

BRITISH RHEOLOGISTS' CLUB.

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Issued for the information
of members of the Club only.

CLUB NOTES.

MEMBERSHIP. The Club now numbers over 280 members. This remarkable increase shows how wide is the interest in Rheology at the present time, and augurs well for the post-war development of the Club.

OUR HEARTIEST CONGRATULATIONS are extended to our Past-President, Sir Geoffrey Taylor, F.R.S., who has been awarded the Copley Medal of the Royal Society.

IT IS WITH DEEP REGRET that we record the death of Mr. H. W. J. Hathaway, who was killed as the result of an accident while engaged in war work, in July of this year. Mr. Hathaway joined the Club in August 1942. He showed great promise, and his death is a real loss to Rheology.

FUTURE MEETINGS

Members will shortly receive notices of the next meeting of the Club to be held, in association with the Faraday Society and the Plastics Group of the Society of Chemical Industry, at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, at 2.30 p.m. on Wednesday, January 24th, 1945. Dr. G. W. Scott Blair will read a paper on "The Rheology of Plastics" which will be followed by a discussion.

A joint meeting with the Institute of Petroleum will be held on Wednesday, April 18th, 1945, in the Hall of the Institute of Petroleum, London. The meeting will last from about 3.30 to 9.00 p.m., including an interval for a buffet supper and private conversations. Five or six short papers will be read under the general title "Rheology of Petroleum Products," and there will be full opportunity for discussion. Details will be forwarded to members in due course.

Plans for a week-end conference in the summer of 1945 are, at the time of writing (Dec. 15th, 1944), not as well-advanced as had been hoped. It has proved impossible to find accommodation and board in Oxford, Cambridge, Bristol, Reading or Nottingham. The Hon. Secretary would be glad to receive suggestions from members as to a possible place of meeting. An attendance of at least 150 should be anticipated. Suggestions for a programme will also be welcomed.

Plans for other meetings are under consideration by the Committee.

PUBLICATIONS

The publication of the proceedings of the Oxford Conference is being seriously held up owing to war-time conditions, but slow progress is being made.

Through the courtesy of the Editor of "Paint Technology" and the help of Dr. R. H. Leach, a full account of the discussion on "Tack," held at the Annual General Meeting in October, has appeared in that Journal (October number) and copies will be forwarded to members as soon as possible.

RHEOLOGY ABSTRACTS.

Note.—The Club assumes no responsibility for the opinions expressed by abstractors. These are given in square brackets.

217. The electrical and elastic properties of amorphous polar polymers.
R. F. TUCKETT. *Trans. Farad. Soc.*, **50**, 448, 1944.

The simple Debye theory is not adequate for a quantitative description of dielectric phenomena, and the idea of a relaxation time dependent on internal viscosity is shown to be unsound in the case of high polymers. Reasons are given for correlating the dielectric effects with the high elasticity, and in both cases an orientation time is involved. Further, the chain configuration of the molecule involved in the orientation of polar groups, and in the elastic extension are identical (except when the polar groups are on side chains). The experimental data, though meagre, lend support to these ideas.

The question of calculating the energies of activation for the orientation process when there is a *distribution* of orientation times is discussed. L.R.G.T.

218. The liquid state.

J. H. HILDEBRAND. *Proc. Phys. Soc.*, **56**, 221, 1944.

The paper is concerned mainly with problems of solubility and miscibility of liquids. Of special interest to rheologists is the introductory account of present theories of the structure of liquids, from which it is concluded that the "perfect" liquid has the maximum disorder consistent with the volume occupied.

[Viscosity is not discussed.] L.R.G.T.

219. A molecular theory of the viscoelastic behaviour of an amorphous linear polymer.

T. ALFREY. *J. Chem. Phys.*, **12**, 374, 1944.

An attempt is made to apply the conceptions of the kinetic theory of elasticity (developed with reference to a cross-linked polymer) to a polymer in which the molecules are not permanently interconnected. In general, the chains are considered as composed of a range of lengths, each characterised by a retardation time (related to an energy of activation of flow), and the separate contributions of these elements to the applied stress are integrated. In a particular application of the theory, an assumption is made regarding the relation between retardation time and segment length, and an equation for the retardation time spectrum thus derived.

[An interesting approach, but probably very difficult to develop quantitatively]. L.R.G.T.

220. Network structure and elastic properties of vulcanised rubber.

P. J. FLORY. *Chem. Rev.*, **35**, 51, 1944.

This critical review of the statistical methods of Kuhn, Wall and others for dealing with the elasticity of rubber includes a detailed consideration of defects in the network due to loose ends and molecular interlooping. A number of new and valuable experimental observations on elasticity and swelling are given, and their relation to the network parameters is discussed. L.R.G.T.

221. A new Extrusion Plastometer.

H. A. SCHULTZ and R. C. BRYANT. *J. App. Phys.*, **15**, 360, 1944.

Describes an instrument for determining whether a given batch of synthetic rubber tread stock can be forced through a plate die to form a satisfactory tyre tread. The instrument reproduces in miniature, and under close control, the conditions of factory extrusion. Some results are given for GR-S mixes. R.S.R.

222. Drift and Relaxation of Rubber.

M. MOONEY, W. E. WOLSTENHOLME and D. S. VILLARS. *J. App. Phys.*, **15**, 324, 1944.

Drift tests, extending over 8 years, on rubber stocks, are described. An initial rapid drift (the transient drift) lasting 200 days is followed by a slower drift (the steady drift). It was found that the drift varies considerably with the accelerator used. A new method for measuring stress relaxation in tension is described. Relaxation measurements on soft vulcanised rubber under various conditions are reported. A

theory is developed for both transient and steady relaxation, which, however, cannot be distinguished from the Tobolsky-Eyring equation on present data. R.S.R.

223. Hysteresis losses in High Polymers.

H. S. SACK, J. MOTZ and R. N. WORK. *J. App. Phys.*, **15**, 396, 1944.

A preliminary report on experiments designed to investigate possible variation of the elastic properties of plastics and elastics with frequency, at small amplitudes. The measurements confirm previous results that elastic losses are independent of frequency or change only slightly with frequency. R.S.R.

224. GR-S, An Elastically Inverted Polymer.

H. A. BRAENDLE and W. B. WIEGAND. *J. App. Phys.*, **15**, 304, 1944.

The results of Rohde in comparing the elastic hysteresis losses of natural rubber and Buna S under conditions of equal stress are discussed. Curves are given for the stress required to extend GR-S and natural rubber to equal elongations, after various numbers of cycles. For large elongations, it is found that although corresponding initial stress is greater for natural rubber than for GR-S, after a number of cycles the situation is reversed. The development of flex cuts in GR-S tyres is explained in terms of these results. Stress-strain curves before and after ten flexings to 400 per cent. elongation are given for both rubbers, for various stages of cure and these results also bear out the conclusions. It appears that, for the purposes of tyre manufacture, the hysteresis of GR-S at low elongations must be reduced and its hysteresis at high elongations must be increased. R.S.R.

225. Rapid Determination of Elastic Constants of Glass and other transparent substances.

W. T. SZYMANOWSKI. *J. App. Phys.*, **15**, 627, 1944.

A supersonic diffraction method is described for determining the elastic constants of glass and similar transparent materials, in which a relatively intense diffraction pattern is obtained. R.S.R.

226. Viscosity of Water.

J. R. COE, JR., and T. B. GODFREY. *J. App. Phys.*, **15**, 625, 1944.

A preliminary report is given of work carried out on an absolute determination of the viscosity of water. Values of the viscosity at 25, 30 and 40°C. which, it is claimed, are the most accurate available, are given. The method used was that of J. R. Coe, Jr. (*Physics*, **4**, 274, 1933), with certain modifications which are described. R.S.R.

227. Rate of Rise of Water in Capillary Tubes.

G. PICKETT. *J. App. Phys.*, **15**, 623, 1944.

The paper by Rense (*J. App. Phys.*, **15**, 436, 1944) is criticised on the ground that the rise of water in a capillary tube is there assumed to be turbulent. It is argued that the Reynolds' number obtaining in the experiment of Rense is not greater than 200. It is further argued that the experimental results can be accounted for, without any assumption of turbulent flow, if all the forces acting are taken into account. R.S.R.

228. Rate of Rise of Water in Capillary Tubes.

W. A. RENSE. *J. App. Phys.*, **15**, 436, 1944.

The height of column Z vs time t curve for water rising in a capillary tube is obtained by taking photographs of the rising water under stroboscopic illumination. On the assumption that the motion of the water is turbulent, a formula

$$Z = \text{const.} + \frac{1}{K^2} \log t$$

is obtained. It is found that by suitable choice of the constants, this formula can be fitted to the experimental curve. A slight deviation occurs at the end of the rise. It is suggested that these results suggest a dynamic method for finding Reynolds' number. R.S.R.

229. Poisson's Ratio at High Temperatures.

F. L. EVERETT and J. MIKLOWITZ. *J. App. Phys.*, **15**, 598, 1944.

A method is presented whereby both the modulus of elasticity in tension and compression E and the modulus of elasticity in shear, G , may be obtained simul-

taneously from a simple test on a cantilever specimen subjected to combined bending and twist. By means of the relation $\pi = (E/2G) - 1$, values of Poisson's ratio at various temperatures from ambient to 1000°F. were obtained for five common steels. (Author).

230. Miniature and micro suspended level viscometers.

M. M. LAPITZKY and S. THOMPSON. *J. of Inst. of Petroleum*, **30**, 349, 1944.

For use with quantities of oil up to 5 ml. The design is based on the FitzSimons modification of the Ubbelohde suspended level viscometer. The filling bulb has been made spherical and the capillary elongated; the volume of the timing bulb has been reduced and the shape of the suspended level bulb altered. E.W.J.M.

231. Preliminary list of definitions by Standardisation Sub-Committee No. 11.

J. of Inst. of Petroleum, **30**, 249, 1944.

Viscosity.—That property of a liquid which is a measure of its internal resistance to motion and which is manifested by its resistance to flow. The viscosity of a liquid changes with temperature, decreasing as the temperature is increased. E.W.J.M.

232. On the Temperature Dependence of Plastic Deformation and Creep. J. FRENKEL. *J. Phys. U.S.S.R.*, **11**, 49, 1940.

The Becker-Orowan theory of plastic slip (creep) velocity as a function of temperature, is critically surveyed and an alternative theory of plasticity is proposed, assuming that the elastic limit of an ideal crystal lattice is zero.

A relaxation theory of creep is built up from the assumption that the crystal lattice is distorted (and accordingly hardened) by previous slip, and reintegrated by the gradual return of dislocated atoms to regular positions (the rate of this relaxation process is increasing with temperature). Some indications are given of the dynamics of intermittent creep under very small stresses, on the basis of an analogy between the velocity dependence of the elasticity limit and that of the friction coefficient of five solid surfaces. R.C.S.

233. Contribution to the theory of viscosity of macromolecular substances J. J. HERMANS. *Koll. Zeit.*, **106**, 22-29, 1944.

A quantitative explanation of the increase in viscosity is attempted by considering dissolved macromolecules as deformed by the field of force when a velocity gradient is applied. Shearing moduli can be derived statistically. The relaxation time required for the deformed molecules to return to the more probable shape is calculated for the cases when diffusion is taken into account and when it is neglected. The product of shearing modulus and relaxation time is regarded as the contribution of the dissolved molecules to the viscosity. The influence of the nature of the solvent and of the temperature is discussed. R.C.S.

234. Beiträge zur Kenntnis der Viskosität der Milch. (Contribution to our knowledge of the viscosity of milk).

W. SPÖTTEL and K. GNEIST. *Milchw. Forsch.*, **21**, 214-234, 1942.

The authors measure the viscosity of cow, goat and ewe's milk in a Höppler rolling ball viscometer at temps. varying between 10°-50°C. The viscosity (η) of cow's milk taken in the evening is greater than that of morning samples to an extent not accountable in terms of fat content. Holding the milk at 3°-4°C. causes a small increase of η which is not entirely accounted for by changes in the condition of the fat, since the same phenomenon is found (though to a lesser degree) in skim milk.

Contrary to the findings of earlier authors, η , determined in a capillary viscometer, is not lowered by repeated shearing.

Correlation coefficients are quoted against η (in descending order) for fat-free dry matter; dry matter; protein + fat; protein; fat. G.W.S.B.

235. The viscosity of evaporated milks of different solids concentration. E. F. DEYSHER, B. H. WEBB and G. E. HOLM. *J. Dairy Sci.*, **27**, 345-355, 1944.

236. Beiträge zur Messung der Konsistenz von Käse. I. Bericht: Bestimmung der Fließgeschwindigkeit. (Contributions on the measurement of the consistency of cheese. I. Report on the determination of flow rate).

G. SCHWARTZ and O. FISCHER. *Milch. Forch.*, **21**, 110-124 (1942, also *Deut. Molk. Zeitung*, **63**, 448, 1942).

The consistency of Tilsit, Camembert, Edam and Parmesan cheese was measured in a Höppler ball consistometer. Curves plotting rate of shear/stress are typically "plastic." Thixotropy is defined in terms of relative change in consistency produced by shearing. The changes in consistency produced by ripening are studied. As a criterion of consistency, the authors take stress required to produce a flow-speed of 10^{-3} cm/sec. G.W.S.B.

238. Report of viscosity panel : Institute of Petroleum.

J. of Inst. Petroleum, **30**, 42, 1944.

To meet the growing demand for a more accurate expression of viscosity index, a possible departure of ± 0.6 per cent. from the true value is allowed (± 0.3 per cent. for the finished calibrated viscometers and a further ± 0.3 per cent. tolerance for the actual laboratory measurement on a sample of oil). The panel has abandoned the use of 40 per cent. sucrose solution as a primary standard. Water and 60 per cent. sucrose solution are retained as primary standards. The only capillary viscometers permitted are the suspended level, Fenske and B.S.I. E.W.J.M.

239. Physical—Chemical properties of textile Nylon yarns. Sales Section of Nylon Division. Du Pont de Nemours & Co.

Rayon Textile Monthly, **25**, 451, 1944.

"High tenacity" nylon yarns have a tenacity of 6 to 7 grams per denier and an elongation of 11 to 17 per cent. The minimum breaking strength of 210 denier is approximately 2.8 pounds. All nylon yarns possess a low modulus of elasticity with slow but definite stretch recovery. Comparative tension to stretch each of several common fibres 1 per cent. is as follows:—unshrunk nylon 0.25 grms/denier, shrunk nylon 0.10-0.15, silk 0.75-1.16, wool 0.32, cotton 0.50, glass yarn 2.75, cellulose acetate 0.40, viscose rayon 0.70, ramie and cuprammonium 0.90. E.W.J.M.

240. Fluidity determinations on flax cellulose.

W. A. WHITE and T. N. RICHARDSON. *J. Textile Inst.*, **35**, 5, T.53, 1944.

The cuprammonium fluidity of flax cellulose can be determined in a simple and reliable manner by scouring in 2 per cent. NaOH before powdering and by including 0.20 per cent. freshly added pyrogallol in the solution to prevent any change in fluidity during filtration. E.W.J.M.

(Nos. 241-249 inclusive were contributed by the British Refractories Research Association).

241. The Fast and Slow Extension of some Plastic Materials.

R. N. HAWARD. *Trans. Farad. Soc.*, **39**, 267, 1943.

It is suggested in a theoretical discussion that the work taken up by any material under impact may be governed either by the rate at which deformation can take place or by the amount of possible deformation. The results of fast and slow extension experiments are examined and it is found that in this way apparent contradictions can be resolved. Experiments are carried out on the extension and breaking of a cellulose acetate film at different temperatures and it is concluded that temperature changes during adiabatic extension will not be so large as to alter fundamentally the character of the deformation. The work absorption of different materials under changing conditions of testing varies both relatively and absolutely, and the validity of a generalised impact strength is questioned. A more precise formulation of shock conditions appears desirable.

242. Flow of Visco-elastic Materials in Capillaries.

A. C. MERRINGTON. *Nature*, **152**, 663, 1943.

Viscosity determinations were carried out on rubber solutions using a viscometer in which the true pressure-drop along the capillary was measured directly. The measurements indicated the existence of an end effect. A typical family of flow curves was plotted in one rubber solution. These curves emphasise the importance of using long tubes, particularly at high stress, if the results are to be assumed to apply to an equilibrium condition. As the tube length decreases the end effect becomes large in proportion to the total length. The curves show that with increas-

ing stress the end effect increases in magnitude and that this end "correction" deduced from the flow curves and expressed in tube diameters is proportional to shearing stress. Tests made with mineral oils containing metallic soaps show that when the liquid emerges from the capillary it is still elastically deformed and will consequently tend to return to its former "unstretched" condition. This results in the swelling of the emergent column of liquid. Here, again, elastic recovery is proportional to stress, i.e. the "elastic end effect" which results in differences in the flow curves, and the swelling of the emergent column of liquid, are related, and either should give a measure of the elastic property of the material.

243. Experiments on Plasticity, I and II.

H. H. MACEY. *Trans. Brit. Ceram. Soc.*, **43**, 5, 1944.

Two fundamentally simple methods of experiment on plastic clay are given and the data obtained by these methods discussed. In Part I, clay bars are subjected to constant tensional and compressional stresses less than those necessary to produce continuous flow. It is shown that clay is not elastic, but deforms plastically even at the smallest stresses. In Part II, de-aired clay bars are extended at a constant speed and a continuous record of the stress involved is obtained. A wide range of speeds is used and it is shown how the behaviour of the bar varies with the speed. The extension to maximum stress increases considerably as the rate of extension is increased. The discussion is restricted almost entirely to that part of the deformation up to the maximum stress. Very considerable variations in behaviour of apparently identical bars are found, but the stress-extension curves are found to be in good general agreement with the formula $f = B(1 - e^{-aE})$, where f is the true stress per unit area, E is the extension and a and B are constants for any one experiment. The behaviour of three clays is discussed and compared, as is also, in the case of one clay, the effect of not de-airing.

244. Effect of Concentration and pH on the Viscous and Electrochemical properties of Hydrogen Bentonites.

J. N. MUKHERJEE, N. C. SEN GUPTA and M. K. INDRA. *J. Phys. Chem.*, **47**, 553, 1943.

The specific conductivity of dilute suspensions of hydrogen bentonites at first increases linearly with increase of concentration, then rises more rapidly, being convex to the concentration axis, after which the slope again diminishes. Λ (conductivity per gm. of colloid) at first shows a small variation, indicating that it is approximately constant within the limits of experimental error, whereafter it rapidly diminishes and ultimately passes through a minimum. The cataphoretic velocity increases with the concentration and passes through a maximum at approximately the same concentration as that at which Λ passes through a minimum, while yield value first becomes noticeable at approximately this concentration. The pH changes proportionately with $-\log C$. The conductivity per gm. of colloid calculated from the pH is appreciably greater than Λ . The extinction coefficient at first diminishes with concentration and then passes alternately through a minimum and a maximum. Similar variations in the extinction coefficient with time have been observed during slow coagulation of hydrogen bentonites. The coefficient of viscosity increases more rapidly with concentrations than one would expect from a linear relationship. The apparent specific gravity increases with concentration and reaches a constant value, which agrees fairly well with the specific gravity of dry bentonite (dried at 105°C.) measured in toluene. The results suggest that, as concentration rises, aggregates are first formed and that at a still higher concentration these aggregates form some sort of structure which possesses yield value. Variations in the yield value, consistency, and thixotropy with pH have been found to be closely related to buffer capacities from titration curves with caustic soda.

245. Structure and Physical Properties of Plastics.

L. W. TURNER. *Chem. Ind.*, **62**, 492, 1943).

The creep of plastics under stress is discussed with the aid of stress/strain curves. Duration/load curves are also reproduced.

246. Evaluation of Rheological Constants from Tensile and Compressive Tests.

W. LETHERSICH. *J. Sci. Instr.*, **21**, 27, 68, III, 1944.

A formula is derived by which the tensile stress may be related to shearing stress in compression or extension experiments. A relation is, however, only obtainable for certain types of materials—principally incompressible ones. The formula is extended to large strains which leads to a new definition of strain and of Poisson's Ratio. It is also shown that if the tensile force is constant, suitable correction may be made for the change of stress due to change of cross-sectional area. If Poisson's Ratio is 0.5 the correction consists of calculating the strain on the final length of the rod. Comments are made on the original paper by G. W. Scott Blair and R. K. Schofield; an error is pointed out in the mathematics. The author replies to these criticisms.

247. The Stress Distribution at the Neck of a Tension specimen.

P. W. BRIDGMAN. *Amer. Soc. Metals*, Preprint, Oct. 1943.

By approximating the contour of a tension specimen at the neck by a circle, and by using a circle to approximate the lines of principal stress in the neighbourhood of the neck, the distribution of stress across the neck has been found which rigorously satisfies the conditions of plasticity in the conventional form of von Mises. The same solution also applied with an error of only a few per cent. when strain hardening occurs of the amount found under actual conditions. The solution differs qualitatively from the stress distribution in an elastically strained specimen. In the plastic specimen, the tension is greatest on the axis and least on the periphery; the stress system consists of an axial tension, uniform all the way across the neck, plus a hydrostatic tension, which is zero on the periphery and increases to its maximum value on the axis. The effect of the variation of tension across the section is to make the mean tension higher than the true tension of flow. Numerical values and curves are given for converting one tension to the other. Under extreme conditions recently attained experimentally, the correction may amount to 40 per cent. The correction depends on a single parameter, a/R , the ratio of the radius of the neck to the radius of curvature of the contour of the neck. Under experimental conditions a/R is determined to a certain degree of approximation by the reduction area only. There appears to be a close connection between the "cup and cone" fracture often observed and the stress distribution at the neck. The brittle fracture on the axis is associated with the hydrostatic tension prevailing there, while the shearing fracture nearer the outer surface is connected with the shearing stresses which become important near the outer surface.

248. The Percentage Stress Strain Diagram as an Index to the comparative behaviour of Materials under Load.

H. J. GILKEY and G. MURPHY. *Iowa Eng. Expt. Sta. Bull.*, No. 159, 1943.

The overall record of a test as represented by a stress-strain diagram, a load deflection diagram, or a torque-twist diagram does not necessarily indicate the nature of the breakdown which occurred; shape comparisons should, in many instances, supply important clues to the relative nature of the breakdown action within the specimens compared. Relative shapes of load deformation curves can be compared readily by converting loads and deformations to percentages of the load and deformation at a datum point at or near the ultimate and superimposing curves. Percentage comparisons for relative shapes may be made at any percentage of the ultimate strength. The higher the datum stress selected the more complete and discriminating will be the comparisons. For many purposes a datum at 95 per cent. of the ultimate has been found satisfactory. All percentage curves for datum points within the proportional limit coincide along a straight line. The ultimate strength is rarely a satisfactory datum stress because the strains which correspond to the ultimate strength are likely to be difficult to determine accurately. The initial slope of the percentage diagram is the ratio of the total strain at a datum point to the elastic strain at the datum point and therefore serves as a useful comparative index for expressing the relative shapes of percentage diagrams, but it does not indicate whether the break-down is gradual or abrupt. The conventional stress-strain diagram and the percentage diagram are based upon the same initial data but each emphasises certain characteristics or properties of the material less apparent in the other type of diagram. All of the properties which can be determined from the conventional diagram can be evaluated from the percentage diagram if the stress and the strain at the datum point are known.

Illustrative cases show that the families of stress-strain curves which represent a very wide range of strength, stiffness and other physical properties for a given material of different types of grades, often coincide when superimposed on a percentage basis. If the relationship between the stress and the strain at datum point is known to exist for the materials in an homologous series, conventional stress-strain diagrams can be constructed for any actual or assumed strength of the materials. The percentage diagram is well adapted for making comparative studies of the differences in shape between stress-strain, (or other load-deformation) diagrams in tension, compression, flexure and torsion or of differences between lateral and longitudinal diagrams or between groups of lateral diagrams. The percentage stress-strain diagram, constitutes a supplement to, rather than a replacement of, the conventional diagram; the latter is essentially quantitative and more convenient for the evaluation of the physical constants which measure properties, whereas the percentage diagram eliminates entirely the quantitative aspect and supplies purely qualitative comparisons of stress-strain behaviour under static loading. With the aid of both types of diagram the effects of the significant variables can be classified as either quantitative, qualitative, or both.

249. Viscosity of recent Container Glass.

H. A. ROBINSON and C. A. PETERSON. *J. Amer. Ceram. Soc.*, **27**, 129, 1944.

A high-temperature concentric cylinder viscometer is described. The calibration checks within 1 per cent. of that obtained by Lillie for a similar apparatus, and provides further evidence of the high degree of reliability of this type of measurement. The contention that the calibration in such instruments is a function of the viscosity is shown to be false. A medium temperature range fibre viscometer for measuring the viscosity of glass in the annealing range was also constructed. It is shown that the Fulcher equation, $\log \eta = -A + \frac{B}{T - T_0}$, fits the data obtained on the two instruments to within 0.5 per cent. for commercial soda-lime glasses. Complete viscosity data as a function of temperature are given for 16 commercial container glasses, and the analyses are also included. These glasses show a wide range of viscosity.

250. Analytical and Integrative Aspects of the Stress-Strain-Time Problem.

G. W. SCOTT BLAIR. *J. Sci. Instr.*, **21**, 80, 1944.

The behaviour of a complex body is not justifiably expressed purely from an analytical approach regarding it as a physical mixture of ideal Hookean and Newtonian components. The integrative view of intermediate molecular conditions, too complex to represent by idealised models, is shown to have some support in Psycho-physical experiments and it is suggested that the final solution lies in the fusion of these two methods of approach. H.C.T.

251. A falling Co-Axial Cylinder Viscometer for the rapid measurement of High Viscosities.

H. L. D. PUGH. *J. Sci. Instr.*, **21**, 177, 1944.

A falling co-axial cylinder viscometer requiring only 12 c.c of material and covering the range 5×10^4 to 10^{10} poises is described. It consists of an inner hollow cylinder encircled by a cylindrical ring with a space between to contain the test material. The design ensures easy filling, rapid temperature equilibrium and loading system which centres the inner cylinder so that it falls vertically.

It is not suitable for materials having pronounced plastic or elastic properties. H.C.T.

252. A Precision Extensometer and its use for the Measurement of Poisson's Ratio.

W. LETHERSICH. *J. Sci. Instr.*, **21**, 180, 1944.

An optical hinge device requiring only one image adjustment is developed for measuring Poisson's ratio under conditions of both stress and strain. H.C.T.

253. Some Applications of the Nutting-Scott Blair Equation.

L. BILMES. *J. Sci. Instr.*, **21**, 183, 1944.

The Nutting-Scott Blair equation is applied to:—

- (a) Extension or compression under constant load;
- (b) Torsion of cylinder;
- (c) Deformation in a capillary tube;

and the equations obtained contain as special cases the formulae given by elasticity and viscosity theory. A method of conversion between the equations obtained ($\beta = 1$) and the elasticity and viscosity formulae is suggested. H.C.T.