

THE BRITISH SOCIETY OF RHEOLOGY

BULLETIN



1984, VOL. 27, NO. 2

CONTENTS

OFFICERS AND MEMBERS OF COUNCIL	I
EDITORIAL	II
BIRMINGHAM CONFERENCE REPORT	21
1983 ANNUAL AWARD	23
MEMBERSHIP NEWS ETC.	25
REQUEST FROM MEMBERSHIP SEC.	30
NOTICE OF AGM	32
FUTURE MEETINGS	33
ADVERTISEMENTS	

HON. EDITOR:
DR. H.A. BARNES
UNILEVER RESEARCH
PORT SUNLIGHT LABORATORY
BEBINGTON, WIRRAL
MERSEYSIDE, L63 3JW

ISSN-0045-3145

OFFICERS AND MEMBERS OF COUNCIL



PRESIDENT: MR. J.F. HUTTON, Thornton Research Centre, P.O. Box No. 1, Chester, CH1 3SH.

SECRETARY: DR. J.J. BENBOW, Department of Chemical Engineering, University of Birmingham, P.O. Box 363, Birmingham, B15 2TT. (Telephone: 021-472-1301, ext. 2789).

TREASURER: MR. T.A. STRIVENS, Physics Section, Research and Development Department, ICI (Paints Division) Ltd., Wexham Road, Slough, Berkshire, SL2 5DS.

MEMBERSHIP SECRETARY: DR. P.C. ANDERSON, B.P. Research Centre, Chertsey Road, Sunbury-on-Thames, Middlesex, TW16 7LN.

ABSTRACTS EDITOR: DR. D.R. OLIVER, Department of Chemical Engineering, University of Birmingham, P.O. Box 363, Birmingham, B15 2TT.

BULLETIN EDITOR: DR. H.A. BARNES, Unilever Research, Port Sunlight Laboratory, Bebington, Wirral, Merseyside, L63 3JW.

ORDINARY MEMBERS:

DR. S.T.E. ALDEHOUSE, B.P. Chemical, Research and Development Department, Sully, South Glamorgan, CF6 2YU.

DR. F.S. BAKER, PERME (W.A.), M.o.D., Waltham Abbey, Essex.

DR. D.C-H. CHENG, Warren Spring Laboratory, Stevenage, Hertfordshire, SG1 2BX.

DR. A. EVANS, Department of Surgery, Royal Victoria Infirmary, Newcastle-upon-Tyne, NE1 4LP.

DR. C.J.S. PETRIE, Department of Engineering Mathematics, University of Newcastle-upon-Tyne, Newcastle-upon-Tyne, NE1 7RU.

MR. H. SCHIMANSKI, Contraves Industrial Products, Times House Station Approach RUISLIP Middlesex HA4 8LH

EDITORIAL

This is the last Bulletin that all our friends "down-under" will receive, so may we take the opportunity to say "cheerio". Over the years they have made a significant contribution to the Society, albeit from afar. Perhaps one day in the not-too-distant future the new Australian Society will be hosting the International Congress and then members of BSR will feel very proud of their grown-up offspring!

The Birmingham meeting proved very enjoyable and served as an opportunity to present the Annual Award to David Boger. This was very appropriate under the circumstances, as David is one of the mainstays in Australia. The meetings and presentations are covered in this issue.

Observant members will have noticed the error in the volume number of the last Bulletin - it should have been 27.1 not 26.4. Sorry!

A number of enquiries have recently been received concerning advertising in the Bulletin - details of our charges etc. are available from the Editor.

British Society of Rheology Conference

GENERAL RHEOLOGY

Birmingham University, 11-13 April 1984

To remind us that size and success are not synonymous, this conference demonstrated the advantages of moderation. Fifty three delegates, five from abroad, heard twenty three papers ranging widely over the rheological field - or perhaps seas would be more appropriate - in which Professor Boger's Annual Award lecture and Mr. Hutton's Presidential Address were clear navigation marks. One could comprehend the inter-relationships between each area charted, aided by an informal atmosphere which fostered discussion rather than disagreement. Synopses will appear in 'Rheology Abstracts'; all the presentations were well attended and worth it.

The papers on the rheology of suspensions contained a neat juxtaposition of reports on keeping particles in suspension and on persuading the suspended phase to consolidate, both turning on non-Newtonian behaviour. The common theme of studies of stretching flows of viscoelastic fluids was the importance, sometimes to the exclusion of viscous effects, of the elastic nature of the fluid. First-order viscoelastic theory is alive and well in Cambridge, correctly predicting stress growth and relaxation in converging flow from dynamic data, while in Birmingham the stress balance in a flowing conical membrane was compared with a readily available reference sample; the elastic trumpet was found to be in harmony with the rubber band. The disparate aspects of suspension and macromolecular behaviour were linked at this meeting both by Professor Boger's wide interests and by R. J. J. Jongschaap's derivation of the stress tensor, equally applicable in either case and likely to be of great value in elucidating microrheological phenomena. Meanwhile empirical relationships such as the Cross equation and the related Sisko equation continue to serve well in practical situations. It was good to hear a careful evaluation of the physical meaning of the parameters obtained by data fitting.

Progress in complex situations depends on high quality data in large quantities, i.e. via automation techniques such as those described. As treatment against the endemic black box syndrome, we were warned of spurious wall slip velocities from laser velocimetry and told how to deal with cone-and-plate gap setting errors. A fascinating variety of materials were discussed; polysaccharide gums containing only 1.5% solids yet of the consistency of hard rubber, electro-rheological fluids, nitro-cellulose doughs reminiscent of PVC in their behaviour yet more complex because of their multi-level fibrillar structure. Professor Boger described a suspension of short fibres in a high viscosity oil which exhibits constant viscosity but a normal stress directly proportional to shear rate (Boger Fluid II ?). This will doubtless provide as much employment as Boger Fluid I currently does.

The success of this meeting was almost entirely due to Ralph Oliver, whom we must thank most warmly for both the technical and social attractions, including a delightful venue and an excellent dinner, during which Professor Boger was presented with the Society's Annual Award.

I conclude, because it was a fitting conclusion to the meeting, with a note on the President's Address. Against the air of mutual self-confidence engendered by the feeling that the subjects discussed were at least familiar, if not totally understood, the President set a sterner note. We must learn more carefully from the past, not only technically, but in maintaining the common interest of all those involved in rheology. This is especially true at time when new areas of research are opening up, such as, in the past, bio-rheology, and, now, non-equilibrium molecular dynamics.

S. T. E. ALDHOUSE



ALL AWAKE AT BIRMINGHAM

ANNUAL AWARD 1983

The 1983 Annual Award of the British Society of Rheology was made to Professor David Boger, and the framed certificate which signifies the award bears the phrase "in recognition of his important contributions to the understanding of viscoelastic fluids". The choice of this phrase to encapsulate the contributions of David Boger is open to serious criticism on the grounds that it leaves out so much, and this brief discourse may only partly meet that criticism. It is appropriate (and are not this Society's awards always most appropriate?) that the programme of the meeting where this award is presented flanks the Boger lecture on either side by lectures describing experimental work with the well-known "Boger fluids". However a review of projects in which David is currently interested shows that last autumn's conference on "Engineering Rheology" would have been an equally appropriate setting for this award, and indeed he would be equally at home in conferences on "Rheology in Crude Oil Production", "Rheology and Micro-structure" or "Stretching Flows", to go through the list of this Society's last few meetings.

To a breadth of interest in rheological problems from the fundamental to the applied, David Boger has added a distinguished teaching record and service to the Australian Branch of the British Society of Rheology as Secretary (of the Victorian Branch), committee member, conference organiser and President. That relations between that Branch and this Society have remained good during the transition from Branch to Australian Society is due in no small measure to foundations laid during his presidency. His work as a teacher will influence the rheological community and the esteem in which others (notably chemical engineers) hold rheology; at a more immediately perceptible level his graduate students have contributed and do contribute in research which we see published.

This general and necessarily superficial eulogy may be tempered and given a slight technical edge by addressing briefly the question of why "the understanding of viscoelastic fluids" was singled out from among so many interests and achievements. The outstanding feature of this work has been care and thoroughness in carrying out an experimental programme over a period of several years on flow through contractions (and expansions) in pipes. The films he has taken have been seen by many British rheologists, and are recommended to those who have not seen them. The problem addressed is one of obvious practical importance, and also potentially of enormous fundamental significance. The "Boger fluids" have attracted so much attention because they offer the possibility of distinguishing effects in die entry and other flows which are attributable to the elasticity of the fluid from those which are attributable to inconstancy of viscosity and from those which require both elastic and shear-thinning behaviour.

A personal note is perhaps more necessary on this occasion than when we honour one of our domestically produced rheologists. We may perhaps be forgiven for thinking of David Boger as Australian, since he arrived in Australia many years ago "not even knowing what a non-Newtonian fluid was". He came to Monash University from a pre-rheological upbringing in the U.S.A., having trained as a chemical engineer at Bucknell University and the University of Illinois, and acknowledges a great debt to Professor O. E. Potter at Monash for showing him the way to true enlightenment through rheology. His arrival at Monash coincided with that of an R-16 Weissenberg Rheogoniometer and the two newcomers clearly had difficulty settling down since David admits to "not being able to measure the viscosity of water" with the instrument. Nevertheless he stayed at Monash (or at least was based there) for seventeen years, until moving to his present post of Professor of Chemical Engineering at the neighbouring University of Melbourne.

A fuller account of his scientific activities or of his globe-trotting would fill several issues of our Bulletin. One final quotation from his private correspondence will serve as an excuse for eschewing this: after more than half a page outlining a considerable number of his current research interests he says, with an almost British mastery of the art of understatement, "I think I am over-committed". It is therefore a great pleasure to welcome David Boger as he spares a few days from his busy schedule to join this Society at its Birmingham Conference and receive its 1983 Annual Award.



THE PRESIDENT MR. J.F. HUTTON (RIGHT), PRESENTS
THE 1983 ANNUAL AWARD TO PROFESSOR D. BOGER

MEMBERSHIP NEWS

Applications for Membership

The following applications were approved by Council at its last meeting (March 1984).

The symbols at the end of each entry refer to the interests of the member according to the following classification:

- f member's main interest is rheology
- p rheology is a secondary interest
- e approach is experimental
- t approach is theoretical
- s area of work is pure science
- a area of work is technology
- A metals
- B composites
- C solid polymers
- D molten or dissolved polymers
- E natural fibres
- F liquid – liquid systems
- G liquid – solid systems
- H particulate solids
- I glasses, ceramics
- J oils, greases
- K building and road materials
- L foodstuffs
- M biological materials
- N theoretical models
- O other systems

Mrs Susan Moira ANDRUSZKO
Wyeth Laboratories
Huntercombe Lane South, Taplow
Maidenhead, Berkshire

BSc, M.P.S

pesa FG

Dr Gholam Reza ASSAR
Dept of Process & Chemical Engineering
Heriot-Watt University
Chambers St., Edinburgh EH1 1ST

BSc (Hons), MSc, PhD

fetsa J

Mr Robert Stanley BADHAM
Dept of Chemical Engineering
The University of Birmingham
PO Box 363, Edgbaston
Birmingham B15 2TT

City & Guilds Cert.

fea DGJLM

Dr Leif R BOHLIN
Bohlin Rheologi AB
Science Park, Ideon, Box 742
S-22007 Lund, SWEDEN

Fil.Kand, Fil.Lic., Fil.Dr.,
Docent

fetsa BDFGJLM

Dr Patrick BOURGIN
Laboratoire de Mecanique des Surfaces
Ecole Centrale de Lyon
36 Av Guy de Collongne
69131 Ecully
FRANCE

Dipl.Eng., Docteur Ingenieur

fetsa DEJLN

Mr Joe G CABRERA
Department of Civil Engineering
University of Leeds
Leeds

Dipl.Eng. (Civil Eng)

pea FGHK

Mr William Robert CHAPMAN
Holt Lloyd Ltd
Nat Lane, Winsford
Cheshire

BSc (Hons)

eta BDFGJ

Mrs Susan Mary CHICK
Carri-Med Ltd
Interpret House, Curtis Rd, Dorking
Surrey

HND, Part I & II RIC

feta BDEFGHIJKLMN

Mr Peter Louis FINLAY
Integrated Petronics Systems Limited
120 Woodgrange Road
London E7 0EW

MSc

pea DFGJKLM

Dr Aloyse FRANCK Rheometrics GmbH Lyoner Strasse 44-48 D-6000 Frankfurt 71 WEST GERMANY	Chem Eng fesa BDGL
Mr A Jeffrey GIACOMINI McGill University Dept of Chemical Engineering 3480 University St. Montreal, Quebec, CANADA, H3A 2A7	BSc (Eng), MSc (Eng), P.Eng fetsa CD
Mr Trevor GREGORY Dept of Civil Engineering University of Leeds Woodland Road, Leeds, LS2 9JT	GRSC, MSc fetsa GHK
Dr David G. HARE Bradbury Wilkinson PLC Gatwick Road, Crawley Sussex	BSc, PhD pea G
Mr David George HOPEWELL Cadbury Schweppes PLC., Group Research The Lord Zuckerman Research Centre The University Whiteknights, Reading, RG6 2LA Berkshire	LRSC fetsa GL
Prof Yatchko IVANOV Central Laboratory of Physico-Chemical Mechanics Bulgarian Academy of Sciences Acad. G. Bontchev Street, IV km., Bl. I Sofia 1113 BULGARIA	PhD fetsa BCDGKLN
Mr Steven Michael JOHNSON British Gypsum PLC Beacon Hill, Newark Nottinghamshire	 fea G
Mr Niels Christian LARSEN Dumex Ltd Frags Boulevard 37, DK 2300 s, DENMARK	MSc. Pharm. petsa FG
Miss Odette MAGAUD Centre de Recherches Nord CdF Chimie SA BP1 62160 Bully les Mines FRANCE	Dipl.Chem.Eng fetsa CD

Debora Flanagan MASSOUDA
Colburn Lab., Chemical Engineering Dept.
University of Delaware
Newark, Delaware
USA

B.ChE
fetsa DFG

Mr James Haydon SEXTON
WR Grace Ltd Teroson Division
Cromwell Road, St Neots
Cambridgeshire

Grad.Plastics & Rubber Inst.
pea DG

Dr Jacqueline A SLIPPER
Wyeth Laboratories
Huntercombe Lane South, Taplow
Maidenhead, Berkshire

B.Pharm, PhD
pea FG

Dr Malcolm Richard Douglas STEBLES
Aarque Systems Ltd
PO Box 70, Blackthorne Road
Colnbrook, Slough

PhD, BA, MA
pea EFGH

Dr Jackie WOOD
Dept of Pharmacy
The University of Manchester
Manchester M13 9PL

BSc, PhD, MPS
fetsa DFGJ

Dr Anagnostis E. ZACHARIADES
IBM Corporation
Research Division (K42/282)
5600 Cottle Road, San Jose
California 95193
USA

BSc(Hon), PhD
fea CDM

RESIGNATIONS

R.L. BALLMAN. Monsanto Company. USA
Late Notification. Resigned in 1982. Joined in 1964

Mr K.A.EVANS. United Biscuits (UK) Ltd, Maidenhead
Joined in 1979

C KOEN. Consultant, Mareil-Marly France
Joined 1975

Mr G ZEMP. Contraves AG, Zurich, Switzerland
Joined in 1968

DEATHS

Dr J.R SCOTT. Shrewsbury
Died in Sept. 1982, Joined in 1944

Eirich receives Bingham medal

Frederick Roland Eirich has received the Eugene Cook Bingham Medal for 1983 from the Society of Rheology in recognition of his excellent contribution to rheology.

Eirich was born in Austria in 1905. He studied chemistry at the University of Vienna and obtained his PhD in 1929 and his *Habilitation* in 1938. His thesis, on colloidal gold, was written under the supervision of Wolfgang Pauli, one of the most prominent colloid chemists of the period and father of the Nobel laureate in physics.

In 1932, Eirich joined Herman Mark, who was assembling an interdisciplinary research team at Vienna in the field of natural and synthetic polymers. While there, Eirich focused on the viscosity of dilute solutions, and also established a small group devoted to the study of molecular hydrodynamics.

The German *Anschluss* of Austria led Eirich to emigrate to England, where he joined Sir Eric Rideal at Cambridge. There he continued his work on the fundamental aspects of colloidal suspensions, with emphasis on their rheological properties. In 1940 he

went to Australia, where he worked on a variety of problems concerning flow and tribochemistry. Returning to England in 1943, he again took up his teaching and research activities at Cambridge, until, in 1947, he rejoined Herman Mark at what is now the Polytechnic Institute of New York, in Brooklyn. In Brooklyn, Eirich's group worked on a wide range of topics in the field of polymers, again with emphasis on transport phenomena, the relationship between structure and physical properties, general rheology and mechanical testing, absorption and adhesion, and the properties of polyelectrolytes. Recently, stimulated by the work of T. L. Smith and M. L. Williams, Eirich has made contributions to the molecular aspects of the rupture polymers.

Eirich's influence has also been felt through his work as editor of the five volumes of *Rheology: Theory and Applications*, a series of symposia on high-speed testing, and the *Transactions* of the Society of Rheology (1952-56). He was also vice-president and president of the society 1969-73.

CHAPTER AND VERSE

From time to time members write in frustration that they have not been allowed to claim their membership dues against tax. Now a routine investigation of the more dusty of the Society's files has revealed a letter signed by the Senior Principal Inspector of Taxes (do they come any greater) which approves the British Society of Rheology for the purposes of Section 16 of the Finance Act of 1958 and that the whole of the annual subscription paid by a member will be allowable as a deduction. If that is not enough then please quote

Your ref: C.I./SUB/872 10th September 1959

and if you are due for any relief that you have not been allowed then you should apply to your tax office for form P358.

A REQUEST TO ALL MEMBERS OF THE BSR

The list of Members of the British Society of Rheology was last issued in 1979. The Council of the Society would like to issue up to date lists at more frequent intervals in future. During the past year the membership records of the Society have been put in a database on a microcomputer. The principal use of this system is to enable the Membership Secretary to keep better track of the payment of subscriptions and to produce mailing labels for the posting of the Societies Bulletin and Rheology Abstracts. These records will also be used to produce an up to date membership list later this year.

Past membership lists have included, in addition to the member's name and address, a set of letters which give an indication of the member's particular areas of interest in Rheology. The current records of these interests will, in most cases, be those that each member listed on his/her application form when they first joined the Society. It is therefore very probable that in many cases these will now be out of date. The BSR would like to ensure that the next membership list is as up to date as possible before it is issued. We would therefore request each member to check the copy of his/her individual record which has been enclosed with this copy of the Bulletin. This copy has also been sent to you to ensure that we are not in breach of the new regulations governing the keeping of computerised records.

An explanation of each of the fields used in the records is given below. A list of the abbreviations used to define member's interests is also given. Please make any corrections and additions which you feel are necessary on the form and then return it as soon as possible to the Hon. Membership Secretary at the following address.

Mr P.C. Anderson
32 Queensway
Feltham
Middlesex
England
TW13 7NS

It would be more informative to other Members if the first address in the records, which will be the one published in the new membership list, is that of the member's place of work. To overcome the problem many members have of all mail being opened by secretarial staff before they receive it, the bulletin envelopes will in future be stamped "Personal". If however you still wish to receive the Societies mail at home, then ensure that this is the first of the two addresses on the record form. The only information that will be published in the Membership List will be the member's name and title, the first of the two addresses in the records, the year of joining the Society and the abbreviations for the member's interests.

TITLES OF ITEMS IN RECORDS

EXPLANATION OF MEMBERSHIP RECORDS

SURNAME:	UPDATED:	Surname is used as a rapid search index.
TITLE & FORENAMES:		Updated refers to most recent address change.
ADDRESS:		Title, etc: Full name as used on labels
		Address: The first address is the one used for mailing. Unless otherwise requested it is the Member's Business address.
COUNTY:		
COUNTRY:	POSTCODE:	Business telephone number.
BUS. PHONE NO.:		Alternate address is usually the Member's home address unless given above. Otherwise the business address.
ALTERNATE ADDRESS:		
COUNTY:		
COUNTRY:	POSTCODE:	Class: Ordinary (ie British), European, American, Overseas, Honorary.
HOME PHONE NO.:		NO: No: Membership number.
CLASS OF MEMBER:		Date of joining the BSR.
DATE OF ELECTION:		Applies only if Membership lapsed earlier.
PREVIOUS MEMBERSHIP:		Dates and Offices held on BSR Council.
COUNCIL SERVICE:		
AGE:		Date of birth. Not essential.
INTERESTS:		Interests: Please see table and update to your current interests.
SUBS PAYMENT METHOD:		Payments usually made by cash, cheque, Banker's order, bank drafts, Girocredits, etc.
BANKER:		Name and address of Member's bank. For use only if other addresses are out of date.
PAYMENT RECORD:		
YEAR: DATE:	AMT:	Payment record lists subs year, date of credit and amount paid for last four payments.
YEAR: DATE:	AMT:	
YEAR: DATE:	AMT:	
YEAR: DATE:	AMT:	
REMINDERS:		
1ST DATE:	2ND DATE:	Dates on which reminders of overdue subscriptions were sent to members.
3RD DATE:	4TH DATE:	
BULLETIN SUBSCRIBER:		Whether Bulletin is posted to member.
ABSTRACTS SUBSCRIBER:		Whether Abstracts are posted to member.
ABSTRACTS CONTRIBUTOR:		Names of journals for which a member provides abstracts, if any.
COMMENTS:		Comments: Miscellaneous entries such as dates of correspondence, special requests, etc.

NOTICE OF THE ANNUAL GENERAL MEETING

The 40th Annual General Meeting of the British Society of Rheology will be held on Wednesday, 12th September, 1984 in the Physics Lecture Theatre, U.C.W., Aberystwyth, commencing at 5.30 p.m.

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

- (i) The election of a President for 1984-86.
- (ii) The election of other officers and members of Council, 1984-85.
- (iii) The receipt of a report and audited accounts from Council.
- (iv) Dealing with matters raised by Council or by any member, and receiving suggestions from members for consideration by Council.

Nominations received to date are as follows:

President	:	Prof. I M Ward
Secretary	:	Dr J J Benbow
Treasurer	:	Mr T A Strivens
Membership Secretary	:	Dr P C Anderson
Editor (Abstracts)	:	Dr D R Oliver
Editor (Bulletin)	:	Dr H A Barnes
Ordinary Members	:	Dr S T E Aldehouse Dr F S Baker Dr D C-H Cheng Dr C J S Petrie Mr H Schimanski Dr A Evans

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

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

THE BRITISH SOCIETY OF RHEOLOGY
SECOND
NOTICE OF CONFERENCE

TOPIC "RHEOLOGY OF LUBRICATION & OTHER INDUSTRIAL PROCESSES"

VENUE Physics Department, University College of Wales, Aberystwyth

TIME 11th - 13th September, 1984

PROVISIONAL SCHEDULE

Tuesday, 11th September, 1984

- 1.00 p.m. Lunch at Penybryn Hall
- 2.00 - 5.30 p.m. "Lubricants and Lubrication"
- Professor D Tabor (Cambridge University) on
Molecular Models in Lubricant Viscosity.
- Dr D M Heyes (Royal Holloway College) on
Molecular Mechanisms of Shear Flow.
- Dr J H R Clarke (UMIST) on
Molecular Dynamics Calculations.
- Dr G C Maitland (Imperial College) on
Effects of Chain Flexibility and Inter-
molecular Forces on Rheological Properties.
- Dr D R Oliver (Birmingham University) on
Load Enhancement Effects by Polymer-thickened Oils.
- Dr B Briscoe (Imperial College) on
Friction of Organic Polymer Films.
- 6.00 p.m. Annual General Meeting of BSR.

Wednesday, 12th September, 1984

- 9.00 - 12.30 p.m.) "Industrial Rheology Workshop" including
- 3.00 - 5.00 p.m.)
- Mr J F Hutton (Shell Research) on lubricants.
- Dr H A Barnes (Unilever) on detergents.
- Mr F N Cogswell (ICI) on molten plastics.
- Dr J R A Pearson (Schlumberger) on Systems Engineering & Industrial Rheology.
- Dr J J Benbow (Birmingham University) on Methods of measuring paste Rheology.
- Mr T C Davenport (BP) on oil recovery.
- 2.00 - 3.00 p.m. Gold Medal Address:
- PROFESSOR K WALTERS
- 7.00 p.m. Reception and Conference Dinner

Thursday, 13th September, 1984

Additional papers have been received on the subject of "friction and lubrication", making it a distinct possibility that there will be a morning session including a visit to the Rheology Laboratory, Dept. of Applied Mathematics. One or two more papers could be included, but they must be sent to the President within the next week.

UNIVERSITY OF WISCONSIN—MADISON

MADISON 53705

MATHEMATICS RESEARCH CENTER

**Symposium on
Viscoelasticity and Rheology
October 16-18, 1984**

The Mathematics Research Center at the University of Wisconsin-Madison will hold an Interdisciplinary Symposium on Viscoelasticity and Rheology in Madison on October 16-18, 1984. The Symposium will compare a diversity of views on constitutive theories, mathematical modelling, experimental and numerical methods, and comparisons between theoretical and experimental results. The 16 distinguished invited speakers (applied mathematicians, rheologists and mechanicians) are:

R. C. Armstrong, R. B. Bird, B. Coleman, C. Dafermos,
H. W. Giesekus, Ole Hassager, Dan Joseph, A. S. Lodge,
R. C. MacCamy, David Malkus, M. Renardy, R. Tanner,
E. Walsh, K. Walters, W. D. Williams, L. J. Zapas

A detailed program will be available in August 1984, and further information can be obtained from Mrs. Gladys Moran, Conference Secretary, Mathematics Research Center, University of Wisconsin-Madison, 610 Walnut Street, WARF Bldg., Madison, WI 53705. Information can also be obtained from the organizers: John A. Nohel, Arthur S. Lodge and Michael Renardy.

DRAG REDUCTION 84

An International Conference on the Fundamentals and Applications of Polymer Drag Reduction in Liquid Flows

BRISTOL, ENGLAND
International Association
for Hydraulic Research



2-4 July 1984
University
of Bristol

The 1984 Meeting "DRAG REDUCTION '84" is sponsored by the IAHR Committee on Fundamentals through its Task Force: "Engineering Applications for Drag Reduction", and by the Department of Civil Engineering of the University of Bristol.

General Framework

Polymer drag reduction meetings were held in Cambridge, England in 1974 and 1977. The 1984 Bristol meeting is planned to continue this sequence by reviewing progress made in this subject in the intervening seven years. During this interval interest in the engineering applications aspect of the subject has developed considerably but progress has also been made in exploring the fundamental mechanism of drag reduction.

Conference Fee

£155 (£145 for IAHR Members). This fee includes the technical papers, lunches, and refreshments, two Receptions, the river excursion, and the Conference Banquet for delegates.

Guest Programme

A Guest Programme is arranged for the duration of the conference, including visits to places of interest in and around Bristol and Bath, and is free to guests of delegates, who will also be welcome to attend the Conference Banquet, at an additional charge.

Conference Papers

Additional copies of the conference papers, included in the registration fee for delegates, will be available after the Conference.

FOR FURTHER INFORMATION please contact:

Dr. R. T. Moses,
Organising Secretary,
Drag Reduction '84,
Faculty of Engineering,
Queen's Building,
Clifton,
Bristol BS8 1TR, U.K.

Telex: BUPHYS G 444174
Tel: (0272) 24161 Ext. 846

The Institution of Chemical Engineers



POWTECH 85

5 - 7 March 1985 Birmingham

CALL FOR PAPERS

Papers are invited on all aspects of the Processing or Handling of Particulate Solids, particularly those dealing with industrial topics.

The main areas of the symposium will be:—

- **Particle Formation, both by growth processes (e.g. granulation, crystallization) and size reduction (e.g. milling, grinding).**
- **Handling of Powders (e.g. conveying, storage).**
- **Solid/Liquid Phenomena (e.g. dewatering, slurry transport).**

The organisers would welcome papers dealing with the design and creation of industrial products based on particulate technology. It is intended that a wide range of industries will be covered, including chemicals, minerals processing, pharmaceuticals and food.

The symposium is organised by The Institution of Chemical Engineers and will be held at the National Exhibition Centre, Birmingham, in conjunction with the Powtech 85 Exhibition.

Abstracts of not more than one A4 page should be sent by 14th May 1984 to:—

Miss Fiona Dendy
The Institution of Chemical Engineers,
165-171 Railway Terrace, Rugby CV21 3HQ, UK.
Telephone: (0788) 78214 Telex: 311780

Full versions of papers will be required by the beginning of September 1984.

OTHER MEETINGS

- 25-27 June Essen, Germany. Influence of polymer additives on Velocity and temperature fields (IUTAM)
- Contact Professor B. Gampert, Univ. Essen Gesamthochschule, Fachbereich 12, Maschine technik, Postfach 103764 D-4300 Essen, BRD.
- 19-25 August Lyngby, Denmark. XVI International Congress of Theoretical and Applied Mechanics
- Contact Dr. N. Olhoff, ICTAM, Technical Univ. of Denmark, Building 404, DK-2800 Lyngby, Denmark.
- 29-31 August Brussels, Belgium. Mechanical characterisation of load-bearing fibre composite laminates (Euromech 182)
- Contact Professor A. H. Cardon, Vrije Universiteit Brussel, Faculty of Applied Sciences, Pleinlaan 2, 1050 Brussels, Belgium.
- 3-7 September Prague, Czechoslovakia. 8th CHISA Congress with European Symposia on Stress and Strain Behaviour of Particulate Solids and on Mixing of Non-Newtonian Industrially Important Fluids
- Contact 8th Congress CHISA '84, P.O. Box 857, 11121 Praha 1, Czechoslovakia.
- 4-8 September Moscow, USSR. International Rubber Conference
- Contact Professor V. A. Berestnev, General Secretary, "Rubber 84" Organising Committee, Krasnobogatyrskaya Street 42, Moscow 107258, USSR.
- 12-14 September Nancy, France. Rheology of biological fluids (Euromech 186)
- Contact Professor M. Lucius, Institut National Polytechnique de Lorraine, B.P. 3308, Porte de la Craffe, 54014 Nancy Cedex, France.
- 16-23 September Varna, Bulgaria. 10th International Conference on Nonlinear Oscillation
- Contact Academician G. Brankov, Institute of Mechanics and Biomechanics, "Acad. G. Bonchev" Str. B18, 1113 Sofia, Bulgaria.
- 17-21 September Prague, Czechoslovakia. Optical Methods in the Dynamics of Fluids and Solids (IUTAM)
- Contact Professor M. Pichal, Institute of Thermomechanics, Czechoslovak Academy of Sciences, Puskinovo n.9, CS 160 00 Praha 6, Czechoslovakia.

- 8 May London. Rheology in the process industries (BSR, RSC)
Preliminary announcement,
Contact Dr. H. A. Barnes, Unilever Research, Port Sunlight
Laboratory, Bebington, Wirral, Merseyside. L63 3JW, UK
- ?-? September ? U.K. Experimental rheology (BSR)
Preliminary announcement,
Contact Secretary (Dr. J. J. Benbow)
- 1-4 October Varna, Bulgaria. IVth National Conference on Mechanics
and Technology of Composite Materials
Contact Dr. Ya Ivanov, Central Laboratory of Physico-Chemical
Mechanics, Bulgarian Academy of Sciences,
Acad. G. Bontchev. Str., IV km, BII, Sofia 1113,
Bulgaria.
-

6TH "ROSS PRIORY" RHEOMETRY SEMINAR

To mark the co-operation between Sangamo (the sponsors of previous seminars) and Contraves, the next Seminar will be held in Zurich.

Guest lecturers are:

Prof. K Walters, U.C.W. Aberystwyth
Dr J Ferguson, University of Strathclyde
Dr H A Barnes, Unilever Research, UK

The Seminar will be held on June 14th and 15th and will deal with "Industrial Rheology".

Details of the Seminar including fees etc. can be obtained from:

Mr H Schimanski
Contraves Industrial Products
Times House
Station Approach
RUISLIP
Middlesex HA4 8LH
Tel. 08956 30196

Numerical Simulation of Non-Newtonian Flow

by M.J. CROCHET, *Université Catholique de Louvain, Louvain-la-Neuve, Belgium*, A.R. DAVIES and K. WALTERS, *University College of Wales, Aberystwyth, U.K.*

(Rheology Series. 1)

In development and use, non-Newtonian fluids often encounter complex geometries and extreme conditions in many practically important situations. The advent of very high-speed computers has enabled some headway to be made in the search for theoretical solutions to these practical problems and there has been progress in the general area of the numerical prediction of the behaviour of elastic liquids in complex geometries (with and without free surfaces), which is the basic concern of this book.

It provides a critical review of numerical simulation as applied to Newtonian fluids and an assessment of how this can be adapted to meet the new challenges of fluids with memory. While the authors draw heavily on the wealth of literature available in classical fluid

mechanics, their major concern is to emphasize the distinctive changes necessary in the non-Newtonian situation. In the numerical simulation sections, both finite difference and finite element techniques are considered since both have been employed in the development of the subject.

CONTENTS: Section 1. Non-Newtonian Fluid Mechanics. General Introduction. Basic Equations. Flow Classification. An Overview of Numerical Simulation. **2. Finite Difference Techniques.** Introduction to Finite Differences. Finite

Difference Simulation: Differential Models. Finite Difference Simulation: Time Dependence. **3. Finite Element Techniques.** Introduction to Finite Elements. Finite Element Calculation of Generalized Newtonian Flow. Finite Element Calculation of Viscoelastic Flow. **4. Epilogue.** Outstanding Problems. Future Trends. References. Indexes.

1984 xiv + 352 pages
US \$ 65.50 (USA & Canada)
Dfl. 170.00 (Rest of the World)
ISBN 0-444-42291-9

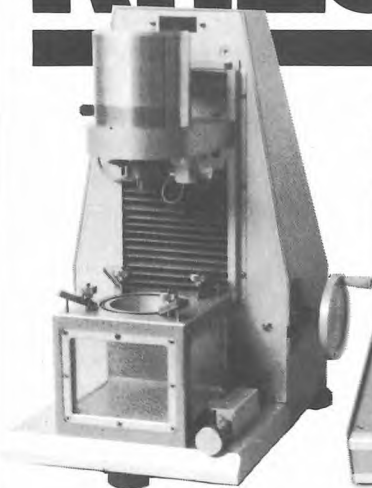
ELSEVIER



P.O. Box 211
1000 AE Amsterdam
The Netherlands

P.O. Box 1663
Grand Central Station
New York, NY 10163

MATERIALS TESTING FROM **SANGAMO** **RHEOLOGY**



Visco-Elastic Analyser
Constant Stress Tester



- Yield stress evaluation
- Creep growth and relaxation
- Oscillatory mode tests
- Temperature to 350°C
- IEEE interface

Other materials testing products include:

- R20 Weissenberg Rheogoniometer
- Elongational Viscometer
- Rheovibron Solids Tester

Now

Computer controlled versions available

For full details contact:

Sangamo Schlumberger Rheology Division
North Bersted Bognor Regis W Sussex PO22 9BS UK
Telephone 0243 825011 Telex 86827

SANGAMO
Schlumberger