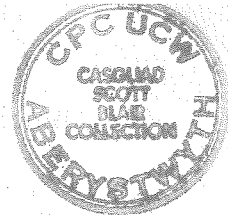


# BRITISH RHEOLOGISTS' CLUB



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## CLUB NOTES.

### Membership.

It is encouraging that in spite of the decision to increase the annual subscription from 5/- to £1, there has been no falling off in membership. The small number of members lost has been made up by new recruits.

### The Bulletin.

Through the kindness of individual members and of certain friendly organisations, the majority of journals which at all frequently publish papers of rheological interest are now covered for abstracting. There are still, however, a few important journals for which abstractors are required. Would members willing to undertake the regular perusal of any of the following journals kindly inform the Editor?

Proc. Roy. Soc. (A and B), Phys. Rev., J. Math. Phys., J. Chem. Educn., Proc. Nat. Acad. Sci. (U.S.A.), Coll. Symp. Mon., Chimie et Ind., J. de Physique, Rec. Trav. Chim. Pays-Bas, Proc. (Dutch) Royal Acad. Sci., Chem. Weekblad, Coll. J. (U.S.S.R.), J. Exper. and Theor. Phys. (U.S.S.R.), Proc. and Bull. Acad. Sci. (U.S.S.R.), Chem. and Metal. Engng., U.S. Dept. Agric. Bulls., U.S. State Exper. Stas. Reps. and Bulls., Agric. Progress, J. Amer. Soc. Agron., Ann. Agronomiques, Ann. Agric. Suisse, Pedology (U.S.S.R.), Keramicheskiĭ Sbornik, Oil and Soap.

It is hoped that, as conditions improve, it will be possible to circulate the Bulletin nearer the date of issue.

### Club Library.

Some of our members and other friends have kindly presented the Club with a number of books and reprints which are kept by the Hon. Secretary and are available for loan to members. They will also be available at the October Conference.

The collection includes: 2nd Rep. on Visc. and Plast. Amsterdam, History of the (American) Society of Rheology by E. C. Bingham, Proc. Acad. Sci. U.S.S.R. 1945, and various Russian reprints dealing with Rheology presented by the (U.S.S.R.) Soc. for Cultural Relations with Foreign countries, back numbers of Club Bulletins and reprints of reports of Club meetings, reprints of papers by A. S. E. Ackermann (clay), H. H. Macey (clay), H. Mark (polymers), E. W. J. Mardles (suspensions, etc.), A. Nissan (viscosity theory), A. de Waele (suspensions, etc.), J. R. Scott (rubber), E. G. Richardson (viscometry), Proc. of Conf. on Visc. Liquids and Coll. Solns. (Moscow 1941) vol. III, and classical papers by the late Prof. A. Bachinskiĭ (through the courtesy of Prof. M. P. Volarovich).

## Bingham Memorial Symposium (American) Society of Rheology.

The Annual Conference of the Society of Rheology for 1946 will take the form of a Symposium in honour of the late Prof. E. C. Bingham, to be held in New York City on November 1st-2nd. Invitations have been sent to a number of rheologists abroad to contribute papers and the proceedings will be published. This publication should constitute a very valuable contribution to rheological literature.

It is very much hoped that the Club will be able to accept a warm invitation which we have received to be represented at the Symposium. Our members who are not able to be at the meeting will wish the Symposium every success and will join our American colleagues in honouring the memory of a great pioneer rheologist.

### "Essays in Rheology."

It is with great regret that we have to inform members that, in spite of earlier hopes, the Proceedings of our Oxford Conference (1944) will not be ready in final form until 1947, although it is hoped a limited number of proof copies will be available at the October Conference in London. The situation is highly unsatisfactory but the prospects for the publication of the Proceedings of the London Conference are much brighter. Through the helpful co-operation of Messrs. Thos. Nelson & Sons Ltd., it is hoped to have preprint proofs of many of the papers available at the meeting and it is probable that the complete Proceedings will be ready to appear in book form fairly early in 1947.

### Future Meetings of the Club.

By the time this Bulletin reaches members the October Conference will have taken place. At the date of writing, it is confidently expected that the week-end will be a great success. An excellent technical programme, the promise of a good attendance, the list of social activities and visits and especially the presence of a number of good friends from overseas, encourage us to look forward to a most enjoyable gathering.

The following meetings are being planned :—

*17th October, 1946.* (Joint Meeting with Society of Chemical Industry, Roads and Building Materials Group) "Rheology and its application to Road and Building Materials," Dr. G. W. Scott-Blair, at 6 p.m., Gas Industry House, Grosvenor Place, London, S.W.1.

*10th December, 1946.* Joint Meeting with the Faraday Society on "Dilatancy and Thixotropy" (details later).

*January-February, 1947.* (Provisional) Joint Meeting with Society of Instrument Technologists.

*1947.* (Provisional) Joint Meeting at Exeter with Chemical Society on Rheology of Clay (or similar topic).

*July, 1947.* Meeting at Bristol. Prof. Mott on "Dislocations in Solid Materials" (details later).

It is also hoped to arrange a Joint Meeting with the Geological Society of London, to visit one of the Research Stations and to arrange a rheological film show.

### Annual Conference, 1947.

The Annual Meeting and Conference of the Club for 1947 will be held at Hulme Hall, Manchester, on September, 11th-14th (details later).

G. W. SCOTT-BLAIR,  
*Editor.*

## Rheology and Colloids.

*" . . . . where the bacillus lives, gravitation is forgotten and the viscosity of the liquid, the resistance defined by Stokes' law, the molecular shocks of the Brownian movement, doubtless also the electric charges of the ionised medium make up the physical environment . . . . The predominant factors are no longer of our scale ; we have come to the edge of a world of which we have no experience and where all our preconceptions must be recast."*

D'Arcy W. Thompson. "Growth and Form."

Two lectures were given by Dr. E. W. J. Mardles before the Exeter section of the Chemical Society on March 1st and 8th, 1946, at the Washington Singer Laboratory on the subjects of rheology and colloids. Many of the most interesting problems in rheology are found with colloidal systems, systems with heterogeneities or abrupt discontinuities of the scale of size, approximately  $1\mu$  to  $500\mu$ . These systems include dispersions of bacteria or viruses, blood, living muscle, plant tissue, protoplasm, a butterfly wing and other living matter. Hypotheses and models proposed by various investigators for explaining the mechanism of muscle action (Burgers, Hill, etc.) were discussed as well as the significance of particle orientation in the myelin sheath of nerve fibres, in boundary layers of lubricants and with regard to the strength of textiles and materials in general.

The importance of particle shape, relative displacements during shear, and particle attractions (van der Waal forces) was touched on in tracing the origin of several well known properties of matter, namely plasticity, dilatancy (Maxwell), rheopexy, work-hardening, flocculation and thixotropy, birefringence, etc. The remarkable rheological changes that occur when "liquid crystals" and other mesomorphic materials are submitted to small temperature changes were described by the aid of diagrams also the recent X-ray work of Harkins on the measurement of micelles of potassium laurate when polar molecules were present.

As the lecture was mainly an introduction to the science of rheology the lecture included a brief historical sketch of the rheological researches of Newton, Graham, Poiseuille, Stokes, Reynolds, Einstein, Bingham and others and an indication given of the use of rheology in gaining an insight into the interior structure of matter, molecular weights, shapes and aggregations.

E.W.J.M.

## RHEOLOGY ABSTRACTS

### 397. Viscosity and plasticity.

E. N. da C. Andrade. *Chem. Age*, **53**, 543, 1945.

A brief summary is given of three lectures. The first deals with the flow properties of various classes of liquids, and two theories of viscosity; the second includes methods of determining viscosity and the rheological behaviour of suspensions; the third covers the rheological properties of solids, with special reference to single metal crystals.

B.R.R.A.

### 398. Flow orientation in isotropic fluids.

A. Bondi. *J. Appl. Phys.*, **16**, 539, 1945.

A theory of flow orientation was developed which is based on a relation giving the change in entropy accompanying molecular orientation under the influence of a stress field, and on the applicability of the Eyring theory of viscous flow. The proposed theory predicts the ratio of the viscosity at attainment of complete orientation to the viscosity of "normal," i.e. random, flow to be equal to the ratio of the average length  $v^{\frac{1}{2}}$  to the actual length of the (fully stretched) molecule. The thermodynamics of a flow-orientated system are outlined, predicting the temperature changes, accompanying adiabatic orientation and disorientation. It is also suggested that the relaxation times in viscous media are large enough to prevent observation of flow orientation in capillary viscometers in many cases.

B.R.R.A.

### 399. The viscosity and working characteristics of glasses. IV. Some observations on the rate of cooling and viscosity of glasses during manipulation by automatic machines.

J. Boow and W. E. S. Turner. *J. Soc. Glass Tech.*, **29**, 199, 1945.

Earlier measurements of the temperature and viscosity of glasses at different stages in the processes of gathering and shaping by hand have been supplemented by a study of the temperatures and viscosities during the shaping processes as carried out by gravity-fed automatic machines of different types. The two glasses studied had the percentage compositions, respectively: colourless,  $\text{SiO}_2$  74.1,  $\text{R}_2\text{O}_3$  0.85,  $\text{CaO}$  9.7,  $\text{MgO}$  0.1,  $\text{Na}_2\text{O}$  15.2; amber,  $\text{SiO}_2$  73.75,  $\text{R}_2\text{O}_3$  1.25,  $\text{CaO}$  9.4,  $\text{Na}_2\text{O}$  15.6. Depending largely on accessibility of the glass at different stages of machine operation, thermocouple, optical pyrometer and calorimetric methods of temperature measurement were applied. The machines included the Hartford Fairmont press-and-blow, the Lynch LA, the Lynch 10 and a mechanical press. The weights of the various types of containers produced by them during these studies ranged between 3 and 23 oz. The temperatures, and corresponding viscosities, of the glass at each stage of operation were found to be influenced by the conditions of manipulation (type of machine), the weight and the colour of the glass. There is a range of temperature and viscosity within which each shaping operation can be accomplished. The ranges of viscosity (in poises) of the glasses were: Gob formation, 2,000—11,000; when leaving the parison mould,  $1.8 \times 10^4$  to  $6 \times 10^4$  (mean values) with viscosities in the hot interior at  $6 \times 10^3$  to  $8 \times 10^3$ ; entry into blow-mould,  $9 \times 10^4$  to  $2.3 \times 10^5$  (mean values), with viscosities in the hot interior of  $1.5 \times 10^4$  to  $5 \times 10^4$ ; when discharged from the blow-mould, interior values in the base of the bottle  $10^6$  to  $10^8$ . These values, which are wide enough to embrace both glasses examined, are derived from methods of operation at a single works. The conditions of temperature and viscosity suitable at each stage for optimum efficiency of production when using

any one glass and a particular type of machine need to be worked out by further systematic study. The need is emphasised for careful determination of the specific heat of glasses over a wide temperature range. B.R.R.A. (*vide* abstr. 201, 202).

**400. Simplified two-dimensional aerofoil theory.**

M. J. Brennan and A. C. Stevenson. *Aircraft Engineering*, **18**, 182, 1946.

A basic method of determining the profiles of laminar flow and high speed aerofoils. E.W.J.M.

**401. Torsion in conical and cylindrical shells intersected by planes.**

F. W. David. *Aircraft Engineering*, **18**, 200, 1946.

It is generally not correct to assume in shells that the shear in any section is in inverse proportion to the area at that section. A design analysis has been developed and for orthogonal cylindrical shells general diagrams are presented for assessing the loads for preliminary design purposes in conical shells of small taper. E.W.J.M.

**402. On the mechano-chemistry of muscle.**

W. A. Engelhardt and M. H. Liubimova. *Biochimia*, **7**, 205, 1942.

The interrelationships between the enzymic, physicochemical and rheological properties of myosin are investigated. Attempts to separate an enzymically active fraction from myosin, or to demonstrate a chemical inhomogeneity in myosin, failed. Adenosine triphosphate produces a reversible decrease in the elastic modulus of myosin fibres, which effect, together with enzymic activity, is abolished by small concentrations of silver ions. Other polyphosphates have a similar, but much less pronounced effect. The mineral anhydrides of phosphoric acid, pyrophosphate and metaphosphate, markedly increase the plasticity and decrease the rupture modulus of the fibres. Adenosine triphosphate increases the elastic after-effect but does not affect the plastic flow. It is the authors' opinion that effects observed in myosin sols, such as changes in viscosity and stream birefringence, can with difficulty be used in the interpretation of muscle mechanics; artificial fibres, and above all observations on surface films, are more likely to provide information directly applicable to the intact muscle. E.C.B.-S.

**403. Stress diffusion problems.**

W. J. Goodey. *Aircraft Engineering*, **18**, 195, 1946.

A study based on Saint Venant's principle that the distribution of stress in a body at points remote from the region of application of the applied loads is independent of the mode of application of these loads, being dependent only on their resultant. The purpose of the series of articles is to discuss the validity of formulæ for stresses and displacements for stresses near the points of application of loads and on the effect of the mode of application of the loads. E.W.J.M.

**404. Molecular weights of viscous hydrocarbon oils: correlation of density with viscosities.**

A. E. Hirschler. *J. Inst. Petroleum*, **32**, 133, 1946.

The author using available published data has attempted correlations whereby molecular weights of lubricant fractions can be calculated from viscosities at 100°F and 210°F. Consideration of more than 700 lubricant fractions indicated that the average composition is sufficiently uniform for the viscosity-density correlations to give satisfactory results provided highly naphthenic fractions, cracked products and synthetic oils are avoided. An empirical equation is proposed. E.W.J.M.

**405. The structure of cellulosic rayons. Part 3. Chain length determinations in cuprammonium solution.**

F. Howlett, E. Martin and J. Swan. *J. Textile Inst.*, **37**, T77, 1946.

Using the Staudinger equation as a basis and a provisional value of  $K_m$  (determined by means of the ultra centrifuge) the authors compute the chain length of cellulosic rayons dispersed in cuprammonium solution, from intrinsic viscosity data.  
E.W.J.M.

**406. Future aircraft developments.**

B. Lockspeiser. *Flight*, 25th July, 1946.

Theoretical study, wind tunnel and flight experiments indicate that the drag of aircraft should be very much less than at present. Wings can be built in which laminar flow can be maintained over more than half the surface but further extension of this area requires boundary-layer control by a combination of shape, accurate manufacture, high finish and wing suction. Fuselages cannot be treated in this way, leading to the conclusion that bodies and tail surfaces should be eliminated. Low drag requirements are such that the wing should always encounter undisturbed air; accordingly tractor airscrews must give place to pushers or jets. To try out these new theories an order has been placed for a twin Derwent 30,000 lb. flying wing with pressure cabins weighing 75,000 lb. An outstanding contribution to high-speed aerodynamics discovered by the Germans during the war was to give the wing a very sharp sweep-back, so diminishing acceleration of the air.

With regard to power generation, much research is required on axial-flow compressors, on the shape and spacing of compressor, turbine blades, etc., at high altitudes.

The athodyd (single propulsive duct without moving parts) of superior efficiency, is based on the high dynamic pressure at the intake at supersonic speeds when no compressor is required.  
E.W.J.M.

**407. The Knoop indenter as applied to testing non metallic materials ranging from plastics to diamonds.**

V. E. Lysaght. *A.S.T.M. Bulletin*, **138**, 39, 1946.

A description of the Knoop indenter used in conjunction with the Tukon hardness tester is given. The indenter is a diamond, ground to a pyramidal form, that produces a diamond shape (rhomb) indentation having long and short diagonals of approximately 7 to 1 ratio. The depth of indentation is about one thirteenth of its length. It is claimed that with light loads (25 g.) impressions with good definition are obtained with thin coatings, e.g. protective finishes, and with brittle materials using loads up to a kilogram the specimen if brittle does not shatter. Precautions with regard to limitations of the instrument are mentioned. Measurements are given as Knoop numbers, e.g. plastics about 2, gypsum 32, orthoclase 560, topaz 1250, alundum 1620 to 1680, boron carbide 2250, diamond 5500 to 6950.

E.W.J.M.

**408. Viscosity blending chart.**

W. L. Nelson. *Oil Gas J.*, **45**, 107, 1946.

A chart is presented for calculating the viscosity of binary mixtures of petroleum oils, or the percentage by volume of the two component oils of a binary mixture to give a required viscosity. The basis of the chart appears to be the logarithmic mixture law.  
A.H.N.

#### 409. Flow through very small channels.

J. Reekie. *Nature*, **157**, 24, 1946.

Air, as distinct from water-vapour, will begin to leak into an evacuated tube when the width of the channel through which the leak occurs is greater than about  $2 \times 10^{-4}$  cm. that is, when the pressure due to the surface tension of the water falls to about one atmosphere. B.R.R.A. (*vide* abstr. 349).

#### 410. Rheological systematics.

M. Reiner. *Rheol. Bull.*, **16**, 53, 1945.

A rheological system is built up through a hierarchy of ideal materials. Of these, three are elemental; and it is shown how all others can be expressed qualitatively through these three by means of structural formulæ. Rheological equations describe the quantitative behaviour of the materials. The parameters appearing in the rheological equations are characteristics coefficients or material "constants" and the rheological properties are determined by the numerical values of these coefficients. Leaving cubical dilation apart, there remain five fundamental properties, viz., viscosity, elasticity, plasticity, dilatancy, and strength, from which other essential properties can be derived. The coefficients may be constants, but in many cases their values are affected by the phenomena of rheological destruction and aging. B.R.R.A. (*vide* abstr. 350).

#### 411. The plastic deformability of brittle bodies.

E. Ryschkewitsch. *Glastech. Ber.*, **20**, 166, 1942.

Experiments on the scratching of glass and sintered, highly refractory oxides led to the conclusion that the simple grinding process takes place in at least three stages: (i) release of stress; (ii) plastic deformation without the removal of particles of the material; and (iii) tearing up and fracture of the material, with or without the local removal of particles. Fine surface polishing is considered to be not polishing at all, but the release of stress. B.R.R.A. (*vide* abstr. 388).

#### 412. Elasticity of muscle in relation to actively developed twitch tension.

G. M. Schoepfle and A. S. Gilson, Jr. *J. Cell. Comp. Physiol.*, **27**, 105, 1946.

Muscles were allowed to shorten 0.3% while under tension. The tension change was identical in both active and resting muscle, indicating that the elastic properties are unaffected by contraction. It is suggested that contraction is effected by a change in configuration of the plastic matrix of the sarcoplasm whereby lateral pressure is erected upon the sarcolemma. E.C.B.-S. (cf. Abstr. No. 389).

#### 413. The Strachan-Messmer elastometer.

J. Strachan. *Paper-Maker*, 1946, **111** (5), 290.

Apart from providing a rapid and accurate means of comparing the rigidity of papers for commercial purposes, this instrument provides a means of investigating the physical properties of paper by separation of elastic bending from flexural bending, and also from plastic flow of the miscelles, and recovery of the deformation due to the latter. The instrument named the "Elastometer" is described and illustrated. For accurate work the test must be carried out under standard humidity conditions. P.A.T.R.A.

**414. The stressing of cabins under uniform pressure.**

E. W. H. Thompson. *Aircraft Engineering*, **18**, 155, 1946.

A mathematical approach to the determination of the end loads, shears and bending moments induced by uniform pressure in a cabin former ring of any odd shape and how these vary according to changes in the space parameters of cabins of simple mathematical form. E.W.J.M.

**415. The mechanical testing of extreme pressure lubricants (with special reference to hypoidoils).**

H. L. West. *J. Inst. of Petroleum*, **32**, 206, 1946.

Information, collected mainly from U.S.A., on the use of various testing machines for lubricants. E.W.J.M.