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THE BRITISH SOCIETY OF RHEOLOGY

BULLETIN — No. 4, 1964

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DR. D. W. HADLEY,
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BRITISH SOCIETY OF RHEOLOGY

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University College of Wales, Aberystwyth.

CHANGES IN THE BULLETIN?

Are you satisfied with the Bulletin, or would you prefer its scope to be widened? The Bulletin depends upon members of the Society for its contributions, and the more contributions received the more varied will be its contents.

Two more articles are in hand for the series on the applications of rheology, dealing with topics as diverse as dairying and synthetic fibres. Further contributions would be welcome, and if you are interested in writing 5,000 words concerning specific applications of rheology, please let the Editor know. Complete manuscripts would not be required at this stage.

General articles, letters to the Editor, and items for a news of members column will always be considered for publication. Views on improving the Bulletin, without increasing production costs by an undue amount, will always be considered.

OFFICERS AND COMMITTEE OF THE SOCIETY 1964-65

The Society's new President, in succession to Dr. R. Roscoe, is Professor A. J. Kennedy of the College of Aeronautics, Cranfield.

Mr. P. E. Knapp has resigned as Editor of the Bulletin, and is replaced by Dr. D. W. Hadley.

Dr. K. Walters and Mr. B. Warburton have been elected to the Committee to fill the vacancies caused by the retirement of Mr. D. R. Reid and Dr. J. H. C. Vernon.

The remaining Officers are as before.

REPORT OF THE HONORARY SECRETARY 1963-64

The past year, the first year of your present Honorary Secretary's term of office, has been a busy one. He can fully endorse the comments made by his predecessor in last year's report, on the difficulties of running a Society of this kind without permanent staff or premises, but he would also pay tribute to the continuing help and willingness shown by other Members of Committee in sharing the burden of work.

- I. *Constitution.* New Rules came into force during the year.
- II. *Membership.* Total membership can be an important economic consideration in a society's administration. An encouraging increase in total membership, from about 380 in 1963 to 438 at present, can be reported. The Society is greatly indebted to Dr. Tattersall, our Membership Secretary, for all his hard work.

A number of pamphlets describing the Society's activities are now available and it is hoped that members will make use of these with a view to introducing new members. It has always been the policy of our retiring President, Dr. Roscoe, to encourage drives towards increased membership.

III. *Overseas Membership and Activities.* An increasing number of rheologists on the Continent appear to be showing interest in the Society's activities. The two Australian (Victoria and New South Wales) Branches have continued to be very active.

IV. *Meetings Held.* Two symposia have been held as follows: Rheological Properties of Clays and Fine Powder Suspensions. Keele University, September 26-27th, 1963. (Attendance of about 70.)

Rheology of Paints and Allied Products (Joint Meeting with the Paint Research Station). April 29th, 1964. (Attendance of 200.)

V. *Meetings Projected.* Flow of Powders and Granular Solids. Nottingham University, April 6-8th, 1965.

Colloid Gums. Joint Meeting with Colloids and Surface Activity Group Society of Chemical Industry, London, March, 1966.

(Suggestions for above papers would be welcomed.)

VI. *Rheological Research.* Rheological research has been a very live topic during the year under review.

By agreement between the Executive Committee of the Society and the National Engineering Laboratory, East Kilbride, a "British Society of Rheology and National Engineering Laboratory Joint Survey of Rheological Research in Britain" was started during the year.

As empowered at the 1963 Annual General Meeting, the Executive Committee appointed an Exploratory Committee on Rheological Research. This met three times under the chairmanship of Dr. A. S. Lodge and the Society is indebted to the twenty or so members of this committee who gave their time and thought to the problems facing rheological research.

The Exploratory Committee presented its final Report in June, 1964, and this was accepted in principle by the Executive Committee at its July Meeting. Special consideration is being given to this important matter under Items 6 and 7 of the A.G.M. Agenda.

VII. *Relations with Other Bodies.*

1. *British Standards Institution*

The Society was represented on B.S.I. Committees as follows:

C/17	Viscosity	Dr. E. J. W. Mardles
C/17/3	Viscosity of Petroleum Products (International)	Mr. J. F. Hutton
CHE/50	Test Methods for Powder Properties	Mr. R. J. Cole
CHE/50/2	Particle Density, etc., of Metallic Powders	Mr. R. J. Cole
CHE/50/4	Particle Density, etc., of Non-metallic Powders	Mr. C. C. Mill
M/62/4	Starch Viscosity	Dr. H. G. Muller
PLC/17	Testing of Plastics	Dr. M. F. Culpin
RUC/10/4	Physical Testing of Rubber ...	Dr. D. Bulgin

It would be appreciated if members would notify the Secretary of other B.S.I. Committees of potential interest to the Society. It would seem from perusal of the Annual Report of the B.S.I. and of "B.S.I. News" that there may be many areas where such representation might well be extended.

2. *Institution of Chemical Engineers*

Professor P. V. Dankwerts, Shell Professor of Chemical Engineering in the University of Cambridge, represented the Institution of Chemical Engineers at a meeting of our Exploratory Committee and gave it the benefit of his advice and experience as Chairman of the analogous Chemical Engineering Research Exploratory Committee.

Dr. J. H. C. Vernon, for part of the year, represented the Society on the Working Party for Materials Science and Technology originally set up by the Institution.

3. *Society of Chemical Industry—Colloids and Surface Activity Group*

Cordial relations have been established and the possibility of a joint meeting (see above) is being explored.

VIII. *Publications.*

1. *Bulletin.* Publication of the Bulletin, as a useful means whereby contact and communication with members is maintained, has continued. As a new feature, articles of general rheological interest have appeared. The Society is much indebted to the retiring Bulletin Editor, Mr. P. E. Knapp.

2. *British Rheology Abstracts*. British Rheology Abstracts is, of course, now a firmly established publication of the Society. The Executive Committee has given considerable attention this year to improving the economics of publication. It is, therefore, very gratifying to be able to report a successful outcome of negotiations with Pergamon Press Ltd. Improved terms, likely to amount to an increased income to the Society of about £350 p.a., have made it possible for the Committee to postpone recommending, at least for another year, any increase in membership subscription. The debt the Society owes to Mr. Whorlow (Editor) and his loyal team of Abstractors who have made this possible, is most apparent.
3. *Symposia*. A more satisfactory basis for publication of the Society's symposia as they occur has received some attention and is commended to the new Committee for further consideration.

R. J. COLE,
Honorary Secretary.

THE BRITISH SOCIETY OF RHEOLOGY

ACCOUNTS FOR THE YEAR ENDING 30th JUNE, 1964

		INCOME		
1962/3		£	s.	d.
748	Balance at 1st July, 1963 ...	678	3	10
327	Subscriptions	372	2	0
13	Interest P.O.S.B. Account ...	13	5	6
704	Meetings	343	16	8
20	Sale of Bulletin	16	0	
		£1,408	4	0

		EXPENDITURE		
1962/3		£	s.	d.
237	Printing and postage of Bulletins and Abstracts ...	286	3	6
180	Committee and administra- tive expenses	306	11	7
712	Meetings	325	7	4
4	Income Tax	4	13	0
	Refund on subscriptions ...	3	2	0
	Refund on sale of Bulletin ...	16	0	
678	Balance at 30th June, 1964 ...	481	10	7
		£1,408	4	0

(Signed) G. K. JONES,
Hon Treasurer.

(Signed) ALAN G. WARD,
Hon. Auditor.

EXETER CONFERENCE, 28th-30th SEPTEMBER

The meeting was divided between two topics: the first day being devoted to papers on rheogoniometry, and the remainder of the meeting to discussion on the teaching of rheology. In addition Dr. R. Roscoe delivered the Presidential address, and visits were organised to a brickworks and a pottery.

Professor K. Weissenberg delivered the first paper on "The Role of Rheogoniometry in Continuum Mechanics" in which he endeavoured to show that the measurement of flow properties (all stress and rate of strain components) at a fixed point in space provides a key to the whole of Continuum Mechanics. It was impossible to do full justice to such a major study in the time allotted, and most of those present would have welcomed a longer exposition.

Several papers dealt with the study of liquids using the Weissenberg cone and plate viscometer, and tended to review past work rather than present new information. The paper given by Mr. J. E. Roberts, one of the pioneers of rheogoniometry, referred to work carried out some ten years ago in an attempt to distinguish between three constitutive equations. Mr. Lammiman another of the original workers in this field gave a detailed account of the "correct" method of use of a rheogoniometer, emphasising points of detail which were often disregarded by the majority of workers. In later discussions his attitude on these matters became less rigid, but he still emphasised the necessity of recognising the approximations that one often had to make (e.g. to avoid time effects) and the resultant increase in error.

Mr. Langborne's paper discussed in some detail the mechanical improvements that had been made to the instrument since the early prototype. He then dealt with attempts to analyse results, for a damping fluid, on a theoretical basis, choosing the Oldroyd theory. For steady rotation his viscosity curves did fit the theoretical equation he derived. Oscillatory testing, however, did not give agreement between theory and practice, as the constants in steady rotation should have been derivable from relaxation times and were not. A brief outline of future possible developments of the instrument, e.g., extension of the frequency range was given. Two papers were presented by Mr. R. King. The first gave flow data for three polyethylene polymers, and the second dealt in some detail with the latest modifications to the instrument marketed by his company.

A flow instability in the cone and plate viscometer was described by Mr. J. F. Hutton. Silicone oils were examined using a Ferranti Shirley viscometer, and the elastic energy, from normal stresses, was related to the energy required to create a new surface. Meniscus effects, separation of the plates and plate diameter affected the onset of "fracture" and showed good agreement between theoretical and practical results. There was some discussion as to the use of the term "fracture" and as to the real cause of this effect.

Dr. J. Harris concluded the session with a paper on the interpretation of experiments on polymer solutions in a coaxial cylinder rheometer. It should be possible, using phase-lag measurements, to distinguish between models showing different relaxation time spectra.

At the end of the conference Dr. H. Giesekus showed an excellent film of secondary flow occurring round a rotating bob and between a cone and plate (30° angle!). The liquid used was 1% solution of carboxy methoxy cellulose in water, and the flow times were demonstrated by injection of dyed material. Two "layers" of liquid rapidly developed, with virtually no interchange of materials in the case of the rotating bob. Dr. Giesekus had calculated, on the basis of the Erickson theory the expected secondary flow pattern in the cone and plate system and agreement between theory and practice was remarkably good.

All speakers in the second part of the conference agreed to limit the topic to teaching of rheology to University students and some advocated that it ought even to be reserved to postgraduate courses. However, there were several speakers who outlined schemes for incorporating the essentials of rheology into undergraduate applied physics courses. The scheme proposed by I. H. Hall (Manchester C.S.T.) was the most carefully considered and had been integrated with the remainder of the mathematics and physics training. R. W. Whorlow (Battersea) felt that there was little hope of a course labelled "Rheology" being given space in a physics degree syllabus. Undergraduates should, however, hear about rheology; most do not at present. Illustrations from the rheological field would be valuable in many courses, particularly thermodynamics and properties of matter.

J. R. A. Pearson (Cambridge) discussed the difficulties that arise in teaching rheology unless more mathematics than usual are available to the student. He advocated a more thoroughgoing change in mathematics teaching to overcome this difficulty. He outlined a syllabus in continuum mechanics which would provide the mathematical tools necessary. The same difficulty had been overcome by A. S. Lodge in a scheme which has recently been published ("Elastic Liquids" A. S. Lodge). He entitled his lecture "Finite Strain without Tensors (or Rheology without Tears)" and he ably demonstrated his theme. Whether the student could always build on Lodge's approach was queried by one or two speakers but there is no doubt that his approach does overcome some of the difficulties facing non-mathematical rheologists today.

The contribution of T. Ll. Richards (Birmingham C.A.T.) took the form of a concise historical survey of the deformation of metals, and, although informative, was possibly a little out of the general context of the session. Dr. J. Harris (Queen's, Dundee) queried whether there was need for the meeting, in attempting to prove that rheology could not fit as a subject into any educational plan. His departure immediately after the paper curtailed discussion on this explosive

theme, but it was felt that in view of Dr. Harris's extremely narrow definition of rheology the difference between the speaker and the remaining delegates was possibly one of semantics rather than applied science.

Several speakers, mainly from industry asked about short courses for graduates. The dichotomy between the industrial short—a few weeks—and the academic short—not less than a term—was not resolved, but the representatives of the academic schools of rheology promised to go away and think out some schemes, having heard that there was a demand from industry. The discussion was useful in the exchange of views and in informing rheologists of the changes at the Universities, but might have been even more useful if less philosophy of education had intruded.

During the education session Dr. R. Roscoe delivered, with his characteristic verve and enthusiasm, a Presidential Address entitled "Mistakes in Rheology." Amongst those singled out for attack were the confusers (particularly geophysicists) of solids and liquids, and the misusers of activation energy. The address ended, however, on a more constructive note, with a plea for more theoretical work and co-operation between experimentalists and mathematicians.

An extremely full programme was completed by an unofficial evening meeting on "Unification," organised by Mr. A. Graham and Dr. G. W. Scott Blair, and reported elsewhere.

The Conference Secretary is to be congratulated on the successful organisation of the meeting, and it is hoped that in future years he will ensure that both the weather conditions and the surrounding country are up to this year's high standard. A further thought for the future is the possibility of arranging late night transport back to Halls of Residence if the road from the distant town centre has an average gradient greater than 1 in 4.

J.R.B.
D.W.H.
K.W.H.

A UNIFIED APPROACH TO RHEOLOGY

It is sometimes thought that the study of rheology is fragmented by the barriers that surround different industries and contrasting materials. Initially attention was concentrated on the features of structure and behaviour by which materials were most in contrast, and theories thus tend to be tied to these contrasting features. Many materials are, however, composite, with the satisfactory performance of the whole depending, in critical applications, on a rheological balance between contrasting constituents. Since studies of materials treated as continua suggest that sub-division may be artificial, some form of unification of rheology may be possible.

It is feasible that overall similarities in rheological behaviour may be recognised for a wide range of materials if attention is given to a sufficiently extended time scale, or if computer techniques are used for handling problems of many variables.

An informal meeting held during the recent Exeter Conference resulted in the formation of a small group, consisting of Mr. A. Graham, Mr. K. A. Lammiman, Dr. G. W. Scott Blair and Professor K. Weissenberg, with Dr. J. Kubat and Dr. H. Giesekus as foreign correspondents, which is to meet from time to time to consider the possibility of a unified approach to rheology. The group is not an official sub-committee of the Society, and any member who feels an interest in the topic of unification should communicate directly with Mr. Graham at National Gas Turbine Establishment, Pyestock, Farnborough, Hants.

BINDERS FOR RHEOLOGY ABSTRACTS

New members may be unaware that binders are available for Rheology Abstracts. The Society cannot hold a stock of these binders, and members who require them are asked to obtain them individually.

The recommended binder will hold 8 issues (two complete years) and is made of stiff board, covered with Leathercloth and Milskin; the Abstracts are retained by wires. The title and years are gold blocked on the spine.

They are supplied by: Easibind Limited, 84 Newman Street, London, W.1.

Members should write direct to the makers, asking for a binder for Rheology Abstracts and giving the year or years concerned. The cost is 16s. 0d. each post free.

NOTES AND NEWS

The Joint British Committee for Stress Analysis, which is serviced by the Institution of Mechanical Engineers, is planning to issue a periodic bulletin to persons in the United Kingdom who are interested in Stress Analysis.

Before embarking on publication of the bulletin, which would give information on current meetings and other activities, publications, etc., the Committee would like to know the probable demand. Would members interested in Stress Analysis please communicate with the Secretary of the Joint Committee, at 1 Birdcage Walk, London, S.W.1.

If a decision is taken to produce a bulletin or newsletter no charge will be made, and the interval between each issue will be determined by the material available, and its urgency.

The Institution of Chemical Engineers is co-operating with the American I. of C.E. to hold a joint international conference in London on 13th–17th June, 1965. Among the ten main topics to be discussed are symposia on: application of mathematical models; transport phenomena; reaction kinetics, with emphasis on polymerisation phenomena; and mixing—theory related to practice. Details can be obtained from the Institution at 16 Belgrave Square, London, S.W.1.

A new edition of “Scheme for a Part-time Course in Chemical Engineering,” has been published by the Institution of Chemical Engineers. The Scheme represents the official Notes for Guidance on the arrangement and control of courses leading to H.N.C. in Chemical Engineering, and Endorsement Certificate. Copies may be obtained from the Institution.

The Society of Rheology (U.S.A.) has awarded the Bingham Medal for 1964 to Professor J. M. Burgers of the University of Maryland, for outstanding contributions to both general rheology and the flow of crystalline solids.

The Winter Meeting of the Society of Rheology will be held at Santa Barbara, California, on January 28th–29th, 1965, with the programme featuring several review talks by outstanding rheologists. The Winter Gordon Conference on Polymers will be held at the same hotel immediately following the Rheology Meeting. Details obtainable from C. C. Surland, Dept. 4520, Aerojet-General Corp., P.O. Box 1947, Sacramento 9, California, U.S.A.

The Group Francais d'Etudes de Rhéologie, formed in 1954 under the guidance of the Centre National de la Recherche Scientifique, has been reorganised as a self-governing body, with the new name of Groupe Francais de Rheologie. Details may be obtained from M. Persoz, 68 Bd. Saint-Michel, Paris 6.

The Annual Exhibition of Scientific Instruments and Apparatus, organised by the Institute of Physics and the Physical Society, is to move from its traditional home in London for 1965. It will be held at the Manchester College of Science and Technology from 5th–8th April.

A conference on Stress Analysis is to be held in Bristol from 7th–9th April, 1965. Further information is obtainable from the Administration Assistant, The Institute of Physics and the Physical Society, 47 Belgrave Square, London, S.W.1.

The Materials and Testing group of the Institute of Physics and the Physical Society is organising a conference on Internal Friction in

Solids, to be held in Manchester from 7th–9th September, 1964. The final scope of the meeting will depend on the nature of the communications submitted. Intending participants should submit a title and abstract of their paper to Dr. G. Leak, Department of Metallurgy, The University, Manchester 13.

A course of ten lectures on "Industrial Rheology" is being held at the College of Technology, Liverpool on Monday evenings at 7 p.m., beginning 18th January, 1965. The programme is as follows:

18th and 25th January	Introductory Lectures	...	DR. D. J. SHAW
1st February	...	Instrumentation and Ex-	
		perimental Techniques	...
			DR. D. C. H. CHENG
8th February	...	Rheology of Emulsions	...
			MR. P. SHERMAN
15th February	...	Biorheology	...
			DR. G. W. SCOTT-BLAIR
22nd February	...	Mechanical Properties of	
		Polymers	...
			MR. B. WRIGHT
1st March	...	Rubber Elasticity	...
			DR. L. R. G. TRELOAR
8th March	...	Oils and Greases	...
			MR. J. F. HUTTON
15th March	...	Rheology of Clays	...
			MR. F. MOORE
22nd March	...	Surface Rheology	...
			DR. D. A. HAYDON

Application for admission to the course (Fee £2) should be sent to The Head of The Chemistry and Biology Department, College of Technology, Byrom Street, Liverpool, 3.

A postgraduate course of about nine lectures on the Rheology of Metals will be given at Battersea College of Technology on Wednesday evenings, 6.30–8.30 p.m., commencing January, 1965. The first four lectures, by A. G. Crocker (Battersea College of Technology) will be concerned with the physical processes occurring during metal deformation. In the remaining lectures B. Lengyel (Imperial College) will consider large plastic deformations of metals from a continuum viewpoint. Further details and application forms may be obtained from the Secretary (Rheology Course), Battersea College of Technology, London, S.W.11.

New Members

NAME AND ADDRESS	INTERESTS
R. S. Clark, Grad.Inst.P., 72, Kechill Gardens, Bromley, Kent.	P.V.C. calendering and extrusion.
J. B. Crofts, B.Sc., F.R.I.C., 180, St. Leonard's Rd., East Sheen, London, S.W.14.	Adhesives, foods, creep, extrusion, emulsions.
N. Gerald, B.Sc., A.Inst.P., Cherrydale, St. Richard's Drive, Aldwick, Bognor Regis.	Rheogoniometry, polymer melts, capillary rheometry.
K. Lawrence, B.Sc., Ph.D., A.R.I.C., 13, Meadow Way, Burgh Heath, Tadworth, Surrey.	Polymer melts, rheogoniometry, capillary rheometry.
R. L. Pemberton, Grad.R.I.C., 8, Goddington Lane, Orpington, Kent.	P.V.C. extrusion, rotational and oscillatory viscometry, capillary methods.
D. J. Ray, Warren Spring Lab., Gunnels Wood Road, Stevenage, Herts.	Suspensions, viscometry.
G. R. South, B.Sc., 17, Boxhill Way, Strood Green, Betchworth, Surrey.	Printing inks, adhesives.
L. Brandts Buys, Ing.Tech., 24, Avenue Echevin Van Muylders, Bruxelles, 15, Belgium.	Paints.
G. Manfre, C.S.V. "Vetrocoke", P. Marghera, Venezia, Italy.	Glass, plastics.
D. Freson-Rose, L.en.Sc., 48, Avenue du Frene, Bruxelles, 2, Belgium.	Paints.
R. R. Zangger, Mech.Eng., 20, Kirchweg, Oberengstringen, Switzerland.	Rheometry, materials.