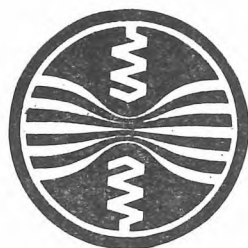


BULLETIN



BRITISH SOCIETY OF RHEOLOGY

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Hon. Editor:

M. CAMINA,

Paint Research Association,
Waldegrave Road,
Teddington,
Middlesex.

FOREWORD

The number of symposia, conferences and meetings which we would like to attend seem to be increasing every year. A joint meeting with the Italian and Dutch Societies was recently held in Pisa, our Autumn meeting is shortly to take place in Edinburgh and a joint conference with the Chemical Society is planned for January 1978. For those interested in Food Technology there is also a symposium in December. It is quite probable that the interests of the majority of our members is not rheological so that there are, therefore, other relevant conferences they would like to attend.

There is no doubt that technical meetings broaden the outlook and on rare occasions, to quote Luther Meyer (in translation), "it was as though scales fell from my eyes, doubt vanished, and was replaced by a feeling of peaceful certainty". Discussions after the lectures, without the pint, are often far too short so that the introduction of "Poster Sessions" at the Edinburgh conference should be an improvement to B.S.R. meetings.

If committees should misjudge the general interest of conferences, however, or if the number of meetings saturate the market and the pocket, then attendances will begin to fall. But until such signs are noticed and while people feel the need to organise and attend technical meetings, then we will continue to hold them.

OFFICERS AND MEMBERS OF COUNCIL 1976—77

President: DR. J. J. BENBOW, I.C.I. Ltd., Agricultural Division, Billingham, Teesside.

Secretary: MR. F. N. COGSWELL, I.C.I. Ltd., Plastic Division, Welwyn Garden City.

Treasurer: DR. D. R. OLIVER, Department of Chemical Engineering, University of Birmingham, Birmingham.

Membership Secretary: DR. T. E. R. JONES, School of Mathematical Sciences, Plymouth Polytechnic, Plymouth.

Abstracts Editor: DR. D. MARSHALL, Institute of Polymer Science, Loughborough University of Technology, Loughborough.

Bulletin Editor: MR. M. CAMINA, Paint Research Association, Teddington, Middlesex.

Ordinary Members:

DR. K. M. BEAZLEY, 44 Brockstone Road, Boscoppa, St. Austell, PL25 3DP.

DR. D. C-H. CHENG, Warren Spring Laboratory, Stevenage.

MR. T. C. DAVENPORT, B.P. Research Centre, Sunbury-on-Thames, Middlesex.

MR. A. EVANS, Department of Surgery, Royal Victoria Infirmary, Newcastle-upon-Tyne.

DR. J. FERGUSON, Department of Fibre Science, University of Strathclyde, Glasgow.

DR. M. SHERRIFF, Department of Pharmaceutical Chemistry, School of Pharmacy, Brunswick Square, London.

SCIENCE RESEARCH COUNCIL—NON-NEWTONIAN FLOW PANEL

The Non-Newtonian Flow Panel was set up by the Chemical Engineering and Technology Committee of Science Research Council in September 1975, with the terms of reference (1) to implement the recommendations of the Non-Newtonian Flow Report and (2) to assess grant applications received as a result of the publication of the Report. As the Panel continues its work in the second year of existence, this article has been prepared for members of the British Society of Rheology to inform them of the origins of the Panel, the aims and objectives that has been developed to meet its terms of reference, and the current work programme.

Background

The Non-Newtonian Flow Panel has its roots in the joint Institution of Chemical Engineers—British Society of Rheology Working Party on Non-Newtonian Flow (*B.S.R. Bulletin*, 1970, 13, 67–68), whose report was published in the *Chemical Engineer*, January 1971, 11–15. Subsequent to publication, discussion was held between the Institution, the then Ministry of Technology (now the Department of Industry) and Science Research Council. One of the terms of reference of the joint Working Party was to identify area of activity where further work should be actively encouraged. As a result of the tripartite meeting, Science Research Council set up the Non-Newtonian Flow Working Party.

The S.R.C. Working Party, under the chairmanship of Professor J. F. Richardson of University College of Wales, Swansea, was given the task to identify areas where further work on non-Newtonian flow could be expected to yield results leading to beneficial applications in industry, agriculture and medicine. The findings of the Working Party were published as "Non-Newtonian Flow. A review of problems and research", by S.R.C. in June 1975 (*B.S.R. Bulletin*, 1975, 18, 43). Some 1,300 copies were distributed to universities, industry and other organisations interested.

In November 1975, an open meeting was arranged by S.R.C. in the rooms of the Royal Society in London to present the Non-Newtonian Flow Report and to discuss its contents and implications. The one-day meeting was attended by more than 60 people from universities and industry. There was lively discussion about areas where further work is needed and how the research and the application of the results should be divided between the academics and the industrial engineers.

Subsequent to the publication of the Non-Newtonian Flow Report, the Non-Newtonian Flow Panel was set up by S.R.C. with the terms of reference stated in the introduction. The Panel held its

first meeting in February 1976 and its current membership consists of the following:

Professor W. L. Wilkinson, chairman (University of Bradford)

Dr. K. M. Beazley (English Clays Lovering Pochin)

Dr. D. C-H. Cheng (Warren Spring Laboratory)

Mr. T. C. Davenport (British Petroleum)

Mr. J. E. Porter (University of Newcastle)

Dr. A. E. A. Rose, secretary (Science Research Council)

The Panel has a distinct and separate existence from the S.R.C. Polymer Engineering Directorate (*B.S.R. Bulletin*, 1975, 8, 54-55; 1976, 19, 1). It has been agreed that the Non-Newtonian Panel will not cover the area of polymer processing which falls within the terms of reference of the Directorate. But close liaison will be kept between the two committees.

Work Programme

The work of the Panel falls into three areas: (1) Development of a portfolio of S.R.C. grants supporting research proposals in accordance with the recommendations of the Non-Newtonian Flow Report; (2) Assessment of grant applications; and (3) the Rheology Instruments Project.

A Portfolio of S.R.C. Grants

The Panel aims to take an active role to implement the recommendations of the Non-Newtonian Flow Report, one of which is that non-Newtonian research should be encouraged in certain areas as named in the Report. The message is directed at academic research workers who are anxious that their work is relevant to practical problems and at industrialists and others who wish to encourage research in universities and polytechnics.

In pursuant of this policy, the Panel has embarked on a programme of visits to universities and polytechnics to discuss with appropriate research workers their plans for research in this area, to review their needs and to acquaint them with what the Panel aims to achieve. To date, visits have already been made to the Universities of Birmingham, Bradford and Salford, and University College of Wales in Swansea. Some of the topics discussed are rheological characterisation, multiphase slurry flow in pipes, arrays and paper making equipment, and polymer extrusion. Other visits are planned, and suggestions for further visits are welcome.

The Panel has also visited the Paper Industries Research Association in Leatherhead. Among the problems and research needs facing the industry, two were particularly emphasised. Namely (i) **ink piling in printing** which reduces ink transfer through the machines from rollers to paper, resulting in loss of colour in the

final print, and (ii) energy consumption in preparation of fibre stocks for paper and board making, involving the dispersion of wood pulp and wastepaper, removal of dirt and contray material, and refining of the individual fibres. The Research Association indicated its willingness to co-operate with any research workers who may wish to look into these problems.

Assessment of Grant Applications

The Panel assesses grant applications made to S.R.C. in the area of non-Newtonian flow and fluid mechanics, in addition to their being sent to outside-S.R.C. referees in the usual way. Individual Panel members consult their circle of colleagues before the applications are discussed at Panel meetings.

In addition to commenting on the merits of the application in the form in front of the Panel, the Panel aims to be constructive about any criticisms made and, where applicable, hopes to assist in improving the project proposals. Visits have been made to discuss details with applicants and to explain what the Panel has in mind. Other applicants have been put in touch with relevant industrial companies, with the view that the proposed work might be modified to be more specifically relevant and that there should be more intimate involvement of industry at all stages of an investigation so that the practical application of the results can be encouraged. In time, the Panel hopes that the applicants will have had prior discussion with industry before submitting their project proposals.

It should be emphasised that the role of the Panel in grant application assessment is advisory only. The final decision whether to make a grant or not rests with the Chemical Engineering and Technology Committee.

The Rheology Instrument Project

It is well known that many research workers in rheology have to become instrument designers/makers, whereas what they want to do is the measurement of rheological properties. Existing commercial equipment have increasingly proved to be inadequate because more and more new frontiers in rheological properties are being explored. The S.R.C. Rutherford Laboratory, though primarily involved with high energy physics, has considerable expertise and resources in instrument engineering and allied disciplines that might be harnessed to support this requirement of academic research. The Non-Newtonian Flow Panel has therefore initiated discussions with Rutherford Laboratory, to explore this possibility.

It is thought that to enable the Laboratory to make a good start, it should be given specifications of the rheological instruments

needed by rheologists. The Panel has therefore co-opted Mr. F. N. Cogswell (I.C.I. Plastics Division) and Professor K. Walters (University College of Wales, Aberystwyth) to form an advisory group to formulate the specifications. At the moment the requirements for four types of instruments (for elongational viscosity, constant shear-stress viscometer, and viscometers for very low and very high shear rates) are being considered. It is proposed that a more detailed report on this area of the Panel's work will be published separately soon, so that the advisory group can obtain feedback from the rheology community, academic and industrial, as a whole.

It is anticipated that when the new instruments are built, they will be made available to academic and other workers for evaluation and use in connection with their research projects.

Future Prospects

The Non-Newtonian Flow Panel is now in its second year of existence. To be effective in its work, it must be in tune with the needs of the rheological community. The Panel therefore invites members of the British Society of Rheology and others to contact it through S.R.C. or through its members. It would be pleased to discuss ideas for research projects within the areas named in the Non-Newtonian Flow Report, whether from academic workers or industrial chemists/engineers. More specifically, the Panel would like to receive further views on new rheological instruments and what uses to which they may be put.

D. CHENG.

EXTENSIONAL FLOW RHEOMETERS

In an earlier communication Dr. Cheng has outlined the activities of the Non-Newtonian Flow Panel of the Science Research Council under the Chairmanship of Professor Wilkinson. One activity of that Panel is the formation of a Working Party to study rheometer design and to make recommendations for instrumentation which will facilitate the study of non-Newtonian flow. In this context the Working Party is able to draw on the engineering and design skills of the Council's Rutherford Laboratory. As part of its activities the Working Party is considering the design of elongational flow rheometers and this note outlines the progress which has been made so far in that respect.

Fundamental interest in stretching flow rheology is a comparatively recent phenomena. Ten years ago one might have scoured the literature in vain for relevant references. Today virtually every issue of the major rheological journals contains a paper centred on

some aspect of elongational flow. Even so practical data on stretching flows are rare and often qualitative and there exists a need for more fundamental data and also for more versatile rheometers. The need is both to satisfy industrial design strategies and to verify fundamental theoretical predictions. In particular it would be valuable to develop a system capable of working with the whole range of fluids from water to pitch and to include also disperse phase systems.

The Working Party has outlined proposals for, and the Rutherford Laboratory has made preliminary design studies of, three types of elongational rheometer.

1. *Fundamental Rheometer* to operate under a programmed stress or strain rate history and to study the independent variable as a function of time. It is anticipated that this rheometer will only be suitable for systems whose viscosity is greater than 10^4 Ns/m².
2. *Comparative Rheometer* based on laboratory spinning, or dominantly elongational flow of considerable industrial importance.
3. *Speculative Rheometer* based on lubricated, converging flow to obtain a high degree of versatility both in range of material type and in deformation history.

An outline of the principles on which these rheometers are designed is appended and anyone wishing to study the proposals in greater detail is invited to apply to the Secretary of the Working Party—Dr. A. E. Rose (S.R.C., State House, High Holborn, London). Further proposals for elongational flow rheometers would be welcomed by the Panel and those submitting programmes to the Panel may like to consider how the future availability of these instruments could be integrated with their programmes.

Appendix—Fundamental Rheometer

Munstedt (Rheol. Acta 15, 10, 517 (1976)) has demonstrated that a constant stress tensile rheometer can be developed to give information on viscosity and elasticity with a high degree of reproducibility and accuracy for polymer melts with a viscosity greater than 10^4 Ns/m². It is proposed to develop that approach using a closed loop feedback between deformation and applied force, initially to maintain constant applied stress but in due course to maintain any prescribed deformation system.

Appendix—Comparative Rheometer

Ferguson (Trans. Soc. Rheol. 18, 4, 541 (1974)) has developed an instrumented spin line suitable for examining the stretching flow behaviour of polymer solutions. It is proposed to develop the instru-

mentation of this rheometer to make it more sensitive and more robust in operation. The present instrument is limited to operation under ambient conditions and a second desirable extension will be to provide an environmental chamber particularly for work at higher temperature.

Appendix—Speculative Rheometer

Shroff (Trans. Soc. Rheol. in press) has demonstrated that simple studies of converging flow can yield qualitative information about elongational rheology which is directly comparable with that obtained in laboratory spinning. Free surface methods of measurement are limited in their applicability—in particular it is very difficult to study a material whose resistance to deformation is “tension thinning” because of a tendency to necking. Constrained converging flow is not subject to this limitation—but precise analysis is difficult. Shaw (J. Appl. Polym. Sci. 19, 2811 (1975)) has proposed lubricating the die surface to minimise the surface shearing effects. On the assumption of plug flow it is, in principle, possible to construct a die shape to give a uniform rate of extension when a material is extruded. It is proposed to develop an experimental lubricated converging flow system to test the principles of such a system—initially for a pure shear extension. If successful it is hoped to extend the development to a versatile extrusion driven extensional rheometer.

Secretarial Report

P.R.I. AWARDS GO OVERSEAS

For the second year major awards made by the Plastics and Rubber Institute have gone overseas. Awards for 1976, just announced are:

The Colwyn Medal

Mr. J. M. Massoubre, Co-ordinator of Research and Technical Activities at Michelin Tyre and Rubber Company, Clermont-Ferrand, France, has been awarded the Colwyn Medal for 1976.

The Hancock Medal

Mr. H. M. Collier, Managing Director, Dunlop Estates Berhad, Malaysia, has been awarded the Hancock Medal for 1976.

CALL FOR PAPERS

Pneumotransport 4

Fourth International Conference on the Pneumatic Transport of Solids in Pipes

June 1978 in U.S.A. BHRA Fluid Engineering in
conjunction with Colorado School of Mines.

**International Conference—
“The Toughening of Plastics”**

The Polymer Properties Group Committee of the Plastics and Rubber Institute is planning a major international conference on Toughening of Plastics to take place in June 1978. A major sector of the plastics industry is concerned with the production and processing of rubber toughened plastics, including HIPS, ABS, toughened grades of PVC, polypropylene, epoxy resins, and other related products. The aim of the conference is to take stock of current knowledge relating to the industry, including the chemistry of toughening, manufacture of toughened polymers, structure-property relationships, rheology, melt processing and fabrication, and the economic outlook for toughened plastics.

Contributions to the programme are invited and prospective authors should submit a synopsis of 100–150 words to Mrs. Carol-Anne Alcorn at the Plastics and Rubber Institute, 11 Hobart Place, London SW1W 0HL.

**International Polymer Latex Conference
London—Autumn 1978**

The Plastics and Rubber Institute proposes to hold an international conference devoted exclusively to the subject of polymer latices and their applications. It is intended that the scope of the conference should embrace all types of polymer latices, including non-aqueous latices. The Institute believes that this will be the first conference of its type to have been held.

The exact dates have not yet been decided, but it is expected that it will be held in September 1978, and that it will occupy 3 days. The venue will be London.

The provisional subject headings for the conference are:

- preparation, manufacture and properties of latices
- testing and specifications
- latex dipping
- latex foam
- textile applications
- paper applications
- latex surface coatings
- latex adhesives and binders
- other latex applications

Proposals for papers, should reach the P.R.I. headquarters not later than 31st August 1977.

FUTURE MEETINGS

THE BRITISH SOCIETY OF RHEOLOGY'S CONFERENCE

Edinburgh, 7th-9th September 1977

General Rheology and Stretching Flows

The annual Conference this year is being held at the University of Edinburgh during the last week of the world renowned Edinburgh Festival. Non-members of the Society will be as warmly welcomed as members. Accommodation has been booked in the Pollock Halls of Residence close to the centre of the City.

Papers have been received from Canada, Finland, Italy, Mexico, the Netherlands, Rhodesia, Turkey, U.S.A., U.S.S.R. and W. Germany as well as Britain, and the programme is now complete. If there is a sufficient response, a Poster Session will also be held and intending authors should write to the address below for further details. Booking forms will shortly be available, as will details of the Festival events (both Official and the Fringe). Prospective delegates should write to:

Dr. J. Ferguson,
Department of Fibre Science,
University of Strathclyde,
George Street,
GLASGOW G1 1XW.

FOOD TEXTURE AND RHEOLOGY

The International Union of Food Science and Technology is organising a symposium on "Food Texture and Rheology" at the Queen Elizabeth College (University of London) London, England from 19th to 22nd December.

Further details and registration forms are obtainable from Dr. P. Sherman, Department of Food Science, Queen Elizabeth College (University of London), Campden Hill Road, London W8 7AH, England.

COURSES

SOLID-LIQUID SEPARATION

6th to 9th September, 1977

Following the outstanding success of the 1974 and 1975 courses the Institution is sponsoring a further and extended course on Solid-Liquid Separation to be held at the University of Bradford from 6th to 9th September, 1977.

The course is intended for chemical engineers and graduates in related disciplines such as chemistry and mineral processing who are seeking a concise coverage of the essential principles and recent developments of importance in the subject. The lectures will be given by a group of international specialists and practical demonstrations of some equipment will be included.

Further information may be obtained from Dr. L. Svarovsky, School of Powder Technology, University of Bradford, Bradford BD7 1DP, W. Yorks.

TRAINING COURSE IN FLUIDS RHEOLOGY

Warren Spring Laboratory

Stevenage, 21st-25th November, 1977

Following the successful course last year, Warren Spring Laboratory is repeating it in the Fourth Training Course in Fluids Rheology in November 1977. The course is aimed at the practising rheologist, physicist, chemist and engineer, as well as the newly-appointed rheologist. The course covers three main topics:

1. A wider introduction and background knowledge to fluids rheology.
2. Detailed instructions on viscometric techniques and how to get the best out of commercial instruments.
3. Industrial applications, product formulation, quality and process control, processing equipment design, selection and operation.

Instructions will involve lectures, practical periods, example classes, seminars and surgeries on industrial problems in open sessions and privately with W.S.L. staff in confidence. A course manual will be supplied.

The content draws on the experience of some one-and-a-half decades of rheological research and industrial work at the Laboratory and on the numerous courses and Particle Workshops that the Laboratory has organised or taken part in. It has been approved by British Society of Rheology and the Institution of Chemical Engineers.

The course is residential and to preserve its special nature, attendance will be restricted to a maximum of 24. The Course Organiser is Dr. D. C.-H. Cheng. Further information may be obtained from :

Mr. R. A. Richmond,
Materials Handling Division,
Warren Spring Laboratory,
PO Box 20,
Gunnels Wood Road,
Stevenage,
Hertfordshire SG1 2BX.
Telephone: Stevenage 3388
Telex: 82250.

APPLIED RHEOLOGY REPORTS FROM WARREN SPRING LABORATORY

The following reports have been issued by Warren Spring Laboratory. B.S.R. members can obtain copies on loan through normal library channels, or in case of difficulties from W.S.L. Library. They may also purchase copies from W.S.L., but please send payment with your order.

1. Viscometric testing of a barley-meal/water mixture for pipeline design. R. A. Richmond, W.S.L. Res. Report No. LR248 (MH), 1977, 44pp, £6.00.
2. A Theoretical discussion of the use of torque measurement to determine mixedness and mixing rate. D. C.-H. Cheng, W.S.L. Res. Report No. LR207 (MH), 1974, 28pp, £1.50.
3. On the role of torque measurement in mixing with heat transfer, mass transfer and chemical reaction. Including the determination of curing properties of rubbers and polymers. D. C.-H. Cheng, W.S.L. Res. Report No. LR208 (MH), 1974, 18pp, £1.50.
4. The effect of the lack of rigidity of the platen support system on dynamic measurement on the Weissenberg Rheogoniometer. D. C.-H. Cheng, W.S.L. Res. Report No. LR205 (MH), 1974, 30pp, £1.50.
5. The characterisation of thixotropic behaviour of fluids with a distribution of structure. D. C.-H. Cheng, W.S.L. Res. Report No. LR203 (MH), 1974, 9pp, £1.50.

APPLICATIONS FOR MEMBERSHIP, MARCH 1977

Stephen T. E. Aldhouse, B.A. f,et,a,D.	B.P. Chemicals Ltd., Research & Development Dept., Technical Service & Applications (Plastics), Sully, Penarth, S. Glamorgan, CF6 2YU
Thomas Cochrane, B.Sc. p,e,C.M.	Dept. of Physics, University College of Wales, Penglais, Aberystwyth.
Mr. J. J. Deer f,et,a,D.F.G.H.J.L.M.	The School of Pharmacy, Brunswick Square, London, W.C.1.
Dr. F. H. Gortemaker, D.Tech.Sc. f,et,sa,B.C.D.F.G.H.J.L.M.N.	Unilever Research, Postbus 114, Vlaardingen, The Netherlands.
Dr. Jeffrey B. Pedley, B.Sc., Ph.D. f,et,a,D,G,H.	Shell Research Ltd., Sittingbourne Labs., Sittingbourne, Kent.
Stephen Michael Richardson, B.Sc., Ph.D. f,t,sa,D.G.N.	Dept. of Chemical Engineering, Pembroke Street, Cambridge.
James Elliott Robinson, B.Sc., M.Sc., DIC. p,et,a,C.D.	BXL (Polyethylene Div.), P.O. Box 25, Inchyra Road, Grangemouth, Stirlingshire.
Dennis John Shepherd, B.Sc. p,e,F.G.H.	E. J. Arnold & Sons Ltd., Art Materials Div., Wardpack North, Cumbernauld.
Rowland Wyn Williams, B.Sc. f,et,sa,D.F.J.N.	Dept. Applied Mathematics, University College of Wales, Penglais, Aberystwyth.

RESIGNATIONS

Dr. G. H. West	Mr. R. S. Higgingbottom
Mr. R. G. Cooper	Dr. J. C. Guthrie
Dr. K. G. Schmidt	Dr. J. R. Arthur

OBITUARY

Dr. Keith Frater, a member of the Society since 1965, has died of cancer at the age of 36.

Dr. Frater was educated at the University College Swansea where in 1962 he graduated with a first class honours degree in Applied Mathematics, winning the departmental prize. He continued in Swansea as a postgraduate student working under Professor Oldroyd on time-dependent flows of elastico-viscous fluids, for which he received his Ph.D. in 1965. After a brief period as Lecturer in Applied Mathematics at the University College Bangor, he moved to Glamorgan Polytechnic, as it was then, in 1966 where at the time of his death he was a Principal Lecturer.

Dr. Frater is survived by his wife and three children, to whom we extend our condolences.

R.S.J.

DIARY

1977

6—9 September. "Solid-Liquid Separation Course," Bradford University.

7—9 September. "General Rheology and Stretching Flows," Edinburgh.

14—15 November. "Rheology of Inorganic Materials," Mons, Belgium.

21—25 November. "Training Course in Fluids Rheology, Stevenage.

19—22 December. "Food Texture and Rheology," London.