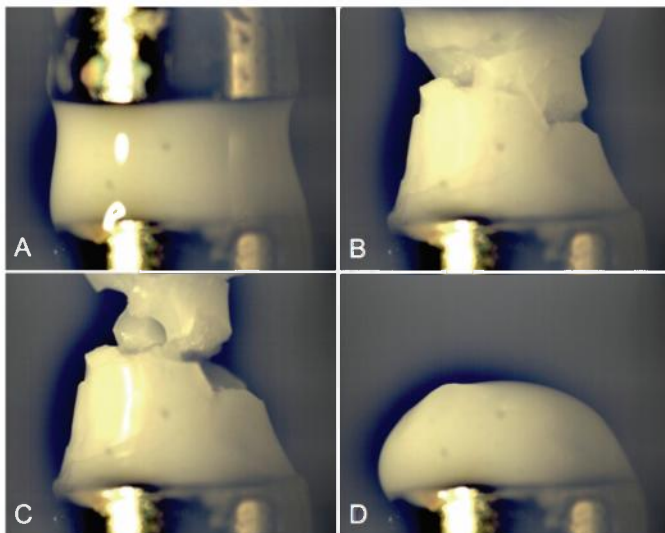

THE BRITISH SOCIETY OF RHEOLOGY

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EDITORIAL

Welcome to Volume 54 (issue #1) of the British Society of Rheology Bulletin. This issue is all about past presidents of the BSR. We have an interesting article from Ralph Oliver about John Benbow's novel contributions to the world together with an article from a certain "J H Watson" which many of members may remember from Bulletins past (this past president prefers to remain anonymous). Separately we have an article from the 2012 Vernon Harrison Award winner, Dr Neil Goulding, and, to make the end of his tenure as Editor of the Journal of Non-Newtonian Fluid Mechanics, an interview with Roland Keunings.

Rob Poole, Liverpool March 2013.

SUBMISSIONS TO THE BULLETIN

Submissions to the Bulletin are welcomed. Electronic submissions by email to the Editor (bulletin@bsr.org.uk) are preferred in word format (e.g. .doc or .docx). Please always provide a contact name, address, e-mail, or telephone number in case of problems. The deadline for submission is Feb. 15th, June 15th and Oct. 15th, respectively, for three issues annually. 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 for details.

COVER ILLUSTRATION

The front cover image shows uniaxial stretching of a hard-sphere colloidal suspension (volume fraction: ~ 0.6). At rest, the suspension shows a liquid-like behaviour (A), however under uniaxial stretching it fractures like a solid (B,C). Finally, when stress is removed the suspension returns to liquid-like behaviour (C). A full description is provided in M.I. Smith et al., Nature Comm. 1, 114 (2010). Thanks to Dr. Volfango Bertola (University of Liverpool) for providing the image.

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 Rob Poole (bulletin@bsr.org.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, including

- advance your knowledge by attending our conferences
- receive publications including Rheology Abstracts, Bulletin and Rheology Reviews
- learn of current instrumentation and accessories plus new developments.
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The Society is non-profit making and is registered as a charity. For the details, you are warmly welcome to visit our web site <http://www.bsr.org.uk/>, and to apply for membership on-line.

Benbow's Brainwave

D R Oliver

Introduction

In the 1950's and 1960's it became apparent that car exhaust fumes were a major atmospheric pollutant. A grey-brown photochemical smog often affected Los Angeles, Tokyo and other large cities. Oxides of nitrogen and sulphur, plus unburnt hydrocarbons, were the main culprits.

By 1968, American cars were being forced by new laws to reduce exhaust emissions, sometimes by "add on" devices, but the VW Golf was one of the first production cars to be fitted with a catalytic converter. Platinum-rhodium catalysts were used at first, but the supporting material needed to be strong enough to sustain engine vibrations and fluctuating temperatures of up to 1000°C. A large surface area was needed and early lead in the fuel could poison the catalyst.

Benbow's contribution

The major breakthrough came when Corning inc. licensed extrusion technology from ICI and combined it with cordierite paste (magnesium aluminium silicate) to produce durable honeycomb blocks. Less well-known is that the work at ICI was done by John Benbow, a BSR President now recognised for more recent work on paste extrusion and the book which bears his name (1). In the book, he mentions the die design, with a lovely picture of the ceramic honeycomb on the front cover, without saying he did the basic work! ICI must have made hundreds of millions of pounds from the licensing arrangements but John, the archetypal backroom boy, remained the dignified loyal employee.

Early on, John realised that hexagonal shapes fitted together, and also that hexagonal headed bolts were common. So his first attempt to make a suitable die involved bolt heads arranged over feed holes (figure 1(a)). In this form, the gaps need to be wide enough for the bolts to rotate for assembly. Figure 2(a) shows one of the better results obtained in this way but flow uniformity was a problem, and the form of die shown in figure 1 (b) was adopted. Milling was first used to form the array of slots on one

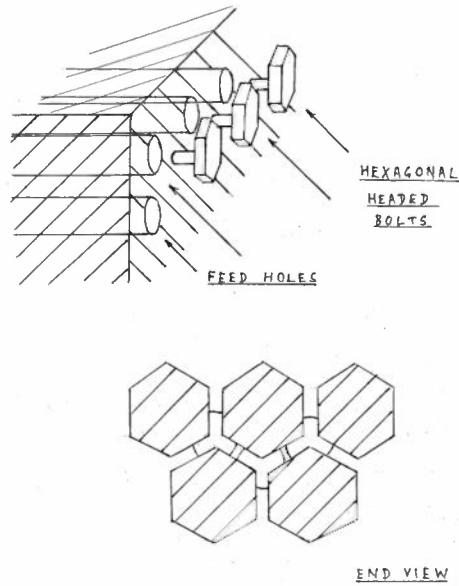


Figure 1 (a): Early die design

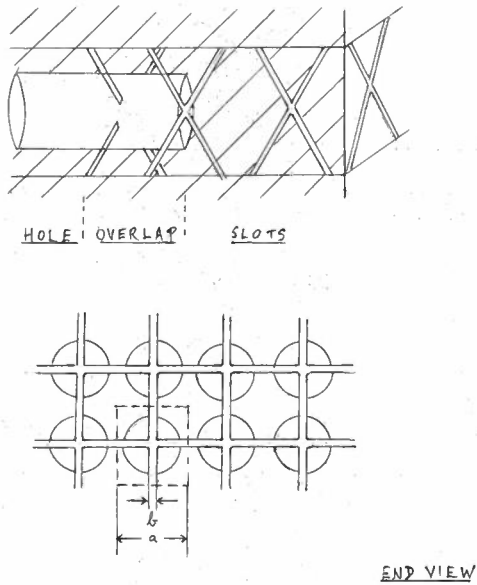


Figure 1 (b): Later die design

end of the die, whilst entry holes on the other end lined up exactly with the intersecting parts of the slots. The holes and slots overlapped in the central area; importantly the cross-sectional area available for flow fell on entry to the holes and fell further on entry to the slots. This, allied to the tendency of pastes to produce plug flows, ensured the desired uniformity of the final honeycomb product.

The wall thickness of 0.25mm was reduced to 0.10mm by the use of spark erosion to cut the slots, different hole patterns also became possible, as shown in figures 2 (b) and 2 (c). These greatly increased the channel (cell) density and wall thicknesses of 0.05 mm are now possible. The internal surface area for catalytic conversion of the exhaust gases is greatly enhanced.

Flow of Pastes

Whilst still at ICI, John realised that pastes flowed in a different manner from most non-Newtonian fluids. Later, after moving to Birmingham University, he studied paste flows in detail and developed the series of equations mentioned below.

The most unusual feature of paste flow is that paste velocity often has a very small effect on wall shear stress. In this respect, its resemblance to solid/solid friction could be noted. Also, when paste is forced through an orifice, paste velocity is less important than the contraction imposed on the material. In fact, it more resembles wire-drawing!

Figure 3 shows the effect of paste velocity on wall shear stress for flow in a tube, using four examples from my own work. All have a relatively large yield stress but only one, the toothpaste, exhibits a well-known form of non-Newtonian flow (Herschel-Bulkley). The others show little effect of paste velocity on wall shear stress. Figure 4 shows broadly similar effects for the orifice flow of three pastes, though in this case the hydroxyapatite flow resembles that of a pseudoplastic having a very low flow behaviour index. These characteristics permit the use of comparatively simple equations which are understandable to engineers.

In collaboration with John Bridgwater, the book “Paste flow and Extrusion” was published in 1993⁽¹⁾. This summarises the derivation of the four-parameter Benbow-Bridgwater equation for flow through tubes:

$$P_T = 2(\sigma_0 + \alpha V) \ln \frac{D_0}{D} + 4(\tau_0 + \beta V) \frac{L}{D} \quad (1)$$

where P_T = pressure required to force paste into and through tube, V = paste velocity in tube, D_0 = diameter before entry, D = diameter of tube, L = length of tube, σ_0 = bulk yield stress, τ_0 = initial wall shear stress, α = velocity factor for bulk yield stress and β = velocity factor for wall shear stress.

Both stresses (and pressures) are measured in Pa and the units of α and β are Pa.s.m^{-1} . The first term represents the pressure required to force the paste into the tube and the second the pressure to force it along the tube. (A more complicated version of the equation allowing for possible curvature of the lines was also presented). For multihole dies, (N holes) such as the first section of that in Benbow’s design,

$$P_T = 2(\sigma_0 + \alpha V) \ln \frac{D_0}{DN^{1/2}} + 4(\tau_0 + \beta V) \frac{L}{D} \quad (2)$$

The honeycomb section

Each of the many entry holes leads into slotted region as shown in figure 1 (b). Entry to the slots is allowed for by considering the cross-sectional area change from the holes to the slots (A_H/A_S), which exceeds one so that paste velocity again increases. See also ref (2).

The dotted square shown on figure 1 (b) delineates the area of the honeycomb section into which each hole feeds. The whole honeycomb is a multiple of this unit, the factor being the number of holes. Area change on entry to this section is

$$\frac{\pi D^2}{4b(2a - b)}$$

where a = distance between hole centrelines (and between “cross” centres) and b = slot width.

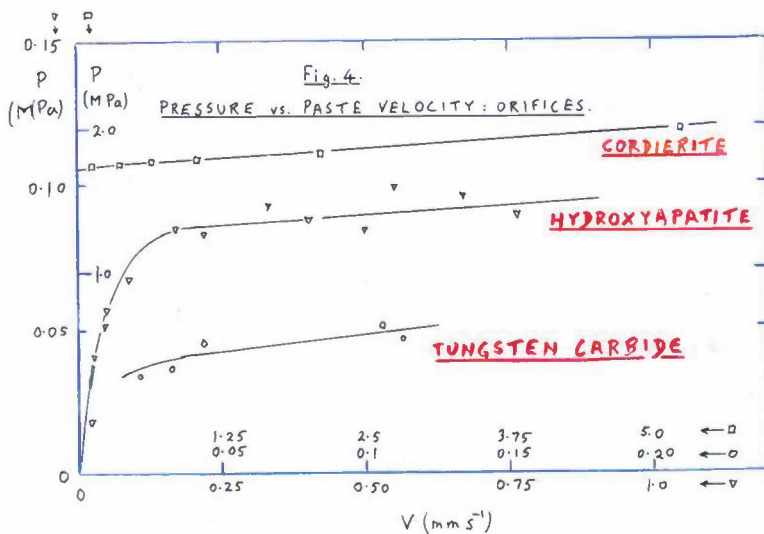


Figure 4: Pressure vs. paste velocity: orifices

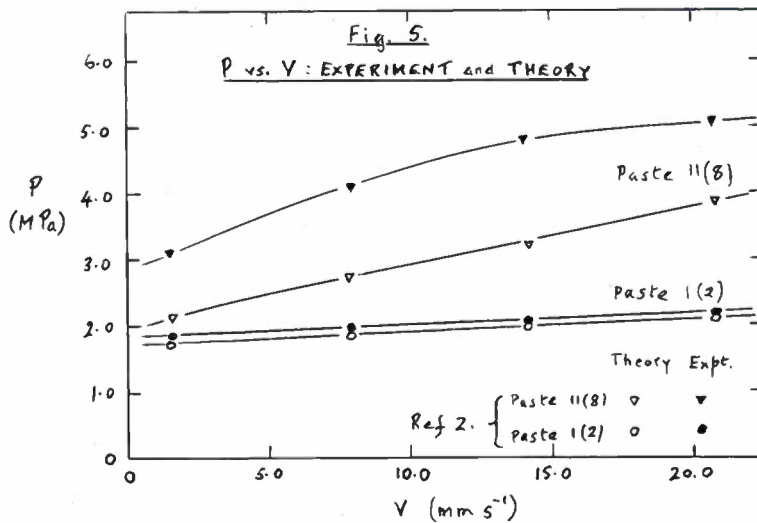


Figure 5: Comparison of experimental data and theory

The cross-sectional area of each cruciform flow area is $b(2a - b)$ and the internal surface area is $4L_H(a - b)$ where L_H = length of honeycomb section

The shear stress at the walls τ is

$$\tau = P_H b(2a - b) / 4L_H(a - b) \quad (3)$$

where P_H = pressure required to force paste along honeycomb section

Thus

$$P_H = 4\tau L_H(a - b) / b(2a - b) \quad (4)$$

The pressure required to drive the paste into and through the honeycomb only is

$$P_H = (\sigma_0 + \alpha V) \ln \frac{\pi D^2}{4b(2a - b)} + 4(\tau_0 + \beta V) \frac{L_H(a - b)}{b(2a - b)} \quad (5)$$

Now, by adding the hole pressure P_N from equation (2) and the honeycomb pressure P_H from equation (5), we obtain the total pressure required to cause extrusion from the whole system. Figure 5 shows a comparison of this total theoretical pressure with measured pressure for two pastes taken from ref (2).

Assumptions

- (a) The overlapping region of holes and slots has been ignored at this stage.
- (b) No allowance has been made for distorted channels on the edge of the honeycomb die.
- (c) It is assumed that the paste produces straight lines in graphs such as figures 3 and 4.

Conclusions

John Benbow's novel design of die allowed honeycomb catalyst supports to be mass produced for the car industry. The ceramic pastes used permitted thin-walled channels to be made, combining large surface area with remarkable resistance to thermal and mechanical shock.

The unusual flow properties of pastes lead to the Benbow-Bridgwater equations, which are particularly well adapted to the problem of pressure drop prediction in complex dies. As can be seen from equations 1, 2 and 5, "entry" pressures can be separated from shear induced pressures within tubes and slots. It is necessary to evaluate the paste constants from separate experiments and eventually to compare the calculated pressure drops with those obtained in real dies. In conclusion, it may be stated that John Benbow has made major contributions of both the practical and theoretical kind in the field of paste flow.

D. R. Oliver
School of Chemical Engineering
The University of Birmingham

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An interview with Roland Keunings

To mark the end of his tenure as Editor of the Journal of Non-Newtonian Fluid Mechanics – or “JNNFM” to its friends – Prof. Roland Keunings agreed to provide an interview with the Bulletin to tell us about his decision.

You are standing down as Editor after eleven years (eight as co-Editor), why now?

RK: I decided to step down at the end of my current editor's contract mainly for two reasons.

The most important one is that I felt it timely to inject new blood in the leadership of JNNFM. Indeed, I have always believed that any type of leadership should not be exercised too long, for the benefit of all parties involved.

Also, I have viewed my editorial duties as a significant responsibility, a unique privilege, but also as a service to the "non-Newtonian" community. Quite frankly, after 11 years, the "service" part has become a bit heavy. Considering that I have also served as Pro-Vice-Chancellor for Research of my university in the period 2004-2009, you realize that I have spent a very significant part of my waking hours over the last decade promoting and evaluating the works of colleagues. I now wish to focus again on my own projects.

What has changed about the Editorial process over the past ten years?

RK: The advent of the Elsevier Editorial System (EES) has brought major changes of course. In the pre-EES era, roughly the first three years of my term, papers were submitted to me directly, either in paper (yes!) or pdf format. I then had to take care of the review process by e-mail, without any clerical help. I used to maintain a local database (a big word for a large Excel file) to keep track of the fate of each individual submission. The EES has made the admin side of the job much easier indeed. In fact, without the EES, I would have been unable to continue to serve JNNFM while being PVC-R.

What part of the job did you enjoy the most?

RK: I truly enjoyed the interaction with authors and referees. With only very few exceptions, the dialogue has always been constructive and positive. Also, to be able to have advance access to the literature is fascinating. Finally, I found it rewarding to play a useful role in maintaining the quality standards of JNNFM.

And what part will you miss the least?

RK: Frankly, I have been a happy editor. I even found some fun in sending personalized reminders to late referees (no doubt they will recognize themselves when reading this interview). But to give you an answer, I won't miss the ocean of JNNFM-related e-mails received and sent during my tenure. They have certainly contributed to my current addiction to smartphones, tablets and the like.

It may surprise some, but I found it relatively smooth and easy to reject papers once having received convincingly negative reviews. Indeed, I always did my best to identify the most competent and trustworthy referees. During my term, I have requested the opinion of about 250 different referees, and the nice thing about serving a "niche" journal like JNNFM is that I know almost all of them on a personal basis. Difficult situations did sometimes arise, however, when the two referees had orthogonal opinions about a particular paper. In a way, this shows the limits of the review process. I would then either request the opinion of a third referee or else, if at all possible, I would myself play the role of that third referee.

I know many people in the community really appreciated the speed with which papers were dealt with during your tenure. What was your secret for dealing with papers so efficiently?

RK: I guess the secret is to feel at home with parallel processing and to assign a sufficiently high priority to JNNFM duties. This being said, I sincerely hope the added value of my editorial efforts is not limited to processing speed. More important to me is the overall quality of the review process and ensuing editorial decisions.

In the past 10 years JNNFM has published more than 1000 papers (!). So you must have dealt with a lot as Editor. Do you know the exact figure?

RK: Yes, I do: 1260 papers have been submitted to me in total. For an editor, the figure that really matters is the number of submissions, which also includes the revised manuscripts: my grand total amounts to 2300 submissions.

At this time, only 25 papers remain in my pipeline. The end is near!

And how many of those did you reject!?

RK: My overall rejection rate has been 45%. Thus, of the 1260 initial submissions, about 700 have been published in the end, an overwhelming majority of which in significantly revised form.

Note that 30% of rejections have resulted from the review process itself. I have taken the responsibility to reject 15% of initial submissions without sending them to referees. Indeed, I did not want to waste the precious time of my competent and busy referees on papers that I considered unsuitable for JNNFM.

What are your thoughts on the future of academic publishing? Do you foresee a time when the major academic publishers will move to a more open model?

RK: In my opinion, open access and evolution of the review process will be key issues in the coming years. Both topics are serious and difficult ones. They would deserve more elaborate and thoughtful answers than I can provide now.

I convinced myself over the last few years that an open access model should be adopted for the publication of all research works supported by public funds: anyone should be able to access scientific papers free of charge. The publishing model should be economically-viable and fair to all parties involved (public funding agencies, publishing houses, professional societies, authors, referees and editors). Obviously, it should also maintain or even improve the scientific standards that are currently met. I do not share the simplistic view that web publishing is cheap and easy to run. As

long as publishing houses offer a useful service, and I am convinced they do, they should get paid for it (but at the right price!). I hope that all parties involved will progressively reach an agreement along those lines.

The review process that is in place today is a bit like democracy: it has many drawbacks but remains the best available system that we know of. I believe however that the advent of web-based publishing will have an impact here as well. In my opinion, it is up to professional societies to come up with thoughtful proposals.

What are your plans for the future?

RK: I won't bore you with the full list (which is "under construction" anyway), but one project is to co-author a book on the Proper Generalized Decomposition. The writing is almost half-way done and the book should be published by the end of the year. Another project is to learn Japanese. Note the hidden link to rheology: recently, I bought a copy of the wonderful book "Basic Technical Japanese" co-authored by our eminent colleague Bob Bird. I wrote an e-mail to Bob about this, and he was quite pleased indeed! Yet another project, certainly the most important one, is to get ready for the birth of our second granddaughter, end of March.

Many readers might not be aware that you are an excellent amateur classical guitarist (I can wholeheartedly recommend a visit to <http://rolandsguitar.blogspot.co.uk/> for those who want to hear how good), does making music impact on your scientific career in any way?

RK: Very kind of you, Rob. Well, playing classical guitar has been a passion for almost forty years. To the extent that it contributes to my well-being (hopefully that of my indulgent audience as well), I would say it does have a positive albeit indirect impact on my professional activities. I started to record about two years ago, and it has been very rewarding to observe a growing internet audience. I don't mean to enter the music industry, though, and my home-made recordings are posted in full "open-access" mode! Voilà, many thanks Rob for this opportunity to share my editorial views and experience!

Vernon Harrison Award Winner 2012

Neil Goulding
(n.goulding@bristol.ac.uk)

Department of Earth Sciences
University of Bristol

Department Of Mathematics
Cardiff University

My PhD research was focussed on the development of a novel approach for the recovery of the continuous relaxation spectrum of a viscoelastic material from experimental data. The main result of my thesis is that continuous wavelet analysis can be used to establish natural models for the continuous relaxation spectrum of a polymeric material. A method of wavelet regularization was developed for the practical recovery of the continuous spectrum over a limited range of relaxation times [1].

Recovery of the continuous relaxation spectrum of a viscoelastic material from experimental data is an exponentially ill-posed inverse problem. Different methods have been used to deal with the inherent ill-posedness of the problem. Most methods use a discrete relaxation spectrum, e.g. nonlinear regression [2], Tikhonov regularization [3] and sampling localization [4]. But different methods give rise to different discrete spectra; there is no unique discrete relaxation spectrum.

It is an inherent premise in the Boltzmann formulation of linear viscoelasticity [5] that, for shear deformations at fixed temperature and pressure, every material has a unique relaxation spectrum. Previous work in approximating continuous spectra has relied exclusively on parametric curve fitting models, e.g. the work by Baumgaertel & Winter [6], Anderssen [7] and Stadler & Bailly [8]. There is no theoretical foundation for relating these empirical models directly to the mathematical theory of linear viscoelasticity. The results of my thesis show that wavelet analysis establishes natural models for the continuous relaxation spectrum. In particular, it is shown that there exist scaling function transforms that are intrinsic to the theory of linear viscoelasticity, which give rise to natural representations for the continuous spectrum.

One of the most commonly performed experiments is the oscillatory shear experiment, which allows the capture of real and imaginary parts of a

complex shear modulus, $G^*(\omega)$, for a limited range of sampled frequencies ω_i . The data, $G'(\omega_i)$ and $G''(\omega_i)$, are known respectively as the storage and loss moduli. Working with logarithmic variables (log–frequency and log–time), it may be seen that **the loss modulus is a scaling function transform of the continuous relaxation spectrum**. This is a fundamental observation that motivates the most important results of the thesis.

It is shown how the decomposition formula of Calderón and Mallat [9] may be used to reconstruct the spectrum from measurements of storage and loss moduli. The Calderón-Mallat formula splits the spectrum into two parts. The Calderón term is essentially a sum over all scales up to a constant σ of the spectrum's (mother) wavelet transforms, whereas the sum over all scales *above* the constant σ are incorporated into the Mallat term, by introducing the scaling function transform (scaling functions are also known as father wavelets). Splitting the spectrum into two parts gives a natural way of regularization, where σ is a regularization parameter. High resolution terms are kept in the Calderón term, whereas the Mallat term constitutes a low-pass filter applied to the spectrum.

At practical levels of resolution, the spectrum may be represented as a finite sum of hyperbolic scaling functions (essentially equivalent to discretizing the Calderón-Mallat formula and using the Mallat term only). These individual atoms are selected from a dictionary of translated scaling functions, by a process now outlined. Transformed dictionaries are developed, whose atoms are used to fit the storage and loss moduli data. As long as σ is rational, the required convolutions can be calculated analytically via residue calculus. I used a linear search algorithm to select m atoms to simultaneously fit the storage and loss moduli data, to subsequently construct an m -sparse approximation of the spectrum [1].

There are two principal regularization mechanisms, namely, sparsity (m , the number of terms in the sum), and scale (σ , which controls both resolution and smoothness). The method of wavelet regularization can be illustrated by recovering spectra from both synthetic and real data [1].

I compare the data fits and their associated spectra for different values of m and σ , and select the smallest value of m compatible with acceptable root

mean square (RMS) error levels. But sparsity alone cannot determine the shape of the spectrum: an additional criterion is required for choosing the scale σ . Tikhonov and entropy regularization induce smoothness in the recovered spectrum by imposing penalty constraints. Such penalties are essentially *a priori* mechanisms for regularization. In implementing wavelet regularization, it is convenient to use instead an *a posteriori* criterion based on minimum total curvature. Starting with the premise that spectra are necessarily smooth, I choose the smallest value of m and a value of σ which together give the smoothest spectrum that fits the data to an acceptable tolerance [1].

For the real data sets (and the synthetic data sets that contains noise) that I analyzed in my PhD thesis, a scaling function approximation for the relaxation spectrum was sufficient. In these cases, enriching the approximation with wavelets (essentially from the Calderón term) generally resulted in fitting the noise in the data. However, in the case of noise-free synthetic data, wavelet enrichment can be used to reduce the RMS error to incredibly low levels.

Several other search and pursuit algorithms are introduced in my thesis, in order to select the atoms of the transformed dictionary. Each of these methods gave similar results to the linear search algorithm. Also, further valid choices of hyperbolic scaling function were derived in the thesis, which also led to consistent results in the shape of relaxation spectrum.

Expressing the loss modulus as a scaling function transform also leads to the development of the error term for one of the simplest approximations to the relaxation spectrum, which Ferry [10] attributes to Fuoss & Kirkwood [11]. It is shown that this error term is in fact a wavelet [1].

To conclude, I have developed a new approach to continuous relaxation spectrum recovery through wavelet analysis. Regularization of the ill-posed problem can be controlled by the choice of σ , which determines the width of the scaling function, and m , which determines the number of basis functions used.

Finally, I would like to acknowledge my PhD supervisor Russell Davies, the complex fluids research group at Cardiff University and my current

employers, University of Bristol. I would also like to thank EPSRC for funding my PhD, and to the BSR for awarding me this prestigious award.

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The Mystery of the Missing Data

Some observation on what is called ‘Cogswell’s analysis’

I confess that the post caused a warm glow in my heart. Here, amongst the general computer generated mail – most of which was addressed to my colleague Holmes and most of which he directed vaguely towards the recycling bin – was a genuine hand written missive with a proper postage stamp on it and, best of all, my name. The Liverpool postmark brought back happy memories and I resolved to enjoy these before finally opening the letter to discover its contents.

“Confound it Watson!” grunted Holmes some time later. “You have been sitting there for half an hour day-dreaming and fanning yourself with that confounded letter with a smirk on your face. And, by the way, I can tell you that the letter is not in a female hand – so do not get too excited. Why do you not open it?”

By his observation, in which I had never known him to err, Holmes had shattered my dream. I took from him the proffered pen-knife and solemnly opened the letter. “Sharpen my scalpels!” I exclaimed. “It comes from the Editor of the Bulletin inviting me to prepare a scientific paper for him. This is a great honour. He even suggests a title: ‘An historical overview of Cogswell’s analysis’, whatever that is.” I passed the letter across to the outstretched hand of my colleague.

Holmes perused the paper, held it up to the light, and finally concluded: “Well Watson, I see no concealed message though I feel that you may be in error in being gratified by the honour. His meaning is plain: he is prepared to overlook the fact that you have not paid your subscription to this august body for some time if you write an article for the Bulletin. In suggesting that you write about Cogswell’s analysis he is prompting you to remember that we spent a considerable amount of time on ‘The Case of the Missing Industrialist’¹. I seem to recall that Mr Cogswell was a member of that rheological subspecies which is probably now virtually extinct.”

¹ “Elongational Flows and the Case of the Missing Industrialists” Bulletin **34**, 2, 47-50 (1991)

“The Case of the Missing Industrialists, Part 2: the Waterloo Syndrome” Bulletin **35**, 3, 80-83 (1992)

“The Case of the Missing Industrialists, Part 3: Parkinson’s Law” Bulletin **38**, 3, 88-96 (1995)

“Rhombus Shear; a case of Natural Obsession” Bulletin **40**, 1, 15-21 (1997)

“Encounters with Angels” Bulletin **47**, 2, 60-64 (2005)

“The Life and opinions of . . .” Bulletin **50**, 1, 22-23 (2009)

“Negative normal stress differences! I do believe that you are right Holmes. Although we never managed to find them, I certainly hope that some conservationist has established a captive breeding programme so that they will not totally disappear. Perhaps Cogswell’s analysis is one of the seeds that is bearing fruit. But where should I start looking?”

Holmes sniffed dispassionately. “You know my methods Watson: Google it.”

Some hours later I laid my laptop aside, gathered up the papers that I had printed off, and went to find Holmes. He was in the kitchen surrounded by a marvellous array of fungi that he had spent the afternoon gathering.

“Supper?” I enquired hopefully.

Holmes treated me to a withering look. “Intoxicants,” he responded. “Supper is at the local chip shop, and it is your turn to fetch it.”

An hour later, and with the remains of a rather fine Puligny Montrachet in front of us, Holmes enquired about my researches.

“It appears to have all started in 1972,” I explained, passing across a copy of a paper² that appears to have been the first use of Cogswell’s analysis to calculate elongational viscosity by the study of contraction flows. “The purpose was to supply data that could be used in engineering design of polymer processing operations involving complex geometry flows.”

Holmes nodded. “That is all very commendable no doubt, but surely not of much interest to the academic community who form the main body of your membership.”

“There you are wrong Holmes,” I corrected the great man. “Independent commentators have shown that, where there is overlap, the analysis provides data that agrees satisfactorily with direct measurement. Thereby it offers a relatively easy way of measuring elongational viscosity over a wide range of conditions and provides data which can be used to validate a whole range of predictions from increasingly sophisticated equations of state.”

“A deviation from the original objective but one which might gratify a former industrial rheologist,” muttered Holmes. “Pray show me a typical example.”

² “Converging Flow of Polymer Melts in Extrusion Dies” Polym Engng & Sci **12**, 1, 64-73 (1972)

Passing across a paper³ that seemed to demonstrate the recent use to which the analysis had been put, I pointed out: “There appear to be several papers along a similar line of which this is a most meticulous example. Its conclusion – that the use of ‘the Molecular Stress Function model for describing extensional viscosity behaviour can save some experimental efforts’ – will surely be welcomed by those who otherwise work up to their armpits in gooey liquids for little reward. Using this model makes experimental rheology virtually redundant.”

Holmes browsed the copy that I had printed out. His brows wrinkled then set in a frown. He referred back briefly to the 1972 paper, that I had already shown him, then, ignoring my protests, he started to deface the graphs of the paper that I had printed out.

“What are you doing!” I protested.

“Simply drawing in lines of constant stress,” he retorted. “The originator of the Molecular **Stress** Function model evidently concurred with Mr Cogswell in considering that stress is the dominant factor determining the response of the molecule, and I was simply trying to see the results through their eyes.”

“And your conclusions are?”

“I conclude, Watson, that, in respect of the analysis of contraction flows, three-quarters of the information is missing from the results that are presented here and that which is presented, and which fits the theory so well, is truly astonishing.”

“Bouncing Putty! What do you mean about missing data?” I demanded. “Surely the extensional viscosity characteristics demonstrated here are probably more comprehensive than for any other similar system in the literature.”

“The most obvious omission is the viscosity in shear from the capillary experiments. The text makes clear that such experiments were made between 10 and 1,000 sec⁻¹ yet there is not a mark on Figure 5 of Aho’s paper³ to show what those results were. It appears that those data were simply used in the calculation of apparent extensional viscosity and then consigned to the dustbin; it would have been at least gratifying to see that they tied up satisfactorily with steady shear measurements obtained by rotational methods.”

“The other omission,” continued Holmes, “is the two sets of elastic response in shear and extension as derived from measurement of the post-extrusion

³ Johanna Aho, Victor Hugo Rolón-Garrido, Seppo Syrjälä and Manfred H Wagner “Extensional Viscosity in Uniaxial Extension and Contraction Flow – Comparison of Experimental Methods and Application of the Molecular Stress Function Model” Annual Transactions of the Nordic Rheology Society **17** (2009). See also Aho et al. *JNNFM* **165** (2010) pp212–218

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Thermo Scientific HAAKE RheoScope module: image acquisition at (very) high shear rates using a stroboscope light source

Key words

Thermo Scientific HAAKE MARS, Thermo Scientific HAAKE RheoScope module, Stroboscope light source, Data acquisition at high shear rates, Emulsions, dispersions

The optionally available stroboscope light source extends the capabilities of the HAAKE RheoScope module, facilitating on the one hand an investigation of rheological phenomena on a structural level also at (very) high shear rates and providing on the other hand an improvement of the quality of the microscopic images at lower shear rates due to a shorter exposure time and a higher light intensity.

Thanks to the stroboscope light source, e.g. the behavior of paints and inks during the coating process can be investigated with the RheoScope or the coalescence of emulsion droplets under high shear rates. Shear-induced orientation and deformation in a sample as well as the structural disaggregation and recovery under defined temperature and shear conditions are further examples.

Instead of using a cold light source, a stroboscope (model BVS-II Wotan, Polytech GmbH) can be connected to the RheoScope module using the same light guard. This modification can be made done by the user within seconds without any tools. The stroboscope light source is equipped with a Xenon flash lamp and has a maximum flash frequency of 200 Hz. In order to synchronize the microscopic data acquisition with the flash light of the stroboscope, only the integration time of the camera in the HAAKE RheoWin software needs to be adapted.

High quality images can be obtained up to a shear rate of $44\,000\text{ s}^{-1}$ using the HAAKE RheoScope camera in combination with the stroboscope light source. Based on experience and depending on the individual sample, images up to a shear rate of 2000 s^{-1} can be taken with a cold light source. This means, that the use of a stroboscope light source with the HAAKE RheoScope module extends the measuring range by factor of 20.



Thermo Scientific RheoScope module

In Fig. 1 microscopic images of a dispersion of mineral oil in silicone oil are depicted at three different shear rates using a cold light source (Fig. 1a - c) and a stroboscope (Fig 1e - f). A plate/plate measuring geometry with a diameter of 35 mm and a polished surface using a measuring gap of $50\text{ }\mu\text{m}$ was used. Significant differences are already visible at a shear rate of 1290 s^{-1} (Fig. 1b and 1e):

Images taken using a stroboscope have a much higher quality than those obtained with a cold light source.

Fig. 2 shows, that high quality images up to a shear rate of 44000 s^{-1} can be taken using a stroboscope light source.

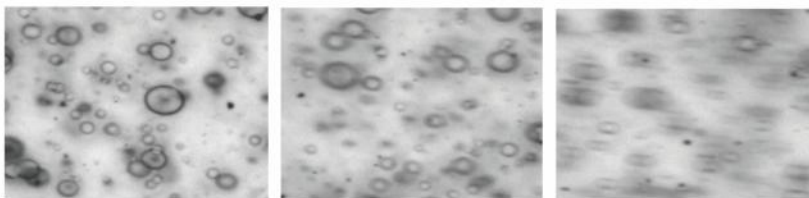


Fig. 1a - c: Images taken using a cold light source at different shear rates: 630 s⁻¹ (1a), 1290 s⁻¹ (1b) and 2520 s⁻¹ (1c)

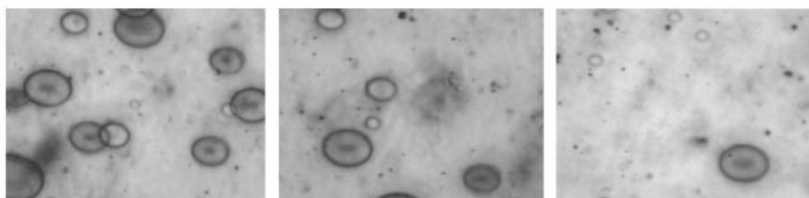


Fig. 1d - f: Images taken using a stroboscope light source at different shear rates: 630 s⁻¹ (1d), 1290 s⁻¹ (1e) and 2520 s⁻¹ (1f)

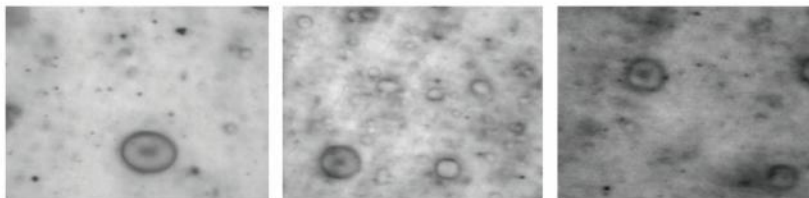


Fig. 2a - c: Images taken using a stroboscope light source at higher shear rates: 5670 s⁻¹ (2a), 12600 s⁻¹ (2b) and 44000 s⁻¹ (2c)

Order information

222-2050 Optional accessory for HAAKE RheoScope module: Stroboscope light source with Xenon flash lamp with maximum flash frequency of 200 Hz (85 V – 265 V / 50 Hz – 60 Hz)

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swelling of the extrudates. Associated with his analysis in the 1972 paper² your Mr Cogswell provided methods of calculating the recoverable strain from that well-known phenomenon and demonstrated that, at the same stress, the modulus in tension is three times greater than that in shear – which would have comforted classical physicists – and, more importantly that at high stress all the melts tended to a limiting elastic response of about two units of recoverable strain in tension and six units in shear. This limiting elastic response is of the greatest importance on considering the analysis of the viscous response in extension; one of the great difficulties in establishing steady flow conditions in ‘classical’ uniaxial extension at high stress is that it is especially hard to make measurements at high deformation where the elastic response is saturated; by comparison, in contraction flow experiments, as Aho and her colleagues³ point out, the maximum extensions in the experiment reaches strains of the order of 5 so that the elastic response is fully saturated. This requirement seems to me to be an essential feature of the value of the contraction flow analysis as a method of studying elongational viscosity.”

Holmes paused, and I tried to absorb all that he had told me. Finally, I ventured: “The failure to incorporate the shear results from capillary flow does seem strange, it would have added another three decades to the data and so provided a more complete picture, but the tie up between rotational and capillary methods is so well known that it would hardly be worth the ink plotting in a few more points just to satisfy purists.”

His second point about the elastic response required a rather different response. “I am afraid, Holmes, that fellow Cogswell rather exceeded the bounds of good taste when he wrote about high stress level elastic response. Modern theoretical appreciation is that field is altogether far more complex than Cogswell would have one believe. Indeed, I think it fair to say that theoreticians find it wise to discourage public consideration of such matters altogether. This is why they do not confuse matters by describing unverifiable properties. Anyway, in this day and age the notion of measuring post-extrusion swelling is too undignified to warrant consideration. Gone are the days when experimentalists would sit in front of a ram extruder with a pair of tweezers cutting and weighing extrudates and measuring their cross-section; today you put the sample in at one end, press a button, and then come back in five minutes for the printout. All that nonsense about recoverable strain is a thing of the past.”

Holmes was clearly shocked by my revelation. “Watson, you are a genius. That explains it.”

“Explains what?” I prompted, always glad to find my insights appreciated.

“It explains why I was so astonished by the elongational viscosity data that fits the theory so well. You will recall being cross with me for drawing lines of constant stress on your graphs. What had puzzled me was that the great

majority of the points from the measurements from contraction flows are at stress levels at or above 10^6 Pas. In 1972 Mr Cogswell was quite clear that at such stress levels the streamlines in melts of low-density polyethylene rupture; indeed the whole reason for that paper was to define engineering strategies to avoid such rupture with its consequent deleterious effects on the product. Now you tell me that, forty years later, such factors are totally ignored – for want of observing the quality of the extrudate – and that Cogswell’s analysis is being applied to situations of non-laminar flow, where he would never have dreamt to apply it.”

“Holmes, there you have it exactly. You see now the power of the theory which allows prediction of the results even when the flow is non-laminar!” But I confess that I found myself uneasy at what I had just said, especially when Holmes moved to finish the bottle of wine as though he regarded the issue at an end. “I know you have this notion that the fracture strength of liquids is extraordinarily low and that such a concept should be at least acknowledged by the theoretical community – indeed I recall writing an essay⁴ on the subject at your behest – but surely this cannot be the time to press the issue.”

“Indeed Watson, if Cogswell could not induce recognition of such concerns, who are we to comment?”

“But tell me,” Holmes continued changing the subject, “what happened to Cogswell after 1972? I imagine that Google provided you with information on that subject.”

“Yes indeed. It seems that the boulder published his rheological memoirs⁵ in which, as well as his elongational flow heresies, he managed to propound all manner of unreasonable views including the influence of pressure on viscosity and flow induced crystallisation not to mention cataloguing a vast array of flow anomalies with unjustified comments on their origin. Despite all that the work was reprinted and is still available today. I managed to hack into his royalty account and find that those memoirs still sell – though mostly outside the UK. He then spent some years developing advanced composite materials of uncommon durability and thermo-formability⁶; thermoplastic composites are becoming of increasing importance today, though again mostly outside the UK. Cogswell then

⁴ “Breaking point” Bulletin **43**, 3, 85-91 (2000)

⁵ “Polymer Melt Rheology; a guide for industrial practice” Geo Godwin Ltd (1981), Woodhead Publishing (1994)

⁶ “Thermoplastic Aromatic Polymer Composites; a study of the structure, processing and properties of carbon fibre reinforced polyetheretherketone and related materials” Butterworth-Heinemann (1992)

dropped off the radar for some time. His most recent publication⁷ – about Armageddon and St Paul – suggests that he may be in the grip of some kind of religious mania.”

“Let us hope that he finds what he is looking for,” reflected Holmes. “Who knows he might stumble across the missing data.”

J H Watson, 2nd December 2012

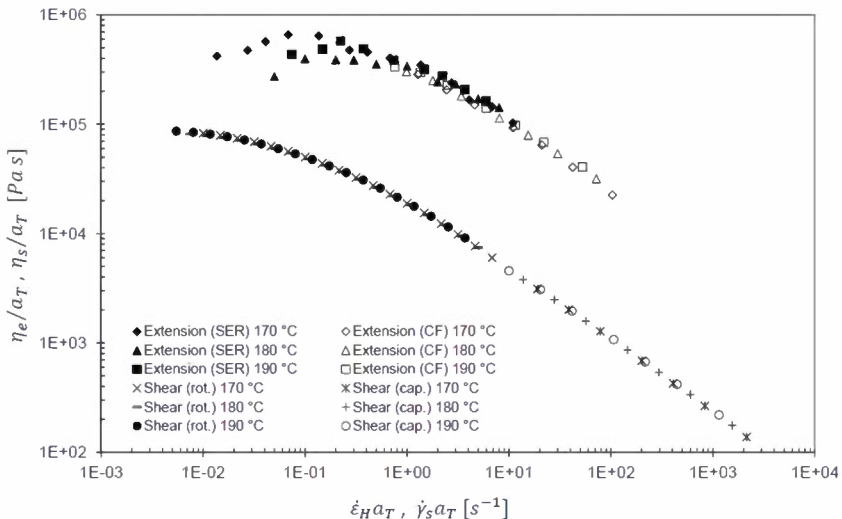
⁷ “1760: Armageddon; the Journal of Horace St Paul” Gralene Books (2010)

Letter to the Editor

Dear Editor,

It is truly a pleasure to see that our work has found the interest of Dr. Watson. It reminds me of my own little contribution as Dr. Watson in the Bulletin (The case of the missing industrialist: The outburst of the Newton syndrome, Bulletin British Soc. Rheol. 39 No.2 (1996), 28-31).

Concerning Dr Watson's request: of course the shear data were measured (although not published as the focus of the work was on elongational viscosity), and I attach the data (viscosities are in units of Pas, time is s). All viscosities are below 10e6Pas and the maximum shear stress measured in a 20/1mm die is 3.5e5Pa.



We wish you and Dr. Watson all the best for 2013!

Best regards
Manfred

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BSR Student Travel Awards

The 301st Council Meeting established the principle that student travel grants have the objective of encouraging students to disseminate their research. Applicants for a student travel bursary must normally have been a member of the Society for 9 months, may be working worldwide and presenting research at a conference, by paper or poster. The grant will be made on receipt of a report on the event.

The British Society of Rheology wishes to establish a transparent mechanism for the award of travel bursaries and to solicit applications from its student membership. Travel bursaries are available to student members of the Society to present their research at a conference that contains a strong rheological element, in situations where no other sources of funding are available to cover the whole cost of the meeting. Suitable conferences include the International Congress of Rheology, the Annual European Rheology Conference and conferences organized by the Society.

The next closing date for consideration of the award of a travel bursary is Thursday 28th February 2013 with successful applicants notified by 8th April. Applicants should include in their submission the name and location of the conference, the title, authors and abstract of the paper submitted to the conference, a breakdown of the projected costs of attending the meeting and a supporting letter from their research supervisor. The support of the British Society of Rheology should be mentioned in the conference presentation. The Society's logo may be used for this purpose. Payment of the bursary will be made on receipt of a report on the conference. The conference report will be published in the Bulletin of the Society.

Applications for a travel bursary should be sent to the Secretary (secretary@bsr.org.uk).

Simon Cox
BSR Honorary Secretary

BSR Annual Award 2013

Nominations are invited for the BSR Annual Award 2013. Each year the BSR makes an award to an individual in recognition of their contributions to rheology. The criteria for the award focus on the scientific merit of the candidate: a person who has made a significant contribution to rheology either through a single paper or more sustained activity. The recipient in 2012 was Tim Phillips, in 2011 David James, and in 2010 João Maia.

Nominations, with a brief supporting statement, should be sent to the President, on president@bsr.org.uk, by the end of May 2013.

Simon Cox
BSR Honorary Secretary

NOTICE of the 72nd Annual General Meeting

The 72nd Annual General Meeting of the British Society of Rheology will be held at the Kavli Royal Society International Centre, Chicheley Hall, Chicheley, Newport Pagnell, Buckinghamshire MK16 9JJ on Tuesday 26th March 2013 at 5.15pm.

The minutes of the 71st Annual General Meeting follow this notice.

Members are reminded that, under rule 7(b), the business of the meeting includes:

- * Election of Officers and Council members.
- * Receipt of a report and accounts from Council.
- * Dealing with matters raised by Council or by any other member and receiving suggestions from members for consideration by Council.

Council's nominations for Officers and Council members are:

President	Prof. P.R. Williams
Hon. Secretary	Prof. S.J. Cox
Hon. Treasurer	Mr S. Goodyer
Membership Secretary	Prof. T. N. Phillips
Bulletin Editor	Dr R.J. Poole
Abstracts Editor	Dr N.E. Hudson

Ordinary members of Council:

- * Dr M. Charalambides
- * Dr B. Dobraszczyk
- * Dr S. Fielding
- * Mr P. Hodder
- * Dr M. Tassieri
- * Dr R. Watson

Dr. W. Frith becomes Immediate Past President, having served his two-year term as President.

Further nominations for Council or for any of the Offices are invited. Nominations should be sent to the Secretary or made at the meeting (rule 5(b)). Nominees must be members of the Society, must confirm in writing that they are willing to stand and must be proposed and seconded by two members of the Society. The Hon. Secretary would be pleased to receive notice of any matter that any member wishes to raise at the AGM.

Members who cannot attend the AGM are invited to make nominations or approve Council's nominations by email or post to the Honorary Secretary:

Prof. S.J. Cox
Institute of Mathematics and Physics
Aberystwyth University
Aberystwyth SY23 3BZ
Email: secretary@bsr.org.uk

Minutes of the 71st Annual General Meeting

Manchester Interdisciplinary Biocentre, The University of
Manchester, Monday 19th March 2012, starting at 5pm.

1. Present

The President and 21 members. Nine votes were cast by email.

2. Apologies for absence

Received from Helen Wilson, Simon Cox, David Binding, Peter Hodder.

3. Minutes of the 70th AGM

Council asked to make the following changes to the circulated minutes:

- replace 5.5 with “The Publications Manager reported, in absentia, that Bulletin 52:1 had been sent out to members”
- replace 5.6 with “The Publications Manager reported, in absentia, that Abstracts 54:1&2 had been published on the website.”

This was agreed as a true record of the meeting and signed by the President.

4. Matters arising

There were none.

5. Reports of the Officers

5.1. President

Bill began his report by thanking BettinaWolf and Xue-feng Yuan for organising the Non-Newtonian Club (NNC) here at Manchester University. You may be aware that we normally hold the BSR AGM in conjunction with the Easter Meeting of the Institute of Non-Newtonian Fluid Mechanics (INNFM), however, since such meetings are not held during years when the International Congress occurs, we had to find an alternative venue. This NNC meeting provided the perfect alternative for hosting the AGM and I would like to extend the BSR's thanks to the organisers for fitting us into their agenda. This NNC meeting has had a lot of effort put into it in an attempt to revive what has at times been a somewhat flagging event, as was highlighted by the concerns expressed in the president's report last year. I would say that this meeting has been a success and I would also like to congratulate the organisers for their efforts, and Richard Buscall for an excellent keynote presentation. I hope this is a first step in developing some real momentum behind what should be a very useful resource for people embarking on rheological research.

Continuing on the theme of meetings, last year's Midwinter Meeting was held at University College London and organised by Helen Wilson and Oliver Harlen. The theme was on "Complex Flows and Complex Fluids", it built on the success of recent Midwinter Meetings with more than 50 participants attending, and many interesting talks, and I would like to offer my congratulations to the organisers.

The next Midwinter Meeting will be held in Aberystwyth, it will be organised by Simon Cox and David Binding, and will have the theme of "Extensional Flows". This will also be the venue for the 2011 BSR Annual award presentation to Prof. David James. The delay to this presentation due to David not being able to come to the last Midwinter Meeting because of prior commitments.

We will resume our close and fruitful collaboration with the INNFM next year and hold the AGM in conjunction with the 2013 INNFM meeting which will be held at the new Royal Society Kavli centre in Bedfordshire. This is a great location and so should be a date for your diaries. The BSR Council held an away-day in conjunction with last year's September council meeting partly in order to discuss in more detail how we can improve our website. We considered options from a complete re-design to merely doing maintenance, and in the end have reached a compromise which will involve some redesign, but without the need for the expense of a full overhaul.

We continue to receive strong support from the instrument manufacturers who support the BSR meetings, publications and awards to students for which we are very grateful. However, we are aware that how the BSR works together with manufacturers is something that we should review from time to time in order that we are able to provide a forum for manufacturers to provide any sponsorship they may wish, and to get their messages across to our members in a way that is both fair to all manufacturers and to our members. As a result we will be approaching manufacturers in order to get their input on how we can improve our provision of advertising services and opportunities for sponsorship. Any input we receive will also be used to steer how we provide advertising on our website.

Last year the BSR Council was informed that the European Society of Rheology had received a proposal to amend its constitution in order to allow individual membership of the ESR. The underlying reason for this is that some of the national societies in Europe have very low membership. This is a sensitive topic not least because a European Society of Rheology that allows membership is potentially a competitor for national societies. The ESR has formed a sub-committee (of which I am a member) to consider the proposal and how any concerns could be addressed and mitigated, the resulting draft proposal is due to be presented to representatives of the national societies at the forthcoming ISFRS in Zurich next month in order to

get feedback. I understand that the finalised proposal will be put to a vote at the 2012 ICR in Lisbon, we will keep you informed of developments.

Finally I would also like to take this opportunity to thank all the members of the BSR Council for all their efforts over the past year. I have enjoyed working with them and have relied heavily of their support and advice. They do a great deal in the background to keep the society functioning that is not obvious and so I would like to take this opportunity to thank the officers individually. Simon Cox took over as secretary this year, and is doing a great job, unfortunately he can't be here today, and so I would also like to thank Alex Lubansky for standing in for him. Steve Goodyer, who is continuing his excellent job as treasurer. Tim Phillips has continued his very efficient job of membership secretary. Alex Lubansky is doing a great job with the abstracts and is ably helped as always by Nick Hudson and I would like to thank them both. A special thanks goes to Xue-feng Yuan who is stepping down as Bulletin editor this year, he will be replaced by Rob Poole.

Finally David Binding and Helen Wilson are stepping down from the council. I would like to say a special thank you to them, both from myself and on behalf of the rest of the Council for their contributions to the running of the society over a number of years, both as ordinary members and as officers where they both did excellent jobs.

5.2 Treasurer

Steve reported that bank statements at the end of December indicated that the society officially made a net gain of 2850 in 2011. However, a cheque for 3,600 relating to MWM2011 costs was cashed during the first week in January and realistically we made a small loss of around 750 during 2011. This is in line with our plans and projections and leaves the society with a net balance of just over 60,000. All publishing activities break even although advertising revenue for the bulletin has fallen in recent years. Membership subscriptions generated over 5,000 and income from the MWM was around 4,800. The main costs incurred by the society relate to publishing of the bulletin and rheology abstracts (6,600).

In 2012 monies will be used to modernise the BSR website and to try and better establish the non Newtonian club (along with other activities to promote rheology).

5.3 Hon. Secretary

In the absence of the secretary, Alex read a written report from Simon. After a year as Honorary Secretary, I must first thank Helen Wilson for answering my many queries. Hopefully I've learnt enough now, but she may yet be pestered. Somewhat embarrassingly, I am unable to attend the AGM this year, and so I must thank Alex for stepping into the breach today (and tomorrow). There were two excellent applications for the Vernon Harrison Award last year, and both were awarded

prizes and gave their award lectures at the Mid-Winter Meeting in London. First prize went to David Hoyle (Leeds), for his thesis on “Constitutive modelling of branched polymers in non-linear response”, and second prize went to Hao Yu (Sheffield) for his thesis on “The physics of cellulose ethers: phase separation and gelation”. The BSR’s Travel Awards offer UK PhD students who are members of the society a contribution of 250 towards attending a rheological conference of their choice to present their work. There were two applications for Travel Awards last March and four in October. We awarded them to Imtiaz Hussain (Reading) to attend the AERC 2011 at Suzdal, to Suzanne Claus (Cardiff) to attend the 17th International Workshop on Numerical Methods for Non-Newtonian Flows in Blois Castle, France, and to Qi He (Nottingham) to attend the 6th International Symposium on Food Rheology and Structure in Zurich. In addition, council decided to offer special travel awards for the ICR in Lisbon this year, open to UK PhD students where were not necessarily non-members. We approved five applications, on the basis that their abstracts were accepted, and they will each receive a year’s membership of the Society. These five are: K. Glover (Oxford), C. Rowlatt (Cardiff), C. McIlroy (Leeds), Y. Wang (Strathclyde), and I. Hussain (Reading).

The 2011 Annual Award was given to Prof. David James (Toronto), although he will not give his award lecture until the mid-winter meeting in Aberystwyth this coming December. Many of you will already have seen his “Reflections” in the latest Bulletin, followed by Bill’s citation. There is also a call for nominations for this year’s award, and it would be good to have input from as many members as possible (please contact Bill before the end of May).

Last, but not least, the TA/BSR Poster Prize was awarded to Robyn Moorcroft (Durham) for her poster presentation at the Mid-winter meeting in London last December. She will use it to present her work on “Transient Shear Banding In Complex Fluids Under Start-up Shear” at the ICR in Lisbon.

5.4 Membership Secretary.

Tim reported that

- The total current membership (on 14th March 2012) is 357, of whom 77 (18%) are Honorary Members, 252 (72%) are UK based, 57 (15%) are from Europe and 48 (13%) are from the rest of the world.
- The total membership reported at last years AGM was 364. There have been 12 new members and 19 resignations 12 of these were from members given a years free membership following the BSR Midwinter Meeting in Nottingham.
- Richard Buscall was transferred to honorary status.

- Take-up of membership following the offer of a years free membership has been patchy with 5 taking up membership following AERC 2009. Potential members are now asked to confirm that they wish to join the BSR before they are issued with access to the website, and are then advised to enter their personal details so as to receive all BSR publications.
- A considerable amount of time is spent chasing members for their membership fees. As of today there have been 175 membership fee payments for 2012, which given that there are 77 honorary members means that 105 are still outstanding.

5.5 Bulletin Editor.

Xue-Feng gave a brief request for articles and wished Rob luck.

5.6 Abstracts Editor.

Alex reported that we are producing two releases a year. Thanks to Nick Hudson for his fantastic support. I think it is a very useful publication serving a niche purpose, even if not the most exciting read, and I do recommend people consider it as another search option. It is only as good as the abstracts we get, so if anyone can help, it may only take an hour now-and-again and would be tremendously appreciated.

6. Officers and Council members

Of the ordinary members standing for Council, Binding has withdrawn. There being no further nominations, the remaining nominations circulated with voting papers were approved unanimously by those present at the meeting. The Council for 2012-13 was therefore elected as follows:

Hon. Secretary	Prof. S.J. Cox
Hon. Treasurer	Mr S. Goodyer
Membership Secretary	Prof. T. N. Phillips
Bulletin Editor	Dr R. Poole
Abstracts Editor	Dr A. Lubansky

Ordinary Members of Council

Dr B. Dobraszczyk
 Dr S. Fielding
 Mr P. Hodder
 Dr N. E. Hudson
 Dr B. Wolf

Bill Frith has one more year to serve as president.

7. Any other business

There was none. The meeting closed at 7pm.

Alex Lubansky
Acting Secretary

Bill Frith
President

Conference reports

BSR Student Travel Award Report for the 16th International Congress on Rheology, Lisbon, Portugal, 5-10th August 2012

Thanks to the BSR Student Travel Award, I was able to attend the International Congress on Rheology in Lisbon, Portugal in August 2012. It was my first international conference and was by far the biggest I have attended. The conference was held at the Belém Cultural Center, next to the Lisbon riverfront and surrounded by several historical buildings and landmarks. My eyes were opened to shear number of fields that rheology covers; there were 11 parallel symposia, including my areas of interest Non-Newtonian Fluid Mechanics, Complex Flows and Constitutive and Computational Modelling. In addition there were 3 special symposia on Rheology of Bio-Pharmaceutical Systems, Rheology of Nano- and Natural Composites and the Professor Ken Walters Commemorative Symposium. I had the pleasure of being introduced to Ken at the start of the conference and thoroughly enjoyed the symposium.

In addition to the symposia, a plenary lecture was given at the start of each day, except Friday when two were given just before lunch. I particularly enjoyed Gareth McKinley's lecture on using Large Amplitude Oscillatory Deformation to characterise complex liquids and soft solids - a tool called "Rheological Fingerprinting". Another plenary lecture I found particularly interesting was given by Paula Moldenaers on Morphology Development in Immiscible Blends. Some of the scenarios Paula presented are of direct comparison to the models I have been considering during the course of my PhD and I hope to be able to do some comparison in the future.

I was given the opportunity to present my research on "The Immersed Boundary (IB) Method for Fluid-Structure Interaction Problems with Discontinuous Viscosity/Viscoelastic Fluid". This was only my second time giving an oral presentation at a conference and, although I was very nervous, I was looking forward to it. I was encouraged by the questions which were asked and the interest the audience seemed to have in my work.

As well as a broad and well-designed technical program, there was a social program. There was a Port wine and Portuguese pastries session on the Monday evening, the conference dinner was on the Tuesday night and there was a trip and beach party on the Wednesday. Unfortunately I was unable to attend the trip and beach party as this wasn't included in the student fare which was a shame as it would have been a great opportunity to meet people in a more informal manner. The conference dinner was fantastic and a fun evening in a lovely historical building.

The XVIth International Congress was a big success and a massive thank you has to be given to Joao Maia, Crispulo Gallegos, Igor Emri and their team of organisers for organising such a fantastic event. It was a privilege to be a part of it and the experience will remain in my memories for years to come. I have returned home with a renewed enthusiasm for my own research and I am looking forward to the completion of my thesis.

Christopher F. Rowlatt, Cardiff.

28th International Conference of the Polymer Processing Society, Pattaya, Thailand 11th to 15th December 2012

I would like to extend my gratitude to the BSR for contributing to the opportunity to attend and present my work at the 28th Polymer Processing Society (PPS) conference held in the exotic city of Pattaya. The PPS conference takes place annually to gather international polymer scientists, engineers and industry. This year, there were a healthy number of participants with varying age groups ranging from young student researchers to the senior citizens of the polymer field. A symposium was dedicated to the memory of Toshiro Masuda (1937-2012), an exceptional rheologist who contributed significantly to the study of dynamic viscoelastic properties of monodisperse polystyrene. The meeting was masterminded by Krisda Suchiva and the organising committee; and I would like to thank them and the support staff for making 28th PPS a success.

The theme of the conference was covered over 10 general sessions with more than 500 oral and poster presentations reporting on topics such as rheology, processing methods (injection/microinjection/blow moulding), mixing and compounding, structure morphology and process modelling. The main interests for me were ‘Rheology and Rheometry’ and ‘Polymer Composite and Nanocomposites’ due to the relevance of these topics to my work. Furthermore, there were 4 special symposia featuring food rheology and processing, biodegradable polymers, frontier processing technology and natural rubber. The poster session was held on the second day to provide an opportunity for students to showcase and discuss their research work.

During the meeting, I particularly enjoyed the plenary lecture presented by Peter Van Puyvelde on his approach of using classical rheometrical flow to study processing conditions under controlled thermal-mechanical history. Another interesting presentation was delivered by Petra Pötschke regarding the influence of the extrusion processes on carbon nanotubes length and dispersion on the electrical and mechanical properties of polymer nanocomposite that was discussed within the specific mechanical energy input framework.

My presentation in the ‘Rheology and Rheometry’ session was entitled “Viscoelastic Melt Rheology and Time-Temperature Superposition of Polycarbonate-Multiwall Carbon Nanotubes Nanocomposite”. I presented a method that enabled the application of time-temperature superposition on nanocomposites. The presentation generated intriguing questions and valuable comments from the audience that encouraged further experimental investigation to consolidate current findings.

I am grateful to have met insightful and enthusiastic people who have engaged with my work and provided helpful feedback that is crucial to my work at the current stage. The experience has improved my communication skills, allowed me to recognise where my research sits and revealed the supportive network of researchers that contribute to this field. The meeting highlighted the invaluable role rheology plays in understanding of polymer processing. The next meeting, PPS 29th will be held in Nuremberg, Germany from 15th-19th July 2013.

Gabriel Choong YH, Nottingham.

BSR Midwinter Meeting on “Extensional Flows” held at old College, Aberystwyth, 17th to 18th December. 2012

The 2012 Midwinter Meeting concerned extensional flows. It was organised by Simon Cox and held in the beautiful environment of Old College in Aberystwyth. Around 40 delegates were present, with good blends of career stages, geographical locations and academic/industrial workers represented.

The conference was structured around two invited presentations (Eggers and McKinley), the Annual Award Lecture (James) and the Vernon Harrison Award Lecture for the best PhD thesis (Goulding).

The first invited presentation was given by Jens Eggers from Bristol and concerned thread formation and instability in polymeric fluids. It was particularly interesting here to see a good combination of experimental and theoretical material, and with a novel exploration of the possible effects of flow-concentration coupling in the pinch-off dynamics.

The second invited talk was by Gareth McKinley of MIT. This started with an excellent pedagogical review of air-blast atomization. New experimental results were then presented for the size distributions of droplets in weakly elastic fluids, which were shown to be well described by a Gamma function. A caution was issued against fitting data with a Gaussian, which fails in the large droplet end of

the distribution, to which the human eye is particularly sensitive in practical coating applications.

The BRS's Annual Award of 2011 was presented to David James of the University of Toronto. David's award lecture comprised an excellent review of his impressive research career experimenting with dilute polymer solutions, and with Boger fluids in particular. It was particularly interesting here to see new results concerning flow past an array of cylinders, not least because this geometry provides an opportunity to study the interplay of extensional and shear effects.

The Vernon Harrison Award for the best PhD thesis was presented to Neil Goulding (Cardiff/Bristol), who gave a very clear presentation concerning the use of continuous wavelet analysis to model the continuous relaxation spectrum of polymeric fluids, demonstrating how to reconstruct the relaxation spectrum from measurements of storage and loss moduli.

The meeting also benefited from a very high standard of contributed presentations, a poster session, and from a delicious and sociable conference dinner.

Suzanne Fielding, Durham

Commentary on the 337th Council Meeting of the BSR

Old College, Aberystwyth University

As a relatively new member of the BSR council it has fallen to me to provide the commentary on the 337th council meeting. This meeting was held at the conclusion of the successful mid-winter meeting at the Old College in Aberystwyth. The weather was appropriately wintery with grey skies on the first day and clearing skies the next, providing excellent views across the sea. This very attractive stone building looking out over the sea saw about 40 people attend to see a range of interesting and informative presentations. I am sure details of the mid-winter meeting have been provided elsewhere in this bulletin.

The council meeting was held in a cosy classroom with walls covered in Welsh language posters. A quorate group of the council were able to attend, unfortunately some of the council had to leave early to ensure their railway connections would provide a return journey that day.

The council meeting opened with apologies from those who had to depart early and those who had been unable to attend the mid-winter meeting. A brief run through of the items to be undertaken from the last meeting ensured that any outstanding business was completed or in hand. The office bearers reports were presented and discussed. The survey of members being particularly well covered. I am sure you all received a reminder email arising from this discussion. If you have not had time to complete the survey please do, your input will allow the council to know what we should be undertaking to keep the society relevant and meet your needs.

The future of the website was discussed and the preparations for the AGM which is to be held in conjunction with the INNFM Meeting at Kavli house (25th-27th of March). With this being the last Council meeting for Bettina Wolf who is not renominating at the AGM, she was thanked for her time and efforts on behalf of the society. Other general business which was covered was the new members in the last year Ben Proudlove, Monica Oliveira, Emma Hodson, Nadji Chioukh, Alexander Holder, Afshin Tarat, Rebecca Hambly, Ross Winter, Idris Mohammed, Clare Payne and Bethan Thomas. The financial report was presented with the year looking to be break even as was expected. The upcoming meetings of the society were discussed with their planning already underway. The meeting drew to a close and the majority of the meeting went to catch the railways back out of Wales for what remained of the week before Christmas.

Richard Watson
Ordinary member of Council

INDUSTRY NEWS

Press release from Anton Parr (PR20131251)



One rheometer, two EC motors, all possibilities: MCR 702 TwinDrive™

Anton Paar introduces a rheometry revolution: MCR 702 with modular TwinDrive™ technology. This is the only available rheometer to cover all possible rheological applications – with an accuracy of 1 nNm and features like the IsoLign Piezo flange, offering measuring gap control down to an unprecedented size of 10 nm.

Anton Paar's TwinDrive™ technology combines two powerful synchronous EC (Electrically Commutated) motor units in a modular setup: The upper EC motor in the rheometer is permanent, the lower EC motor can be extracted and integrated at will. Due to the EC motors' renowned dynamism and precision, users have several options of how to employ these units to fit their specific requirements.

MCR 702, the world's first TwinDrive™ rheometer, can be operated in several test modes to cover all rheological applications – past, present and future.

2EC mode: Operating two EC motors at once opens up entirely new possibilities like counter-rotation, for example. In this “2EC counter-rotating” mode, MCR 702 employs both EC motors as drive units as well as torque transducers. The motors are easily set to rotate in opposite directions; the preset speed is divided and shared by the two motors.

This mode is an invaluable option for microscopy applications, in which the observation of sample particles and structures is sometimes difficult if the sample is sheared and therefore “rushing past” the microscope. The EC motors' counter-rotation can be used to produce a permanent stagnation plane in the measured sample, which is therefore easier to investigate microscopically. Users can easily move the level of this stagnation plane by adjusting the two motors' individual deflections – a simple balance act for the system, yet an unprecedented rheological procedure.

Regarding speed, the 2EC counter-rotating mode simply “doubles the score”. Since the maximum speed difference of the two motors is twice as high as the speed of a single EC motor, the maximum speed difference is doubled – up to 6000 rpm. To determine the required rheological parameters, the speed is calculated from the difference between the two motors' individual speeds, while the torque of one of the motors is recorded.

The 2EC mode also enables users to employ the motors in a more synchronized fashion, making “different demands” on each of them. Because of the EC motors' outstanding precision, one motor is easily brought to a standstill and operated solely as a torque transducer, while the other motor is used as a drive unit only. This turns MCR 702 TwinDrive™ into the best available separate motor transducer rheometer for rotational and oscillatory tests, at the unrivaled torques and normal forces offered by Anton Paar's EC motors only. The list of potential TwinDrive™ applications is endless – rheologists can now begin to imagine future possibilities.

EC mode: In the EC mode, MCR 702 offers users the TruStrain™ capability of the EC motor as well as the option of performing “classic” stress-controlled tests.

In this mode, the lower motor is removed and the upper EC motor is used as a single drive unit and torque transducer. Based on the modular concept of Anton

Paar's MCR series, the removal of the lower motor is easy and reliable, supported by Toolmaster™, the MCR's automatic tool recognition and configuration system.

The EC motor measures and controls the required parameters at the same time. Employing a single drive only, users are given the option of either controlling the shear rate or the shear stress, which opens up the wide array of applications only available for single-motor MCR rheometers.

When operating MCR 702 in the EC mode, users can attach more than 35 different temperature devices or application-specific accessories, all of them readily recognized and configured by Toolmaster™. Whether users choose to employ a cell for high-pressure applications, a device for rheological investigations while applying a magnetic field, or a small-angle light scattering system – the required devices are simply attached. For temperature control in the EC mode, a wide range of MCR temperature devices are available, such as C-PTD 200 and C-ETD 300 for concentric-cylinder measuring systems, or temperature devices for cone-plate systems with full TruGap™ functionality.

IsoLign: Complete gap control. MCR 702 TwinDrive™ is the first rheometer to offer nano-scale precision on several counts – such as low-torque measurements down to a minimum of 1 nNm and the control of angular deflections down to 100 nrad. Now this peak precision also extends to the system's measuring gap control: The new IsoLign Piezo flange performs gap size changes as small as 10 nm. Based on a system of 3 Piezo elements in the flange of the measuring chamber reception, IsoLign is reliably employed in all TwinDrive™ test modes.

Common step-motor-based systems employ a long kinematic chain to translate single motor steps into gap size changes in the micrometer range. Capable of step sizes down to 10 nanometers, IsoLign is decades more precise than any other comparable solution for gap size adjustments.

In high-sensitivity tests over long periods of time (e.g. creep, step strain or step shear rate tests on complex fluids) and tests across vast temperature ranges, the measuring gap is kept constant within lower tolerances than ever before. In combination with the TruGap™ system (US Patent 6,499,336), stable gap conditions are guaranteed over extended measuring times as long as several days.

The key to accuracy: The EC motor technology. The air-bearing-supported synchronous EC (Electrically Commutated) motor is the key component of the MCR series' dynamism and precision.

Whether users perform zero-shear viscosity determinations of low-viscosity polymers or measure highly viscous magnetorheological fluids at high shear rates and strains, the EC motor ensures accuracy across a vast viscosity range. Due to its unique design, the motor features a linear relation between the torque and the input current to the stator coil, which is a great advantage for precise torque control and measurement.

For increased testing flexibility, the motor is easily and reliably set to move in two respective directions depending on the selected test type, allowing for counter-rotation in the 2EC mode, for example.

Based on its rapid and accurate control combined with its extremely wide torque range, the motor is the ultimate torque transducer in the 2EC separate motor transducer application.

The established air bearing technology - with a radial and axial air bearing supporting the motor - is independent of external influences and therefore applicable without further electronic control. Continuously optimized for rigidity, drift stability and robustness, this technology enables low-torque measurements down to a minimum of 1 nNm.

The high sensitivity and increased sampling rate of the patented normal force sensor (US Patent 6,167,752) integrated in the air bearing enables normal force measurements during transient and steady-state tests as well as static normal force measurements for DMTA, tack or penetration tests. The advantage of the sensor's location: Normal force measurements are available for all temperature devices and application-specific accessories.

In summary, MCR 702 TwinDrive™ is a high-precision gateway into the entire world of rheological possibilities.

For further information please contact Ms. Hermine Knapp, Tel: +43 316-257 1350,
E-mail: hermine.knapp@anton-paar.com

CONFERENCE DIARY

2013	CONFERENCES & MEETINGS
25-27 March Chicheley Hall	INNFM Advances in Non-Newtonian Fluid Mechanics Prof. Ken Walters (kew@aber.ac.uk) and Prof. Peter Townsend (p.townsend@swansea.ac.uk). Conference website: http://www.innfm.org.uk/gpage.html
2-5 April Leuven Belgium	AERC 2013 8th Annual European Rheology Conference Organiser/Contact details: Professors Peter Van Puyvelde and Patrick Anderson Conference Website: http://www.rheology-esr.net/AERC/2013/
30 -31 July Zlin, Czech Republic	'Novel trends in rheology V' Contact person: Prof. Ing. Martin Zatloukal, Ph.D. mzatloukal@ft.utb.cz Conference website: http://noveltrends5.ft.utb.cz/home.html
18 – 22 Aug Durham	IUPAC 10th International Conference on Advanced Polymers via Macromolecular Engineering Organiser: Dr Lian Hutchings (l.r.hutchings@durham.ac.uk) Conference website: http://www.dur.ac.uk/soft.matter/apme2013/
13 -17 Oct Montreal Quebec	The Society of Rheology 85th Annual Meeting For updates see http://www.rheology.org/sor/annual_meeting/default.htm
2013	COURSES & WORKSHOPS
14 - 16 May Glasgow	Process Rheology CONTACT: Dr Nick Hudson, Dept Pure & Applied Chemistry, University of Strathclyde, 295 Cathedral Street, Glasgow, UK T: +44(0)141 5482162; F: +44(0)141 5484822 E: n.e.hudson@strath.ac.uk
10 – 11 July Nottingham UK	Rheology Workshop Steve Goodyer, Anton Paar Ltd, 13, Harforde Court, John Tate Road, Hertford, SG13 7Q T: +44 (0)1992 514730; F: +44 (0)1992 514739 E: steve.goodyer@anton-paar.com



The rheometry revolution: TwinDrive™

Anton Paar introduces MCR 702, the world's first
TwinDrive™ rheometer:

One single rheometer with two perfectly balanced EC
motor drives, covering all rheological applications.



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