



BULLETIN OF THE
BRITISH RHEOLOGISTS' CLUB

Address for communications: c/o The Institute of Physics,
at The University,
Reading. Berks.

NO.2

JUNE 1941

Issued (gratis) to
members of the Club
only.

CLUB NOTES

Membership.

The membership of the club is now 89 of whom more than half live in the London area. It is for this reason that the first three meetings of the club are all taking place in or near this area.

Classical Papers on Rheology.

Following the example of our American colleagues, we have decided to translate and issue to members, from time to time, classical papers on rheology which, on account of the difficulty in getting the originals, have probably not been as widely read as they deserve. A little-known paper by Pochettino forms the first of this series and is being circulated to members with this number of the bulletin. We are indebted to Dr. V.G.W. Harrison for the translation. Suggestions for further papers will be welcomed.

Suggestions.

The Committee takes this opportunity of thanking members who have expressed their appreciation of the club and have contributed suggestions and criticisms. These are always gratefully received and given careful consideration.

American Co-operation.

We are glad to note an appreciative paragraph about the club in the November (1940) number of the "Rheology Leaflet" of the American Society of Rheology. Co-operation with our American colleagues is most welcome and we hope to keep in close touch with them especially when the very difficult and controversial questions of nomenclature and definition are being discussed.

Public Interest in Rheology.

It is significant that "John O' London's Weekly" should devote a whole page to an article by J. Harley-Mason entitled "Rheology - A New Science". Many club members would wish they knew as much about thixotropy as the author would have us believe is in fact known. This growing appreciation of the existence of Rheology as a Science is to be applauded and the appreciation of its importance in industry is, it will be remembered, one of the objects of our club. Next time you are asked by a layman "what is Rheology" you can escape an involved discussion, if you will, by suggesting the purchase of a copy of "John O' London's Weekly" for 9th May, 1941.

Next Meeting.

From the forms returned by members, it appears that the subject of most general interest at present is thixotropy and allied phenomena. The question of definition of terms seems to be especially difficult and we are therefore planning (as

members will already have heard) to hold a meeting to discuss this matter. Through the courtesy of the Director and staff of the British Rubber Producers' Research Association, the club has been invited to meet on Saturday, 21st June, at Welwyn Garden City, Herts. Details are given on the attached sheet.

CONCENTRIC CYLINDER VISCOMETERS

Report of the Discussion on Concentric Cylinder Viscometers, held by the club on February 22nd 1941, at the laboratories of the Printing and Allied Trades Research Association, London, with the Director, Dr. G.L. Riddell in the Chair.

The Chairman in introducing Mr. C.C. Mill, said that the Printing and Allied Trades Research Association was not concerned with rheological research as such, but means were needed for assessing the working and printing **properties** of printing inks. A study of viscosity appeared to be important, and the suitability of a Goodeve Thixoviscometer for this purpose was being investigated in the laboratories of the Printing and Allied Trades Research Association.

Mr. C.C. Mill opened the discussion by explaining how printing inks varied in "body" and flow properties, which affected their behaviour on the machine and the quality of the printed result. It was therefore desirable both for research and for works control purposes, to have means of evaluating the physical properties of inks in absolute terms. Important facts about the viscosity of printing inks were:

- (a) Most inks are apparently viscous liquids or solids when undisturbed.
- (b) They usually become less viscous on stirring.
- (c) When sheared continually at a constant rate, the viscosity ultimately becomes constant.
- (d) Inks may be plastic solids - that is, they may show an appreciable "yield value".
- (e) The viscosity of most inks is a function of the rate of shear.

These facts suggested that a concentric cylinder type of viscometer might be a convenient instrument. The conditions to be satisfied were: (1) continuous and constant rate of shear, and (2) rate of shear must be variable.

The Goodeve Thixoviscometer had been designed to satisfy these conditions. The apparatus consisted essentially of a pair of coaxial cones, the outer cone being driven by a constant speed motor. A number of gears gave a choice of four or five speeds of rotation, but the rate of shear was altered mainly by raising or lowering the inner cone, which altered the distance of separation between the two cones. A water bath was attached to the outer cone for temperature control. Two sets of cones were supplied, (1) a large pair with torsion wire control for low and medium viscosities, and (2) a much smaller pair with spring control for high viscosity systems. A wide range of rates of shear was obtainable by using suitable combinations of gears and distances of separation of the cones.

With the large cones the apparatus had been found satisfactory for measuring the viscosities of fairly thin inks. The small cones were, however, less satisfactory. The heat capacity of the outer cone was large, which made temperature control difficult, "end effects" were large and difficult to estimate, and thick inks tended to work out of the space between the cones. This last effect caused the initial

steady deflexion of the inner cone to drop to a low and non-reproducible value after one or two minutes' shearing: this defect was, however, not peculiar to the Goodeve instrument, but was found also with concentric cylinder viscometers.

Finally, Mr. Mill showed typical curves obtained with the Goodeve instrument for laboratory inks consisting of carbon black suspended in mineral oil. The results obtained with a modified Stormer viscometer, in which shearing stress is the independent variable, were also briefly described.

The meeting was then thrown open for general discussion.

Dr. Goodeve pointed out that the results obtained with a viscometer are largely dependent upon the **previous** history of the material. In order to obtain reproducible results it was necessary to set up a steady state by shearing at a constant rate until equilibrium was attained. The use of a concentric cylinder or concentric cone viscometer enabled this to be done in an easy and convenient manner.

Dr. Mardles said that he had had an opportunity of trying the Goodeve thixoviscometer and comparing the results with those given by a plastometer. He found that the temperature control was not adequate, and the torsion wires supplied were not fine enough. He had been interested in dilute gelatine-glue sols and had found that these, unlike the systems investigated by Dr. Goodeve, gave curves convex towards the reciprocal shear axis. He thought that the Club should give serious consideration to the definition of the term "thixotropy". Later, he stated that for paints he found that rotation viscometers give high readings, and he showed examples of rotating forks and paddles which he had successfully employed in place of the inner cylinder.

Mr. Foster thought that for many systems a study of viscosity was not enough. He was interested in gum tragacanth sols of viscosity 1 - 2 poises. Some of these showed all the symptoms of an under-boiled gum although the viscosity appeared to be correct, and he thought that the subject of "stringiness" deserved attention.

Mr. de Waele thought he might answer the query raised by the previous speaker as to a possible interpretation of stringiness in terms of plastometric behaviour. Certain materials, normally with a small degree of "shortness", under certain conditions involving none but physical change, could exchange this for stringiness and "tack". The stress/velocity gradient lines of the two materials was found to differ by an intercept on the stress axis in the former case and a greater curvature starting at or nearer the origin in the latter.

He was unable to appreciate the desire to employ rotation viscometers for any but roughly quantitative observations of so-called thixotropy, in view of the far greater accuracy furnished by capillary instruments. Both forms of instrument at present available failed for the examination of materials of very high consistency for the reasons already mentioned by Mr. Mill, but if air pockets in the mass could be eliminated, the employment of greater pressures would remove the limitations on consistency at present imposed by the capillary instrument.

He regretted the introduction of discussions on thixotropy at a stage of progress when the definition of the term needed so much clarification. As originally coined by Freundlich, it implied a change of tangible rigidity with shear. Plastometrically recognisable changes could be analysed into several

component factors which persisted for more or less time after arrest of shear, as distinct from mere non-Newtonian fluids such as cellulose and rubber sols, the "thixotropy" of which was reduction of apparent viscosity with increasing rate of shear during shear. Such non-Newtonian fluids presented neither tangible rigidity nor thixotropy in the generally accepted sense. When, however, certain systems wholly or partly lost their sensible rigidity temporarily as a result of shear, e.g. certain printing inks, organic and inorganic aqua-gels, etc., the mobility, intercept of the linear portion of the line, or yield value (yield point) might all or severally change. Although the complexity of the phenomena was indicated in a publication several years ago ("The measurement of plasticity", The Science of Petroleum, Oxford University Press), the term thixotropy was still being employed in a loose manner leading to confusion.

He further suggested the desirability of convening an informal conference to discuss experiences of the separate phenomena of thixotropy and thereby to adopt a rational nomenclature.

Dr. Lessing stressed that the practical significance of measurements made should always be borne in mind; for example, viscometric measurements made on printing inks might bear no direct relation to their behaviour on the machine. In many cases laboratory conditions were appreciably different from those met with in practice.

Dr. Arnold pointed out that there appeared to be two distinct conceptions of thixotropy. The first was that of a reversible gel-sol transformation produced by agitation, the second was that of a system the apparent viscosity of which varied with rate of shear. He thought that both should be recognised and definitions based on them in order to avoid the present ambiguity.

Mr. Lawrence hoped that more work would be done on sol thixotropy and dilute systems.

Dr. White stated that one of the disadvantages of the present design of Goodeve thixoviscometer was that the rate of shear was not constant over the surface of the cone, but was greater at the top than at the bottom. This disadvantage could be overcome if the section of the cones was a tractrix. He pointed out that the construction of such cones was quite practicable, since the tractrix was one of the few curves which could be "ground to itself".

Finally Mr. de Waele regretted that the attention of the meeting had been restricted entirely to one type of rotation viscometer, i.e. the Couette, McMichael or the later Goodeve, in which the velocity of shear was the independent variable. The Stormer instrument, in which, on the contrary, a variable stress was applied and resulting velocity observed, permitted of the recording of time-of-rest effects. Thus, certain low stresses might not only result in progressively diminishing rotation velocities, but might even fail after sufficient time of rest to produce any shear at all. The instrument as supplied, however, needed considerable mechanical improvement.

In the afternoon session of the meeting, a demonstration of a Goodeve thixoviscometer and of a modified type of Stormer viscometer was given. 35 members were present.

RHEOLOGY ABSTRACTS

Note: The Club assumes no responsibility for the opinions expressed by abstractors; these are given in square brackets.

20. Determination of the Tenderness of Peas. H. Campbell and H.C. Diehl. Western Canner & Packer, 32 (10), p.48 and (11), p.51. 1940. - An instrument has been designed to determine the tenderness of raw peas intended for canning or freezing. The toughness of peas is that property which resists shearing or grinding during mastication and the method adopted must measure the force required in the shearing operation. Owing to the variation in tenderness of individual peas it is necessary to test large samples simultaneously. In the "tenderometer" the force required to press a certain quantity of peas through a standard grid is determined.

It has been shown that, provided the size of the peas in the sample is fairly uniform and standard conditions of temperature are maintained, a fairly close correlation exists between tenderometer readings, maturity of peas as determined by a chemical method and judged grades of tenderness of cooked or frozen peas.

F.D.F.

21. Experiments on Thixotropic and other Anomalous Fluids with a New Rotation Viscometer. J. Pryce-Jones. J. Sci. Instr. 18, p.39, 1941. - The viscometer described is based, in principle, upon the rotation of two identical Couette units rotating in opposite directions. A continuously variable speed gear gives a wide range of rate of shear and the inner cylinders are suspended from a frame attached to a torsion wire; this carries a small mirror which is used to indicate deflexions by the usual lamp and scale method, or on a photographic plate.

The application of this instrument to the study of anomalous viscosity, thixotropy, dilatancy, elastic recoil, yield value, and the degree of dispersion of suspensions of solids in liquids is illustrated experimentally by comparison with truly Newtonian fluids, and a critical review of rheological terms is deduced from results obtained with the apparatus.

By reason of the direct comparisons that can be made with the instrument using a true Newtonian fluid in one unit and the material under examination in the other, the instrument should be a valuable aid in the formulation of more precise rheological definitions and classifications.

H.C.T.

22. The Colloidal Nature of Clay with Reference to Papermaking. B.W. Rowland. Paper Trade Journal, 111 (16), pp.41-46, 1940. This discussion is of a theoretical and technical nature concerning the colloidal attributes of clays which are of technical concern to the papermaker and is intended as a preface to a number of research projects in progress at The Institute of Paper Chemistry and which will appear in consecutive order as student thesis publications. No new data are presented in this paper, but an attempt is made to call attention to those colloidal characteristics of clay which are of particular concern. Recent experience in the paper industry with papermaking clays has forcibly called attention to the fact that paper is made with clays which differ widely in their colloidal characteristics, these differences being of minor concern in the past but of increasingly important concern in the future. This is due to technological advance in papermaking which calls for more exacting knowledge concerning the characteristics of all raw materials.

In certain instances it has been found critical for the paper manufacturer to examine the characteristics of clays and not only to select the ones most adapted for his purpose but to make extraordinary efforts to get the colloidal properties of these clays under sufficient control so as to insure uniformity. The present discussion attempts to lay down a theoretical background and to point out in some detail the nature of these colloidal properties which have received attention. B.W.R.

23. The Fluidity of Silk Solutions. C.H. Garrett and F.O. Howitt. J. Textile Institution, 32, p.11, 1941. The silk was dispersed in a reagent containing 8% of ethylene diamine and 6% of cupric hydroxide and subsequently neutralised with an equal volume of acetic acid to give a concentration of 5% (wgt/vol); the fluidity was determined by using a U-tube type of viscometer of small capacity, bore 0.088 cm. A fluidity range of approximately 4 to 50 was obtained for untendered silk and silk tendered until the tensile strength approached zero. Reasonable agreement was found in the results obtained with concentrations to 6% and those values calculated from Baker's Empirical equation $\eta = (1 + ac)^k$. E.W.J.M.

24. The Plasticity of Animal Fibres. J.B. Speakman and S.Y. Shah. J. of Soc. of Dyers and Colourists, 57, p.108, 1941. Human hairs were stretched different amounts in distilled water at 25°C., and curves prepared illustrating the decay of tension at different extensions and at different temperatures, etc. At low extensions where the amorphous phase of the fibre is primarily affected the rate of decay of tension is small but at extensions above 23% approx., where the crystalline phase begins to undergo conversion from α to β Keratin, the rate of decay of tension is high.

The rate of relaxation increases with increasing temperature up to 60°C, beyond which little further change takes place. Rapid relaxation can be brought about at 25°C. by means of alkalis, etc. which are known to cause disulphide bond breakdown. E.W.J.M.

25. The dissolution of chemically modified cotton cellulose in alkaline solutions, Part VI relations between fractional solubility in sodium hydroxide solution and fluidity in cuprammonium solution. T. Brownsett and G.F. Davidson. J. of Textile Institute, 32, No.2, p.125, 1941. The fluidity in cuprammonium solution was determined by the method of Clibbens and Geake (capillary viscometer of specified dimensions). Oxycelluloses prepared by the action of alkaline hypobromite or alkaline hypochlorite or of dichromate in the presence of sulphuric or oxalic acid give approximately the same fluidity - solubility relation as hydrocelluloses but neutral hypochlorite and acid hypochlorite oxycelluloses are considerably more soluble and periodic acid and meta periodate oxycelluloses considerably less soluble than hydrocelluloses of equal fluidity. Part VII. T. Brownsett and D.A. Clibbens. The solubility of modified cotton cellulose in a strong base increases with the fluidity (degree of chemical modification) of the cellulose but in view of the imperfect theoretical understanding of the solubility relations this method as a basis of comparison remains an arbitrary one. E.W.J.M.

26. A device for measuring the body of cream cheese. Z.D. Roundy and W.V. Price. J. Dairy Sci. 24 pp. 135-137, 1941. The authors describe a penetrometer in which a cone of standard size and shape is forced, by means of a weight, into a mass of cream cheese in a beaker. The beaker stands on a spring-balance, which records the pressure exerted. The weight rests on a piston which slides snugly within a closed cylinder. The cylinder is by-passed and the rate of fall of the piston and hence of the weight plus cone is controlled by means of a valve. When this valve is closed

the piston is prevented from sinking by a cushion of air. There is some discussion on the most suitable dimensions for the plunger.

The paper is clearly preliminary and the data presented are limited to a few figures only. G.W.S.B.

27. Crystallisation Phenomena in Raw Rubber. L.R.G. Treloar. Tran. Faraday Soc. 37, pp. 84-97, 1941. It has already been shown by the author that the plastic flow in raw rubber does not, in general, increase continuously with increasing extension, but rises to a maximum at intermediate extensions, then subsequently falls. There is also a transition in the elastic retraction phenomena in this intermediate region. Both these effects were attributed to the crystallisation which occurs on stretching.

In the present paper this crystallisation is studied quantitatively by examining (a) the double refraction developed on stretching and (b) the accompanying changes in density. It is found that (at room temperatures) crystallisation occurs first at about 300% elongation, increases rapidly to about 450%, and then in a linear manner up to the breaking point. These data are correlated with the above mechanical properties of raw rubber and an attempt is made to draw a picture of the molecular structure of the material. Author.

28. Relation between molecular weights and physical properties of rubber fractions. G. Gee and L.R.G. Treloar. Rubber Ind. 16, pp. 184-197, 1940. A study of the viscosities and osmotic pressures of solutions leads to values of molecular weight (M) for 4 different molecular fractions of the pure rubber hydrocarbon $(C_5H_8)_n$ ranging from 63,000 to 360,000. In general, the range of elastic extensibility was found to increase, and the accompanying plastic flow to decrease with increasing M, as would be expected. The intermediate fraction (M = 350,000) had properties almost identical with whole rubber. It is concluded that elasticity is a fundamental property of the long-chain molecule, and that the essential properties of whole rubber are not dependent on the presence either of a low-molecular constituent or of a "gel-skeleton". Also the non-hydrocarbon constituents of crude rubber have no fundamental effect on the properties of this material. Authors.

29. On a dynamic method for the study of elastic materials. I.S. Lazurkin. Acta Physicochimica U.S.S.R. 12, pp. 669-680, 1940. Description is given of an apparatus for measuring elastic deformations of rubber plastics at frequencies between 1 and 2000 vibrations per minute and at temperatures between -180° and +200°C. The temperature effect on deformation depends on frequency. S.

30. On the mechanical (elasto-viscous) properties of thin gliadine layers. A.S. Achmatov. Acta Physicochimica U.S.S.R. 12, pp. 253-268, 1940. Unimolecular layer of gliadine grain spreads when placed on the surface of HCl-solution and exerts - as is known - a twodimensional pressure and has a phase boundary potential. The time to reach equilibrium was investigated and the resistance of the molecular film measured by the oscillating disc method. The collapse of the layer when exposed to ultra-violet light was proved by the disappearance of this resistance. S.

31. Fundamental Study of Clay: Preparation of a Purified Kaolinitic Suspension. A.L. Johnson and F.H. Norton. J. Amer. Ceram. Soc., 24, p. 64, 1941. Describes method of purification and effect on relations between viscosity of slip and pH and amount of added NaOH. Uses Couette type viscometer with electro-magnetic damping. H.H.M.

32. Stress-Strain Hysteresis in Certain Clays and Other Substances. H.H. Macey. Nature, 147, p.146, 1941. Describes a looseness of structure possessed by certain clays when in the plastic condition. The name of "backlash" is proposed, by analogy, for this property, and an explanation put forward based upon the probable structure of these particular clays. Rice starch, which has a totally different structure, also shows this property when in concentrated suspension in water and attention is drawn to the possibility that more common phenomena such as thixotropy may arise in different ways in various substances and require different treatments. Author.

33. Rheology of Plastic Materials. D.C. Broome and L. Bilmes. Nature, 147, p.176, 1941. An outline of studies of extension under tension and recovery of asphalt strips. Supports the procedure suggested by Scott-Blair and Coppen (Nature, 146, p.840, 1940) of plotting by strain against log time and expressing experimental curves by an expression $\psi = S \epsilon^{-1} t^k$ where S is shearing stress, ϵ is strain, t is time and ψ and k are constants for the particular material, being substantially independent of S . H.H.M.

34. Further Investigations of the Properties of Clay Suspensions. G.D. Hobson. J. Inst. Petrol., 26, p.533, 1940. A number of clay suspensions have been examined in a capillary tube viscometer under different pressure gradients. Data were obtained on the relationships between rate of flow and complex suspensions, and on the effects of heating, viscosity temperature coefficients and ageing. The Hatschek concentric-cylinder viscometer did not prove very satisfactory for examining these suspensions. The phenomenon of sedimentation under shear in a concentric-cylinder viscometer was investigated. Attempts to determine yield values directly by using cylinders and vanes in a torsion apparatus brought to light an interesting feature which is probably coupled with thixotropy. Preliminary work on the estimation of the amount of water bound by different clays was undertaken, and apparently amounts up to 25 per cent or more of the weight of the dry clay are held thus. (From Physics Abstracts).

35. The Resistance to the uniform motion of a solid through a viscous liquid. R.B. Block. J. App. Phys. 11, p.635, 1940; criticism under same title by J.T. Burwell, J. App. Phys. 12, p.257, 1941. The author considers that he has evidence that slip may occur between the surface of a solid and the (Newtonian) liquid in contact with it when the solid is in steady motion through the liquid at speeds below the turbulence level. His experiments consisted in timing the rolling of a steel ball down the inside of a straight glass tube filled with a mixture of methyl alcohol and glycerol and slightly inclined to the horizontal. Some of the difficulties of interpretation are pointed out by Burwell.

The most serious objection, not mentioned by Burwell, is that the motion of the liquid has a singularity at the steel-glass contact. The results cannot therefore be taken as evidence of slip until rigorous hydrodynamical analysis has been made. P.W.

36. Measurement of solid friction of plastics. A. Gemant. J. App. Phys. 11, p.647, 1940. The author has modified for use with soft substances a method, due to Förster, for measuring the "internal friction" of elastic solids. An elastic rod is suspended horizontally by attaching two points of it to headphone movements. Vibrations of adjustable frequency are set up in one of these and picked up and measured at the other; a frequency response curve is thus obtained; the sharpness of the resonance peak of the curve is an inverse measure of the internal friction of the rod. The author modifies this method for soft materials by replacing the rod by a thin-walled steel tube and taking differential

measurements with the tube empty and then filled with specimen. Measurements are quoted for paraffin wax at room temperature and over a short range at the M.P.; also for glass and polystyrene rods fitting in the tube with oil filling.

The method seems likely to be useful for empirical purposes. It requires and deserves theoretical investigation. P.W.

37. Optical properties of colloidal suspensions in relation to the measurement of particle-size frequency. E.G. Richardson. J.App.Phys. 11, p.653, 1940. This paper is, in part a description of an apparatus for rapidly determining the size-frequency distribution of polydisperse material, such as clay or pigment. A well-mixed suspension of the material in a transparent liquid is centrifuged at low speed; after a suitable time an instantaneous shadow photograph of the moving cell is taken in monochromatic U.V. radiation. The negative is microphotometered and gives the distribution of opacity in the centrifugate. In order to convert to (integrated) particle-number as a function of size, we need to know the light-absorbing power per particle for various sizes. This is known (a) if the diameter, d , is much larger than the wavelength (opacity $\propto d^2$) and (b) if d is much smaller than the wavelength (opacity $\propto d^6$; Rayleigh). For the intervening region (d about 0.365μ) the author reports his experiments on TiO_2 of known particle-size.

His results differ markedly from the theoretical predictions of Jobst (Ann. d. Phys. 76, p.863, 1925), presumably because the particles are not spheres. Non-sphericity, though not invalidating the work in question, invalidates both the theory of light absorption and that of sedimentation and is too frequently overlooked. Experimental work on the settling and light absorption of non-spherical particles of known form is much to be desired. P.W.

38. Velocity of compressional waves in petroleum fractions at atmospheric and elevated pressures. C.J. Vogt. J. App. Phys. 11, p.658, 1940. Velocity of sound in hydrocarbon oils was measured between $14^\circ C$ and $99^\circ C$ and between 1 and 400 atmospheres.

39. Flow of gas through porous media. J.L. Fowler and K.L. Hertel. J. App. Phys. 11, p.496, 1940. The authors measured flow of air through plugs of cotton, wool, rayon and glass wool and compared their results with Kozeny's theory. In addition to the effects of varying the obvious geometrical variables, the effects of varying the compactness of the plugs and shape of the cross-section of the fibres were found to be in good agreement with theory. The numerical constant in the formula was found to be nearly equal to that for flow of liquids through sand beds, glass beads, etc.

For a continuation of this work, with special reference to the orientation of the poros, see R.R. Sullivan and K.L. Hertel, J.App.Phys. 11, 761, 1940. P.W.

40. Studies in Lubrication:

- VI: Electrolytic models of full journal bearings, F. Morgan, M. Muskat and D.W. Reed; J. App. Phys. 11, p.141, 1940.
- VII: Lubrication of plane sliders of finite width, Muskat, Morgan and M.W. Meres; J. App. Phys. 11, p.208, 1941.
- VIII: Lubrication of plane sliders, Morgan, Muskat and Reed; J. App. Phys. 11, p.541, 1940.
- IX: Effect of pressure variation of viscosity on the lubrication of plane sliders; Muskat and H.H. Evinger; J.App.Phys. 11, p.739, 1940.

41. Theory of the plastic properties of solids. F. Seitz and T.A. Read. J. App. Phys. 12, pp.100 and 170, 1941. This series of papers summarises the existing state of knowledge concerning the permanent straining of crystalline materials (metals etc.) P.W.

42. New Instrument for Rheological Studies of Plastic Substances. C.R. Bailey. J. Ind. Eng. Chem. (Anal. Ed.) 13, p.173, 1941. A very complex torsion instrument is described for studying the flow and rupture of plastic substances in general. The apparatus is capable of modification to suit a wide range of materials but is described in this paper for use for lyogels in particular. G.W.S.B.

43. Measurement of Flow Properties with the Gardner Mobilometer. P.W. Kinney. J. Ind. Eng. Chem. (Anal. Ed.) 13, p.178, (1941). A Gardner mobilometer, slightly modified, is studied with special reference to Kaolin - manila copal resin solutions. The instrument has already been used, in slightly modified forms for many materials: paints, foodstuffs, coal-tar, clay, etc. It appears to consist of a hollow cylinder filled with the material, through which a plunger rod attached to a disk, sometimes perforated with holes, is allowed to sink. The time taken for the rod and disk to fall a known distance is recorded.

The instrument is doubtless well-known in certain industries and full references are given to the original papers. Some rheologists may feel regret that a knowledge of earlier papers is assumed to such an extent that this paper, read alone, is extremely difficult to understand. G.W.S.B.

44. A Gelometer for Starch Pastes. R.M. Hixon and B. Brimhall. J. Ind. Eng. Chem. (Anal. Ed.) 13, p.193, 1941. An apparatus is described for studying both the deformation and breaking strength of gels of 6 - 9% starch (i.e. soft gels). A cylinder of the gel is placed on a plate with a hole in the centre attached to a U-tube containing water. Suction, measured on a water manometer, is applied and the amount of deformation of the gel is measured by reading the volume of water in the U-tube displaced by the gel as it is deformed. G.W.S.B.

45. An improved Thixotrometer. R.W. Kewish. J. Ind. Eng. Chem. (Anal. Ed.) 13, p.195, 1941. An improved modification of the apparatus described by Kewish and Wilcock (Ind. Eng. Chem. 21, p.79, 1939) and similar to those of Freundlich and Røder (Trans. Farad. Soc. 34, p.309, 1938) and of Schofield and Scott Blair (Trans. Farad. Soc. 27, p.630, 1931) in which the sideways movement of a sphere through the material under investigation contained in a beaker or jar was observed. The author has now replaced the sphere by a disk and made other improvements in the apparatus, such as the addition of an electro-magnetic clamp. Experiments with paints show a probable error of 3.55% for single observations which is not considered excessive in view of the big variations encountered in the trade. G.W.S.B.

Note: It has not yet been possible to secure copies of the following papers for abstracting.

46. On the influence of pressure up to 1000 kg/cm² on the viscosity of very viscous liquids. M. Wolarowitsch. Acta Physico-chimica U.S.S.R. (1940) 13, pp.69-82.

47. Orientation of molecules in flowing anisotropic liquids. W. Zwetkoff and W. Marinen. Acta Physicochimica U.S.S.R. (1940) 13, pp.219-241.

48. The speed of crystallization of some silicate glasses as a function of viscosity. A. Leontjewa. Acta Physicochimica U.S.S.R. (1940) 13, p.423.