

THE BRITISH SOCIETY OF RHEOLOGY

BULLETIN



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1991/92

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EDITORIAL

This issue has all the details of the Society's Annual Conference in Cambridge. I look forward to seeing a good attendance for this meeting, with its interesting programme and the added attraction of joint participation with our French counterparts in the Groupe français de Rhéologie. Do not forget the Annual General Meeting, which will be held during the Conference.

We are grateful to those members who replied to our questionnaire on *Rheology Abstracts* and the Bulletin. Geoff Brownsey has prepared a preliminary report on the replies and the subject will be discussed in Council for decisions to be made.

In this issue we are asking for a response of a different kind. The working group considering a handbook of rheology, provisionally entitled *Rheology A-Z*, have prepared a draft list of topics which is published in this issue. We invite you to comment on or suggest other topics and concepts and to offer yourselves or nominate others as authors of articles. Please contact David Cheng.

Copy date for next issue: September 15th.



A SHORT HISTORY OF MOLECULAR SIMULATION APPLIED TO RHEOLOGY

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Computers can now be used to predict material properties from their molecular-level behaviour, using techniques going under the general title of molecular simulation. I think that this is a timely subject for discussion because RISC workstation desktop computers have become available recently costing little more than a 486 PC. These have brought within the budget of most research laboratories sufficient computing power to perform meaningful molecular simulation studies. No longer is molecular simulation the preserve of those fortunate enough to have access to central supercomputing facilities.

The steps needed to perform molecular simulation are quite simple to understand. A 'box' of model particles, which could be small molecules or macromolecules modelled in some approximate sense, is established in the computer. This is shown in Figure 1. The black solid circles represent particles in the simulation cell. The dashed circles are periodically repeated images of these. They are introduced to minimise surface effects if no surfaces are required in the simulation. The molecules are allowed to move around and interact in a way as close

as possible to the way in which the real system would behave at a microscopic level. From this sequence or 'snapshots' of the liquid structure can be calculated the stress and strain and hence the rheology. Molecular

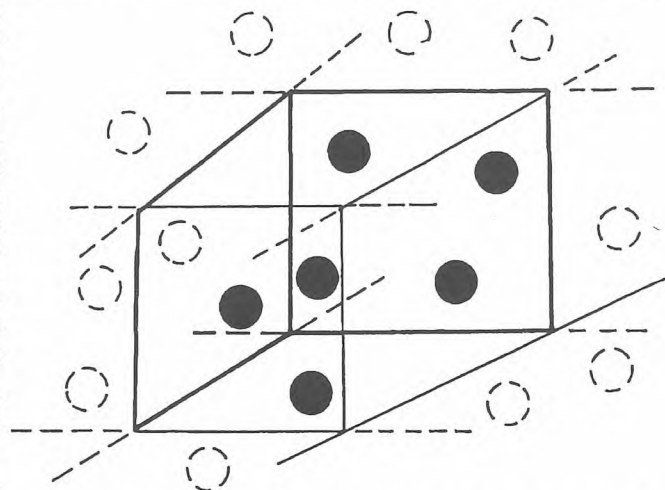


Fig. 1 Picture of a simulation cell with 6 molecules in it (usually there are several hundred). The cell is surrounded in up to three directions by periodically repeating images of itself.

'flavours'. The Molecular Dynamics (MD) method is based on Newton's equations of motion and is ideal for studying molecular fluids (e.g., n-alkanes, surfactants in micelles and Langmuir films) where essentially all the atomic components are explicitly included in the model. Brownian Dynamics in its various approximations is based on Langevin equations of motion and is ideal for studying macromolecular systems in a solvent (treated as a continuous background). To date there have been few (if any?) instances where these methods have led directly to the manufacture of specific materials — so-called molecular engineering. Not that there is anything in principle preventing us from doing this, the computer power (even with today's RISC workstations) is sufficient to put neithersufficient chemical detail in the simulation nor is the length of simulation in real time sufficient to be this specific. What we have to be content with for the time being is to use these techniques to gain an idea of what parameters in the molecule have the greatest impact on the rheology. In fact, this is not a bad thing at all — as it leads to an understanding of the rheological processes in a more 'generic' sense, which is more suitable for developing molecularly-based theories for the rheology.

My main purpose in this short note is to sift through the vast literature on molecular simulation and to illustrate some of the milestones in this field that have relevance to rheology, and therefore to provide an 'entry-point' into the literature. Therefore the references have a bias towards the more recent publications.

The first appearance of rheology in molecular simulation was in the 1960s, when a non-intrusive method was devised for calculating the Newtonian viscosity, η_0 , of molecular fluids using Molecular Dynamics (MD). The Newtonian viscosity was calculated from the equilibrium trajectories of the molecules — simply by monitoring the time decay of shear stress fluctuations in an unsheared sample. In a *tour de force* of statistical mechanics it was shown that the shear viscosity, η_s , is given by a so-called Green-Kubo formula,¹

$$\eta_s = (V/k_B T) \int_0^\infty \langle S_{\alpha\beta}(0) S_{\alpha\beta}(t) \rangle dt \quad 1$$

where V is the volume containing N , molecules, T , is the temperature and $S_{\alpha\beta}$ is the $\alpha\beta$ ($\alpha \neq \beta$) component of the stress tensor $\underline{S}$, which for monatomic fluids is

$$S_{\alpha\beta} = -\frac{1}{V} \left(\sum_{i=1}^N m_i v_{\alpha i} v_{\beta i} - \sum_{i=1}^{N-1} \sum_{j>i}^N (r_{\alpha ij} r_{\beta ij} / r_{ij}) \frac{d\phi(r_{ij})}{dr} \right) \quad 2$$

where v_α is the α component of the velocity of an arbitrary particle and

$r_{\alpha ij}$ is the α component of $\mathbf{r}_{ij}$, the vector separating the centres of the two molecules i and j , and $\phi(r)$ is the interaction potential between the molecules. In the simulation the function in the $\langle \dots \rangle$, called a time correlation function, is calculated. The integral in Eq. (1) is performed at the end of the simulation. It may seem inconceivable that the viscosity could be obtained without shearing the fluid! One way of appreciating this is to note that thermal fluctuations in a liquid will introduce into the fluid domains of localised shear strain, perhaps over several molecular diameters. Each of these will cause the 'local' stress to increase and then decay as the strain pattern changes. It is the stress response to these transient shear strains that the formula uses to calculate the shear viscosity.

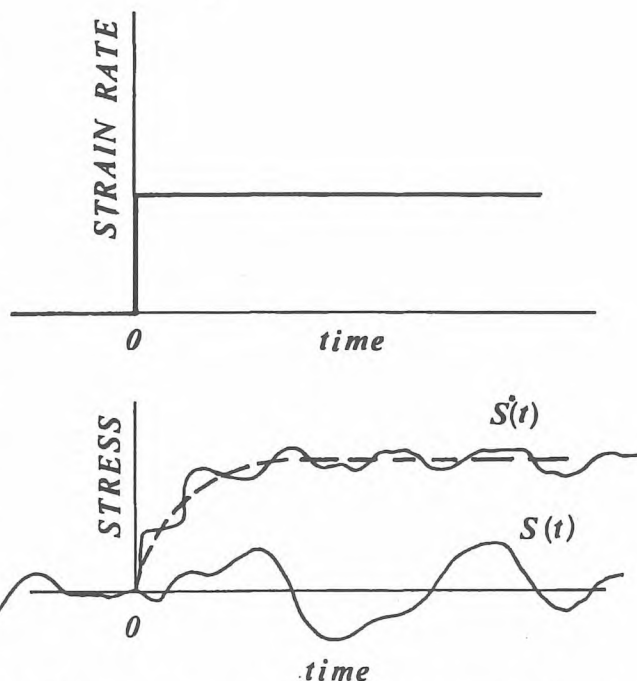
Experimentally, viscosity is measured by applying a strain rate and measuring the stress in the fluid. It is only under these circumstances that departures from purely Newtonian behaviour can become apparent. In the early 1970s so-called Non-equilibrium Molecular Dynamics, (NEMD), techniques were developed to apply a finite strain rate to molecules in the molecular dynamics cell. An influential publication² introduced shear flow in the MD cell by sandwiching it between two fluid walls translating in opposite directions. Although this bears a close resemblance to the experimental situation, I think it is fair to say that this boundary-driven flow has not found wide use in molecular simulation. For a variety of reasons, boundary-free or homogeneous shear schemes have found more favour, partly because they make better use of the limited number of molecules that can be handled (usually up to several thousand). The 1980s could be said to be the decade in which the shear equations of motion were placed on a firmer theoretical footing. One major advance by Evans and Morriss was to extend the Green-Kubo treatment to consider non-Newtonian flow.³ Consider a liquid that is sheared from time $t = 0$, as shown in Figure 2. The stress develops along a non-equilibrium trajectory, $S^*(t)$ (where the $*$ denotes a non-equilibrium state). They defined a transient time correlation function, $\langle S_{\alpha\beta}(0) S_{\alpha\beta}^*(t) \rangle$, which can be used to evaluate the non-Newtonian viscosity as a function of shear rate, $\dot{\gamma}$,

$$\eta(t, \dot{\gamma}) = (V/k_B T) \int_0^t \langle S_{\alpha\beta}(0) S_{\alpha\beta}^*(t) \rangle dt \quad 3$$

This relates the time-dependent apparent viscosity to a correlation between fluctuations in stress in the equilibrium and non-equilibrium states. (In the limit $t \rightarrow \infty$ we have $\eta(\dot{\gamma})$.) This is a landmark discovery because it places rheology on a firmer statistical mechanical basis. Equation (3) is valid for arbitrarily large shear rates and can be

generalised to specify normal pressure differences.³

A recent application of homogeneous shear NEMD investigated the shear thinning of n-butane.⁴ The main problem with NEMD currently is that computer power limits it to fairly small molecules by rheological standards, which only start to noticeably shear thin at $\dot{\gamma} \sim 10^{12} \text{ s}^{-1}$. At



turned on at time $t=0$. The lower figure shows the associated shear stress response. The dashed curve is the average of even during a many such responses. The wavy solid lines show the time development of the stress for the small sample at equilibrium. simulation of tens of picoseconds there is appreciable shear heating, which has to be thermostatted out in some *ad hoc* manner. The consequences of this have still not been fully resolved.

In the mid-1980s Brownian Dynamics, BD, simulation was developed to calculate the rheology of model colloidal dispersions/suspensions. The technique is structurally the same as NEMD except that the equations of motion are Langevin rather than Newtonian, causing the particle motion to be heavily damped. The particle trajectories in the simulation are presumed to be thermostatted through the solvent. The technique is coming into its own now, and is being used to help interpret neutron and light scattering data of sheared colloidal systems. In its own right it is being used to correlate shear-induced structural changes in the colloids with the rheology. It has been applied to, for example, near-hard sphere suspensions, electro-rheological fluids and depletion flocculated

systems.⁵ The main outstanding problem with BD is the hydrodynamic coupling between the particles, present in the real system, which has proved difficult to include cost-effectively in the simulations. Fortunately, the evidence to date suggests that simulations that do not have any many-body hydrodynamics get much of the physics right. Quantitative agreement requires some 'renormalisation'.

I think that we can be confident that molecular simulation will increasingly be used to help interpret experimental rheological data and be used to develop soundly-based theories in this field.

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- ² W. T. Ashurst and W. G. Hoover, *Phys. Rev. A*, 11 (1975) 658.
- ³ D. J. Evans and G. P. Morriss, *Phys. Rev. A*, 38 (1988) 4142; see also D. J. Evans and G. P. Morriss, *Statistical Mechanics of Nonequilibrium Liquids*, Academic Press, London, 1990.
- ⁴ S. Chynoweth, U. C. Klomp and Y. Michopoulos, *J. Chem. Phys.* 95 (1991) 3024.
- ⁵ J. R. Melrose, *Europhys. Lett.*, 19 (1992) 51.

EUROPEAN STANDARD FOR STEADY-SHEAR NEWTONIAN AND NON-NEWTONIAN VISCOSITY MEASUREMENT BY CO-AXIAL CYLINDER VISCOMETRY*

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INTRODUCTION

The need for developing international rheological measurement standards was outlined by our colleague Nigel Heywood in an article published in the Bulletin in 1990¹. In the concluding remarks, it was mentioned that Warren Spring Laboratory (WSL) and Physikalisch-Technische Bundesanstalt (PTB) at Braunschweig, Germany, intended to embark upon a joint programme of work which, it is hoped, will be funded through the BCR applied metrology programme of the European Community and by British and German Governments.

Since then, much effort has been made to secure the funding. During the course of discussions with BCR, it became clear that the aims set out in Nigel Heywood's article were too broad to be tackled in their entirety from the outset. WSL and PTB have therefore revised their approach. It was decided to confine the work in the first instance to the development of a European Standard for steady-shear Newtonian and non-Newtonian viscosity measurement by co-axial cylinder viscometry. The justification of this decision and the outline of the proposed work are described in this article.

BACKGROUND

To date, there has been an increasing trend in the use of rotational instruments for rheological measurement as routine in a wide range of process industries in areas of product formulation, quality control, engineering design and process control. Materials used or produced in these industries exhibit non-Newtonian properties. Both steady-shear viscosity or flow curve and viscoelastic properties (such as creep compliance and complex modulus) are commonly measured. A range of commercial instruments is available for such use.

When making these measurements, many users have questioned the accuracy and traceability of the results obtained. In general, viscometer and rheometer manufacturers

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1. provide factors for Newtonian viscosity but give no guidance to the calculation of non-Newtonian viscosity;
 2. claim that end effects are eliminated or minimised via the design of test geometry but this is often not substantiated;
 3. make little, if any, mention of other instrumental effects;
 4. do not provide precision (repeatability and reproducibility) and accuracy figures;
 5. give no traceability to the international standard viscosity (water value at 20.00°C) for the results obtained, especially non-Newtonian viscosity values, and
 6. provide computer software which tend to be 'black boxes'.
- Different equations may be used by different manufacturers for calculating shear rates and different numerical algorithms to determine best fit. These would give different final results.

As the results are unreliable and not traceable to the international standard viscosity, it is not surprising that comparisons between commercial instruments show little agreement or do not result in specific figures being given for precision and accuracy nor guidance procedures to be followed for the best results (eg. the COST 90 Collaborative Study on foodstuffs² and the M1 fluid 'round-robin' exercise³).

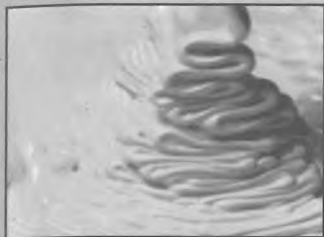
With the ever-increasing drive in industry to quality assurance through registration with British Standards Institution (BSI) under BS 5750/ISO 9000 and accreditation by U. K. National Measurement Accreditation Service (NAMAS) and similar bodies in other EC countries, there is increasing pressure from users and manufacturers alike for the development of traceable standards for measurement procedures, which will include the use of Standard Reference Materials (SRMs), for calibration of rotational viscometers.

There is no international or national standard relating to viscoelastic measurements and little, if any, literature information on instrumental errors on viscoelastic measurements. As regards steady-shear viscosity measurement, there is currently only one international standard, ISO 3219: 1977 "Plastics — Polymers in the liquid, emulsified or dispersed state. Determination of viscosity with a rotational viscometer working at defined shear rate". Currently, this is under revision and has a new title ISO/DIS 3219 "Plastics — Determination of viscosity using a rotational viscometer with defined shear rate". Although this is specific to plastics, it is closely based on the more general German standard DIN 53019 and can be applied more widely to other materials. However, the standard is not very specific

Thermoplastics



Thermosets



Suspensions and Emulsions



Elastomers

action rheaction

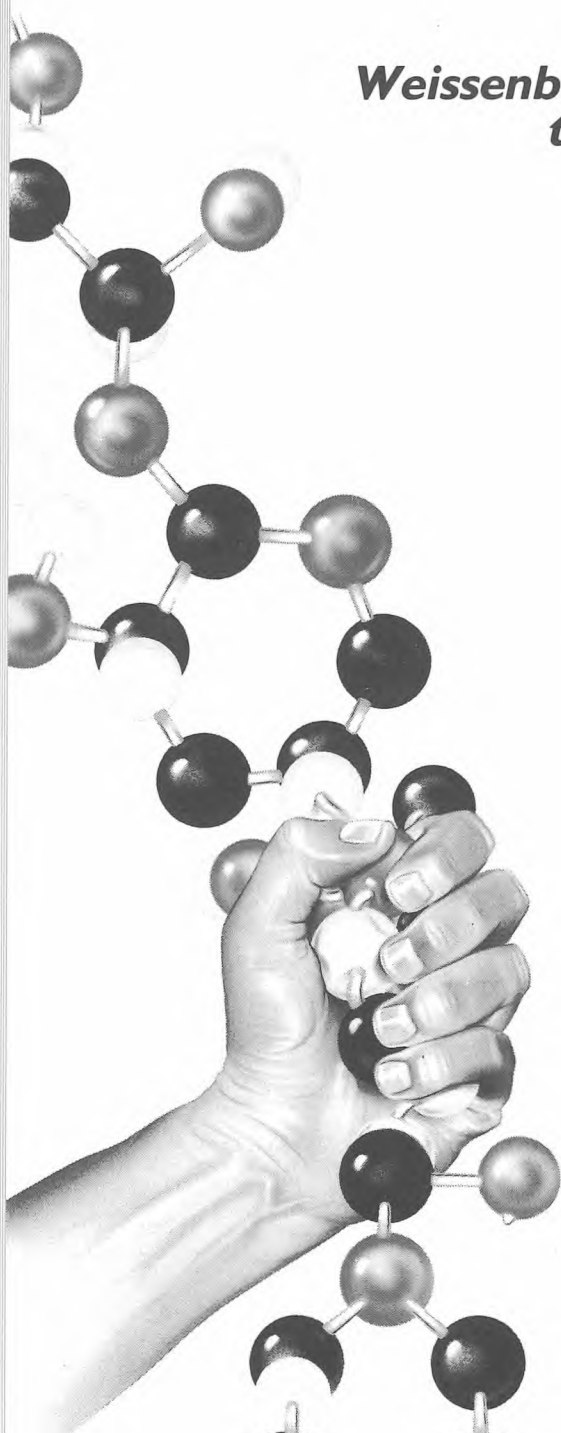
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about many aspects of instrument errors although much information exists in the literature. Moreover, it does not provide the level of precision and accuracy expected for the measurement or demonstrate traceability. For these reasons, it was decided that in establishing standards for rheological measurement, the first step should be to develop European standards for steady-shear Newtonian and non-Newtonian viscosity measurement by rotational viscometry.

Clearly, new traceable standards will need to be developed for all the main viscometric test geometries (co-axial cylinder, cone and plate, parallel plate, disc and tube.) As the co-axial cylinder is regarded as the test geometry giving the least number of errors and is available from most, if not all, viscometer manufacturers, it has been selected to be developed as the first of a series of European rheological measurement standards.

PROPOSAL OF WORK

The aim of the present proposal is to develop a European standard for steady-shear Newtonian and non-Newtonian viscosity measurement by co-axial cylinder viscometry that will extend the ISO 3219 further.

By assessment and codification of existing knowledge in the published literature together with research in areas where existing knowledge is inadequate, standard procedures will be developed. Results of this work will be published in a definitive handbook. It will cover

1. Standard test procedures for Newtonian and non-Newtonian viscosity measurement including criteria for steady state or equilibrium flow curve. Basic equations for calculation of shear stress, shear rate and viscosity;
2. Procedures for basic calibration, covering metrology for sensor shape and dimensions, torque measurement and rotational speed;
3. Sample temperature control requirements;
4. Instrumental effects due to setting up or alignment errors, end effect, wall effect including wall roughness, material of construction and wall slippage;
5. High shear rate limitations due to secondary flow and viscous heating effects;
6. Repeatability, reproducibility and accuracy;
7. Calibration using standard or reference Newtonian and non-Newtonian fluids (to be developed) and traceability to the international viscosity standard, water value at 20.00°C;
8. Standard specification of computer algorithms for measurement control and data treatment and 'hard core' structure of computer software.

This handbook will form the basis for accurate measurement of viscosity of Newtonian and non-Newtonian fluids by co-axial cylinder viscometry. Confidence in the procedure developed will be obtained by demonstrating traceability of the measured viscosity to the established water viscosity value.

Discussions will be held with national accreditation bodies for the standard to be incorporated in the criteria for implementation.

Companies will be encouraged to use the procedures described in the handbook to meet the requirements for quality assurance through registration with BSI under BS 5750/ISO 9000 and accreditation under NAMAS or similar other EC bodies

CALL FOR SUPPORT

The EC Directorate General for Science, Research and Development will soon be issuing a formal call for proposals for the EC Measurement and Testing Programme (MTP), the successor to the BCR programme. However, rheology is not specifically identified in the List of Priority Topics for Areas 1, 2 & 3 of the programme but MTP is asking for suggestions for new subjects for inclusion. If you feel, as we do, that this area of work should be included, please contact Neil Alderman on 0438-741122 ext. 2757.

REFERENCES

- ¹ Heywood, N. I., "The development of international rheological measurements standards", BSR Bulletin, 33 (3), 50-56, 1990.
- ² Prentice, J. H. and Huber, D., "Results of the collaborative study on measuring rheological properties of foodstuffs.", In: *Physical Properties of Foods*, R. Jowitt *et al* (eds), Applied Science, London, 1983.
- ³ Proc. Int. Conf. on Extensional Flow, Combloux, France, 20-23 March 1989. In *J. Non Newtonian Fluid Mech.*, 35 (2+3), July 1990.

RHEOLOGY A TO Z

PROPOSED HANDBOOK OF RHEOLOGICAL TOPICS AND CONCEPTS

As part of its services to members and for the promotion of rheology, BSR has set up a working party to investigate the preparation of a Handbook of Rheological Topics and Concepts so as to fill a niche between a glossary of terms and the journal review or the full academic tome; to give the reader an introduction and an appreciation of the subjects, and to supply key references for further study.

The readership would cover university students, laboratory technicians, industrial engineers, industrial and academic research scientists; from those with very little knowledge to those who are very expert in some areas but need help in the areas of rheology in which they are not knowledgeable. Many industrial people have no knowledge of rheology as a science, but they have come across rheological problems in practical experience, crude empirical tests and complex industrial processes. The Handbook is aimed at anybody who wishes to acquire an understanding of specific rheological subjects quickly and an entry into the literature.

The Handbook will consist of entries by topic/concept, in alphabetical order. Some will be one- or two- line definitions, but most will be articles of up to four pages. An initial list of topics/concepts is appended. There will be an index in the usual style.

As the working party has formulated these ideas, it would now like to seek the views of BSR members and world rheologists. You are invited to comment on the idea and objectives of the Handbook, and to suggest further topics and concepts for inclusion.

We shall also be seeking authors to contribute articles on topics and concepts. You are invited to offer yourself, or to make nominations of others whom we may approach. Instructions to Authors will be available that describe how the subjects should be approached and the articles written up. Referees will also be needed to read and comment on the draft articles.

We look forward to receiving your reactions. Please write or contact us by 15 September 1992, or as soon as possible thereafter, via Dr D. C.-H. Cheng (Chairman of the Working Party),
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Letchworth,
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United Kingdom; phone and fax no. (0462) 672146.

INITIAL LIST OF TOPICS AND CONCEPTS

This initial list has been prepared to prompt ideas. The Working Party welcomes your suggestions of further topics and concepts that should be included in the Handbook. The entries have been laid out here in some sort of order by subject to help in the compilation. In the Handbook, they will be ordered alphabetically.

The Working Party has also prepared supplementary papers that describe the scope of each topic/ concept and what should be included in each article. These will be made available to potential authors and referees.

FUNDAMENTALS

continuum mechanics, constitutive equations, flow and deformation, Navier-Stokes equation, non-dimensional numbers, rheology, stress, strain, tensors, vectors.

DESCRIPTION OF RHEOLOGICAL BEHAVIOUR AND DEFINITION OF MATERIAL FUNCTIONS

consistency, creep, elasticity, extensional viscosities, fatigue, fracture, friction, hardness, hession, normal stresses, particle mechanics, photorheology, plasticity, pressure dependence, psychorheology, relation between material functions, Cox-Merz rule, shear-history dependence, surface rheology, superfluidity, syneresis, time dependency, viscoelasticity, complex dynamic (oscillatory) properties, creep/recoil, stress relaxation, stress growth/decay, time-temperature superposition principle, soil mechanics, (shear) viscosity, temperature dependence, thixotropy, wall slip, yield stress.

MODELS

Doi-Edwards models, liquid crystal models, flow curve models, Bingham model, models, network models, spring-dashpot models, viscosity of suspensions — concentration equations.

MEASUREMENT METHODS

birefringence, dynamic property measurement, rheometers, viscometers, rotational viscometers, co-axial cylinder viscometer, other geometries, end/edge effect, secondary flow effect, viscous heating effect, extrusion rheometers, tube viscometer, slit rheometer, glass capillary tube, Redwood viscometers, efflux viscometers, flow cups, melt flow indexer, Marsh funnel, commercial viscometers, controlled stress instruments, normal stress measurement, extensional viscosity measurement,

oscillatory property, on-line measurement, photorheology, national and international standard methods, industry standards, slump tests, indexing methods, viscoelastic measurement.

MATERIALS BY CLASS

molecular solutions, colloidal suspensions, electroviscous effects, DLVO theory, Brownian motion, solids suspensions, concentration effect, particle shape effect, particle size effect, particle size distribution effect, shear rate effect, dense suspensions, electro-rheology, magneto-rheology, wet solids/damp powders, emulsions, gels, liquid crystals, polymer solutions, powders, micellar solutions, mixtures, suspensions.

MATERIALS

adhesives, agrochemicals, blood, body fluids, bitumens, ceramics, clays, composites, confectionery, drilling muds, elastomers, foodstuffs, fresh concrete, grouts, hardened concrete, inks, metals, oils, paints, pharmaceuticals, plastics, sealants, thermoplastics.

APPLICATIONS

lubrication, process control, quality control, hoppers, printing, sedimentation/creaming, engineering applications, particle migration, pipeline transport, mixing, roller coating, screw conveyors, screw extruders, polymer extrusion, polymer processing, plasticisers, flow improvers, extrusion cooking, workability.

THE RHEOLOGY OF INORGANIC BUILDING MATERIALS

This one day meeting was held at the headquarters of the Society of Chemical Industry, Belgrave Square, London on General Election day, April 9th, 1992. Introduced by the Chairman as the antidote to the election, the date had been fixed long before the election was called and the clash reminded one speaker of the International Symposium in Germany at which he delivered the opening paper. In that case the national holiday to celebrate the unification of the country, in 1990, had been called for the opening day of the symposium and our man therefore had the honour of delivering the first scientific paper in the new country.

The meeting was a joint venture between the Construction Materials group of the Society of Chemical Industry and the British Society of Rheology and attracted over 60 delegates of whom only about a third were members of either organisation. It was pleasing to see delegates from a wide range of industrial companies including cement and plaster producers, specialist chemical and polymer latex producers, product formulators and users.

After introductory talks on rheology, instruments and methods, by Phil Banfill and Dick Whorlow the day continued with a series of talks concentrating on particular types of materials. Phil Banfill referred to Scott Blair's famous "Bill" who was that imaginary character found in most industries with an ability to decide subjectively whether a material's rheology is right for the job and who needed no measurements to support his judgement. From the comments of various speakers it was evident that Bill is alive and well in the construction industry. However, he is not afraid to put in some more water to make it right, with unfortunate consequences for the hardened properties of his products.

Delegates heard talks on plaster (Richard Rouse), concrete (Geoff Tattersall), grout pumping (Mike Hutchinson), mortar (Phil Banfill), concrete repair materials (Ted Kempster) and tile adhesives (Cyril Potter). Recognising that the materials and products are applied when plastic and subsequently cure and harden, the organisers' stated intention was to show how rheology can help in their formulation to achieve the required behaviour in use. In the event this objective was achieved only in part and it became apparent that in much of the construction industry rheology is either not regarded at all or merely as an optional accessory. Nevertheless the talks by Tattersall, Banfill and Hutchinson showed that scientifically sound work can result in useful progress from rheological investigations, and it is always interesting to hear what happens in other branches of industry.

In conclusion the arrangements for the meeting were good and it was supported by four industrial exhibitors, two rheology instrument manufacturers and two specialist materials producers whose displays attracted a lot of interest during the extended break for an excellent buffet lunch.

Phil Banfill

NOTICE OF THE ANNUAL GENERAL MEETING

The 52nd Annual General Meeting of the British Society of Rheology will be held on Tuesday, September 15th 1992 at Sidney Sussex College, Cambridge starting at 5. 30 p.m..

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

- (a) The election of Officers and Council Members for 1992-93.
- (b) The receipt of a report and audited accounts from Council.
- (c) Dealing with matters raised by Council or by any Member, and receiving suggestions from Members for consideration by Council.

Arising from 's wish to stand down from Council there is a vacancy.

Nominations received to date are as follows:-

President:	Dr D. R. Oliver
Honorary Secretary:	Mrs C. A. Moules
Honorary Treasurer:	Mr P. C. Anderson
Membership Secretary:	Dr D. J. Hourston
Bulletin Editor:	Dr P. F. G. Banfill
Abstracts Editor:	Dr G. J. Brownsey

Ordinary Members of Council:	Mr R. E. Carter
	Dr A. Evans
	Dr N.E. Hudson
	Dr M. R. Mackley
	Prof. P. Townsend

There is one vacancy resulting from the retirement of Dr R. Buscall after four years service. He is not eligible for re-election.

Nominations for Council or for any of the Offices are invited. Nominations should be sent to the Secretary or may be made at the meeting (see rule 5(b)).

The Secretary would be pleased to receive notice of any matter that any Member wishes to raise.

C. A. Moules
Honorary Secretary

MINUTES OF THE 51ST ANNUAL GENERAL MEETING

HELD AT WILLS HALL, BRISTOL UNIVERSITY
ON TUESDAY 10TH SEPTEMBER 1991

The meeting started at 17. 10 with 31 members present.

Dr Cheng, President, displayed the gavel which had been presented to the BSR by Prof Ferguson, the immediate past President.

1. APOLOGIES FOR ABSENCE

Apologies had been received from Dr Buscall.

2. MINUTES OF THE 50TH AGM

Dr Hudson proposed that the Minutes, which had been published in Vol 34, No 2 of the Bulletin, be accepted. Dr Hourston seconded the proposal which was unanimously agreed. President duly signed.

3. MATTERS ARISING FROM THE MINUTES

There were no matters arising.

4. REPORTS OF THE OFFICERS

4. 1 PRESIDENT

The President read his report which is published in Vol 34, No 3 of the Bulletin. There were no questions.

4. 2 HONORARY TREASURER

Mr Anderson presented the financial report and accounts which are published in Vol 34, No 3 of the Bulletin. There had been an excess of expenditure over income of £2855 . Of this £2,200 was lost at the Golden Jubilee Meeting which had cost £100,000. The losses had been predicted at a higher figure due to invited guests and therefore the overall outcome was considered a success. Mr Anderson predicted a further drop of similar proportion for the next year. The overall position was sound however, and to help collect fees, the Society was now able to accept credit card payment.

Dr Carter proposed and Dr Banfill seconded acceptance of the accounts. This was agreed. Dr Hudson proposed and Dr Evans seconded the continued service of Alfred Simmons and Co as Auditors. The motion was carried unanimously.

Dr Heywood asked why the projected figures for next year showed 500 members paying £10 when the Society had nearer to 800 members. Mr Anderson said he would leave the Membership Secretary to answer.

4. 3 MEMBERSHIP SECRETARY

Dr Hourston said that the records which were on 7 disks of the Old Apple IIe had been entered into the Society's new Mac LC and used up 1

disk. He was now in the process of ascertaining who the active members were and had set himself a target of 6 months to provide a true record of the membership. During the year there had been a net increase of 37 members compared with 64 the previous year.

Dr Heywood asked how he would determine the membership number. Dr Hourston said that once the fees had started to come in he would send out letters to non-payment 'members'.

Dr Meeten suggested the society had a brochure describing its activities. Dr Hourston said that such a leaflet was in draft form and that membership forms would be printed from time to time in the Bulletin. Dr Cheng suggested each member tried to recruit one new member.

4. 4 BULLETIN EDITOR

Dr Banfill said that the typeface and style of the Bulletin had changed since he used a form of Desk Top Publishing. He had kept a similar format to the previous editor with some new features which included an article of general interest and a competition.

The history of the Society was also being featured. In the past year advertisers had dropped away but there had been an increase in various kinds of insertions. Dr Banfill asked the membership for feedback to help produce the Bulletin they enjoyed. Mr Schimaniski asked if the month could be put on the front page as he was never sure how Nos 1-4 related to time. Dr Banfill said No 1 meant assembled in the first quarter (March), No 2 (June), No 3 (September) and No 4 (December). He said he would try to accommodate the date somewhere on the front page but away from the Vol/No.

Dr Gillings said he had appreciated the Bulletin for over 40 years. He enjoyed the past history which may be the focus for others to continue searching the archives. He was in touch with the President over the possibility of putting on a display of early rheological instruments in a showcase at University College, London. He talked about a Nickel tube oscillating at 5000/s in 1936. Warren Spring Laboratory had parts of an R14 Weissenberg Rheogoniometer. Members with interesting exhibits are asked to contact the President.

Dr Meeten said he thoroughly enjoyed the Bulletin, which he read from cover to cover, in its present state. He pleaded for it not to be made bigger and better as this would make it become unreadable and would no longer fit in his pocket.

4. 5 ABSTRACT EDITOR

Dr Brownsey said that there was an increase in the number of journals being covered with about 1000 abstracts in total for 1990. He estimated this would amount to approximately 400 pages which he hoped was user friendly. He said he was indebted to Pergamon for their support and although they had now been taken over by Elsevier, Pergamon would continue to operate as before.

Dr Brownsey said that all four issues of Rheology Abstracts would be out by the end of the year. He said the burden rested with the abstractors and he was still needing more volunteers. Book reviews and abstracts of theses were covered and he asked members to send in their own papers directly to him. To date 155 journals were being covered by 14-15 abstractors. He reported that University subscriptions were dropping. Mr Whorlow congratulated Dr Brownsey on reaching 1000 abstracts. Dr Brownsey said Dr Evans had also reached this figure 10-15 years ago and that quality and not quantity was the criterion. Dr Evans also congratulated Dr Brownsey on running a subject index with each issue which was well received by all.

4. 6 HONORARY SECRETARY

Mrs Moules presented her report which is published in Vol 34, No 4 of the Bulletin.

5. ELECTION OF OFFICERS AND MEMBERS OF COUNCIL 1991-1992.

The list of nominations from the outgoing Council had been published in Vol 34, No 2 of the Bulletin.

Mr Carter, after initially stepping down from his position as a Member of Council, had been proposed by Prof Wetton and seconded by Dr Baker. He was still willing to stand. There were no further nominations and the names on the list as given by Council, including Mr Carter, were duly elected as follows:-

Honorary Secretary:

Honorary Treasurer:

Membership Secretary:

Abstracts Editor:

Bulletin Editor:

Ordinary Members:

Mrs C. A. Moules

Mr P. C. Anderson

Dr J. Hourston

Dr G. J. Brownsey

Dr P. F. G. Banfill

Dr R. Buscall

Mr R. E. Carter

Dr A. Evans

Dr N. E. Hudson

Dr M. R. Mackley

Prof. P. Townsend

6. ANY OTHER BUSINESS

Mr Whorlow asked to send congratulations to Prof. Walters on being made an FRS in Rheology. Dr Cheng read out the list of all promotions and awards which had been printed in the Bulletin Vol. 34, No. 1 and included Dr Buscall whose promotion would be acknowledged in the next Bulletin.

7. DATE OF NEXT MEETING

The Secretary said the next AGM would be held on Tuesday 15th September 1992 during the conference at a time to be given in the programme.

There being no further business the meeting closed at 1817 hours.

QUESTIONNAIRE ON THE SOCIETY'S ACTIVITIES

The questionnaire which was circulated with Bulletin 34 (4) started life as a review of *Rheology Abstracts*, to which questions on the Bulletin and the Society in general were added. This short note describes a preliminary scan of the replies.

Of 650 sent out we had 73 replies of whom 26 were overseas members. Of those replies 80% were in full time salaried employment, split almost equally between private industry and education/research. The main professional affiliations were the Royal Society of Chemistry, Institution of Chemical Engineers, Institute of Physics and the Plastics and Rubber Institute. With so many chemists it is not surprising that *Chemical Abstracts* is the most popular abstracting/indexing journal and 70% of respondents have access to it. 82% of respondents have access to inter library loan facilities to follow up references culled from *Rheology Abstracts* but interestingly 35% had no contact with their library in 1991.

Most people found that coverage of a wide range of materials and systems in *Rheology Abstracts* most valuable and the quarterly index least valuable. Over half said that the whole issue is of interest with 37% finding Solutions, Pastes and Suspensions of most interest. No doubt this reflects the concerns of respondents in industry. Replies included many interesting comments about *Rheology Abstracts* and the following is a selection. Very helpful; more critical abstracting needed; what about conference papers? wide coverage and sectionalised content is good; a larger number of journals should be covered including commercially orientated publications.

Most people scan the whole Bulletin but the Conference Diary was found most valuable, followed by reports of meetings, the technical article and the Commentary. People suggested a lot improvements to the Bulletin including more details on conferences, more technical articles of general interest, reviews of instruments and of specialist publications. One interesting suggestion is to have a rheological problem page: any offers from potential agony aunts or uncles?

Finally there were a lot of complimentary comments about the Society's activities. More smaller meetings (presumably one-day) on a wider range of specific topics (e.g. food, paint, printing ink, polymers) and more local activities would seem to be welcomed, but most people felt that membership is excellent value and the free publications useful. People were suprisingly ignorant about the financial support that the Society can offer. Evidently we need to promote this aspect.

In conclusion, this exercise has provided Council with the best bit of feedback for a long time and we are very grateful to all those who took the time to complete and return their questionnaires. Many Council meetings will be animated by discussions of results and I hope to be able to report again in future.

Geoff Brownsey

COMMENTARY ON 269TH COUNCIL MEETING

There always seems to be too much to do at the midsummer Council, and so it has become a tradition that this meeting at least should be held in reasonably agreeable surroundings. For many years these were provided by the Berrow Court Hotel in leafy Edgbaston, which alas is no more. This year we were greatly indebted to Nick Hudson who had arranged that we could confer in Ross Priory, the University of Strathclyde's magnificent mansion on the southern shore of Loch Lomond. Due to extended travelling times several councillors chose to stay over the previous night (Tuesday June 9th); the obligatory post-prandial stroll down to the water's edge was followed by a stimulating pool competition brought to a finale by a marathon frame in which the combined talents of President and Secretary eventually just defeated our gallant Treasurer.

Thus at just after nine on a beautiful Scottish morning ten of us assembled in one of the most agreeable meeting rooms we have ever used, with views to the north of small craft bobbing on the water, and rabbits grazing the fairways to the east. Only Dick, Geoff and Ralph had not been able to come. Carole's meticulous 8 pages of minutes from the Manchester meeting were subjected to the usual pernickety scrutiny, though only minimal amendments could be suggested. Matters arising would be covered by today's agenda, and so it was time to start the meat of the meeting.

The President, in the Chair for the penultimate time, started his business by giving the result of the 18 country ICR ballot over the venue for the 1996 Congress: Quebec City had been the clear winner. David then went on to consider if BSR was to bid for 2000, where might it be? Not everywhere has a hall for 600 — never mind, plenty of time to think about that in due course. We agreed that he would send a letter giving the Society's support to a bid to include rheological work as an additional subject area for the EC's Measurement and Testing Program.

Awards are always considered by a special sub-committee consisting of the current President and two former presidents (Jim Ferguson and Neil Cogswell this time) who make recommendations to the June meeting. Their suggested recipient for the Annual Award was wholeheartedly endorsed by Council — to find out who it is, be sure to go to Cambridge to hear the citation and applaud the presentation! It was agreed that the size of the accompanying cheque should be adjusted upwards, and that complimentary accommodation for winner and spouse at the September meeting should continue to be offered.

The Treasurer tabled accounts for the financial year so far: income seems to be staying comfortably ahead of expenditure due to contributions of almost £5,000 each from subscriptions, adverts in the Bulletin and our share of the profits from the Abstracts, together with nearly £3,000 in bank interest. Peter had survived an amicable visit by the dreaded VAT-inspector, who had found little to complain about; a minor transgression over Bulletin adverts has now been sorted out. Our long-standing bankers Lloyds had tried to impose charges on the membership subscriptions account of nearly a pound per entry (of which there are a great many) though this has now been waived.

The Secretary had one request from a student for help to go to the ESR; £200 was agreed in exchange for a piece for the Bulletin (the usual arrangement). Carole also obtained authority to arrange amended letterheads for use during the autumn after the AGM.

The Membership Secretary has been particularly busy lately—including writing individually to 264 'members' who, despite continuing to receive the journals, have made no payment for two years or more. Many of these have now paid up, though 23 have specifically resigned; the remainder go into limbo. This means that there are now 522 bona fide members, plus five new applications accepted today. This clarification means that Doug can go ahead with the long-awaited Membership List, which is to have just two sections (UK and overseas). A reprint of the current Constitution will be included — no time for amendments (which can only be ratified by an AGM) as it should be ready in time for Cambridge in September.

The 'free Bulletin' list (mostly exchanges with other national societies) was tabled — consideration to be deferred until after Brussels where many of the recipients are sure to congregate. The midsummer meeting is also designated for consideration of candidates for honorary membership; David will thus be issuing seven new invitations to join the 48 retired members who no longer need to pay a subscription.

Wearing his Bulletin Editor's hat, Phil reported that he had taken delivery of the customary 800 copies of issue 35/1 though due to Doug's pruning activities there were now lots left over. It was agreed that some of these should be flaunted at the ESR and in Brussels to show potential members what a superb magazine they were missing, and that the print run be cut to 600.

Phil then donned his Successful Conference Organiser's hat to report that 64 delegates had attended his 'Inorganic Building Materials' on April 9th, with four exhibitors, despite the counter-attraction of the polling booth. The meeting was felt to be scientifically useful, and should not make a loss so congratulations and thanks all round.

And so to forthcoming conferences, which have for so long been the principal non-publishing activity of the Society. Malcolm brought us up to date with the current position over this autumn's joint meeting with the French society on the Rheology of Gels and Microstructured Fluids in Sidney Sussex College, Cambridge: it looks very good with a full scientific programme on both days. The precise lecture venue will be decided when numbers are more certain; the customary A. G. M. and Conference Dinner (with award ceremony) will be on the Tuesday evening, September 15th. Application form in this Bulletin, and you can reserve your place now and pay later by using your credit card — so why not send off today?

Carole said that she had been underwhelmed by the response to her call for offers of papers on Experimental Measurements for UMIST next spring, so she would be making a few personal approaches, there being less than a year to go. This is an important area and the title is not restrictive so if you have something to offer why not get in touch? After all there are not many locations in the British Isles where you can go for a ride on a tram afterwards! There was also some discussion about a possible joint meeting also for Spring 1993 though nothing final has yet been decided. Arrangements for the autumn 1993 meeting are naturally much less advanced, though Malcolm carried away a deposit to secure accommodation in Robinson College.

It was noted that the North Midlands local area group seems to go from strength to strength — an excursion has now been arranged — and that similar activities should be actively encouraged in other areas. It should not be difficult — an enthusiastic organiser being the prime requirement, and out of pocket expenses are available centrally, so if you would like to start a group in your neck of the woods it is quite possible that Doug's smart new computer could provide a list of locals to help you off the ground.

And so to the various Working Groups. Those responsible for the Handbook of Rheological Topics and Concepts (which is now to have the snappy title 'Rheology A to Z') have prepared a paper for inclusion in this very issue of the Bulletin, so q.v. and please contribute if you can to this radical new venture for the Society. Attention was drawn to the notice inserted by the Transparency Working Group in Bulletin 35/1 which had only just been distributed so there was not much feedback yet. This is another pioneering activity which could be enormously successful with a little good-will all round.

Roy then tabled his minutes from the Scott Blair Collection Working Group which had gathered for the second time in Aberystwyth at the end of May. The collection is progressing well,

with various donations from members and a particularly handsome donation from our publishers Elsevier. The papers from another Club pioneer, Dr E. W. J. Mardles (an early Secretary, and for many years responsible for the mammoth subject indexes to the Abstracts) have now arrived. Arrangements for consultation are as follows: anyone can borrow through the Inter-Library Loans scheme, and anyone can walk into the Hugh Owen Library on the University College campus, go down the stairs and consult, on the premises, from the open shelves any of the books or journal bound volumes and soon a complete set of GWSB's reprints as well. It appears that some time in the future this room may be required for computing, in which case another venue will have to be found, and that there is a long-term possibility of the Society being charged shelf rent.

Under 'housekeeping' matters it was noted that Dick's four year term on Council is up in September, so at least one new nomination will be required for the A. G. M.. Young and enthusiastic members who would be prepared to give some of their time to helping to run the Society please note.

Finally Nick drew our attention to the Maxwell Trust which is setting up a museum in his memory in Edinburgh. No, not our illustrious recently deceased former publisher but the well-known scientist James Clerk Maxwell. A donation to give proper recognition to his contribution to rheology was agreed in principle, so Nick is to sort it out with one of the Trustees.

And so, by road and air, we were eventually able to set off for home; it had been a full meeting — no doubt Carole will need at least eight pages to do justice to the Minutes again — and lasted late into the afternoon. The B.S.R. is an active society, and things will stay that way so as long as there is an effective Council firmly in charge.

Tony Evans.

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RECENTLY PUBLISHED BOOKS

R. W. Whorlow, *Rheological Techniques* second edition, Ellis Horwood, 1992 450pp. ISBN 0-13-775370-5 £60.

This updated second edition covers the principles of all the important, and many of the less important, rheological test methods. All chapters have been revised and a large number of new references are included. A full new chapter has been included to cover the many recent developments in methods for elongational flow measurement. Throughout the book there are references to the impact of computer control on the versatility of instruments and to the importance of flow visualisation techniques in advancing the understanding of flow processes.

Contents: Deformation and Stress; Tube Viscometers; Rotational Viscometers; Transient Behaviour; Extensional Flow; Dynamic tests; Wave Propagation; Analysis of Viscoelasticity Measurements.

W. B. Russel, D. A. Saville and W. R. Schowalter, *Colloidal Dispersions*, Cambridge Monographs in Mechanics and Applied Mathematics, Cambridge University Press, 1992 544pp. ISBN 0-521-42600-6 £24. 95 (Paperback).

This book covers the physical side of colloidal science from the individual forces acting between particles smaller than a micrometre that are suspended in a liquid, through the resulting equilibrium and dynamic properties. A variety of internal forces both attractive and repulsive act in conjunction with Brownian motion and the balance between them decides the phase behaviour. On top of this various extensional fields, such as gravity or electromagnetic fields, diffusion and non-Newtonian rheology produce complex effects, each of which is of important scientific and technological interest.

MEMBERSHIP NEWS

The following applications for membership were approved at the Council Meeting, June 10th, 1992.

Miss S. M. Chandler,
Alcan Chemicals Ltd.,
Chalfont Park,
Gerrards Cross, Bucks,
SL9 0QB.
(feta IK)

Mr B. U. Komanschek,
Manchester Materials,
Sciences Centre,
Grosvenor Street,
Manchester M1 7HS.
(fesa BCDHO))

Dr P. Matricardi,
Dipartimento di Chimica
Universita lasapienza-ple,
Aldo Moro, 5-00185, Roma,
Italy.
(peisa DO)

Dr J. R. Melrose,
Department of Chemistry,
University of Surrey,
Guildford,
GU2 5XH.
(fts FGLN)

Dr G. Robinson
Milpark Drilling fluids,
Souterhead road,
Altens Industrial Estate,
Aberdeen, AB1 4LF.

Dr D. M. Stalker
Royal Ordnance,
Ammunition Division,
Bishopton,
Renfrewshire, PA7 5NJ.
(pea O)

Mr Fen Dong Zhao,
Department of Chemical Engineering,
University of Cambridge,
Cambridge,
CB2 3RA.
(fetsa BD)

The following have resigned: G. R. Sothern, F. J. Hiorns, D. J. Hopewell, I. R. Cameron, M. Swerdlow, A. L. L. Challis, J. E. Daborn, R. H. Thomas, J. M. Brierly, P. H. Wolfenden, K. L. Johnson, L. J. H. Pummell, J. A. Hasnip, R. H. Sellin, R. W. Lambe, P. E. Halstead, K. Lederer, R. G. Larson, A. J. Cooke, J. C. Taylor, S. C. Steadman, V. R. Withers, S. R. G. Flew.

Carole Moules has founded Camtel Sciences as an exclusive agency for Krüss UK. Her new company will carry out all sales and marketing of Krüss products as well as providing technical support and offering consultancy, test development, sample testing and training. It will be able to call upon the expertise of David Cheng, who has recently retired from Warren Spring Laboratory.

CONFERENCE ANNOUNCEMENTS

RHEOLOGY OF GELS AND MICRO-STRUCTURED FLUIDS, AND GENERAL RHEOLOGY

THE ANNUAL CONFERENCE OF THE BRITISH SOCIETY OF RHEOLOGY
JOINT WITH GROUPE FRANÇAIS DE RHEOLOGIE
at Sidney Sussex College, University of Cambridge,
September 15-16th 1992

PROVISIONAL SCIENTIFIC PROGRAMME

TUESDAY SEPTEMBER 15TH

- 9. 00 The dynamics of solutions of highly stretched
 macromolecules in contraction flows. Implications for the
 elongational viscosity.
 U. Cartalos & J. M. Piau, Institut de Mecanique de Grenoble
- 9. 30 Dynamic magnetic birefringence as a diagnostic tool in
 viscoelastic media.
 J-C. Bacri & R. Perzynski, Universite Pierre et Marie Curie.
- 10. 00 Effect of whey proteins and technological treatments of
 milk and curd on the viscosity of fresh cheeses.
 M. Mahaut & J. Korolczuk, INRA.
- 10. 30 Coffee
- 11. 00 Effects of high pressure homogenization on the rheology
 of crushed tomatoes.
 A. Trifiro & S. Gherardi.
- 11. 30 Study of the gelation process in bovine and caprine milk
 systems fermented using "ropy" and "non-ropy" starter
 cultures.
 I. Vlahopoulou & A. E. Bell, University of Reading.
- 12.00 Deformation, melting and relaxation of structured
 colloidal dispersions.
 A. Bradbury, J. W. Goodwin & R. W. Hughes, University
 of Bristol
- 12. 30 Lunch
- 2. 00 Rheology of granular suspensions.
 S. N. Davies & G. H. Meeten, Schlumberger Cambridge
 Research.
- 2. 30 Rheology of polymer gelation.
 R. H. Colby, M. Rubenstein, J. R. Gilmor & C. P. Lusignan,
 Eastman Kodak Co..
- 3. 00 Sheared suspensions and depletion flocculation.
 D. M. Heyes & J. R. Melrose, University of Surrey.

- 3. 30 Tea
- 4. 00 Effect of shear on a lyotropic lamellar phase.
O. Diat & D. Roux, Centre de Recherche Paul-Pascal.
- 4. 30 Modelling the thixotropy of CMC and aluminium
silicate solutions under constant stress.
T. Benezech & J. F. Maingonnat, INRA-LGIA
- 5. 00 Optical observations of flowing molten polymers.
P. Gao, M. R. Mackley & F. Zhao, University of Cambridge
- 5. 30 52nd Annual General Meeting

WEDNESDAY SEPTEMBER 16TH

- 9. 00 Dynamic characterisation of the yield behaviour of a
silicone paste.
J. Varlet & A. Pouchelon, Rhone-Poulenc.
- 9. 30 Rheology of an assembly of gel beads.
F. Lequeux & D. Grosshans, Institut le Bel.
- 10. 00 Rheological behaviour of worm-like micelles.
S. J. Candau, A. Khatory & F. Kern, Universite Louis Pasteur.
- 10. 30 Coffee
- 11. 00 Small deformation measurements of biopolymer gels.
S. B. Ross-Murphy, Kings College London.
- 11. 30 Casein micelles in skim milk as adhesive hard spheres.
C. G. de Kruif, NIZO
- 12. 00 Rheology of polysaccharide "weak gels": comparison of
small and large deformation oscillatory measurements.
R. Lapasin, S. Prigl, R. K. Richardson & E. R. Morris,
University of Trieste/Cranfield I. T..
- 12. 30 Lunch
- 2. 00 Rheology and die swell of xanthan solutions.
C. Allain, M. Cloitre, P. Perrot & D. Quemada,
University of Orsay.
- 2. 30 Dynamic viscoelastic characterisation of sol-gel transition of
a gelatin system. Effect of concentration and gel history on
critical conditions.
C. Michon, G. Cuvelier & B. Launay, ENSIA.
- 3. 00 A study of the setting properties of gelatin using the PL-
Strathclyde rheometer.
R. E. Carter & F. S. Baker, Polymer Laboratories.
- 3. 30 The viscosity of weakly structured dispersions:
anomalous rheometric behavior due to wall slip.
R. Buscall & J. I. McGowan, ICI.
- 4. 00 Close

BRITISH SOCIETY OF RHEOLOGY/GROUPE FRANÇAIS DE RHÉOLOGIE
 Rheology of Gels and Microstructured Fluids
 Sidney Sussex College, Cambridge, September 15th-16th, 1992.

Please register me for the above meeting (BLOCK CAPITALS)

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Affiliation:

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COLLOIDS IN EXTERNAL FIELDS

ROYAL SOCIETY OF CHEMISTRY FARADAY DIVISION
COLLOID AND INTERFACE SCIENCE GROUP
at Sidney Sussex College, University of Cambridge
September 17-18th, 1992

THURSDAY SEPTEMBER 17TH

12. 30 Lunch
14. 00 Electrodynamic 'band' and 'chain' formations in colloidal suspensions.
B. R. Jennings
14. 40 Sedimentation, fractal aggregation and compaction
J. Hinch and M. Couch
15. 20 Tea
15. 40 Simulation studies of model electro-rheology
J. R. Melrose
16. 20 Acoustically induced birefringence in rigid particle suspensions
M. Honeywood
17. 00 Electroacoustic dewatering
R. Wakeman

FRIDAY SEPTEMBER 18TH

- 09.00 Field and flow effects in the dynamics of rod-like micelles
M. Cates
09. 40 Rheological behaviour of worm-like micelles: salt effects
J. Candau, A. Khatory, F. Kern, F. Lequeux
10. 20 Coffee
10. 40 Small angle neutron scattering from rod-like micelles aligned by shear flow
J. Penfold
11. 20 Idealised steady-states for the rheology of colloidal systems
L. Woodcock
12. 00 Structural transitions in surfactant solutions under shear
H. Hoffman
12. 40 Lunch
14. 00 Comparisons of structural changes under shear in different latex dispersions-SANS studies
A. Rennie
14. 40 Static and dynamic properties of phases of surfactants in solution
C. Coulon
15. 20 Structure and interactions of inorganic colloidal dispersions in shear fields
J. Ramsey, P. Lindner

ROYAL SOCIETY OF CHEMISTRY — FARADAY DIVISION COLLOID AND INTERFACE GROUP
COLLOIDS IN EXTERNAL FIELDS

Sidney Sussex College, Cambridge, September 17-18th, 1992

Please complete one form for each person

NAME: Female/Male

AFFILIATION:

ADDRESS for correspondence if different from above:

.....
.....

Please indicate which of the following are required;

CONFERENCE FEES

Speaker	£0
CISG Member	£20
Students, Supervisor/Tutor's signature required	£20
Non-Members	£30

ACCOMMODATION/MEALS

Accommodation (evening 17th, lunch 17th & 18th, tea, coffee and Conference Dinner 17th)	£65
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FOR THOSE NOT STAYING OVERNIGHT IN COLLEGE

lunch, tea and coffee (Thurs 17th)	£11
lunch, tea and coffee (Fri 18th)	£11
Conference Dinner (Thurs 17th)	£25

TOTAL

Cheques (crossed "A/C payee") should be made payable to Colloid and Interface Science Group. Participants from overseas should make arrangements for payment in £sterling or by International Money Order. Payment may also be made by Credit Card. Prices include VAT, but as the Group is a Charitable Trust, it does not have a VAT Registered number. Please return the form with remittance by Tuesday 2nd September 1992 to: Dr I. D. Robb, Unilever Research, Port Sunlight Laboratory, Quarry Road East, Bebington, Wirral, Merseyside L63 3JW.

PAYMENT BY CREDIT CARD: I wish to pay by my Access/Mastercard/Visa/Eurocard* Credit Card.
*delete those which are not applicable

Card Type Number Expiry Date.

Name on Card

Address

.....

Please charge £_____ to the above card

Signature Date

EXPERIMENTAL RHEOMETRICAL MEASUREMENTS

A meeting to be held at the Manchester Conference Centre, UMIST,
Manchester, on March 31st-April 2nd 1993

It is still not too late to offer papers for this meeting which is intended to place an emphasis on practical testing of industrial and biological materials. Speakers will be allocated a 30 minute slot, including discussion. The proceedings will not be published but the abstracts will be included with the programme. Titles and abstracts (about 250 words) should be sent to Carole Moules, Camtel Sciences, 27 Alexandra Road, Stotfold, Hitchin, Herts., SG5 4NA, as soon as possible.

The meeting aims to bring together product formulation chemists, quality control personnel, and production engineers, on the one hand, and research scientists, students and manufacturers of instruments, on the other. There will be an open session during the meeting for people to identify their application problems with feedback from an invited group of experts as well as the audience. A presentation of the preliminary findings of a study set up by the BSR to look at the transparency of rheometer operation and software analysis will be made.

COATING TECHNOLOGY SYMPOSIUM

A symposium on Coating Technology will be held at the University of Bradford, Department of Chemical Engineering September 8-9th, 1992. The Programme will include papers on rheology, mixing and preparation of coating suspensions and various types of coating operations. For further information contact: Dr H. Benkreira, Department of Chemical Engineering, University of Bradford, Bradford, BD7 1DP, Tel.: 0274-383721 Fax: 0274 727859.

PRACTICAL APPLICATIONS OF RHEOLOGICAL MEASUREMENTS

A one day seminar concentrating on measurement techniques for commercial instruments combined with relating rheological data to product development, quality and control will be held in the Gardens Gallery, Plinston Hall, Letchworth, Herts on Wednesday November 25th, 1992. The speakers to date are Dr D. C.-H. Cheng, Mrs Carole Moules and Ms Lindsay Ray. Emphasis will be on applications and the programme includes rheological design for stability/solids suspension, use of particle size distribution to control viscosity and a suggestion to use zeta-potential and electrical conductivity measurement to relate to and modify slurry viscosity. For further details contact: Carole Moules, Camtel Sciences, 27 Alexandra Road, Stotfold, Hitchin, Herts., SG5 4NA Tel.:0763-244280 Fax: 0763-244298.

THEORETICAL RHEOLOGY

A JOINT MEETING OF THE BRITISH AND DUTCH RHEOLOGY SOCIETIES
 at Robinson College, University of Cambridge
 September 22nd-24th 1993

A three day meeting on theoretical rheology will be held at Robinson College. It is proposed to cover topics on: Dilute and concentrated fluid behaviour, Pastes; Particles and Powders, Numerical Simulation

Robinson College is Cambridge's most recent College and participants will enjoy excellent conference and residential facilities. The College lecture theatre seats 240 people and it is hoped that the meeting will attract a wide and International participation.

Offers of theoretical papers and experimental work relating to theory should be sent to the address below, enclosing an abstract of the paper for consideration by the organising committee. If you would like to be put on the mailing list please indicate below. Dr. M.R. Mackley Department of Chemical Engineering, University of Cambridge, Pembroke Street, Cambridge, CB2 3RA.

I enclose an abstract for the Theoretical Rheology Meeting

☐

Please put me on the mailing list for the Theoretical Rheology Meeting

☐

(BLOCK CAPITALS)

NAME

ADDRESS

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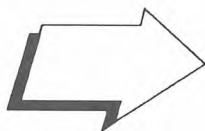
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CONFERENCE DIARY

DATE	PLACE	DETAILS
17-22/8/92	Brussels Belgium	9th International Congress on Rheology, contact: Dr P. Moldenaers, Chemical Engineering Department, Katholieke University Leuven, W. de Croylaan 46, B-3001 Leuven, Belgium.
22-28/8/92	Haiifa, Israel.	'18th International Congress of Theoretical and Applied Mechanics', I. U. T. A. M., contact: Prof. A. Solan, Secretary ICTAM 1992, Faculty of Mechanical Engineering, Technion — Israel Institute of Technology, Haiifa 32000, Israel.
30/8-4/9/92	San Diego, California U. S. A..	'NETWORKS 92-11th meeting of the Polymer Networks Group', contact: NETWORKS 92, c/o BIOSYM Technologies Inc., 10065 Barnes Canyon Road, San Diego, California 92121-2777, U. S. A..
31/8-11/9/92	Glasgow, U. K.	European School of Rheology, contact: Prof. J. Ferguson, Dept. of Pure & Applied Chemistry, University of Strathclyde, Cathedral St., Glasgow G1 1XL.
1-5/9/92	Moscow, Russia.	"Current problem of rheology, biorheology and biomechanics", contact: V. Kulichikhin.
8-9/9/92	Bradford, U. K..	Coating Technology Symposium, contact: Dr H. Benkreira, Dept. of Chemical Engineering, University of Bradford, Bradford BD7 1DP.
7-11/9/92	Brussels, Belgium.	'1st European Computational Fluid Dynamics Conference and 1st European Conference on Numerical Methods in Engineering', contact: Conference Secretariat, E. C. C. O., Rue Vilain XIII 17a, B-1050 Brussels, Belgium.
15-16/9/92	Sidney Sussex College, Cambridge, U. K..	'Gels, microstructured fluids and general rheology', contact: Dr R. Buscall, ICI Corporate Colloid Science Group, P. O. Box 11, The Heath, Runcorn, Cheshire WA7 4QE.
17-18/9/92	Sidney Sussex College, Cambridge, U. K..	'Colloids in external fields', contact: The Royal Society of Chemistry, Burlington House, Piccadilly, London W1V 0BN.
28/9-3/10/92	Dnepropetrovsk, Ukraine	"Annual Meeting", Society of Rheology of the U. S. S. R., contact: V. Kulichikhin.

27/9-2/10/92	Baden-Baden, Germany.	EPF92: 4th International Symposium on Polymeric Materials, contact: Dr U. Biethan, FEA4, Hüls AG, P. O. Box 1320, D-4370 Marl 1.
10 or 11/92	Osaka, Japan	'40th Rheology Congress' Society of Rheology, Japan, contact: Prof. Kunihiro Osaki, Institute for Chemical Research, Kyoto University, Uji, Kyoto 611, Japan.
2-4/11/92	Stockholm Sweden.	'Fluid Rheology', contact: Skandinavisk Teknikförmedling International Ab, Box 205, S-16126, Bromma, Sweden.
7-11/2/93	Santa Barbara, California, U. S. A..	'64th Annual Meeting', Society of Rheology, contact: Dr A. M. Kraynik, Division 1511, Sandia National Laboratories, Albuquerque, New Mexico 87185, U. S. A..
31/3-2/4/93	Manchester. U. K.	'Experimental rheometrical measurements', contact: Mrs C. A. Moules, Kruss UK Ltd., 5/6 Carrington House, 37 Upper King St., Royston, Herts. SG8 9AZ
15-17/9/93	Reading U. K.	'Physical aspects of polymer science', contact: Prof. D. C. Bassett, J. J. Thomson Physical Laboratory, University of Reading, P. O. Box 220, Reading RG6 2AF.
22-24/9/93	Cambridge, U. K.	'Theoretical Rheology' contact: Dr M. R. Mackley, Dept. of Chemical Engineering, University of Cambridge, Pembroke St., Cambridge CB2 3RA.
17-21/10/93	Boston, Mass., U. S. A.	'65th Annual Meeting', Society of Rheology, contact: Dr A. M. Kraynik, Division 1511, Sandia National Laboratories, Albuquerque, New Mexico 87185, U. S. A..
4-7/1/94	Tobago West Indies	"International Symposium on Viscoelastic Fluids", contact: Dr H. Ramkissoon, University of the West Indies, Dept. of Mathematics, St. Augustine, Republic of Trinidad and Tobago.
1994	Spain.	'4th European Conference on Rheology', contact: Prof. C. Gallegos, Departamento de Ingeniería Química, Universidad de Sevilla, Prof. García González, s/n (Edificio de Química), 41012 Sevilla, Spain.
1995	Caracas, Venezuela.	'3rd Caribbean Conference on Fluid Dynamics', contact: Dr H. Ramkissoon, University of the West Indies, Dept. of Mathematics, St. Augustine, Republic of Trinidad and Tobago.



Rheological Test Equipment

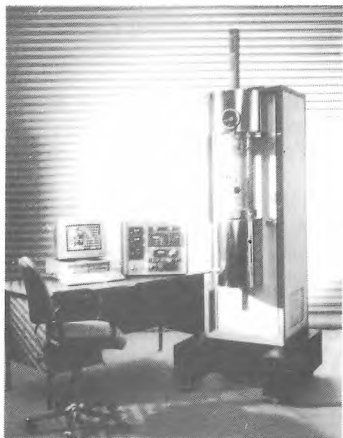
PL CURE RHEOMETER

A versatile and robust instrument for measuring the cure and dynamic flow properties of a wide range of materials such as bitumen, concrete and cements, resins, powder paints, foodstuffs, explosives and pharmaceuticals.



ACER SERIES

Advanced Capillary Extrusion Rheometer Series



A range of robust instruments for measuring the flow properties of many materials such as polymer melts, foodstuffs, energetic materials, filled systems, rubbers and the new high-temperature polymers.

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A device for measuring the viscoelastic flow properties of various materials during extrusion. May be fitted to many capillary extrusion rheometers for research and quality control, and to extruders as on-line rheological monitors.

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A non-contacting on-line instrument for measuring the temperature of extrudates etc. Used for estimating shear heating effects during processing.

NEW

PL MICRO-CAPILLARY EXTRUSION RHEOMETER

A novel and unique instrument for determining the flow and elastic behaviour of spinning melts and dopes. May be used also for printing inks, oils and other low viscosity materials.

Other instruments within the ACER range include 'Thrust' for measuring the pressure coefficient of viscosity; and the ESM extrudate swell monitor for on-line non-contacting measurement of diameter.

FOR FURTHER INFORMATION, CONTACT:

**Polymer Laboratories Ltd., Thermal Sciences Division,
The Technology Centre, Epinal Way, Loughborough, LE11 0QE. U.K.
Tel: (0509) 233300 Fax: (0509) 234905**

