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CONTENTS

Officers and Members of Council	ii
Editorial	iii
Role of Rheology in Understanding the Behaviour of Oils Spilt at Sea: P. Madhvi	108
Mechanics of Non-Newtonian Fluids 1991	117
The British Society of Rheology 1975-1990	118
Awards 1992	121
Secretary's Report	122
Commentary: 267th Council Meeting	124
Recently Published Books	127
Membership News	130
Pierre Gilles de Gennes	131
Competition No 6	131
North Midlands Group	132
Conference Announcements	133

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THE BRITISH SOCIETY OF RHEOLOGY
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 1991/92

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EDITORIAL

It is always pleasing to be able to include items which result from the Society's efforts at encouraging young research workers. The report on the short course held at Udine is written by research students whose travel expenses were partly met by a grant from the Society. The next issue will have an article done by a Pergamon Biorheology Scholar. The Scholarship is administered by the Society and is described elsewhere in this issue.

This issue also includes the last part of the history of the Society, bringing the story up to date. Covering the years 1975-1990, it is written by John Benbow who was active on the Council, including a term as Secretary, during that period. The Society is continuing to evolve, as shown by the discussions in Council, and we look forward to the future.

The Secretary's Report was held over from the last issue because of pressure of space and is included here.

Finally, if all goes according to plan, this issue should be accompanied by a questionnaire on *Rheology Abstracts*. Members will be aware that subscription sales of this publication make a sizeable contribution to the Society's finances, but in the modern world it is hard to recruit abstractors and other ways of information retrieval are increasingly competitive. I urge you most strongly to complete and return the questionnaire so that, informed by members views, Council can formulate future policy.

Copy date for next issue: March 15th



ROLE OF RHEOLOGY IN UNDERSTANDING THE BEHAVIOUR OF OILS SPILT AT SEA*

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INTRODUCTION

Oil may enter the sea in a variety of ways including natural seepage, accidental spills from pipelines, tanker leakages and oil-well blowouts. When oil is spilt and conditions are favourable, it disperses naturally at sea.

In most spill incidents, oil concentrations are high and there may be very little natural dispersion. The properties of the oil and the typical environmental conditions are such that the oil often forms highly stable water-in-oil (hereafter referred to as w/o) emulsions. Figure 1 shows a typical w/o emulsion. Its appearance is similar to dessert mousse; and because of the dark colour they are colloquially known as "chocolate mousse". These emulsions may come inshore and affect sensitive locations such as amenity beaches, salt marshes, nature reserves and harbours.



Fig. 1 Typical water-in-crude oil emulsion

The presence of oil as a slick or as w/o emulsion generates strong public reaction and is therefore unacceptable to environmental regulatory bodies.

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The incidence of accidental spills and the amount of oil spilt into the sea is increasing not only in the UK but also around the world. Some of the well known spills are shown in Table 1; many of these accidents have occurred close to the shore. Stable emulsions were formed and inshore locations were affected.

TABLE 1: SOME MARINE OIL SPILLS

YEAR	INCIDENT	QUANTITY SPILT, METRIC TONS
1967	Torrey Canyon, UK	100,000
1978	Amoco Cadiz, France	230,000
1979	Ixtoc I, Mexico	375,000
1983	Castillo de Belver, S Africa	250,000
1989	Exxon Valdez, Alaska	32,500
1989	Kharg V	70,000
1990	Rosebay, UK	1,100
1991	Gulf War	300,000

Now compare the viscosity of the w/o emulsion with that of the parent crude oil. For example consider a typical North Sea crude oil. Viscosity of the oil at 5°C at a shear rate of 10s^{-1} is 18 mPa s; the viscosity of the w/o emulsion of this oil, water content of 70%, under identical conditions is of the order of 14,000 to 18,000 mPas, ie there is a thousand-fold increase in viscosity.

The volume increase due to the incorporation of the water means that the amount of pollutant that must be recovered is more than doubled. The highly viscous emulsion also impedes the efficient operation of most mechanical recovery equipment. It also results in a cohesive slick that resists dispersion, both natural and chemical.

OIL SPILLS AT SEA

Many responding authorities are attempting to make advance assessments of the impact of oil spill incidents using computer models. Information is required on:

- a) the change of oil properties with time — whether the oil will form an emulsion and when the emulsion will form;
- b) the spreading, movement and natural dispersion of the oil slick - whether the shoreline will be impacted;

The former allows countermeasures at sea to be undertaken whilst the latter requires the treatment of pollutant on land. The predictions must be sufficiently accurate for effective response decisions to be made. A continuing project at Warren Spring Laboratory is addressing this area.

This information can be used through modelling to decide what is the best response strategy to adopt following a spill, eg leave the oil slick to disperse naturally, spray with dispersants, plan for clean-up of beaches, etc. In order to make these predictions, one needs to understand what happens when oil is spilt at sea.

Although the individual processes may act simultaneously, their relative importance during the life-time of a slick will vary. Rheology plays only a significant role in some of these processes. Table 2 shows our understanding of each of these processes.

TABLE 2: OIL SPILL PROCESSES

PROCESS	STATE OF UNDERSTANDING OF PHENOMENON	RHEOLOGY PLAYS IMPORTANT ROLE	ABILITY TO WRITE DESCRIPTIVE EQUATIONS FOR MODELLING
Spreading	fair	✓	fair
Drifting	good		good
Evaporation	good	(affects rheology)	good
Dissolution	good		fair
Dispersion	poor	✓	very poor
w/o emulsion formation	poor	✓	very poor
Photolysis	fair		very poor
Submergence	fair		poor
Biodegradation	good		poor
Shoreline interactions	good	✓	fair
Ice interactions	fair		poor

One particularly important process is the formation of w/o emulsion. This starts soon after the oil is spilt and continues after the bulk of the volatile fractions have evaporated.

The aim of this paper is to:

- identify the role of rheology in the emulsification process;
- identify the lack of quantitative information on w/o emulsion formation and stability;
- stimulate research in this area.

W/O EMULSION FORMATION

Firstly, consider the basics of emulsion formation. Mechanical energy is required to generate increasing interface between the two liquids as the droplet size is reduced, ie

$$W = \gamma A$$

where W = the work required to increase the surface area by amount A , and γ = the interfacial tension between the liquids.

Low interfacial tension therefore favours emulsion formation. This means that for the same energy input a larger surface area is generated. In turn, the interfacial tension is reduced by emulsifying agents which assists the process.

Next, consider the formation of w/o emulsions at sea. The mechanical energy is provided by wind and wave action. The emulsifying agents are naturally occurring surface-active agents in the crude oil. (These are thought to be mainly fine particles of asphaltenes and resins as well as waxes which are dissolved in the oil.)

There are three possible mechanisms through which w/o emulsions may form. Firstly, oil droplets of up to 10 mm are sheared from the underside of the oil slick by waves (Mackay *et al*, 1980). They rise through the water column and coalesce with the oil slick, trapping small quantities of water between the oil layers. This water forms droplets which may or may not sink through and coalesce with the water column beneath. Small water droplets sink slowly and may thus, in essence, become trapped in the oil slick. The concentration of these water droplets increases until it may reach 75 to 80% by volume.

Secondly, oil droplets are sheared from the topside of the slick and from its edges by breaking waves. Again, the mechanism described above is thought to apply.

Thirdly, water droplets are incorporated into the oil slick by the folding and kneading of the oil slick. It is obvious that here both shear and elongational forces play a role in the formation of the emulsion.

RHEOLOGY AND OIL SPILLS

When a spill occurs, a number of questions arise. These are:

a) will the crude oil form an emulsion? If it does, how long does the emulsion take to form? What is the sea-state? How stable is the emulsion? Is it a weak emulsion such that a rough sea-state will break the emulsion or is it a highly stable emulsion which is not only persistent but also resists chemical dispersion?

b) can one predict emulsion stability by measuring emulsion rheology?

c) how does emulsion rheology vary as a function of time?

In order to answer these questions, we need a systematic study of rheological properties of emulsions, droplet size of water, interfacial tension between water and oil, and emulsion stability.

There is some quantitative information published in the literature. Stability is measured both qualitatively and quantitatively in a variety of ways (Aronson, (1991), Johansen *et al* (1988/89), Bobra (1991), Aveyard *et al* (1990)). Published rheological data have so far been restricted to viscosity values at single shear rates.

It is widely accepted in the field that emulsion rheology could be used to predict emulsion stability. Despite this belief, there is only one reference that we have collected to date, which attempts to obtain a correlation between rheology and stability of emulsions.

Johansen *et al* (1988/89) investigated the properties of laboratory-made emulsions of crude oil. The oils were obtained from the Norwegian Continental Shelf. The water content varied from 50 to 80% by volume. Emulsion viscosity was measured at a single shear rate of 100 s^{-1} at 40°C . A Richardson-type equation was used to relate the emulsion viscosity to the water content.

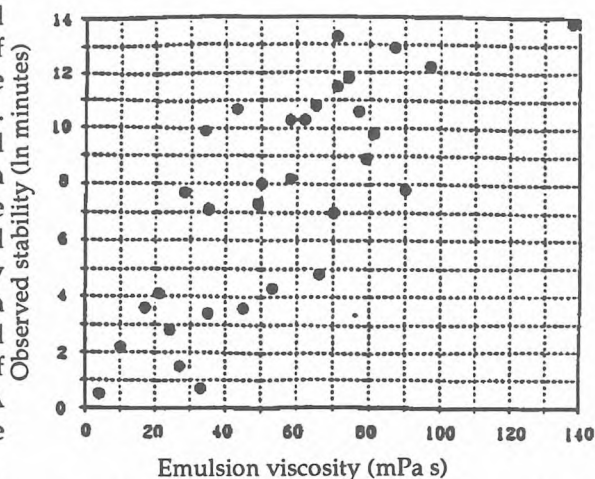


Fig. 2 Single-parameter correlation between emulsion stability and viscosity (Johansen *et al.* 1988/89)

Emulsion stability was measured at normal gravity and under ultra-centrifugation; the time (t) required for 20% of the water to separate from the emulsion was measured. A stability number was calculated using $\ln(g t)$ where g was the normalised gravity.

A single-parameter correlation was obtained between emulsion stability and emulsion viscosity with a correlation coefficient of $R^2 = 0.59$ and is shown in Figure 2. A less significant correlation was obtained between emulsion stability and the o/w interfacial tension (the correlation coefficient being $R^2 = 0.19$). Other parameters gave even small R^2 values.

Johansen *et al* also obtained a multi-parameter correlation which predicted the emulsion stability,

$$S = e^{-9.61} W^{2.91} \eta_o^{-3.63} \eta^{5.06} \quad (1)$$

where S = predicted stability (exp (stability number))
 W = wax content (% w/w)
 η_o = crude oil viscosity (mPas)
 η = emulsion viscosity (mPas)

This correlation had a co-efficient of $R^2 = 0.71$

Despite the amount of scatter in these correlations, it is reasonable to conclude that emulsion stability can be predicted from emulsion viscosity. From an economic view, it would be cheaper to use the single-parameter correlation than the multi-parameter correlation, but less accurate.

The study has a number of shortcomings which are, in turn, reflected in the large scatter seen in the correlations; this will be commented on further in the paper.

WORK AT WARREN SPRING LABORATORY

In order to obtain answers to many of the questions posed earlier, we are carrying out a systematic study of emulsions. The aim is to characterise the rheological properties, interfacial tension, droplet size and stability of the w/o emulsions, with water contents of 50 to 80% by volume. The aim is to predict emulsion stability, and in the long term emulsion viscosity, from one or more easily-measured properties of the crude oil.

THEORY

One mechanism of separation of w/o emulsions is the slow sedimentation of the water droplets. According to Stokes, the sedimentation rate of a spherical particle at infinite dilution, assuming that the tension of the interfacial layer makes the droplet rigid, is given by:

$$V_s = \frac{d^2}{18} \frac{(\rho_w - \rho_o) g}{\eta_o} \quad (2)$$

where d = diameter of water droplet
 g = acceleration due to gravity
 V_s = Stokes velocity, and
 ρ_o, ρ_w = density of oil and water respectively

As the particle concentration is increased, the sedimentation velocity of one particle is affected by the presence of other particles, interacting hydrodynamically and leading to hindered settling. Cheng (1989) has developed an equation with the hindered settling function:

$$\frac{V}{V_s} = \left(1 - \frac{\phi}{\phi_{\max}} \right)^{6.55 \phi_{\max}} \quad (3)$$

where V = settling velocity and
 $\phi, \phi_{\max}$ = volume fraction and maximum packing volume fraction respectively

Therefore, eq (3) would allow the initial rate of settling to be calculated from a knowledge of $d, \rho_w, \rho_o, \eta_o, \phi$ and $\phi_{\max}$.

The emulsion viscosity at low shear rates is given by Sherman (1968) as:

$$\log \left[\frac{\eta}{\bar{\eta}_0} \right] = \frac{\alpha_v}{d_m \left[\left(\frac{\phi_{\max}}{fs \phi} \right)^{1/3} - 1 \right]} \quad (4)$$

with

$$fs = e^{\left(\frac{0.28}{\eta^{0.15}} \right)} \quad (5)$$

where d_m is the mean droplet diameter and α_v is a constant.

Equation (4) will allow the viscosity-droplet size relationship to be calculated.

Another mechanism governing stability is droplet coalescence. By assuming that the rate of coalescence (C) is governed wholly by the probability of rupture of the thin film of oil between the droplets, Sherman gives:

$$d_t = d_0 e^{\left(\frac{C_t}{3} \right)} \quad (6)$$

where d_t and d_0 are the values of d_m at zero time and after time t respectively.

Other equations for sedimentation velocity, emulsion viscosity and droplet coalescence rate are available in the literature. Such equations form the background of our understanding. Measurement of droplet size allows the sedimentation velocity and hence the stability of an emulsion to be predicted. Equating d and d_m between equations (2) and (4), shows that V can be calculated from η . This is the basis for correlation between stability and emulsion viscosity. Substituting d_t in equation (4) shows how emulsion viscosity varies with time, and then in equations (2) and (3) to show how stability can change with time. The Warren Spring Laboratory work will attempt to verify the validity of these equations.

PRELIMINARY EXPERIMENTAL FINDINGS ON RHEOLOGICAL PROPERTIES

Our work has started with the rheology of the emulsions. Viscometric measurements were made on the Haake CV20N using a parallel plate geometry with a gap separation of 1.5 mm. This geometry was chosen because it minimised the amount of sample disturbance during loading and setting-up of the instrument.

The test technique involved obtaining torque-time traces on test-samples at single values of shear rate. This approach was chosen because the initial breakdown rates could be used for correlation with stability.

Measurements were made at 5°C; this reflects the typical North Sea temperature during winter months.

Figures 3 and 4 show torque-time traces obtained at 1 and 10 s^{-1} on a typical North Sea crude oil emulsion, 70% by volume; in the former, four samples were investigated whilst three were investigated in the latter.

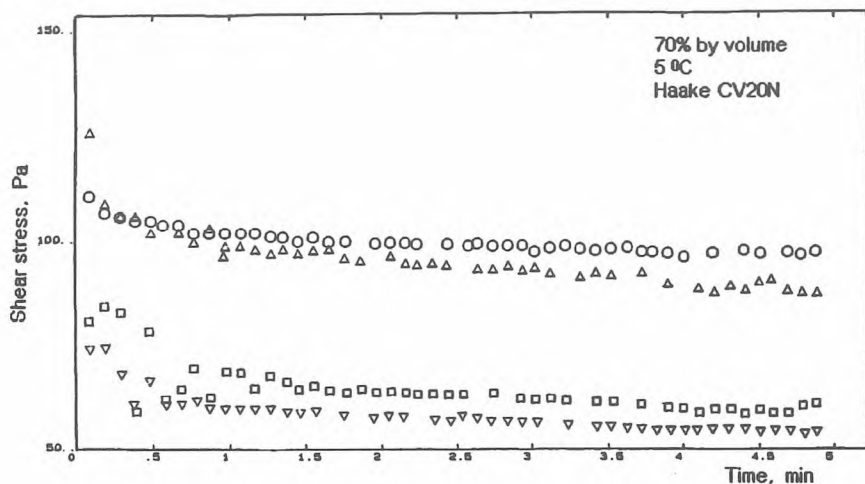


Fig. 3 Torque-time trace at 1 s^{-1} Emulsion of a typical North Sea crude oil.

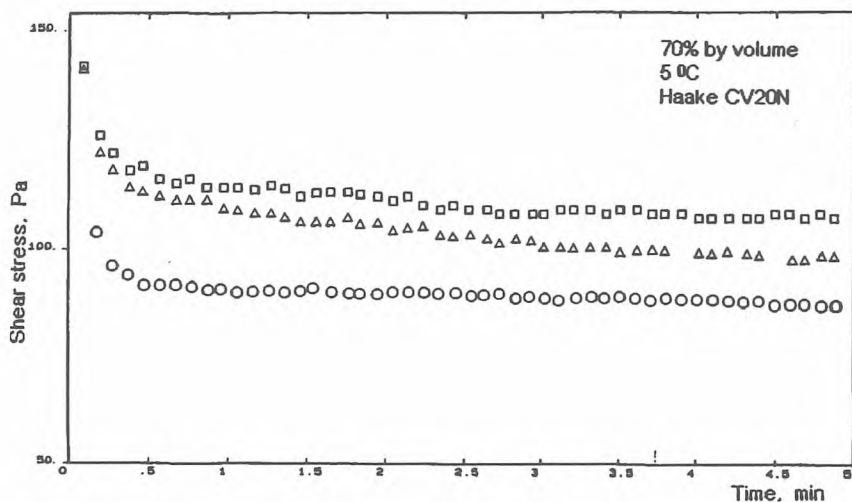


Fig. 4 Torque-time trace at 10 s^{-1} Emulsion of a typical North Sea crude oil

The results show that the emulsion is:

- a) highly heterogeneous. Different samples do not give the same torque-time traces. A band of viscosity values is obtained at each combination of shear rate and time rather than a unique viscosity;
- b) time-dependent. A high initial shear stress is obtained on start-up. This falls to a much lower value as the time of shear is increased;
- c) shear rate-dependent. For a 10-fold increase in shear rate, the shear stress is increased by only about 2-fold.

CONCLUSIONS

The results obtained so far are not new to rheologists. However, they are novel to people working in the field of oil pollution.

A lot of further work needs to be done before one can correlate emulsion stability with emulsion viscosity. These preliminary results show that one is dealing with highly heterogeneous, time- and shear-dependent material. The measurement techniques need to be standardised. These material properties explain in part the large scatter seen in the correlations obtained by Johansen et al in Figure 2.

A number of facts needs to be established before correlations can be obtained. Which viscosity value should be used to predict stability? At what time? What shear rate? Should one measure other rheological properties such as transient viscoelasticity?

In further work, we will be measuring the droplet sizes and sedimentation rates of emulsions in order to compare experimental results with theoretical equations predicting sedimentation and coalescence rates.

Other parameters that have not been mentioned but which are important in understanding the behaviour of oils spilt at sea are the chemical nature of the crude oils and dispersant and demulsifiers. It can be seen that the scope of the research is very wide and there is much that rheologists can contribute. I hope that this paper stimulates this interest.

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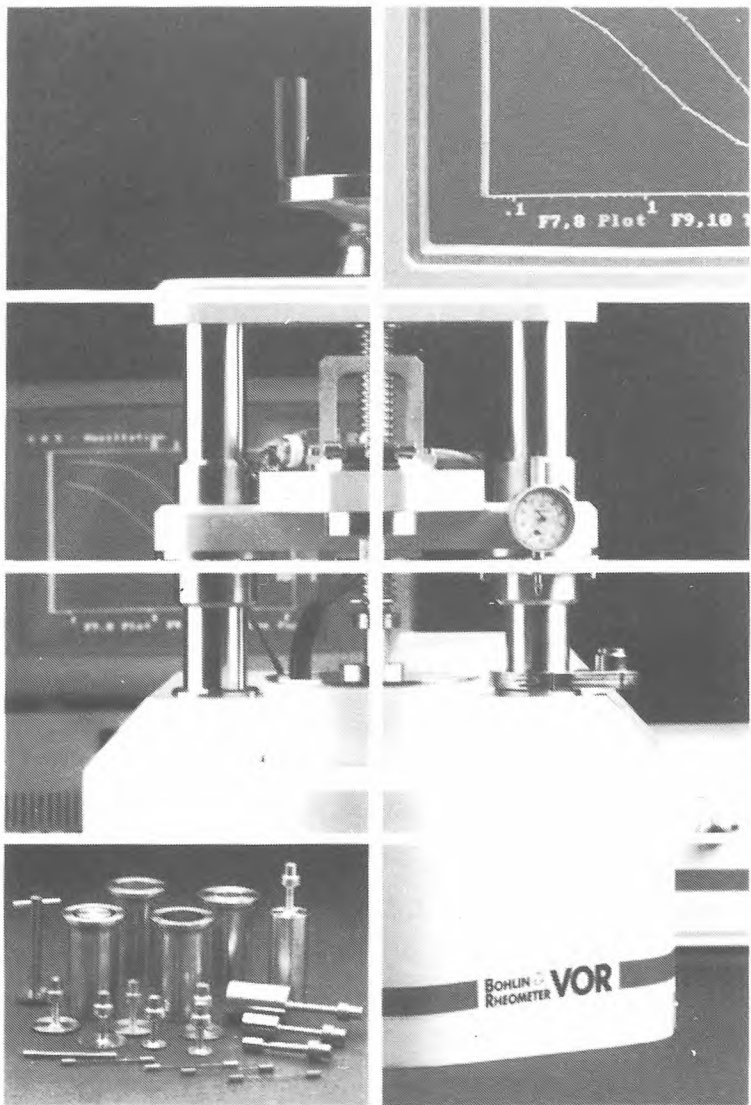
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MECHANICS OF NON-NEWTONIAN FLUIDS, 1991

The five-day annual course was held at the 'Centre International des Sciences Mécaniques' (CISM) in Udine, Italy, from 16th-20th September, 1991. It attracted 48 participants from 16 different countries including Australia, Japan, the U. S. A. and eastern/western European countries. The course was co-ordinated by Professor K. Walters of U. C. W., Aberystwyth.

The programme consisted of 30 one-hour informal lectures given by:
 Professor K. Walters (U. C. W., Aberystwyth, U. K.)
 Professor H. Giesekus (University of Dortmund, Germany)
 Dr R. Jongschoop (University of Twente, The Netherlands)
 Dr P. Henriksen (University of Lyngby, Denmark)
 Professor G. Marrucci (University of Naples, Italy)
 Professor D. V. Boger (University of Melbourne, Australia)

The delegates came from widely differing backgrounds e. g. mechanical engineering, mathematics, atomic physics, etc. and hence the lectures were kept as simple as possible. Copies of the Proceedings were given to every delegate in the form of lecture notes.

In his lectures, Professor Walters discussed the origin of rheology and the behaviour of viscoelastic liquids in various types of flow situations. Professor Giesekus provided the 'framework' for the subject by introducing tensor theory. Subsequently he discussed kinematical, dynamical and thermodynamical concepts.

Dr Jongschoop gave a detailed account of constitutive equations, while Dr Henriksen discussed isothermal/non-isothermal flow problems. Professor Marrucci discussed the progress in rheology on the molecular level. The importance of the chemistry of viscoelastic liquids was also stressed by Professor Boger.

Ample time was given for coffee/lunch breaks during which participants were encouraged to ask questions of the lecturers.

Thanks are due to the organizers for their efforts and to the lecturers for a very clear presentation of the work. Many new friends were made during the course and the enthusiasm shown during the lectures justifies the need for further meetings of this kind.

We would also like to express our sincere gratitude to the British Society of Rheology for their financial support.

R. W. Roberts and A. L. Milton, U. C. W., Aberystwyth

The Society also made a travel grant to enable J. Goshawk, University of Liverpool, to attend the same meeting. He writes: "The course not only opened my eyes to different aspects of rheology, but also enabled me to meet eminent professors in the field, and I would like to thank B. S. R. for supplementing my travel expenses."

THE BRITISH SOCIETY OF RHEOLOGY.1975-1990

Previous articles by Norman Wookey and by Ralph Oliver have described earlier periods in the history of the Society. This survey covers from 1975 to the Golden Jubilee Conference and Third Meeting of European Rheologists held in September 1990.

During this time some of the founder and early members died. The three best known were Scott Blair, Treloar and Oldroyd whose tragically early death at the age of 60 came as a great shock to all who knew him. Each of these was honoured at the time by appropriate memorial lectures. Scott Blair will be permanently remembered by the setting up of the Scott Blair Collection of rheological literature at Aberystwyth. This is available for all Society members to use.

In 1978 Council carried out a survey of members views by circulating a questionnaire asking what form they thought the Society's activities would take in 15 years time. It is now interesting to look back at these forecasts and to compare them with the changes which have actually taken place. From the 88 replies received, representing 15% of the membership, the following points were made.

(a) 59% expected interest to increase in multiphase liquids, 40% expected a rise in work on polymers. In addition to these two subjects, six areas of minority interest were listed and members were asked to select one or more as likely growth areas. The percent supporting each topic were: Biological systems 62%, Foodstuffs 32%, Particulate solids 30%, Building and road materials 15%, Theoretical Materials 13%, and Oils and Greases 8%. At least four other major areas have expanded since this review was made. These are, Composites and in particular fibre filled polymers, Computers for controlling rheometers and analysing their results, Molecular Dynamics, and Numerical Methods to study flow. On the other hand, a distinct drop seems to have occurred in the amount of work done on pure polymers.

(b) The measuring techniques which were expected to increase included Stretching flow 56%, Surface rheology 42%, Oscillatory shear 42%, Bulk properties 27%, Complex geometry methods 25%, Normal stress 19%, Flow birefringence 19%, Capillary flow 15% and finally Steady shear (rotational methods) 8%. There was also strong support for the "... expectation that improved versions of present rheometers will be in use." The number of oscillatory shear measurements have increased considerably in recent years and this is due, in part, to the ability of computers to rapidly analyse the results. (The days when we had to measure the amplitude of each damped oscillation, plot the results on a logarithmic scale, and then measure the slope to find the "log. dec." are, happily, gone.)

(c) Some of the comments on "Approaches to rheology" are particularly interesting. 41 replies considered it likely that we would be discussing the same phenomena and theories at a more sophisticated level with a polarisation between the empiricists and theoreticians. Commenting on replies the reporters (Neil Cogswell and Chris Petrie) noted that several of those who saw this trend as likely "deleted the qualification concerning increasing polarisation between the empiricist and theoretician". An increase in polarisation was seen as a sign of failure by the Society. Is it now timely to consider what is the present situation? (*Comments welcome- Editor*)

Two of the other topics covered in the note showed that members did not want the Society to be absorbed by a larger group and there seemed to be a clear instruction to Council to leave well alone. This view, I think, still applies and looking back it appears that most of the predictions made 15 years ago have come true.

A major change occurred when our Australian friends formed their own Society in 1983. Fortunately this step appears to have increased rather than diminished the amount of interchange between the two groups. We now take it for granted that there will be antipodean visitors at most of our conferences.

Exchange of ideas on a global scale continues to flourish at the International Conferences and European meetings every two years. I have many happy memories of these. The journey from Sorrento to Naples each morning on a chartered ferry was surely a uniquely pleasant way for rheologists to travel to work; I would gladly go back

My most pleasant memories of Prague in 1984 are of enjoying a performance of *The Bartered Bride* in the theatre in which it was originally performed. (A colleague and I shared a splendid box and were, no doubt accurately likened by Ken Walters to the two old men in the Muppet show.)

The Society's Conferences in this country are keenly anticipated as opportunities to meet friends and to progress our subject. Rheology we are reliably told "is a difficult subject"¹ and most of us learn it as an extra subject. From the Society's point of view this is an advantage because it means that scientists having a broad range of disciplines come together to exchange information. The notices of meetings held in this country during the past fifteen years give a good indication of how wide reaching this knowledge is. Conferences have been held on a variety of subjects including Polymer and Rubber Processing, Extensional Flow, Colloids, Molecular Approaches to Rheology, Crude Oil Production, *Conundra Rheologica*, Food Rheology, Rheology in the Laboratory, and Rheology of Fresh Cement and Concrete.

Another useful way of tapping the supply of knowledge is from the range of interests, and the telephone numbers listed in the members' handbook. It is possible to rapidly obtain advice on most rheological subjects by using this.

My memories of Council meetings include outdoor meetings in the gardens of a Birmingham hotel with the papers being periodically retrieved from the bushes. Pre-meeting drinks in the suitably decorated bar of a railway hotel in York occasionally delayed the start of Council work. At other venues our stamina for the afternoon sessions was fortified by the excellent lunches provided by industrial colleagues.

In spite of its modest membership fees, our Society's finances have, thanks to Bulletin sales and conference incomes, remained very sound during this period. This enabled the introduction of an Annual Award in 1977. The purpose of the Award is to recognise the contributions of senior members to rheology and to the Society and also to give encouragement to promising young rheologists. Another noteworthy activity in recent years has been the increased support given to students in the form of grants to attend conferences.

Although the word "club" has long since been dropped from our title this atmosphere still flourishes. Visual evidence of a club-like Society is found in the recently introduced ties. A corner-stone of the Society since it was founded has been its total reliance on the unpaid work of the Council and other willing helpers. In this respect I can do no better than quote from Norman Wookey's article "The welfare of small societies depends very largely on the energy and ability of the officers, and the Society was fortunate in its early years in having officers who combined the keenest interest in rheological matters with unusual ability in committee work and administration." I am sure this is still true today. A welcome aspect of this reliance on "amateur" labour which is, perhaps, not always realised is that it results in absolutely no bureaucracy.

The climax to this period was the 50th Anniversary meeting in Edinburgh last year. Everyone I spoke to agreed that it combined excellent organisation, good papers, a comprehensive display of instruments, an International attendance and a most convivial atmosphere. I have commented in an earlier Bulletin in some detail on this meeting. The outstanding memories I have are of a speech at the banquet by Dr V. G. W. Harrison, a still very sprightly founder member, the new gold Presidential chain of office presented to the Society by David Cheng and the large number of visitors from Eastern Europe who added an extra air of celebration to the occasion.

To sum up the recent history of the Society: it has catalysed many important developments and introduced constructive changes but happily the original ethos persists. "Plus ça change, plus c'est la même chose."

John Benbow

¹ Barnes, H. A., Hutton, J. F. and Walters, K. *An Introduction to Rheology*, Elsevier, 1989.

AWARDS 1992

ANNUAL AWARD

Council makes an Annual Award for furtherance of the Science of Rheology. This award is designed to reflect either contributions made over a prolonged period or it can be used in appreciation of a particular contribution to the field including a single published paper. Council is always pleased to receive nominations for such an award particularly from the peers or supervisors of younger members of the Society whose contributions are judged to be of especial merit or promise. Nominations should be sent to the President.

SCOTT BLAIR SCHOLARSHIP AND SCOTT BLAIR BIORHEOLOGY SCHOLARSHIP

In memory of the work and example of Dr G. W. Scott Blair, the Society and Pergamon Press make available a series of scholarships to encourage excellence in research. The Scott Blair Scholarship of the Society is for research in any field of rheology while the Scott Blair Biorheology Scholarship funded by Pergamon Press, but administered by the Society, is for research in biorheology. The aim is to enable the scholars to undertake activities which would not normally be possible without such a grant, such as a period of work at an overseas University. Both scholarships are available for award in 1992.

PhD students, or equivalent, who are completing their first year of research, and are members of the British Society of Rheology, may apply to become a Scott Blair Scholar. PhD students, or equivalent, who are completing their first year of research in the field of biorheology, and are members of the British Society of Rheology, may apply to become a Scott Blair Biorheology Scholar.

The scholarships will have a value of £500 per annum (or such value as shall from time to time be decided by Council) to be used at the absolute discretion of the scholar. Subject to a satisfactory report from their supervisors, the scholarships will be renewable for a maximum of one more year. Thus they will usually be available during the second and third years of a normal PhD project.

In addition to the annual payment, Council will consider applications for additional funding to attend conferences. The scholars will be expected to present the results of their research at meetings of the Society, and to make occasional contributions to the Bulletin.

The Awardees of the Biorheology Scholarships will be expected to present the results of their research at meetings of the British Society of Rheology, and will be encouraged to publish them in the Journal "Biorheology" in accordance with its editorial policy.

The award of the Scholarships will be decided by Council who cannot enter into correspondence with unsuccessful applicants, and who reserve the right not to award a scholarship in any particular year.

Applications for the Scholarships should be sent to the Secretary of the British Society for Rheology as soon as possible. The application should be on no more than two sides of A4 paper and contain: personal details of the applicant, a description of the research, notes on any special uses envisaged for a proportion of the scholarship, and an endorsement from a person with supervisory responsibility for the research.

TRAVEL GRANTS FOR STUDENTS

The Society makes grants to students engaged in research in rheology to attend and present their work at meetings on rheology, both its own and those of other societies. Members of the Society, who are full-time students, may apply in writing to the Secretary to be considered for an award and that application should be supported by the student's supervisor. The application should give details of the proposed expenditure, the title and date of meeting and the title of the paper to be presented. They should be submitted in time for consideration at a Council meeting before the money is needed, i.e by the beginning of March, June, September or December.

The amount and number of such awards will be at the discretion of Council.

SECRETARY'S REPORT 1990 — 91

I was elected amidst the euphoria surrounding our Golden Jubilee Conference in Edinburgh and, perhaps to be expected, this year has lacked the excitement building up to such a memorable event.

However, for me this has been a year to renew old working practices as I recall the years I spent in Warren Spring under the guidance of David Cheng who now heads the Council as our President.

The Golden Jubilee meeting had many memorable moments, not least the presentation of two Gold Medals to Sir Sam Edwards and Professor H. Giesekus and the Annual Award to Dr David Heyes. It was a tremendous success and all the organisers and participants should be congratulated on making it a special event in our history.

Unfortunately the following meeting on Extensional Flow in Industry planned for March did not materialise. However this acted as a spur to rally the Council to get back on an even keel and starting with the Engineering and General Rheology AGM meeting of September 1991

further conferences are already arranged for Building Materials (April 1992), Gels and General Rheology (Sept 1992), Experimental Rheometric Measurements (April 1993) and Theoretical and General Rheology (Sept 1993).

A major change has taken place in the collection of conference fees and membership subscriptions: we have gone plastic. I am sure our Treasurer will have more to say about this.

The membership list has given some concern but with the aid of an updated PC there should be a new version in print before long. I hope this will encourage more localised meetings as suggested by Dr Tattersall.

Two studies have been set up this year to look at a) a Handbook of Rheological Terms and b) Transparency in rheometer operation and computer software. Reports are not expected until next March.

Three students have been sponsored by the BSR to attend a course on Mechanics of non-Newtonian fluids in Udine this September.

I would like to urge you to support the European School of Rheology which is being co-ordinated by Professor Ferguson and held in Strathclyde August 31st to September 11th 1992.

I would like to mention my personal thanks to Dr Jones at Aberystwyth for overseeing the Scott Blair Collection and to our European Secretary, Dr Petrie for keeping me so well informed: I promise to send you the minutes of Council from now on.

It is disappointing to note that no nominations have been received for either the Scott Blair Scholarship or the Scott Blair Biorheology Award this year. I look forward to receiving nominations for deserving candidates in the near future.

I would like to add my congratulations to Dr Paula Moldenaers for her work on Intermittent Shear Flow in liquid crystalline polymers which has been recognised through the Annual Award for 1991.

I would like to thank our friends from other Societies who gave us gifts to mark the Golden Jubilee meeting; a beautiful piece of glass from the Scandinavian Society, the bound lecture notes of Professor Boltzmann from the Austrian Society, an illuminated address from the Bulgarian society and a seal tool depicting the Society's logo which I received during the year from the Czechoslovakian Society. These gifts will be on display during the AGM Conferences.

Finally as a reminder of our 50th Anniversary, I have some hallmarked, "gold on silver" stick pins at £10 each and Jubilee ties (gold logo on navy) at £6.50 as well as a stock of 'everyday' Society ties (red logo on grey or navy) at £5.50.

In conclusion, I look forward to another interesting year working on your behalf.

Carole Moules

COMMENTARY ON 267TH COUNCIL MEETING

It seems to have become a tradition that the December Council Meeting is held in or close to London. Thus, all of your Council Members dutifully headed for the Scandic Crown Hotel near Victoria Station, where, on the door of Board room D on the 9th Floor, a sign announced that the "British Society of Rheo/o" was meeting. Despite the combined efforts of British Rail and the IRA (who had planted a bomb near Clapham Junction the previous day), all of the Members except one arrived on time. After refreshments of coffee and Danish pastries, admiring (?) the view of Victoria Station from the balcony, and complimenting the efficiency of the hotel in providing such business essentials as a hole punch and stapler, the Council settled down to business, whizzed through Apologies for Absence, then got down to the Minutes of the Last Meeting in parallel with Matters Arising.

Should we commission a glossy brochure to drum up more members with a marketing campaign, or should we rely on the present word of mouth method? Should we make a bid to host an International Congress? Tony Evans and Roy Carter would, with Dr Mervyn Jones at Aberystwyth, form a sub-committee to administer the Scott Blair collection and expenditure of the interest from Mrs Scott Blair's legacy, and to consider the position of Society Archivist.

12.10 and the President has signed the previous minutes! On to the President's Report. The deadline for bids to host the 1996 International Congress was January 15th— only a month away. Should we bid for this one, or the next one? A decision for 1996 would be announced in August 1992. A flyer had been received from the US Society — could we circulate these with the Bulletin? Breaths were held as a critical experiment was performed. Whew! It does fit into the BSR envelope. Tell them to send 800 copies! Mutual collaboration with our US cousins was heartily welcomed, and would continue. The Sheffield Local Group were holding their second meeting the next day, on "Rheology of Metal Slurries". Seems to be going well — how about more local groups? The Institute of Chemical Engineers had suggested a joint meeting in Spring 1993 on Rheology of Particulate Systems. The President will get details of venue and costs, Dick Buscall to handle other items.

Peter Anderson gave his account as Treasurer. Some advertisers still had not paid. Some Members had over-paid their fees by not cancelling their old Standing Orders. Were we winning on VAT or was Vatman robbin'! No — we were ahead. Grants for student travel had been sent and spent.

Carole Moules reported on a low-cost publisher, had registered us with the Foundation of Science and Technology, and told us that Prof J Harris had retired.

Doug Hourston said that 17 applications for membership and one resignation had been received. The Society had renewed its registration until February 1995 under the Data Protection Act at a cost of £75. He hadn't been able to give the old Apple IIe computer away to a good cause — he had had to sell it! A lot of members were still only paying £5 instead of £10, and about half of the membership was in arrears. Updating of the membership records was well under way, and the new list of members should appear in mid-1992. The Council commended Doug on his hard work.

Lunch-time at last, Scandinavian style. What was Gravad Lax, who or what was Jansson's Temptation? Christmas Ham and Christmas Cheese were the only reminders of the Festive Season.

Back to work, and it's the Bulletin Editor's turn. Phil Banfill was concerned about advertisers not paying on time. Should he stop advertisements for the worst offenders? 'Course he should. Should the back page and other prestigious places be booked for ever, cost more, or should editorial discretion reign? It's reigning! "Sherlock Holmes" had been detected. Complaints that the competition was too hard. Next competition is to design the next competition. Still no bids for Scott Blair Scholarships — action needed to attract some candidates.

Geoff Brownsey, the Abstracts Editor, reported that volume 34 (2) was out, and that (3) and (4) would be a single issue which should be mailed before Christmas. There was some lateness because the sub-contract printers had liquidated. There were 1019 abstracts in 1991, and the format for 1992 would be unchanged, except that abstracts for theses would be added. There was growing competition in the market place. Should we ask members how much they value the Abstracts? The Journal needed a cash injection to develop.

"Rheology of Gels" was set for 15-17 September 1992 in Cambridge, reported Malcolm Mackley. A Mystery Speaker would appear at the conference dinner. "Theoretical Rheology" would also be held in Cambridge, in September 1993. Sponsors and speakers required. Who would be on the organising committee? — a press gang is appointed!

"Engineering Rheology" at Bristol was successful and made a profit, thanks to the organisers, Nick and Roy. "Rheology of Building Materials" was scheduled in London for April 9th, 1992. Rheometric Measurements would be at UMIST on March 31st to April 2nd 1993.

It's five to four, and there's a long way to go; shall we postpone some discussion to the next meeting, or have an extra meeting to catch up? Dates of next three Council meetings decided — Carole will fix the venues.

The Working Party on the "Handbook of Rheological Terms" reported by 16. 30 the discussion is getting heated. Should we go ahead or not? Is there a demand? Do we have the authors? What cost? Publish ourselves or use an outside publisher. 16. 45, and at last a proposal, seconder and a vote to progress. Ralph Oliver, President-Designate had sent a proxy vote.

What was progress with the "Transparency of Software" Working Group? Howard Barnes was chairing the group, and hoped to submit a paper at the next Council meeting.

European School of Rheology at Strathclyde University — would the Council underwrite the conference? Is it strictly a BSR affair? What are the other participating Societies contributing? Much heated debate.

17. 15 only six members left, others getting itchy feet, and still some way to go. And the coffee's gone cold! Into Any Other Business. Scott Blair's old laboratories at Shinfield were closing — are there any historical artefacts which could be saved? Roy would investigate.

17. 30 — that's it! No — hold on. We haven't elected a Chairman in case the President can't get to a meeting. OK — it's Tony! Let's get to the rush hour to relax.

Roy Carter

RECENTLY PUBLISHED BOOKS

Slurry Handling :Design of Solid-Liquid Systems, Brown, N. P., & Heywood, N. I., Editors, Elsevier Science Publishers, 1991. 668pp., ISBN 1-85166-645-1 £110. 00.

Topics covered are: Slurry properties, Analysis and prediction of flow behaviour, Experimental techniques and pilot plant studies, Pumps and feeding systems, Mechanical design of pipelines, Instrumentation and control, Preparation ,storage and recovery and Long-distance slurry transport.

Emulsion polymer technology, Athey, R. D. Jr., New York: Marcel Dekker 1991. 304pp., ISBN 0-8247-7850-2 \$110. 00.

Based on the author's 25 years' experience in the practical applications of polymer latices in paints, adhesives, paper coatings and carpet backings, and written in a reminiscent vein, this book contains useful tips and leads for anyone with the job of finding good formulations. The polymers, stabilisers, biocides and pigments used in these formulations are reviewed.

Introduction to Nonlinear Optical Effects in Molecules and Polymers, Prasad, P. N. & Williams, D. J., Chichester: Wiley 1991. 320pp. ISBN 0-471-51562-0 £39. 80.

This is the first book devoted exclusively to one of the fastest growing areas of chemistry, optics and material science: nonlinear optics in organic materials. Written to be used as a reference book by researchers of varied backgrounds, this book minimizes detailed mathematical presentation and emphasises concepts. It deals with the mathematical and physical concepts in a conceptual manner so the field can be grasped without first having to master electromagnetic theory.

Powder Coatings, Misev, T. A., Chichester: Wiley 1991 390pp. ISBN 0-471-92821-6 £ 60. 00.

Discussed in this book are the chemistry of powder coatings and their formulation principles, the coverage also extends to resins and crosslinkers. Subsequent chapters detail the parameters which affect powder coatings properties, the technological aspects of production and various techniques for the application of powder coatings. A concluding chapter takes a broad look at the future developments in this field.

Mechanics of Composite Materials; A unified micromechanical Approach, (Studies in Applied Mechanics Volume 29) Aboudi, J., 328pp. Amsterdam: Elsevier 1991. ISBN 0-444-88452-1 \$125. 50.

In the last decade the author has been engaged in developing a micromechanical composite model based on the study of interacting periodic cells which can analyse elastic as well as nonelastic constituents (e. g. viscoelastic, elastoplastic and nonlinear elastic). Contents: Fundamentals of the mechanics of composites, Basic models in the mechanics of composites, The micromechanical method of cells, Strength and fatigue failure, Viscoelastic behaviour of composites, Nonlinear behaviour of resin matrix composites, Inelastic behaviour of metal matrix composites and Imperfect bonding in composites.

The Kinematics of Mixing: Stretching, Chaos and Transport, (Cambridge Texts in Applied Mathematics 4) Ottino, J. M., 378pp. Cambridge University Press 1989. Hardback ISBN 0-521-36335-7 £55. 00, Paperback ISBN 0-521-36878-2 £22. 50.

This book presents a unified and systematic account of the kinematics of the mixing of fluids. Contents: Flow; trajectories, and deformation; Conservation equations, change of frame, and vorticity; Computation of stretching and efficiency; Chaos in dynamical systems; Chaos in Hamiltonian systems; Mixing and chaos in model flows; Flows and lamellar structures; Mixing with diffusion and reaction at small scales; Breakup of fluid microstructures.

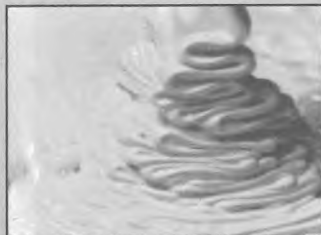
Gases, Liquids and Solids and Other States of Matter, Tabor, D., 406pp. Cambridge University Press 1991. Hardback ISBN 0-521-40488-6 £ 45.00 Paperback ISBN 0-521-40667-6 £15. 95.

The second edition has been reworked and completely new material included. Contents: Atoms, molecules and the forces between them; Temperature, heat and the laws of thermodynamics; Perfect gases — bulk properties and simple theory; Further theory of perfect gases; Imperfect gases; The solid state; The elastic properties of solids; The strength properties of solids; Thermal and electrical properties of solids; The liquid state; Liquids: their flow properties; The colloidal state of matter; Some physical properties of polymers; Dielectric properties of matter; Magnetic properties of matter.

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Food Polymers, Gels and Colloids, Dickinson, E., Editor, 576pp. Cambridge: The Royal Society of Chemistry 1991 ISBN 0-851-86657-3 £47. 50.

This book describes the recent developments in the understanding of the role of food polymers in determining the properties of food colloids. It provides a comprehensive and up-to-date account of current activity in the field and covers such topics as: interaction and aggregation behaviour of proteins and polysaccharides in solution; formation and stability of emulsions and foams; interfacial behaviour of food surfactants and macromolecules; structure and rheology of solutions, gels and glasses. A major underlying theme is the importance of basic physico-chemical and colloid science principles in understanding the complex behaviour of multi-phase, multi-component foods.

The Storage and Conveying of Wet Granular Solids in the Process Industries, A Specialist Review, Heywood, N. I., 300pp. Royal Society of Chemistry, Process Technology Group of the Industrial Division 1991 £28. 00. Contact Mr C. H. Stoor, 38A Sandling Lane, Penenden Heath, Maidstone, Kent ME14 2DY.

This review describes equipment and methods for storing and conveying wet solids in the form of slurries, pastes, cakes and damp powders. Emphasis is given to surveying to what extent it is currently possible to use data from small-scale test work when designing systems for wet solids handling, including equipment selection and sizing, and the specification of equipment operating conditions. Chapter 1 provides a general introduction. Chapters 2 and 3 discuss the relevant bulk properties of wet bulk solids and slurries respectively, together with the available small-scale test equipment to measure these bulk properties. Chapters 4 and 5 cover the storage of wet bulk solids and slurries respectively, while chapters 6 and 7 cover wet solids conveying. Finally, chapter 8 provides a survey of on-line instrumentation for wet solids, including moisture sensors, density meters, flowmeters and viscometers/consistometers.



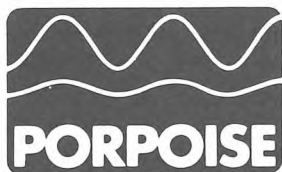
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MEMBERSHIP NEWS

The following applications for membership were approved at the Council Meeting, December 17th, 1991.

Mr R. Crisp,
Nestec York Ltd.,
P. O. Box 204,
York YO1 1XY.

(pesa GHJL)

Mr P. F. Mahon,
ICI, SRC Lab 245,
P. O. Box 42,
Hexagon House,
Manchester.
M9 3DA
(petsa GHO)

Dr G. H. McKinley,
Division of Applied Sciences,
Room 316 Pierce Hall,
Harvard University,
Cambridge, MA 02138,
U. S. A
(fesa BDGO)

Ms E. M. Rowlands,
Unilever Research, Port Sunlight Lab.,
Quarry Road East,
Bebington, Wirral,
L63 3JW.
(fetsa DFGJM)

Mr S. Smith,
Carri-Med Ltd.,
Glebelands Centre,
Vincent Lane,
Dorking, Surrey.

(feta)

Mr M. A. Wells,
Technical Development Dept.,
Cadbury Ltd., Bournville Lane,
Bournville,
Birmingham,
B30 2LU.
(feta GHL)

Dr K. E. Evans,
Dept. of Materials Science & Engineering,
University of Liverpool,
P. O. Box 147, Liverpool
L69 3BX,
(petsa BCDN)

Dr D. K. Majumdar,
Astor Chemical Ltd.,
Tavistock Road,
West Drayton,
Middlesex.
UB7 7RA
(feta BCDEFGHJLO)

Mrs M. Mooney,
Wellcome Environmental Health,
McIntyre House, High St,
Berkhamsted,
Herts, HP4 2DY

(pea DFGHO)

Mrs G. Saunders,
Carri-Med Ltd.,
Glebelands Centre,
Vincent Lane,
Dorking, Surrey.
(fetsa O)

Mr T. J. Trail,
Applied Chemistry,
& Physical Science,
Napier Polytechnic,
Merchison Site,
Colinton Rd., Edinburgh.
(fetsa BCDO)

Mr P. R. Wood,
Dept. of Chemical Engineering,
Cambridge University,
Pembroke Street,
Cambridge,
CB2 3RA.
(fetsa D)

Dr N. E. Hinrichsen,
Center for Industrial Research,
Box 124 Blindern,
N-0314, Oslo,
Norway.
(fetsa CD)

Mr J. McGowan,
ICI Corporate Colloid
Science Group,
11 The Heath,
Runcorn,
Cheshire. WA7 4QE
(fetsa DGN)

Dr H. Rohm,
Dept. of Dairy Research
and Bacteriology,
University of Agriculture,
Gregor-Mendel Straße 33,
A-1180 Vienna, Austria.
(fetsa FGLM)

Dr N. E. Sherman,
Dept. of Chemical Engineering,
University of Cambridge,
Pembroke Street,
Cambridge, CB2 3RA.
(petsa G)

Mr E. M. P. Vrig,
BP Nutrition,
P. O. Box 50,
3880 AB,
Putten,
The Netherlands.
(petsa CGHL)

J. A. Cole has resigned.

Professor John Harris has retired from his post in Malawi and now lives in Hereford.

PROFESSOR PIERRE-GILLES DE GENNES

Rheologists will have been delighted by the news of the Nobel Prize for Physics awarded to Professor de Gennes. His work has ranged over many fields including liquid crystals, polymer motion, surface dynamics and wetting. His work on liquid crystals laid the foundation of a field of research which led to liquid crystalline polymers. His investigation of the way polymer molecules and their individual parts move in concentrated solutions led to the now well established concept of reptation; this work also involved some earlier ideas put forward by Sir Sam Edwards. His work on surface dynamics led to predictions about surface interactions involving polymers and their conformation at interfaces and stimulated work on the forces which cause a liquid drop to spread on a surface. He has shown that many disparate physical systems such as magnets, superconductors, liquid crystals and polymer solutions can be unified by a general theoretical approach. The award of the Nobel Prize is richly deserved.

COMPETITION

In 1990, we introduced the idea of having a competition in each issue of the Bulletin because we thought that Members would appreciate the opportunity to escape for a little while from their more serious pursuits in rheology and indulge in something a little more frivolous. However, the response has been disappointing and the last competition did not stimulate even one entry.

We are not sure why. Is it that science is now such a deadly serious matter that there is no longer any fun in it, or is everybody under such pressure from bureaucrats and accountants that they dare not let up for a moment? We are humble enough to allow that we may have been going about it in the wrong way so, as a final fling, we put the ball into your court.

Competition No. 6 is to devise Competition No. 7. If that does not work we shall give up. Entries to: Dr G. H. Tattersall, 174 Millhouses Lane, Sheffield S7 2HE. Closing date March 15th 1992. As usual, a BSR tie or a £5 book token to the winner.

NORTH MIDLANDS GROUP

The second meeting was held on December 18th in the School of Materials, University of Sheffield. Dr David Kirkwood who was scheduled to speak was at the last minute prevented from doing so, but he provided a worthy deputy in Mr Alan MacLelland who gave an interesting account of his work on the rheology of metal slurries. A very lively discussion was stimulated and the value of the contact, in a small group, of rheologists working in different areas was amply demonstrated. The next meeting will be held at 2 p. m. on Thursday March 26th 1992 in the department of Civil and Structural Engineering, University of Sheffield, when Peter Prentice of Nottingham Polytechnic will talk about some aspects of his work in polymer melt processing.

We hope more Members of the Society, particularly those from industry, will join the group.

RHEOLOGY SEMINARS AT WARREN SPRING LABORATORY

Warren Spring Laboratory will be holding the following one-day Seminars in 1992. A seminar at Stevenage on Mixing Technology on March 12th will deal with assessing mixture quality, selecting the correct mixer and estimating power consumption. A seminar at Stevenage on Suspension Rheology, on March 19th will deal with the characterisation of flow properties and the interpretation of data, including some industrial case studies. Seminars on Viscometers and Rheometers will be held at Stevenage on March 11th, at Haydock Park, Manchester on April 15th and at the Forte Crest Hotel, Newcastle on May 20th. The aim of these will be to highlight the various factors to consider before selecting a rheometer to use or buy.

The cost of each seminar is £225 + V. A. T..

For further information contact: Susan Gartside, Warren Spring Laboratory, Gunnels Wood Road, Stevenage, Herts. SG1 2BX. Tel: (mornings only) 0438 74112.

CONFERENCE ANNOUNCEMENTS

RHEOLOGY OF INORGANIC BUILDING MATERIALS A JOINT BRITISH SOCIETY OF RHEOLOGY/SOCIETY OF CHEMICAL INDUSTRY SEMINAR

At The Society of Chemical Industry, London on Thursday April 9th 1992

The objective of this meeting is to show how rheology can help users of the many materials and products in construction which are applied plastic and subsequently cure and harden. How they flow and are moulded during use and application can make the difference between satisfactory and unsatisfactory long term performance.

PROGRAMME

- | | | |
|-------|--------------------------------|---|
| 10.00 | Introduction to Rheology. | Dr P. F. G. Banfill,
University of Liverpool |
| 10.45 | Instruments and Methods | R. W. Whorlow, Consultant,
formerly University of Surrey |
| 11.30 | Discussion | |
| 11.45 | Fresh Concrete | Dr G. H. Tattersall, Consultant,
formerly University of Sheffield |
| 12.15 | Plaster | R. Rouse, Redland
Plasterboard Ltd. |
| 12.45 | Lunch | |
| 14.00 | Radioactive Waste Materials | Dr C. R. Wilding,
AEA Technology |
| 14.30 | Pumping of Cementitious Grouts | M. T. Hutchinson and
R. J. Mangabhai, Trafalgar
House Technology Ltd. |
| 15.00 | Fresh Mortar | Dr P. F. G. Banfill,
University of Liverpool |
| 15.30 | Tea | |
| 16.00 | Rheology in Concrete Repair | E. Kempster, Consultant
formerly Building Research
Establishment |
| 16.30 | Tile Adhesives | C. Potter, Ardex (U. K.) Ltd. |
| 17.00 | Discussion | |
| 17.15 | Close | |

Registration Fees: Members of SCI or BSR £55, non-members £85, Students £15. Exhibition space will be available at the cost of £140. For further information and to register contact: The Conference Dept., Society of Chemical Industry, 14/15 Belgrave Square, London.

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

THE ANNUAL CONFERENCE OF THE BRITISH SOCIETY OF RHEOLOGY
at Selwyn College, University of Cambridge,
September 15-16th 1992

Registration Form is enclosed with this Bulletin.

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

CALL FOR PAPERS

Offers of papers are invited 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, Kruss UK Ltd., 5/6 Carrington House, 37 Upper King Street, Royston, Herts., SG8 9AZ, as soon as possible. The closing date is June 1st 1992.

The meeting aims to bring together product formulation chemists, quality control personel, 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.

Further details will appear in following issues of the Bulletin.

SHORT COURSES OFFERED BY THE UNIVERSITY OF BRISTOL

The following courses will be organised by the University of Bristol.

INTRODUCTION TO POLYMER SCIENCE March 2-6th 1992.

SPRING SCHOOL IN COLLOID SCIENCE April 6-10th 1992.

WORKSHOP ON THE CHARACTERISATION OF INTERFACES, May 10-13th 1992.

EUROPEAN SCHOOL IN COLLOID SCIENCE, October 5-9th 1992, Strasbourg, France.

For further information contact: Dr Susan Pringle, Dept. for Continuing Education, University of Bristol, Wills Memorial Building, Queen's Road, Bristol BS8 1HR. Tel: Bristol (0272) 303611, Fax: Bristol (0272) 254975.

FIRST ANNOUNCEMENT

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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THE CARRI-MED RHEOLOGY SEMINAR, 1992

This seminar will be held at Thatchers Resort Hotel, Nr. Leatherhead, Surrey on March 3rd and 4th, 1992. With a mixed programme of theory and practice there will be plenty of opportunity to talk informally with rheology experts including: Dr H. Barnes, Unilever plc, Dr T. E. R. Jones, Plymouth Polytechnic, Professor K. Walters, University of Aberystwyth, Dr J. Ferguson, University of Strathclyde and Dr G. Maitland, Schlumberger Cambridge Research Limited. For further information contact: Mrs A. Cooke, Carri-Med Ltd., Glebelands Centre, Vincent Lane, Dorking, Surrey RH4 3YX. Tel: Dorking (0306) 886180.

COMPUTER AIDED DESIGN OF NEW MATERIALS

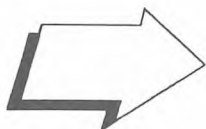
A one-day meeting will be held at the University of Surrey on April 7th, 1992. The meeting will be mainly concerned with computer simulation and modelling of materials and will have sections devoted to inorganic solids, liquids and polymers. There will be talks on smart fluids (colloidal suspensions), emulsions relevant to the food industry, polymers and micelles under flow, process modelling of polymers, epoxy resins, zeolite catalysts, superconductors and semiconductors.

For further information contact Mrs M. A. Sacre, Department of Chemistry, University of Surrey, Guildford GU2 5XH.

CONFERENCE DIARY

DATE	PLACE	DETAILS
23-27/3/92	Swansea, U. K..	'8th International Conference on Finite Element Methods for Flow Problems', contact: FEMIF8 Conference Secretariat, Dr E. J. Probert, CDR, Innovation Centre, University College Swansea, Singleton Park, Swansea SA2 8PP, U. K..
7/4/92	Guildford, U. K.	'Computer-Aided Design of new Materials', contact: Mrs M. A. Sacre, Dept. of Chemistry, University of Surrey, Guildford GU2 5XH
6-10/4/92	Barcelona, Spain.	'3rd International Conference on Computational Plasticity', contact: Eugenio Onate, COMPLAS III Secretariat, Centro Internacional de Metodos Numericos en Ingenieria, Modulo C1, Campus Norte UPC, Gran Capitan, s/n 08034 Barcelona, Spain.
9/4/92	London, U. K.	'Rheology of Building Materials', contact: R. J. Mangabhai, TH Technology, Maple Cross House, Denham Way, Rickmansworth, Herts.
5/92	Tokyo, Japan.	'19th Annual Meeting' Society of Rheology, Japan, contact: Prof. Kunihiro Osaki, Institute for Chemical Research, Kyoto University, Uji, Kyoto 611, Japan.
26-29/5/92	Glasgow, U. K.	Residential Course: 'Theoretical, Experimental and Industrial Aspects of Rheology', contact: Dr N. E. Hudson, Dept. of Pure & Applied Chemistry, University of Strathclyde, Cathedral St., Glasgow G1 1XL.
31/5-5/6/92	Lake Garda, Italy.	'Rheology, Processing and Properties of Polymeric Materials', contact: Prof. G. Marrucci, Naples, Italy.
6-8/7/92	Wollongong, N. S. W. Australia	4th International Conference on Bulk Materials Storage, Handling and Transportation and 7th International Symposium on Freight Pipelines, contact: Prof. Peter Arnold, Dept. of Mechanical Engineering, The University of Wollongong, P. O. Box 1144, Wollongong, N. S. W. 2500, Australia.
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	Haifa, 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, Haifa 32000, Israel.

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| 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 |
| 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 | Selwyn 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 | Cambridge, U. K.. | 'Colloids in external fields', contact: The Royal Society of Chemistry, Burlington House, Piccadilly, London W1V 0BN. |
| 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. |
| 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. | 'Experimental rheometrical measurements', contact: Mrs C. A. Moules, Kruss UK Ltd., 5/6 Carrington House, 37 Upper King St., Royston, Herts. SG8 9AZ |
| 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., | '65th Annual Meeting', Society of Rheology, contact: Dr A. M. Kraynik, Division 1511, Sandia National Laboratories, Albuquerque, New Mexico 87185, U. S. A.. |



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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.



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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.

SLIT FLOW MONITOR (SFM)

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.

EXTRUDATE TEMPERATURE MONITOR (ETM)

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

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.

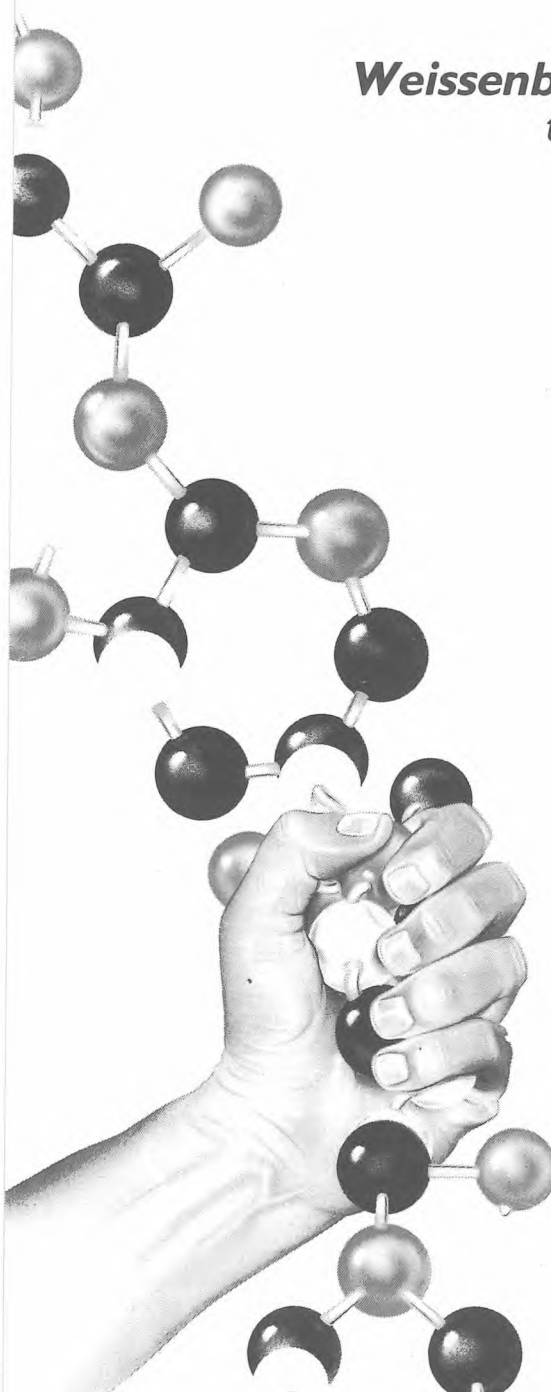
Other instruments within the ACER range include 'Thrust' for measuring the pressure coefficient of viscosity; and the ESM extrudate swell monitor for on-line non-contacting measurement of diameter.

NEW

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



A detailed illustration of a hand squeezing a long, flexible chain of spheres connected by rods, representing a polymer or fluid under stress. The spheres are shaded to show depth, and the hand is rendered with realistic detail, showing the fingers and thumb applying pressure to the chain.

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