of his contribution to the theoretical rheology of complex micellar and particulate fluids.

Phil Banfill

April 2009



The obverse (face side) of a BSR Gold Medal

## **A Citation of BSR 2009 Gold Medal**

### **– Tom McLeish FInstP FRSC**

The Gold Medal is BSR's premier award: since it was founded in 1966 only 15 have been awarded to individuals, who have been adjudged to have made an outstanding fundamental contribution to rheology, which has been influential and has stood the test of time. Recognising the honour of hosting the European Rheology Conference we have decided to award two in 2009. Both medallists are well known to the rheological community and share the common feature of having started their research careers in the Cavendish Laboratory of the University of Cambridge, in the group headed by Sir Sam Edwards (himself a recipient of the Gold Medal in 1990).



The BSR Gold Medal was awarded to Professor Tom McLeish (on the left) by Professor Phil Banfill (on the right), the BSR President then, at the European Rheology Conference in Cardiff in April 2009.

Tom McLeish was educated at Emmanuel College, Cambridge, graduating in Physics in 1984, and completing a PhD under Robin Ball entitled “Molecular models of polymeric flows” in 1987. He was appointed ICI Research Fellow in the Cavendish Laboratory, Cambridge, working on gelation, before moving to the

University of Sheffield as lecturer in 1989, where he built up a group working on the theory of dynamics of complex fluids. He became Professor of Polymer Physics at the University of Leeds in 1993, where he remained until 2008, when he took up an appointment as Pro-Vice-Chancellor for Research at the University of Durham. He is a Fellow of both the UK and American Institutes of Physics and of the Royal Society of Chemistry, and has received several prizes, including the Weissenberg Medal of the European Society of Rheology (2007), the Annual Award of the British Society of Rheology (2000) and the Journal of Rheology Publication Award in both 1999 and 2006. He has held posts on editorial boards and scientific committees worldwide, including organising two residential research programmes for the Isaac Newton Institute for Mathematical Sciences and one for the University of California Santa Barbara. He directed the UK Polymer Interdisciplinary Research Centre 2003-2008 and the Multiscale Polymer Processing Consortium (MuPP) since 1999, and was instrumental in setting up the Leeds Life Science Interface initiative which led to the EPSRC White Rose Doctoral Training Centre (joint with Sheffield) in Biomolecules and Cells (2004). He is consultant to a number of industries. Much in demand as an invited speaker at conferences, he is also passionate about communicating science more widely and speaks to schools, on television and radio, on issues ranging from the physics of Slime to the interaction of faith and science. He has published over 150 papers on rheology, microstructure, dynamics and instability of polymeric systems, many of which are highly cited.

He would list his research interests as including molecular rheology and processing of entangled polymeric fluids (especially the role of molecular topology), and macromolecular biophysics including protein dynamics, folding and interactions, and biological self-assembly. Building upon the theoretical ideas of Doi and Edwards, where a polymer molecule is constrained to move within a tube by what de Gennes called reptation, he extended the concept to more complex branched polymers, including stars and pom-poms, all of which are of industrial or biological importance. This has led to new families of molecularly based constitutive models linking the bulk rheology to the molecular structure of all sorts of polymers, attracting the support of manufacturers of these materials and leading to considerable development of the research field in the UK, as witnessed by the Polymer IRC and MuPP mentioned above. McLeish and his group have successfully taken abstract molecular concepts and turned them into industrially relevant solutions of complex flow situations. He has also championed the development of new structural probes such as neutron scattering on polymers under flow as a complement to rheological measurement.

Tom's outside interests include music and he is willing to play the French horn on request. (On one memorable occasion he played in a small ensemble in Kings College Chapel, Cambridge, in front of 800 delegates at the International Congress on Rheology in 2000 – he said that it was the most daunting task he had ever

undertaken.) With his family he makes music of many kinds both instrumental and sung. As a lay reader at his local church, he is also keen to discuss issues of science and religion.

I am therefore delighted to be able to present, on behalf of the British Society of Rheology, the Gold Medal to Professor Tom McLeish in recognition of his contribution to the theoretical rheology of complex polymer fluids.

Phil Banfill

April 2009



The reverse (back side) of the two BSR Gold Medals

## New Council Members



Dr Simon Cox is a Reader in Applied Mathematics at Aberystwyth University, and an EPSRC Advanced Research Fellow. He has a degree in Applied Mathematics from the University of Warwick, and completed his PhD with Mark Cooker on "Pressure Impulses caused by Wave Impact" at the University of East Anglia. He then took a postdoctoral position with Denis Weaire in the School of Physics at Trinity College Dublin before moving to Aberystwyth in 2005. His current research interests include the structure and dynamics of foams and related cellular materials, and in particular determining the influence of structure on rheology through modelling, simulation and experiment.



Dr Bettina Wolf is an associate professor at the Division of Food Sciences, University of Nottingham. She would like to introduce herself in the following.

My research interests are in the field of microstructure, flow behaviour and product performance. Most of my research is on food materials but I do like working on model systems as well as on all kinds of non-food structured systems. My first experience in rheology takes me back a couple of decades to Quakenbrueck in Northern Germany (that's ignoring any lectures on the subject during my diploma course in chemical engineering at the University of Karlsruhe). Erich Windhab recruited me into his team at the German Institute of Food Technologies (DIL) to have lots of fun in the rheology and microstructure lab. Analysing edible samples (!) part of our role was to help businesses solving their processing or product stability problems, or simply to act as a well equipped QC lab. Under his supervision I did a PhD in the field of shear-induced droplet deformation half way through which I followed his move to *ETH* in Zurich. I gained some insight into working in an academic environment. A couple of years after I obtained my PhD degree, I joined Ian Norton's team at Unilever Research in Colworth House. That was very enjoyable and despite being in industry, my targets were to publish papers and to communicate my research at conferences. I was recruited into the University of Nottingham about three years ago. The research interests of my colleagues in Nottingham have allowed me to widen my research spectrum, and to, for example, seriously look at what we do with cream on our skin, or with chocolate in our mouth.

## Report on the 5<sup>th</sup> Annual European Rheology Conference

The 5<sup>th</sup> Annual European Rheology Conference, AERC 2009 was held at Cardiff University, Cardiff, UK, with the contributions of over 200 oral presentations and over 100 posters. The conference aimed to strengthen communication between Europe and the rest of the world, and build up the trend from the old to the new in the rheological field of research. There were 6 parallel sessions including 11 themes: blends, copolymers and nanocomposites; process modelling; rheometry and beyond: advanced experimental methods; interfacial phenomena, surfactants and foams; suspensions and colloids; viscoplasticity, solids rheology; biopolymers, biorheology and food rheology; constitutive modelling; non-Newtonian fluid mechanics; computational modelling; flow-induced phase transitions and instabilities; and industrial rheology and processing. From 15<sup>th</sup> April to 17<sup>th</sup> April, the historic Cardiff city accommodated us with a mild spring weather. Conference dinner was held in the National Galleries and Museum of Wales with a drink provided prior to the dinner in the impressionist galleries. The atmosphere stimulated the participants' broad interests in the universe as well as their artistic ideas.

On 15<sup>th</sup> April, the conference started with Prof. Tim Phillips' welcome presentation emphasising the idea of cooperation between academia and industry, and how this chain would work to fit the market needs. Then the 6<sup>th</sup> Weissenberg Award was presented to Prof. Ole Hassager from Technical University of Denmark (DTU) with a brief introduction of the culture of the award and Prof. Hassager's contribution. It was quite a joyful time to share the poem composed from the committee of the European Society of Rheology to celebrate his success in sciences. The first lecture was then delivered by Prof. Hassager on the nature of the extensional flow with an innovative rheometer developed by him and his group. In the afternoon, the British Society of Rheology Gold Medal was awarded to Prof. M. Cates followed by his lecture on construction of a constitutive model to describe colloidal glass. During the parallel sessions, I was interested in the themes of viscoplasticity, solids rheology; blends, copolymers and nanocomposites; suspensions and colloids. One of the studies talked about a yield stress peak or a storage modulus peak at intermediate pH range which was related to jamming. Then the exploration of yield stress found that a previous hypothesis of flow behaviour of the material below the yield point was actually brought by shear banding. Another exploration of shear thickening explained the re-entrant solid transition phenomenon after a shear localisation regime, where shear would actually induce dilation of the particles.

On day 2, the 2<sup>nd</sup> BSR Gold Medal was awarded to Prof. T. McLeish by Dr Oliver Guy Harlen, the new president of the British Society of Rheology. Then Prof. McLeish gave a lecture outlining successful collaboration between industry and university in a large project concerned with material design (<http://www.mupp2.com>). The afternoon plenary lecture was delivered by Prof. J.

Hyun talking about an extended simulation model constructed recently for transient solution describing non-isothermal, viscoelastic film blowing process. I've been to the parallel session, i.e. a talk about strain recovery of resin. Three distinctive recovery stages had been characterised, of which the first stage was related to heat release and the latter two were more related to entropic behaviour. This was followed by a talk about a novel double ring wall geometry for interfacial rheology based on an iterative procedure taking into account the moment of linearity of the interfacial velocity profile and subphase drag. With its much simplified design, experimental results showed a high flow sensitivity which is comparable to the magnetic rod rheometer in both continuous shear and oscillatory shear over a large dynamic measurement range. Further development of the geometry would allow the measurements of surface pressure and surface rheological properties. Taking into account of partial slip in a system of glass fibre composites, a talk about a nano-scaled fibre simulation considering hydrodynamic interactions showed good agreement with previous experimental data.

On the last day, the morning plenary lecture was delivered by Prof. G. McKinley. He talked about microfluidic rheometry and gave a comprehensive review on contraction flow, especially highlighting the importance of studying the stagnation point in a T-channel device which would be an indication of instability and unsteady state of the flow. One of his group's advances on birefringence technique was shown as well. Then in the afternoon, Prof. M. Graham talked about transport and collective dynamics in suspensions of swimming micro-organisms. During the parallel sessions, I particularly enjoyed Prof. D. Weitz's keynote lecture about on the nature of the storage modulus and the bulk modulus in high phase volume suspensions of soft colloids using a novel microfluidic device and its native correlation with the mechanism of osmotic pressure.

Afterwards, I stayed in the session of biopolymers, biorheology and food rheology where my major sits in. In the keynote lecture, Prof. C. Gallegos talked about an overview of new bioplastic materials based on proteins. He highlighted the effects of thermal-mechanical processing on biopolymer conformation and microstructure, transparency induced from high pressure compression-moulding processing, and controlled-release profiles from an improved protein-plastisiser affinity. Then there were topics covering the areas of biology, pharmaceuticals, food sciences, and printing techniques:

- I) With the help of rheological characterisation as well as sensory assessment, different types of food textures were studied in a systematic way for the treatment of swallowing disorder. It was found that extensional viscosity correlated with the ease to swallow rather than shear viscosity. Then a simple falling-rod "kitchen texturometer" was designed to fit these analyses.
- II) A food grade Boger fluid had been successfully built up for the study of saltiness and mouth feel perception. Rheological experiments on steady shear viscosity, filament stretching technique, and microfluidic contraction flow showed significant difference between the Boger fluid and the solvent.

However, the difference is insignificant on saltiness perception and it might be due to an uncontrolled eating pattern or dilution with saliva.

- III) During the characterisation of coating materials, results of the linear viscoelastic range and creep test using rheometer were more sensible than the detection of texture analyzer. Then shear viscosity was in a good agreement with the viscoelastic behaviour of the liquid coating materials.
- IV) The talk of Fourier Transform Mechanical Spectroscopy had successfully explored the fractal dimension of blood clots and then the effect brought by the presence of heparin was thought to prolong the coagulation time and reduce the value of fractal dimension.
- V) Taking into consideration temperature, hematocrit and volume expander effects, a blood simulation model had been built up and it is indicative of moderate changes in the time-averaged flow field.
- VI) A physical model for predictive modeling of haemodynamics was constructed based on the quantitative rheological characterisation of whole blood, including the study of its macromolecular effects, the correlation between material functions and blood compositions, and the presentation of time-resolved images of cellular fluid dynamics in shear flow and in microfluidic.
- VII) Macro- and micro-rheology was used to distinguish local heterogeneity in complex fluids, where a cell cytoplasm system was subjected to disruption and time-dependent recovery. Interesting findings of living cells as particles embedded within the cytoplasm showed a transient enhancement of diffusive motion of particles in the similar study. I've given a talk about a healthcare relevant mixed gel system of a protein and a polysaccharide, in which a gelation model had been proposed from data of controlling the molar proportion of the crosslinker, the pH environment, or the polymer concentration. As suggested, there would be further interest to look at the long term stability of the mixed gel system as to meet the clinical needs of the final product.

It was a nice trip to this conference walking around the exhibition of posters and the industrial equipment. I've been interested and talked to people about their novel synthetic polymeric materials, and also received helpful information of an impressive methodology studying the interfacial rheology of immunoassay proteins and surfactants. By attending this conference, I gained a broader overview of the field of rheology and I have generally enjoyed the experience. Then the view from industrial applications would highlight the interesting themes where academic research could contribute to. Making this journey to Cardiff, I would like to pay my grateful appreciation to both the British Society of Rheology and TA Instrument for their kind encouragement and the financial support.

Yuanyuan Dong  
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Registration desk in 2009 AERC

## Report on the 5<sup>th</sup> Annual European Rheology Conference

The 5th Annual European Rheology Conference (AERC 2009) was my first opportunity to attend an AERC as a research student, because I had been to AERC 2003 but was too young to participate. Following the tradition of European Rheology meetings, AERC 2009 was a 3-day conference (15th - 17th April) split into symposia that reflected mainstream and emerging areas of rheology. The aim of AERC 2009 was to contribute to the advancement of rheology by bringing together interested researchers from Europe and the rest of the world, and by bridging traditional themes with modern trends.

The symposia were on the following topics: blends, copolymers and nanocomposites; process modelling; rheometry and beyond: advanced experimental methods; interfacial phenomena, surfactants and foams; suspensions and colloids; viscoplasticity, solids rheology; biopolymers, biorheology and food rheology; constitutive modelling; non-Newtonian fluid mechanics; computational modelling; flow-induced phase transitions and instabilities; industrial rheology and processing. In addition, the meeting included the 2009 Weissenberg Award Lecture and the 2009 BSR Gold Medal Lecture.

AERC 2009 was organized by the INNFM, the Institute of Non-Newtonian Fluid Mechanics (Wales) on behalf of the BSR, the British Society of Rheology. The meeting was held in Cardiff, the capital of Wales. Cardiff is home to many national institutions, including the National Museum of Wales and the much-admired Millennium Stadium. The city centre skyline is a testimony to its heritage and ambition, with landmark buildings ranging from the ornate civic centre to the historic Cardiff Castle. Cardiff is well established as 'Europe's Youngest Capital' but its history dates back more than 2000 years to the Romans. In the centre are many attractive pubs where, at the end of a conference day, I joined with researchers met at the conference, and we talked and relaxed.

My contributions to the conference were a co-author on a presentation by my supervisor Prof. João Maia, entitled "A New Controlled Stress/rate Extensional Rheometer for High Viscosity Systems" and a poster entitled "An Experimental Study on the Criteria for Failure of Polymer Melts in Uniaxial Extension: the test case of polyisobutylene melt in different deformation regimes". Besides showing the work of our research group to the scientific community, it was an opportunity to talk with others about research and to listen to opinions and suggestions about developing other ideas.

The symposia those I attended most often were those on Blends, Copolymers and Nanocomposites, Non-Newtonian Fluid Mechanics, Viscoplasticity and Solids Rheology, Industrial Rheology and Processing, and Rheometry and Beyond, where our work was included. I was especially interested in the keynote lecture of M.

Mackley, and the oral presentations by, K. Yu, P. Szabo and D. Auhl because these works concerned new methods to measure and model extensional flows.

The conference organization was very good and I congratulate the INNFMt and the BSR for the excellent job. Cardiff was also a pleasant city to visit. I am very grateful to The British Society of Rheology for awarding me a Student Travel Bursary, which made the visit possible.

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Discussions during coffee time in 2009 AERC

## Report on the 5<sup>th</sup> Annual European Rheology Conference

The 5th Annual European Rheology Conference (AERC 2009, 15-17 April) was organized by the INNFM (Wales) and the BSR in Cardiff. Numerous oral presentations and posters detailing high quality scientific works were given covering a wide research area. The AERC 2009 has been successful in encouraging researchers to share their knowledge and build links between Academia and Industry. In this report, I would like to focus on a collection of oral presentations and posters concerning the rheology of complex fluids in microscopic flow, a subject highly relevant to my current research project.

I gave a presentation on the quantitative flow characterization of polymer solutions in microfluidics. The results of molecular characterizations, rheometric measurements and flow measurements were included. Semi-dilute PEO solutions flowing through a microscale fabricated planar abrupt contraction (8:1) – expansion (1:8) geometry were studied using a micro-particle image velocimeter ( $\mu$ -PIV) for Weissenberg ( $Wi$ ) numbers up to 200 and for four different elastic numbers. A flow pattern diagram has been constructed, showing a transition from steady flow to elastic unstable flow at a  $Wi$  number of around 30 as flow rate increases. The quantitative data generated, such as the velocity field and pressure drop, can be used to critically evaluate well-established constitutive models, in particular at higher  $Wi$  number regime. Also the data can be used to improve constitutive models allowing for a better prediction of the dynamics of semi-dilute polymer solutions. Non-Newtonian fluid mechanisms in microfluidics were also investigated experimentally by Sousa *et al.* (*Universidade da Beira Interior*), specifically considering microfluidic rectifiers for viscoelastic fluid flow.

Khomami B. (*University of Tennessee*) gave an inspired keynote lecture on the simulation of polymeric solution dynamics. In order to better understand nonlinear flow phenomena previously poorly understood and to accurately predict industrial flows, his team has developed a multi-scale modelling strategy, incorporating the dynamics of different length scales, namely molecular (molecular dynamics), mesoscopic (Brownian dynamics) and continuum mechanics. This method has been validated by checking its prediction for the flow transition and pattern formation in simple and complex fluid flows including applications to polymer processing.

Emerging microfluidic technology has provided an opportunity to develop micro-rheometric devices to characterize rheological properties of complex fluids in the high  $Wi$  flow regime. This is not currently possible using commercial rheometers. In the meeting, the experimental and numerical investigations of fluid flows in various small scale geometries including capillary, cross-slot and contraction flows were presented.

The quantitative characterizations of molecular orientation and stretch of dilute and semi-dilute polymer solution in oscillatory cross-slot extensional flow was reported in the presentation and poster by Haward *et al.* (*University of Bristol*). They characterized the flow of the polymer solutions in a micro-oscillatory cross-slot extensional flow device using birefringence measurements and measured the velocity field using  $\mu$ -PIV. The Trouton ratio in the extended strand was estimated to be approximately 2000, which is consistent with slender body theory. The results show how the stagnation point dominates the flow field and is relevant to all viscoelastic fluids in extensional flows. Also, Sadati *et al.* (*ETH Zurich*) presented experiments using flow-induced birefringence and PIV to demonstrate two-dimensionality of a polymer flow in a lubricated cross-slot rheometer. Numerical simulation work of flow dynamics in a cross-slot geometry was conducted by Morozov *et al.* (*The University of Edinburgh*) to probe stress singularities and the formation of birefringent strands in stagnation flows of dilute polymer solutions.

Multipass Rheometers (MPR) have been developed by the Mackley M. (*University of Cambridge*) group. The MPR is an excellent instrument to characterize the rheology of complex fluids, having the capacity for microstructure, optical and x-ray investigation.

By imposing the flow rate and measuring the pressure drop, Lanzaro *et al.* (*University of Manchester*) have developed a microfluidic rheometer capable of measuring the shear viscosity of semi-dilute polymer solutions in high shear rate regions ( $\dot{\gamma} \sim 10^5 s^{-1}$ ). Micro-PIV was used to characterize flow dynamics to investigate shear-thinning phenomena.

The plenary lecture titled Microfluidic Rheometry of Complex Fluids was given by McKinley G. (*MIT*). T-shaped microfluidic devices with a cavity can generate free stagnation point flow. Results from these devices were compared with results obtained from T-shape geometries without cavities. Different contraction shapes including abrupt and hyperbolic geometries have been investigated experimentally and numerically. The pressure drop across a symmetric contraction-expansion geometry was measured by microfabricated pressure sensors. The experimental results with dilute and semi-dilute polymer solutions show that the pressure drop increases linearly at low Deborah ( $De$ ) number and the Trouton ratio  $Tr = \eta_{ext} / \eta$  remains constant, but an enhanced pressure drop and Trouton ratio were observed as  $De$  number increases.

All works, both those mentioned and not mentioned, give us a better understanding of the dynamics of complex fluids in microscopic flow. Many thanks to all who contributed to and presented research works in the AERC 2009. The AERC provides great opportunities for researchers from all around the world to exchange their knowledge and experiences, to discuss the advancement of rheology and to strengthen collaborations.

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Exhibition in 2009 AERC

## **Commentary on the 325<sup>th</sup> Council Meeting of the BSR University of Leeds, December 16<sup>th</sup> 2008**

Council gathered in Leeds at the end of the highly successful midwinter meeting on "Microstructure and Rheology". After such an active scientific meeting, maybe we didn't have quite the reserves of energy you'd hope for the Council meeting, but sandwiches and (importantly) coffee brought us up to speed.

As always, the discussion was wide-ranging, but a few key issues were where we spent the most time. One was the (then future) AERC in Cardiff, in April 2009. Tim Phillips had put huge amounts of work into this, and was able to report an impressive list of plenary and keynote speakers. Paper and poster submissions had been received (over 300 in total) and were with the mini-symposium organisers for decisions.

Another key point of discussion was Rheology Reviews. It had been decided some time ago that Rheology Reviews 2007 should be offered free to BSR members in good standing; full advertising of this had been postponed repeatedly because the publication itself wasn't ready. This delay had two basic reasons: one, that David Binding, who has worked on all the issues published so far, now has less time to dedicate to it; and two, that we're starting to have difficulty getting copyright to re-use figures from papers in leading journals. It's clearly key that review articles should be able to reproduce the material they are reviewing, but this is becoming a more and more expensive and slow process. Nonetheless, David had the content for Rheology Reviews 2007 available, and when Nick Hudson volunteered to take it over he relinquished it with great relief. As BSR members will know, Rheology Reviews 2007 did then come out in early 2009, and Rheology Reviews 2008 is well on the way now too. However, there is another issue - Roland Keunings, who has been our Editor, but his term of office is coming to an end. We need to make a decision about the future of Rheology Reviews, in view of the copyright issues and also the workload it has been imposing on David. This point won't go away: we'll see it again at the next Council meeting!

There were, of course, routine Council matters which were dealt with relatively quickly. The finances were looking reasonably healthy; we ratified a couple of new members; and the Bulletin was looking for special articles to celebrate the 50<sup>th</sup> Volume. That was the easy stuff!

The final issue that took up a large part of the meeting was Council's nominations for both Council as a whole, and for the Officer posts, ready for the AGM in Cardiff. The purpose of this process (where Council has a nomination for each post) is not to discourage others from standing, but to make sure we don't hit the embarrassing and difficult problem of coming out of the AGM with a missing post on Council. Both Nick Hudson as Abstracts Editor / Publication Manager, and

David Binding as Treasurer, were coming to the end of their maximum four-year tenure of the posts; it's generally felt that it's unreasonable to expect anyone to join Council and instantly become an Officer, so ideally we needed to find nominees for both these roles from within the Ordinary Members on Council. After very little arm-twisting John Embery volunteered to take over as Treasurer; however, no-one could be persuaded to replace Nick as Publications Manager. It became clear that we were in an exceptional position, as all the other ordinary members of Council were unavailable for some reason - for instance, Tim Phillips was far too busy running AERC to take on anything else, and Mike Webster is Treasurer of the ESR which is a huge contribution to the wider rheology community. We decided to formulate a proposed modification to the constitution, to allow an Officer to serve for a fifth year in just such a circumstance; the details were sorted out by email after the meeting (and in the end, adjusted slightly and then approved at the AGM).

We also had a short discussion about the website. We agreed that we would like, in the not too distant future, to have the website robustly hosted as <http://www.bsr.org.uk> without any visible forwarding (currently to alternative servers in Swansea and Newcastle) to enhance our web presence. The plan was largely postponed to the next Council meeting, but we agreed on the principle.

We managed to finish in a little over two hours - impressive stuff, but important when two members are trying to get back to Wales, two to Scotland, and everyone's in the throes of preparing for Christmas!

Helen Wilson.

## **Commentary on the 326<sup>th</sup> Council Meeting of the BSR University of Cardiff, April 16<sup>th</sup> 2009**

The 326th Council Meeting was held during the AERC 2009 at the University of Cardiff, starting at 12.40pm on the 16th April. After carrying our lunch up three flights of stairs, we performed a size segregation experiment based upon waistlines and available space around the table: if you can imagine all twelve council members (an unusual event in itself) jockeying for comfortable positions around a table in a broom cupboard in an attic, then you will have a good idea of the spirit of the meeting.

Our new president, Oliver Harlen, took the chair (but didn't touch it because of his sticky fingers), Helen Wilson performed the office of secretary, and three new members of council were present (Cox, Poole, Wolf) as well as the usual suspects.

In addition to the standing items on the agenda, we started with a presentation given from a standing position in the doorway by Job Thijssen & Rut Besseling, who are organizing the next mid-winter meeting in Edinburgh on the subject of rheology and soft matter. Council were satisfied that the planning for the meeting is well under way, after a discussion of budgets and appropriate numbers of invited speakers.

With time already running short (before the next plenary of the conference), the president picked out only those agenda items that appeared urgent. Most were concerned with the public image of the society, and how to maximise our exposure to a rheological audience. There is a plan to produce flyers, which would include a BSR membership form, to distribute at conferences: we discussed what form they should take, and whether we need to worry about a data protection tick-box (yes!).

The future of Rheology Reviews was also raised, given not only the pressures involved in producing it but also the relatively low readership and citation rate; possible options include approaching a publisher to turn it into a journal and to work more closely with the European Society to promote and market it.

Happily, the Student Travel Bursary competition attracted a large number of applications, and the council made a note that it may have to consider stricter guidelines in the future; in the meantime, supervisors of PhD students are urged to encourage them to join the BSR as early in their career as possible!

Membership Secretary Phil James continues to purge the membership database of non-payers of long-standing, and will shortly be sending out renewal notices.

It was agreed to investigate moving the website to a more secure server, and aiming to use the bsr.org.uk domain name to its full extent.

Finally, a subgroup of council was charged with simplifying the procedure for the payment of invoices. The president then closed the meeting, and council returned to the conference.

Simon Cox



Happy smile after all the hard work in organising 2009 AERC



The Non-Newtonian Club (NNC) is an informal rheology discussion group which provides low-cost, informal, one-day meetings which provide an excellent forum for industrial and academic rheologists to meet together informally to present work in progress, raising key needs and concerns, and discussing unresolved practical and modelling issues that may be inhibited at more formal conferences. The agenda of the most recent BSR NNC meeting and the corresponding abstracts can be found at <http://innfm.swan.ac.uk/bsr/frontend/nonnewtonianclub.asp>.

The Non-Newtonian Club Meetings are held 2 - 3 times a year and provide a forum for those practicing rheology to meet. Presentations (typically 20-30 minutes) are made by academic and industry-based scientists, as well as young scientists, presenting on a range of topics that involve rheology in a relatively informal and friendly environment. To encourage phd students and 'young' scientists to present, we offer an award for the best presentation from phd students or 'young' scientists. We endeavour to keep these meetings free. Should you wish to host, sponsor, or participate in such an event, please let me know.

The next NNC meeting will take place in Schlumberger Cambridge Research sometime in October/November 2009. We are still looking for speakers from anyone involved with rheology as long as their material relates to the subject. Attendance is free of charge and includes tea/coffee and lunch courtesy of Schlumberger Cambridge Research. The best young speaker will receive a prize sponsored by Anton Paar. For further information visit the BSR website or contact [steve.goodyer@anton-paar.com](mailto:steve.goodyer@anton-paar.com)

Steve Goodyer

# **The British Society of Rheology – Midwinter Meeting 2009**

## **The Flow of Soft Matter**

**School of Physics & Astronomy, King's Buildings  
University of Edinburgh**

**14-15 December 2009**

The 2009 BSR Midwinter Meeting aims to provide an overview of the current research on the rheology of soft matter – an exciting field in which theory, simulations and experiments meet to explain the flow of complex fluids. Confirmed speakers and provisional titles:

Prof. Michael E. Cates  
*Shear banding in soft glasses*

The University of Edinburgh

Prof. Martin van Hecke  
*Flow of Foams*

The University of Leiden

Prof. Geoffrey C. Maitland  
*Rheology of mixed-shape colloidal gels*

Imperial College London

Contributions for oral and poster presentations are invited. Please download the abstract template from the conference website and return it via e-mail by October 2<sup>nd</sup> to Job Thijssen: [j.h.j.thijssen@ed.ac.uk](mailto:j.h.j.thijssen@ed.ac.uk)

Further details of the meeting are available via the 'BSR meetings' link at the BSR website: <http://www.bsr.org.uk/>

## **INDUSTRY NEWS**

### **Anton Paar**

#### **TruGap Functionality**

TruGap™ is now incorporated into all air bearing rheometers manufactured by Anton Paar. This system is unique amongst rheometers since it measures changes in the gap and adjusts the gap accordingly. Once you have seen TruGap in action you will never want to use calculated gaps again.

#### **Free CDs explaining Viscometry and Rheometry**

Interactive, entertaining, scientific....and free! These are available from the Anton Paar website, along with CDs relating to Density and CO<sub>2</sub> measurement.

#### **Rheology Workshop - 25<sup>th</sup> / 26<sup>th</sup> November 2009**

This years winter workshop will take place at Bradford University. The course is an ideal introduction to rheology for both newcomers and those involved for a few years who wish to dig deeper. The course includes a free copy of the “Rheology Handbook” by course leader Thomas Mezger and also incorporates hands on practical sessions with modern rheometers. For further information please contact Steve Goodyer or visit the Anton Paar website

#### **Academic Sales Program**

Do you or your students require a rheometer? Anton Paar offer special sales programs tailored to your needs incorporating academic discount, enhanced warranty and after sales support.

For further information on any of the above items please contact: [steve.goodyer@anton-paar.com](mailto:steve.goodyer@anton-paar.com) or telephone Anton Paar on (01992) 514730.

### **Thermo Fisher Scientific**

Karlsruhe, Germany, (19<sup>th</sup> February 2009) – Thermo Fisher Scientific Inc., the world leader in serving science, today announced the availability of comprehensive rheology solutions for the cosmetic industry to fully characterize suspensions and emulsions. Based on reliable measuring data, parameters like shelf life, haptic and sensoric properties can be optimized. In addition, cosmetic processability and production processes can also be enhanced.

The company's high-end rheometer platform, Thermo Scientific HAAKE MARS, enables customers to examine the connection between a sample's microscopic

structures and rheological properties to analyze stability of multiphase systems or particle size distribution. Visible structures in solutions, suspensions, emulsions, gels and foams can be investigated for rheological phenomena including shear thinning, dilatancy, thixotropy, emulsification, coalescence, aggregation, gelification, dissolution, and flocculation. The rheological and optical data can be monitored during the measurement as well as saved and exported in different formats for further analysis.

Focused on the specific needs for quality control and optimizing production processes, Thermo Fisher Scientific as one of the pioneers in rheology, offers a broad accessory range for the cosmetic industry. For example by using a universal holder for individual containers like glass jars, cans, beakers or cups users no longer need to spend time pouring samples into a measuring cup and as cleaning the cup afterwards. An additional benefit is no destruction to the testing material's structure. Continuous measurements and analysis of small quantities can be directly conducted in microtiter plates.

Efficient and user-friendly measuring routines are guaranteed by the measuring and evaluation software for viscometers and rheometers, the Thermo Scientific HAAKE RheoWin. The software is continuously adapted to customer needs and can be customized to offer convenient operation with default settings for beginners and full access to all relevant measuring parameters for advanced rheologists. Optional software modules are available that e.g. ensure compliance with pharma-specific requirements. Additional information is provided at [www.thermo.com/rheology](http://www.thermo.com/rheology).

Thermo Fisher Scientific successfully supports a wide range of industries with its comprehensive Thermo Scientific material characterization solutions. These products analyze and measure viscosity, elasticity, processability and temperature-related mechanical changes of plastics, food, cosmetics, pharmaceuticals and inks, coatings, or petrochemical products. For more information, please visit [www.thermo.com/mc](http://www.thermo.com/mc).

Thermo Scientific is part of Thermo Fisher Scientific, the world leader in serving science.

## CONFERENCE DIARY

| 2009                                            | CONFERENCES & MEETINGS                                                                                                                                                                                                                                                                                                                                                                                                                    |
|-------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 20-22 July<br>Groningen<br>The<br>Netherlands   | <b>Faraday Discussion 144: Multiscale Modelling of Soft Matter</b><br>Chair of the Organizing committee<br>Dr Mark Wilson, Department of Chemistry, University of Durham<br>South Road, Durham, DH1 3LE<br>Tel: +44 (0) 191 334 2144; Fax: +44 (0) 191 384 4737<br><a href="http://www.rsc.org/ConferencesAndEvents/RSCConferences/FD144/index.asp">http://www.rsc.org/ConferencesAndEvents/RSCConferences/FD144/index.asp</a>            |
| 29 Aug –<br>2 Sep<br>Borovets<br>Bulgaria       | <b>3<sup>rd</sup> Eurosummer School on Biorheology &amp; Symposium on Micro and Nanomechanics and Mechanobiology of Cells, Tissues and Systems</b><br>N. Antonova - +359 2 979 6413 +3592 8707498 - <a href="mailto:essb@bsb-bg.eu">essb@bsb-bg.eu</a> - <a href="http://www.biorheo2009.bsb-bg.eu">www.biorheo2009.bsb-bg.eu</a>                                                                                                         |
| 7-9 Sep<br>Karlsruhe<br>Germany                 | <b>8<sup>th</sup> European Coating Symposium</b><br>N. Willenbacher<br><a href="mailto:norbert.willenbacher@kit.edu">norbert.willenbacher@kit.edu</a> - <a href="http://www.ecs2009.org">www.ecs2009.org</a>                                                                                                                                                                                                                              |
| 18-22<br>October<br>Madison<br>Wisconsin<br>USA | <b>81st Annual Meeting of The Society of Rheology</b><br>Professor A. Jeffrey Giacomin, Rheology Research Centre, the University of Wisconsin-Madison, Mechanical Engineering Building, 1513 University Avenue, Madison, Wisconsin 53706-1572, USA.<br>Email: <a href="mailto:giacomin@wisc.edu">giacomin@wisc.edu</a> .<br>Conference website: <a href="http://rrc.engr.wisc.edu/sor2009.html">http://rrc.engr.wisc.edu/sor2009.html</a> |
| 1-5 Nov.<br>Cyprus                              | <b>Viscoplastic Fluids: From Theory to Applications</b><br>G. Georgiou - <a href="mailto:georgios@ucy.ac.cy">georgios@ucy.ac.cy</a> - <a href="http://www.ucy.ac.cy/~vpf2009/">www.ucy.ac.cy/~vpf2009/</a>                                                                                                                                                                                                                                |
| 13-17 Dec.<br>Florida<br>USA                    | <b>3<sup>rd</sup> International Conference on Mechanics of Biomaterials and Tissues</b><br>Hilton Clearwater Resort, Florida, United States - C. Wilkins - <a href="mailto:ch.wilkins@elsevier.com">ch.wilkins@elsevier.com</a> - <a href="http://www.icmobt.elsevier.com">www.icmobt.elsevier.com</a>                                                                                                                                    |
| 14-15 Dec.<br>Edinburgh                         | <b>The BSR Midwinter Meeting – The Flow of Soft Matter</b><br>Job Thijssen: <a href="mailto:j.h.j.thijssen@ed.ac.uk">j.h.j.thijssen@ed.ac.uk</a><br><a href="http://www.bsr.org.uk/">http://www.bsr.org.uk/</a>                                                                                                                                                                                                                           |
| 2010                                            | CONFERENCES & MEETINGS                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 29-31 March<br>Lake Vymwy<br>Wales              | <b>Institute of Non-Newtonian Fluid Mechanics Easter Meeting</b>                                                                                                                                                                                                                                                                                                                                                                          |
| 11-16 July<br>Glasgow                           | <b>IUPAC 2010 World Polymer Congress (Macro2010)</b><br>Contact: Professor Peter A. Lovell, School of Materials, the University of Manchester, email: <a href="mailto:pete.lovell@manchester.ac.uk">pete.lovell@manchester.ac.uk</a> ; Tel: +44(0)161 306 3568; Fax: +44(0)161 306 3586.                                                                                                                                                  |
| 1-6 August<br>Sapporo<br>Japan                  | <b>5th Pacific Rim Conference on Rheology</b><br>Hokkaido University, Sapporo, Hokkaido, Japan<br>Conference Website: <a href="http://prcr2010.com">http://prcr2010.com</a>                                                                                                                                                                                                                                                               |

| 2009                                                      | COURSES & WORKSHOPS                                                                                                                                                                                                                                                                                                                                                                                                                           |
|-----------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>1-2 July</b><br>Nottingham                             | <b>Rheology Workshop from Anton Paar</b><br>Steve Goodyer, Anton Paar Ltd, 13, Harforde Court,<br>John Tate Road, Hertford, SG13 7Q<br>T: +44 (0)1992 514730; F: +44 (0)1992 514739<br>E: <a href="mailto:steve.goodyer@anton-paar.com">steve.goodyer@anton-paar.com</a>                                                                                                                                                                      |
| <b>24-28 August</b><br>Cuernavaca/<br>Termixco,<br>Mexico | <b>5th International Workshop on Non-equilibrium Thermodynamics IWNET 2009</b><br>Local organisers: Mariano Lopez de Haro, Miguel Angel Olivares,<br>Federico Vazquez Hurtado<br>Tentative topics: Interfacial phenomena, Biological systems,<br>Fluctuations, Small systems, Complex systems, Granular matter.<br>Website: <a href="http://www.nonequilibrium-thermodynamics.ethz.ch/">http://www.nonequilibrium-thermodynamics.ethz.ch/</a> |
| <b>30 Sept<br/>– 1 Oct</b><br>Ireland                     | <b>TA Rheology Training Course:</b> For further information, contact<br>Olivia Gibson; TA Instruments, Fleming Centre, Fleming Way, Manor<br>Royal, Crawley, West Sussex, RH10 9NB; T: +44 1293 658900; F:<br>+44 1293 658901; e-mail: <a href="mailto:Olivia.gibson@taeurope.co.uk">Olivia.gibson@taeurope.co.uk</a>                                                                                                                         |
| <b>25 - 26 Nov.</b><br>Bradford<br>UK                     | <b>Rheology Workshop from Anton Paar</b><br>Steve Goodyer, Anton Paar Ltd, 13, Harforde Court,<br>John Tate Road, Hertford, SG13 7Q<br>T: +44 (0)1992 514730; F: +44 (0)1992 514739<br>E: <a href="mailto:steve.goodyer@anton-paar.com">steve.goodyer@anton-paar.com</a>                                                                                                                                                                      |
| <b>25-26 Nov</b><br>Crawley                               | <b>TA Rheology Training Course:</b> For further information, contact<br>Olivia Gibson; TA Instruments, Fleming Centre, Fleming Way, Manor<br>Royal, Crawley, West Sussex, RH10 9NB; T: +44 1293 658900; F:<br>+44 1293 658901; e-mail: <a href="mailto:Olivia.gibson@taeurope.co.uk">Olivia.gibson@taeurope.co.uk</a>                                                                                                                         |
| 2010                                                      |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>12-15 Jan</b><br>Glasgow<br>Scotland                   | <b>Process Rheology:</b> For further information, contact Dr N E Hudson,<br>Dept of Pure & Applied Chemistry, University of Strathclyde,<br>295 Cathedral Street, Glasgow G1 1XL. Tel: +44 141 5482162;<br>Fax: +44 141 5484822; e-mail: <a href="mailto:n.e.hudson@strath.ac.uk">n.e.hudson@strath.ac.uk</a>                                                                                                                                 |