

THE BRITISH SOCIETY OF RHEOLOGY

BULLETIN — No. 1, 1962

HISTORY
NOT TO BE REMOVED
FROM
FILE.

Hon. Secretary :

DR. M. F. CULPIN,
8 The Broadway,
Pontypool,
Monmouthshire.

Hon. Editor (Bulletin) :

MR. J. F. HUTTON,
"Shell" Research Ltd.,
P.O. Box No. 1,
Chester.

THE BRITISH SOCIETY OF RHEOLOGY

New Members

Elected 20th September 1961

NAME AND ADDRESS

Dr. B. A. Bilby,
Bushey Mount
32 Devonshire Road,
Totley Rise,
Sheffield.

W. W. Crouse Jr.,
Sun Oil Co.,
Marcus Hook,
Pa, U.S.A.

A. T. J. Hayward,
National Engineering Laboratory,
East Kilbride,
Glasgow.

R. G. King,
Farol Research Engineers Ltd.,
North Bersted,
Bognor Regis,
Sussex.

Dr. E. Saibel,
Rensselaer Polytechnic Institute,
Troy,
New York, U.S.A.

P. J. L. Whybrow,
The Mead,
Coventry Road,
Bickenhill,
Solihull, Warwicks.

Elected 7th December 1961

R. R. Blakey,
British Titan Products Co. Ltd.,
Billingham-on-Tees,
Co. Durham.

Dr. J. H. Chapman,
Glaxo Laboratories Ltd.,
Greenford,
Middlesex.

Miss P. D. Emery,
15 Hampton Court,
George Road,
Edgbaston, Birmingham 15.

A. J. Farnley,
200 Icknield Way,
Letchworth, Herts.

INTERESTS

Theory of Plasticity.

Capillary viscometry of high polymer solutions. Shear stability of high polymer solutions.

Oils and greases. Weissenberg rheogoniometer. Non-Newtonian pipe and channel flow.

All materials. Viscometer design.

Stress-strain relationships especially in the non-linear domain.

Concentrated suspensions of solid particles in liquid metals.

Pigment dispersions.

Pharmaceuticals, especially suspensions.

Rubber viscometry.

Aqueous pigment dispersions.



NAME AND ADDRESS	INTERESTS
Dr. H. van Hoorn, Koninklijke/Shell Laboratorium, Postbus 3003, Amsterdam, N. Holland.	Polymers and emulsions. Relation between rheological and other properties.
A. Jenkins, Small and Parkes Ltd., Applied Research Laboratory, Harts Lane, Barking, Essex.	Friction, lubrication and wear.
R. J. Kightley, Joseph Lucas Group Research Centre, The Radleys, Marston Green, Birmingham 33.	Pastes.
Prof. E. Shotton, School of Pharmacy, University of London, 29/39 Brunswick Square, London W.C.1.	Emulsions, suspensions, colloidal solu- tions, viscometry.
R. Smith, Top O'Noggarth, 92 Hale Road, Hale, Liverpool.	Paints, latices and suspensions.
Dr. E. H. Steiner, British Food Manufacturing Industries Research Association, Randalls Road, Leatherhead, Surrey.	
J. R. Taylor, 51A Porth-y-Castell, Barry, Glamorgan.	Paints, Rotex compositions.
R. E. Wetton, Chemistry Department, University of Manchester, Manchester 13.	Polymers.

New South Wales (Australia) Branch

Dr. L. Borsody, 39 Morrice Street, Lane Cove, N.S.W.	Emulsions.
S. E. Coalstad, 54 Bridge Street, Sydney, N.S.W.	Metals, Creams and emulsions. Oils.
Dr. M. C. H. Dodgson, c/o Prince of Wales Hospital, Randwick, N.S.W.	Swelling of gels. Deformation of tissues.
Dr. D. J. O'Connor, Taubmans Industries Ltd., Mary Street, St. Peters, N.S.W.	Surface Chemistry.
Dr. K. J. Whiteley, School of Wool Technology, P.O. Box 1, Kensington, N.S.W.	High polymers.

Elected 1st February 1962

NAME AND ADDRESS	INTERESTS
Dr. W. Anderson, 2 Mount Vernon Avenue, Coatbridge, Lanarkshire.	Biorheology and Rheology of medicants.
Dr. Fann Harding, Nations Heart Institute, Bethesda 14, Maryland, U.S.A.	Blood flow, Suspensions in general.
Dr. M. A. Peyman, 2 Harley Street, London W.1.	Viscosity of Blood.
Dr. H. W. Thomas, Physics Dept., National Institute for Research in Dairying, Shinfield, Reading, Berks.	Blood viscometry. Visco-elastic materials.
J. Broome, Industrial Instrument Dept., Ferranti Ltd., Moston, Manchester 10.	
R. K. Chapman, Messrs. T. J. Smith & Nephew Ltd., Neptune Street, Hull.	Pressure Sensitive Rubber Adhesives, creams and emulsions and gels.
Dr. R. S. Porter, California Research Corp., 576 Standard Avenue, Richmond, Calif. U.S.A.	Polymers.

Notes

1. At meetings of the Cambridge Rheology Club papers have been presented by R. McKennell (Ferranti Ltd.) on "Rotation viscometers and their application to non-Newtonian measurements", and W. J. Thompson (Engineering Laboratory, Cambridge University) on "The rheology of clay soils". Meetings of this group are held at the research station of Spillers Ltd., Station Road, Cambridge. Those who would like advance information on future meetings should write to Dr. H. G. Muller at the above address.

2. Our most recent information on the progress of the journal *Rheologica Acta* is that the first number of volume 2 was in the press at the end of 1961. By the time this note is published subscribers may have already received their copies.

3. The Bond voor Materialenkennis, the headquarters of the Nederlandse Reologische Vereniging, has the new address; Ypersestraat 9, Scheveningen, Holland.

4. At the Manchester College of Science and Technology, Dr. A. S. Lodge has given a course of seven evening lectures on Rheology in the series of post-advanced lectures in mathematics.

5. The Pennsylvania State University, University Park, Pa., has organised three one-week courses on Applied Mechanics and Materials Science to be held in the period 10th–29th June, 1962. The first, entitled Mechanical properties and design, is concerned with stress/strain properties of engineering materials. The second, Dislocations and mechanical properties, aims at acquainting engineers and metallurgists with the fundamentals of crystallographic imperfections. The third, Theoretical and experimental continuum mechanics, emphasises the principles of continuum mechanics and the development of constitutive equations in theories of plasticity and viscoelasticity.

6. A new international journal, "*Materials Research*", will be published quarterly by Heywood & Co., starting this year. The underlying theme of the journal will be that of the development of techniques for controlling the quality of engineering materials from a knowledge of their structure and from an understanding of how structural factors influence their properties. Original papers and review articles will be published and letters to the editors will be accepted for quick publication. All material will be published in English and, if necessary, the publishers will translate articles into English. Abstracts will appear in English, Russian French and German. The General Editor is Dr. E. G. Stanford, Aluminium Laboratories Ltd., Southam Road, Banbury Oxon.

Future Meetings

The Spring meeting of the *British Society of Rheology* at the Battersea College of Technology on 12th and 13th April 1962, on the subject *Temperature effects in Newtonian and Near-Newtonian materials*, will be followed by the Autumn meeting at Harrogate. This will take place on 1st and 2nd October and the subject will be *The rheology of emulsions*. The organisation of the Harrogate conference is in the hands of Mr. P. E. Knapp, 20 Wayside Avenue, Harrogate, Yorks., from whom further information may be obtained.

Looking further ahead to 1963, it is hoped that the Spring meeting will be on *Metals* at Cranfield, and the Autumn meeting on *Soil*

mechanics, which will include flow of clay slips and similar topics. In May 1963 the *International Society of Soil Mechanics and Foundation Engineering* will hold a meeting to which members of *B.S.R.* will be invited. Although this meeting will not be especially concerned with rheology it may well be of interest to a number of Members; and in any case, will not cover the same ground as the proposed *B.S.R.* meeting in the autumn of 1963.

Meetings of the *Victoria (Australia) Branch* during 1962 have been arranged as follows:

- 7th March, 1962, "The rheological properties of dough in relation to disulphide exchange reactions as rate-determining steps", by Dr. F.J.R. Hird (University of Melbourne).
- 6th June, 1962, "Plastic flow in alloys", by Prof. R. W. K. Honeycombe (University of Sheffield).
- 5th September, 1962, Annual General Meeting followed by "Rheology of pigment suspensions", by W. Findlay B.A.L.M. (Paints).
- 5th December, 1962, "Mixing and rheology", by K. Hall (C.S.I.R.O., South Melbourne).

The Australian Branches have joined in the organisation of two symposia to be held at the Congress of the *Australian and New Zealand Association for the Advancement of Science* (ANZAAS) which will take place at Sydney University on 20th—24th August, 1962. The first one, *Flow and deformation in biological systems* will include the following contributions:

- "Rheology of brain", by Mr. Dodgson (N.S.W.)
- "Viscosity and thixotropy of blood", by Mr. Dintenfass (N.S.W.)
- "Flow of blood in capillaries", by Mr. Palmer (N.S.W.)
- "Elasticity of collagen", by Mr. Rigby (N.S.W.)
- "Protein fibres", by Mr. Feughelman (N.S.W.)
- "Rheology of protein solutions", by Mr. Parts
- "Rheology of bread dough", by Mr. Ottoway (N.S.W.)
- "Use of plastics and adhesives in bone fractures", by Mr. Bloch (N.S.W.)
- "Determination of stresses in gelatin", by Mr. Sherwood (N.S.W.)
- "Rheology of sugar solutions",
- "Rheology of interfacial films", by Mr. Tschoegl (N.S.W.)

The second symposium, on "*Non-Newtonian flow and deformation in chemistry and engineering*", includes:

"Viscosity of fluidised bed systems", by Mr. Hagyard (N.Z.)

"Pigment dispersion and rheological phenomena", by Mr. Dintenfass (N.S.W.)

"Rheology of suspensions", by Mr. Findlay (N.S.W.)

"Description of a viscometer", Mr. Battaerd (Vict.)

"Mixing operations of non-Newtonians", by Mr. Hall (Vict.)

"Concrete grouting", by Mr. Vivian (Vict.)

"Flows of metals", by Mr. Axelrad (N.S.W.)

"The influence of moisture changes in the creep of wood", by Mr. Armstrong (Vict.)

"Non-Newtonian lubricants", by Mr. Tanner (N.S.W.)

"Normal stresses in fluids", by Mr. Bell (N.S.W.)

"Rheology of polyethylene", by Mr. Price (Vict.)

The *First European Plastics and rubber Conference* will be held from 18th–29th May, 1962 at the Palais de l'U.N.E.S.C.O., Paris. The organisers of the conference, from whom registration forms etc. are obtainable are the Société de Chimie Industrielle, 28 rue Saint-Dominique, Paris 7^e.

The *Third Congress of the European Federation of Chemical Engineering* to be held in London on 20th–29th June, 1962 has been announced in earlier Bulletins. The organisers, The Institution of Chemical Engineers, 16 Belgrave Square, London S.W.1., have issued a programme detailing the 95 papers to be presented at four symposia on; The interaction between fluids and particles; The handling of solids: Process optimisation; The physics and chemistry of high pressures. Examples of papers of rheological interest (this is not an exhaustive list) are:

"Uniform and non-uniform motion of particles in fluids", by H. Heywood (Woolwich Polytechnic).

"Slip velocity in carrier lines: a direct measurement of particle velocity", by L. Hellinckx (University of Louvain).

"The cohesion between cellulose fibres in suspension", by O. Andersson (Swedish Forest Research Laboratory).

"The fall of spheres through liquid-fluidised beds", by J. Prudhoe and R. L. Whitmore (University of Nottingham).

"The flow of bentonite suspensions through porous media",
by G. K. Jones (The Fullers Earth Union Ltd.).

"The rheology of granular materials with reference to their
behaviour in containers", W. Frazer (R.C.S.T. Glasgow)

"Specific volumes of polymers in solution at high pressures" by
G. Andersson (Uppsala University).

"Plastic deformation of metals", by H. Ll. D. Pugh (N.E.L. East
Kilbride).

A Conference on *Hydraulics and Fluid Mechanics* will be held at the University of Western Australia, Perth, between 6th and 13th December 1962. The theme of the conference is quite general and it is hoped that contributions will be forthcoming from all fields in which the measurement and understanding of fluid flow presents problems. Any Member interested in obtaining further details should write to Dr. Silvester at the School of Engineering of the University.

Note on the use of the term Rheopexy

From: G. W. Scott Blair

This term would appear to have been introduced first by Freundlich (H) and Juliusburger (F) (Trans. Faraday Soc. 31, 920, 1935) who proposed "to call a thixotropic sol which may be solidified by gentle movement *rheoplectic* and the phenomenon itself *rheopexy*". In the following year, Juliusburger (F) and Pirquet (A) defined *rheopexy* as "The solidification of thixotropic sols by gentle and regular movement" (Trans. Faraday Soc. 32, 445, 1936).

Rheopexy is thus clearly defined as a special case of *thixotropy*. Freundlich implies that "the gentle and regular movement" increases the rate of thixotropic re-setting. For the next twenty years or so (1935-55) all the leading "thixotropists" used the term *rheopexy* in this sense: e.g. Pryce-Jones (J) (Proc. Univ. Durham Philos. Soc. 10, 427, 1948) and so it is defined in most modern text-books and encyclopaedias, including the new "*Encyclopaedic Dictionary of Physics*".

So far as I can trace, the first proposal to change the meaning of *rheopexy* came from Ruth Weltmann (Eirich: "*Rheology: Theory and Applications*" 3, 216, 1960) who defines as *rheoplectic* "either a thixotropic or a plastic material that will solidify when subjected to a certain shear and will not regain its more fluid structure immediately after shear removal". I do not fully understand this definition but it would appear to include *negative thixotropy*, e.g. as studied by Eliassaf (J), Silberberg (A) and Katchalsky (A) (Nature, 176, 1119, 1955).

Recently, several authors have apparently taken *rheopexy* to mean any increase in consistency produced by shearing, i.e. to include what Burgers (J.M.) and Scott Blair (G.W.) have called, in some cases, *non-reversible shear-hardening* and in others *shear-thickening* ("*Report on Principles of Rheological Nomenclature*", I.C.S.U. 1949.).

A recent example of this is a letter by Yannas (J.B.) and Gonzalez (R.N.) (Nature 191, 1384, 1961) and I have been in private communication with these authors, both of whom have been most helpful and courteous in answering my criticisms.

The simple question "is *rheopexy* always to be defined as a special case of *thixotropy*?" is complicated by differences of opinion on the definition of *thixotropy*.

It will be recalled that Freundlich first limited this term to a true gel-sol (solid-liquid) transformation but as early as 1935, in his book "*Thixotropy*", he had extended this to include phenomena outside the true gel-sol transformation. The real complication arose when Goodeve (F.C.) and Whitfield (G.W.) (Trans. Faraday Soc. 34,

511, 1938) proposed to include under *thixotropy* any fall in consistency produced by shear, even when recovery is so nearly instantaneous that the flow-force relation is monotonic. Goodeve argued that to limit *thixotropy* to "slow" recovery was arbitrary. The limitation of "slow" depends on the time-scale of our experiments. Few rheologists have accepted this view-point. Reiner has in several places pointed out that most of our definitions do depend on arbitrary time-scales—pitch and glass are commonly treated as solids, and so are mountains, though they "flow before the Lord . . . for Whom a thousand years are as a day". But a few thixotropists still follow Goodeve in including under *thixotropy* what used to be called *structural viscosity* or more recently *shear-rate thinning* (Burgers and Scott Blair loc. cit.).

The National Institute for Research in Dairying,
Shinfield, Reading, Berks.

14th December, 1961.

The above note has been contributed by Dr. Scott Blair on the invitation of the Honorary Secretary, Dr. M. F. Culpin. Obviously the problems of nomenclature, which beset rheologists in the early days of the subject, are still with us. No-one in this country has done more than Dr. Scott Blair in the field of nomenclature and communication between rheologists has been greatly facilitated by his efforts and those of his collaborators. Nevertheless, as the note makes quite clear, there is ambiguity still in the usage of the expressions *thixotropy* and *rheopexy*.

Dr. Scott Blair would like this problem to be discussed at the *Fourth International Congress on Rheology* in 1963. To quote him again:

"The questions which might usefully be put to the Congress would therefore be: (1) Is it agreed to restrict the term *thixotropy* to cases where recovery of consistency on resting is slow enough to produce hysteresis effects in the experiments?; (2) Is *negative thixotropy* accepted as the corresponding correct term when consistency is increased by shearing and falls "slowly" on subsequent standing?; and (3) Is the term "*rheopexy*" to be retained with its original limitation as a special case of *thixotropy*?"

Members are invited to send in their comments on the note and the wording of the questions. In the view of the Honorary Editor (Bulletin) the wording of the questions is not entirely unambiguous. For example, in (1) the recovery could be "slow enough" as to be unobservable: hysteresis will be observed in experiments in which the rate of shear is increased to a maximum value and decreased at a constant rate. Such behaviour is hardly *thixotropic* since the element of recovery is nil. It is believed that this behaviour has, at times, been called *rheo-destruction*. Again, does the definition of *thixotropy* demand complete recovery? There is a case for defining *thixotropy*

as any change in consistency with duration of shearing, or any change leading to a hysteresis loop. The direction of the change would then be indicated by a positive or negative sign; a further qualification would indicate the extent of the recovery process. Such a scheme could lead to the definition of measurable coefficients. For example; of a coefficient of positive thixotropic breakdown, or of negative thixotropic recovery. As defined at present, by some, the qualities *thixotropy* and *rheopexy* do not lead easily to definitions of coefficients.

It is hoped that the above note and comments will provoke a fruitful exchange of views.

Fletcher & Co.,
Printers, 39 Osborne Road
Farnborough, Hants.