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EDITORIAL

HIS MAJESTY KING GEORGE VI.

This Bulletin is late in going to press and we therefore record, with deep regret, the death of His Majesty King George VI. His reign had less of pomp and glamour, and more of danger and sheer hard work, than any other that had gone before; and it is now a matter of history how well the King fulfilled his duties. His fine example during the war years was itself a notable contribution to public morale. The peoples of the Commonwealth, however, have lost far more than a King — they have lost a man whom they respected and loved. We believe that not since the death of Tommy Handley has there been so deep and widespread an expression of public grief — and for much the same reason. The hearts of his subjects were won, not by virtue of high position, not by blare of publicity and the propaganda we associate with dictator countries, but by the King's own fine qualities as a man. To most of us his death has come with all the shock of a personal loss. No finer tribute is possible.

Our sympathy goes out to Her Majesty The Queen, the Queen Mother and the members of the Royal Family in their bereavement.

Back Numbers.

Members are informed that limited quantities of complete sets or single numbers of the Bulletin, extending back to No. 17 (December 1947) are available at the original price of 5/- a copy, and may be had on application to the Hon. Treasurer.

We also have for disposal a few copies of the proceedings of the Bristol Conference (1949), price 10/- each.

Viscosity at High Rates of Shear.

Our attention has been drawn to the existence of a 50-page "Symposium on Methods of Measuring Viscosities at High Rates of Shear" published by the American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa., U.S.A. at \$1.35 a copy. According to our information, the purpose of the symposium was to find a suitable method of testing viscosity at high rates of shear of various additives used in lubricants and fluids. Two promising methods are stated to be investigated and described in detail.

No knowledge is ours until we have digested and assimilated it, and made it part and parcel of ourselves; and there is no more certain way of dwarfing the mind than taking, at second hand, all opinions and thoughts, and being content with them; and, however good the guide, the case is not the least altered.

ARCHBISHOP OF YORK (DR. WILLIAM THOMSON)
in address to students at Leeds Town Hall
3 November 1863 and reported in *The Times*
of 5 November 1863.

UNIVERSITY TECHNOLOGICAL DEGREES IN PAPERMAKING.

The shortage of paper in this country has helped towards a realization of the importance of that material in our daily life. The shortage is felt not only in the supply of newsprint, which naturally obtains the readiest access to the public ear through the daily press, but handicaps the production of all the other multitudinous forms in which papermaking fibres are employed. The difficulties through which the papermaking industry is now passing have stimulated interest in developing the use of unorthodox cellulosic fibres and in the search for new methods of paper production.

Although paper is now produced largely from wood pulp, the greatest concentration of mills in this country is still found round Manchester, in proximity to the source of the original raw material, namely cotton.

To supply trained workers for the paper mills, several technical colleges in Britain provide courses in papermaking which give instruction to a standard suitable for the Final City and Guilds Examination and the Higher National Certificate.

The Manchester College of Technology's courses in papermaking are unique in two respects. In the first place, the College possesses a representative selection of working papermaking machinery, including a 20-inch paper machine as well as the full range of standard paper-testing equipment and the pulp evaluation apparatus recommended by the British Paper and Board Manufacturers' Association. This admits of more advanced instruction in the part-time evening courses, which can lead to the Associateship of the College.

In the second place, the College, representing the Faculty of Technology in the University of Manchester, provides the only University course of paper manufacture in the country, leading to the degree of B.Sc. (Tech.) which may be taken either at the Ordinary (i.e. Pass) or the Higher (i.e. Honours) level. The course aims at providing a sound training on modern technological lines, and, in addition to classes in the theory and practice of papermaking, includes such ancillary subjects as mathematics, chemistry, physics, macromolecular structure and some engineering. It is intended to train men for responsible laboratory, engineering and managerial positions in the industry.

The papermaking laboratories also provide facilities for students working for M.Sc. (Tech.) and Ph.D. degrees in the University as well as for advanced research into the properties of cellulosic fibres and fibre assemblages.

The Papermaking Section, which forms part of the Textile Chemistry Department, is under the direction of W. W. Barkas, D.Sc., F.Inst.P., who will be known to rheologists from his former association with the Forest Products Research Laboratory at Princes Risborough. He joined the staff of the College in 1949 in succession to Mr. F. W. Bailey, and has been appointed Reader in Papermaking Technology in the University of Manchester. The new College extensions, which, when completed, will nearly double its size, have provided the Papermaking Section with a better lay-out for the machinery and with modern laboratories for teaching and research.

The Books teach Darkness was, at first of all,
And Brahm, sole meditating in that Night;
Look not for Brahm and the Beginning there!
Nor him, nor any light

Shall any gazer see with mortal eyes,
Or any searcher know by mortal mind;
Veil after veil will lift—but there must be
Veil upon veil behind.

SIR EDWIN ARNOLD: *The Light of Asia*.

THE BRITISH SOCIETY OF RHEOLOGY.

ACCOUNTS FOR THE YEAR ENDING 30TH SEPTEMBER 1951

(a) General Account.

RECEIPTS.						£	s.	d.
Balance at beginning of year	..	..	..	..	..	151	9	5
Subscriptions	..	..	..	..	..	252	19	8
Donations	..	..	..	..	..		3	0
Royalties	..	..	..	..	..		11	3
Sale of books	..	..	..	..	..	6	5	0
Receipts arising from 1950 Conference	..	..	..	..	..	1	16	0
Refunds	..	..	..	..	..	14	0	0
						<u>£427</u>	<u>4</u>	<u>4</u>
EXPENDITURE.						£	s.	d.
Postage and receipt stamps	..	..	..	..	..	18	15	9
Stationery and Printing	..	..	..	..	..	178	15	0
Secretarial help and Committee expenses	..	..	..	..	..	12	13	6
Expenses connected with meetings	..	..	..	..	..	7	19	10
Purchase of books	..	..	..	..	..	18	0	0
Sundries	..	..	..	..	..		10	10
Balance at end of year	..	..	..	..	..	190	9	5
						<u>£427</u>	<u>4</u>	<u>4</u>

(b) International Union of Rheology Account.

RECEIPTS.						£	s.	d.
Balance at beginning of year	..	..	..	..	..	66	6	1
Donations, etc.	..	..	..	..	..			
Accrued interest	..	..	..	..	..		18	7
						<u>£67</u>	<u>4</u>	<u>8</u>
EXPENDITURE.						£	s.	d.
Printing, etc.	..	..	..	..	..			
Balance at end of year	..	..	..	..	..	67	4	8
						<u>£67</u>	<u>4</u>	<u>8</u>

J. GARDNER OLDROYD,
Hon. Treasurer,
 9th October, 1951.

A. DE WAELE,
Hon. Auditor,
 29th October, 1951.

SUMMARIES OF PAPERS
read at meetings of the Society.

The Strength of Soils in relation to the Performance of Cross-Country Vehicles.

I. EVANS.

Army Operational Research Group, West Byfleet, Surrey.

During the last war the bogging of tanks and wheeled vehicles during operations became at times an extremely serious problem, and some attention has since been given to it by the Army Operational Research Group and others, both in this country and in America and Canada. The findings should make the design of tracked vehicles a more rational and a less *ad hoc* procedure than it has been hitherto.

We took as our starting point the knowledge of soil mechanics which has been gained by civil engineers in the course of foundation engineering. We were able to show that to a first approximation the sinking of vehicles into soft ground is the same problem. Tracked vehicles become bogged when the vertical stress on the track exceeds the ultimate bearing capacity of the soil. As a result of our work it is possible to estimate the "sinkage" of a vehicle of given design when passing over a soil of given bearing capacity. At deep sinkage the vehicle is liable to become bogged.

The bearing capacity of clay soil depends on its shearing resistance or "cohesion." In the course of our work we developed a simple field and laboratory instrument for measuring the cohesion of clay (1, 2) which now promises to become standard equipment in soil mechanics investigations. It is called a vane: a rod has four rectangular vanes which are embedded in the soil. The torque required to cause shear failure in the soil is measured. We have shown that the cohesion deduced from the vane, on the assumption that shear failure takes place over the surface of revolution of the vanes, is the same as the value obtained in a compression test.

The simplicity and accuracy of the vane has made possible a programme of field work, in which we have measured the surface strength of various types of soil in their softer state. Typical results are:

Peats		12lb./sq. in.
Organic Clays		24lb./sq. in.
Stiff Clays (e.g. London Clay, Gault,		
Weald Clay, etc.)		70lb./sq. in.

These values enable the designer to design specifically for the soil.

We have also carried out investigations on "traction," the maximum grip that the soil can afford a track before track slip takes place. In clays traction depends only upon the overall size of track, the depth of the "spuds" (projections from the track), and the cohesion of the clay. Spud spacing and shape have very little effect.

A further interesting point to emerge from the work is that at deep sinkage, when the soil is on the verge of complete plastic failure, traction falls off to zero. This explains a commonplace of tractor experience, that deep sinkage and track slip go hand in hand. It also indicates that engine power alone cannot force a vehicle over ground for which it is too heavy, for no reserve of engine power can compensate for the inability to obtain traction.

(1) I. EVANS AND G. G. SHERRATT. *J. Sci. Instrum.* 1948,
25 (12), 411

(2) I. EVANS. *Geotechnique*, June 1950, p. 46.

Paper read 23 November 1951.

Some Problems in Applying Soil Mechanics to the Action of Cultivation Implements.

P. C. J. PAYNE.

National Institute of Agricultural Engineering, Silsoe, Bedfordshire.

In spite of the wealth of practical experience and craftsman's knowledge available, there is still a demand for soil data, in engineering terms, to assist in the design of cultivation implements. Hence, as a first step towards relating the mechanical properties of soil to their performance, the common implements have been grouped into the following four categories, and attempts are being made to devise tests to put the soil in a corresponding pure state of stress which will enable either the effect on the soil, or the draught of the implement, or both, to be predicted.

FRICITION WITH SOIL UNIMPORTANT.

1. Those which shatter surface clods :

- (a) by applying a slowly increasing pressure such as rollers,
- (b) by applying an impact load such as spring tine harrows.

FRICITION MAY OR MAY NOT BE IMPORTANT.

2. Those that push through comparatively deep layers of soil, such as cultivator tines.

FRICITION VERY IMPORTANT.

3. Those which cut the soil such as knife coulters.
4. Those which combine all these effects as important contributions to their draught, such as mouldboard ploughs.

A clod shear box in which two halves of a clod are embedded in separate plaster casts and forced to shear along a predetermined plane has been constructed, but no comparison of the results with field readings for implements in Group 1a has yet been made.

Other investigators have shown that especially for cutting implements the proportion of large stones and probably clods, besides soil-to-metal friction, have an effect on draught. They have studied soil-to-metal friction in much more detail than the other components of draught.

The group of implements on which most work has been done at the N.I.A.E. is deep tines. When a long flat vertical tine was pulled through the ground, it was found that a wedge of soil was formed on the leading face and moved slowly out of the ground. It was assumed that the wedge was similar to that formed under continuous footings and that the upward movement was due to its lower end being an inclined plane of the same angle of slope as the sides. It was found that the angle of inclination of the sides and lower end of the wedge to the tine was of the order of $(45 + \phi/2)^\circ$, i.e. the angle of the plane of maximum shear stress. ϕ is the angle of shearing resistance. In order to predict the draught of this implement and so verify its mode of action, a torsional shear box was developed to measure the angle of shearing resistance and cohesion *in situ*.

A cylindrical box 5" diameter and 2" deep is forced into the soil, the surrounding soil is removed, so exposing a thin disc of soil about $\frac{1}{8}$ " thick beneath the box, and a twist is applied to the box through a torque meter. Different normal stresses can be applied to the disc by dead weights placed on the top of the box. To find the shear stress acting : the moment against angle of twist can be found with the apparatus by measuring the deflexion of a very long needle, fixed along a diameter of the torsion box, and from this the shear stress against angle of twist curve can be found by graphical means according to the formula

$$S = \frac{3}{2\pi r^3} \left(M + \frac{\theta}{3} \frac{dM}{d\theta} \right)$$

In practice with all the soils studied up to now it has been found that only negligible

error is involved in calculating the maximum shear strength from the simple formula $S=3M/2\pi r^3$. A torque meter mounted on a tripod is used for "no-load" readings. Results from the apparatus have been compared with those from the standard shear box and found to coincide exactly for a pure sand, while for well aggregated soils they varied from 5% less to 20% more over the range of normal stresses practicable at present, i.e. from 0 to 10lb./sq. in.

For the time the normal pressure on the shear plane has, up to now, been measured quite empirically, but from this and using the shear strength values found with the torsion box, it has been possible to predict draughts of the right order of magnitude. Speed has been found to have very little effect on draught.

It is eventually hoped to obtain the draught of implements entirely in terms as fundamental as shear strength, but for the moment it can only be said that the properties that both differ widely and affect draught are angle of shearing resistance, cohesion and friction with metal.

Paper read 23rd November, 1951.

The Relation of Abrasion to Wear in Textiles.

T. H. MORTON

Courtaulds Limited, Bocking, Braintree, Essex

Textiles are defined as a coherent assembly of textile filaments which, in their course of use, are subject to a variety of agents, mechanical, chemical and biochemical. The net result of these actions is that the coherency of the structure is, for one reason or another, reduced and the fabric wears out.

Since the application of an abrasive to a textile material can produce a hole similar to that given by wear, there has been in the past a tendency to equate abrasion with wear. It is more logical to regard abrasion as a component and not necessarily an overwhelmingly important component of wear.

In the past almost every textile laboratory has invented a wear and abrasion testing machine. The means employed have been, in the main, a rubbing of surfaces in contact, but it should be noted in the latest machines, such as the Schiefer, attention is paid to edge abrasion; flexing machines, of a range of motions—namely, Martindale, Shirley Boss Ringwear, Schiefer, Stoll and Taber—are described. It is noted that the present tendency is to move away from rapid and coarse abrasives, such as carborundum, to less abrasive surfaces, such as a standard cotton canvas, or woollen tie-lining fabric.

The late Dr. Pierce of the Shirley Institute may be said to have laid the foundations of textile mechanics. These have been built on more particularly by textile physicists in America, who have done considerable work in correlating the results of laboratory testing with the results of field trials. In particular, the results obtained in the fabrics tested in the Combat Course of the American Quartermaster Corps may be cited.

In normal domestic uses, textiles seem to break down mainly by a transverse cracking of the individual filaments combined with abrasion and the unravelling of the fabric structure. The importance of pure abrasion, flex fatigue and mechanical disintegration of the fabric structure are discussed as components of the wearing out of textile materials.

Wear and abrasion are the result of dissipation of energy in the fabric structure. In the main the stressing of the individual filaments is tensile. Hamburger, by an analysis of the fundamental tensile stress-strain properties of the various fibres, has extracted relationships which give a good guide to the fundamental abrasion resistances of each fibre. It is believed that another fundamental property of the filaments is resistance to flex fatigue. These basic fibre properties must be combined with an appropriate form factor relating to each particular textile structure to give a full picture of the behaviour of the textile in wear. The importance of small amounts of chemical damage in enhancing the tendency of the material to abrasion and wear is stressed and its significance discussed.

Paper read 4th January, 1952.

RHEOLOGY ABSTRACTS

2234. Particle structure and flow properties of coating clays.

C. G. ALBERT. *TAPPI*, 1951, **34** (10), 453.

Data on the flow properties of clay-starch coating colours at relatively high solids contents are presented together with current information as to the structure of clay particles of various sizes. The effect of particle size and shape upon flow properties is shown to be such that the fine particle size fractions are particularly suitable for the preparation of high solids coating colours for roll application. AUTHOR.

2235. Mechanical properties of α -solid solutions of copper, with zinc, gallium, germanium and arsenic.

N. P. ALLEN, T. H. SCHOFIELD AND A. E. L. TATE. *Nature*, 1951, **168**, 378.

2236. Effects of draws and felt tension on mechanical properties of paper.

A. P. ARLOV AND B. IVARSSON. *Svensk Papperstidning*, 1951, **21**, 729. *In English*.

The effect of certain operating conditions on the stress-strain properties of paper is studied. Samples are tested in an automatic stress-strain recorder and the results are expressed as work of deformation for an elongation of 2%. It is shown that changes in the stress-strain properties of the sheet depend upon the dimensional changes of the web. The correlation between dryness, shrinkage and stress-strain properties at various drying conditions is discussed and illustrated diagrammatically. V.G.W.H.

2237. On a fluid motion with a spherical boundary.

R. BALLABH. *Proc. Nat. Inst. Sci. India*, 1951, **17**, 123.

2238. Experimental determination of the difference between the isothermal and adiabatic values of Young's modulus for aluminium.

I. BARDUCCI. *Alluminio*, 1950 (5), 416.

Measurements were made of the log. decrement d_z of the flexural vibrations of an A1 bar as a function of the frequency of vibration. The results fit quite closely the theoretical predictions of Zener, and from the value of the maximum which d_z shows at a particular frequency, the relative difference $\Delta E/E$ between the adiabatic and isothermal Young's moduli was calculated from the equation $\Delta E/E = 2d_z/\pi$. The result, $\Delta E/E = 4.7\%$, is in fair agreement with that calculated from thermodynamic theory. The advantages and disadvantages of this indirect method of measuring $\Delta E/E$ are discussed. SCI. ABSTR.

2239. The measurement of the viscosity of highly viscous plastic mixes at high rates of shear.

J. J. BENBOW. *Brit. J. Appl. Phys.*, 1951, **2**, 359.

2240. A study of fatigue in metals by means of X-ray strain measurement.

J. A. BENNETT. *J. Res. Nat. Bur. Stand.*, 1951, **46**, 457.

X-ray determinations of lattice strain were made on steel specimens under a series of static bending moments. These series of determinations were made on the specimens as normalized and after various amounts of fatigue stressing. The slope of the line relating the bending moment to the lattice strain was found to decrease with increasing numbers of cycles of alternating stress. However, the decrease was of approximately the same magnitude for specimens stressed above and below the fatigue limit, showing that the change was not associated with fatigue damage. AUTHOR.

2241. A new method of measuring plasticity.

R. M. BERTHIER. *Centre d'Etudes et de Recherches de l'Industrie des Liants Hydrauliques, Pubn. Technique No. 25*, pp. 8; *Rev. Mat. Constr.*, 1950 (417).

A simple apparatus is described for measuring the plasticity of clays, soils and fresh mortars and concretes. The apparatus comprises a cubical bottomless mould, which contains the material under test, resting on a thin copper plate. The sides of the mould are hinged so as to permit, without appreciable friction, deformation into a prism having a diamond-shaped base. Deformation is effected by a system of wire, pulleys and weights, and is conveniently measured either by the length of a diagonal or by the angle between two sides. Experimental data are given relating w/c ratio to plasticity of concrete and water content to plasticity of clay. The instrument is considered to be of practical value for the control and specification of concretes and soils. B. S. A. (ABR.)

2242. Comparison of viscosities of rubbers from the McKee worker-consistometer and from the Mooney viscometer.

A. B. BESTUL, G. E. DECKER AND H. S. WHITE. *J. Res. Nat. Bur. Stand.*, 1951, **46**, 283.

2243. Elastic constants of galena.

S. BHAGAVANTAM AND T. SESHAGIRI RAO. *Nature*, 1951, **168**, 42.

2244. A theoretical derivation of the plastic properties of a polycrystalline face-centred metal.

J. F. W. BISHOP AND R. HILL. *Phil. Mag.*, 1951, **42**, 1298.

2245. The cataphoresis of spherical fluid droplets in electrolytes.

F. BOOTH. *J. Chem. Phys.*, 1951, **19**, 1131.

A theory of the electrophoresis of spherical fluid droplets in an electrolyte is developed, and a general formula for the electrophoretic velocity is given in terms of the applied field, the potential distribution in and near the droplets, the dielectric constants and the coefficients of viscosity of the liquid and the electrolyte. S.T.

2246. Comments on several friction phenomena.

G. P. BREWINGTON. *Amer. J. Phys.*, 1951, **19**, 357.

It is suggested that the term dry friction be limited to phenomena observed under highly outgassed conditions. Two theorems are suggested, one on the distribution of heat energy between two friction surfaces and the other on the independence of the heat loss in certain clutches, on the coefficient of friction. Several suggestions using concepts of the physics of the solid state are made to give a better picture of the ultimate cause of friction. AUTHOR.

2247. Micro-slip in metal crystals.

A. F. BROWN AND R. W. K. HONEYCOMBE. *Phil. Mag.*, 1951, **42**, 1146.

2248. The application of Nutting's equation to the visco-elastic behaviour of certain polymeric systems.

R. BUCHDAHL AND L. E. NIELSEN. *J. Appl. Phys.*, 1951, **19**, 1344.

2249. Viscosities of some mixed gases.

J. W. BUDDENBERG AND C. R. WILKE. *J. Phys. Colloid Chem.*, 1951, **55** (9), 1491.

Viscosities at 25°C of the following gases and mixtures of gases are determined by the method of Rankine and Smith: N₂, CO₂, Freon 12, H₂, Ne, H₂-Freon, H₂-CO₂, H₂-Ne, Freon-N₂, Freon-CO₂, Ne-H₂-CO₂, H₂-N₂-Freon, N₂-CO₂-Freon, N₂-CO₂-H₂-Freon, Ne-H₂-CO₂-Freon. The results are considered in relation to the development of general equations for the estimation of the viscosities of gas mixtures from the properties of the pure components. G.E.B.

2250. Physical properties of the perfluoropentanes.

L. S. BURGER AND G. H. CADY. *J. Amer. Chem. Soc.*, 1951, **73**, 4243.

The following viscosity results at 20°C in millipoises are given: $n\text{-C}_5\text{F}_{12}$ 4.94; $\text{iso-C}_5\text{F}_{12}$ 6.28; $\text{cyclo-C}_5\text{F}_{10}$ 7.67. From comparison of energy terms derived from viscosity data the fluorocarbon molecules appear to be either more closely packed or less flexible than hydrocarbon molecules.
E.W.J.M.

2251. On the elastic properties of sodium chloride.

J. CHATELET AND R. CABARAT. *C. R. Acad. Sci., Paris*, 1951, **232**, 2111. *In French*.

Measurement of Young's modulus and the internal friction (f) by acoustic methods. Results are briefly stated: effects of annealing; the influence of the surface state on f ; f 's independence of orientation.
SCI. ABSTR.

2252. Structural conditions during the process of working of chocolate and the effects of dilution.

L. E. CHERNENKO, V. E. MARKOVICH AND L. S. VETKINA. *Kolloidnyi Zh.*, 1951, **13**, 379.

The thixotropy of chocolate pastes is investigated by the Segalova-Rebinder falling cone method (*ibid.* 1948, **10**, 223). Thixotropic behaviour depends on state of sugar micro-crystalline structure and on oleophobic and oleophilic components of the "ground cacao."
G.W.S.B.

2253. Polymer weight-average molecular weight by viscometry.

D. CLEVERDON AND P. G. SMITH. *Chem. & Ind.*, 1951 (44), 936.

This note indicates that it may be possible to determine the true weight-average molecular weight of a polymer by viscometry. The intrinsic viscosity obtained by extrapolating η_{sp}/C versus C plots to $C=0$, is intrinsic not of the polymer but of the solvent-polymer system. It is found that plots for different solvents intersect at a negative concentration. The ordinate of this intersection is defined as the true intrinsic viscosity and correlation is sought between this value and molecular weight. The hypothesis is examined for two sets of data relating to polystyrene.
C.C.M.

2254. The equilibrium of an elasto-plastic body. I.

G. COLONNETTI. *C. R. Acad. Sci., Paris*, 1951, **233**, 593. *In French*.

2255. The equilibrium of an elasto-plastic body. II.

G. COLONNETTI. *C. R. Acad. Sci., Paris*, 1951, **233**, 644. *In French*.

2256. The equilibrium of an elasto-plastic body. III.

G. COLONNETTI. *C. R. Acad. Sci., Paris*, 1951, **233**, 677. *In French*.

2257. Intrinsic viscosities of cellulose as affected by rate of shear.

C. M. CONRAD, V. W. TRIPP AND T. MARES. *J. Phys. Colloid Chem.*, 1951, **55** (9), 1474.

The viscosities are measured of cuprammonium and cupriethylenediamine solutions of seven celluloses covering a wide range of degrees of polymerisation. At low degrees of polymerisation the intrinsic viscosity was unaffected by the velocity gradient, but with the more highly polymerised celluloses it decreased as the velocity gradient increased. The intrinsic viscosities in the two solutions, determined at 500 sec^{-1} , were found to be linearly related. The application of Martin's and other equations for determining intrinsic viscosities to these data is discussed.
G.E.B.

2258. On the structural viscosity of cement pastes and solutions (suspensions?) and of concretes.

A. E. DESOV. *Kolloidnyi Zh.*, 1951, **13**, 346

A "vibroviscometer" is described.

G.W.S.B.

2259. On the decomposition of any state of equilibrium into two simple states derivable from holomorphic functions.

F. TESSIER DU CROS. *C. R. Acad. Sci., Paris*, 1951, **233**, 223. *In French.*

Some theorems on the superposition and decomposition of plane elastic stress distributions are proved, and a result useful for photoelastic techniques is derived.

SCI. ABSTR.

2260. A theory of Rockwell ball hardness.

M. A. DU TOIT MEYER. *Appl. Sci. Res.*, 1951, **A3**, 11.

A theoretical analysis of the Rockwell method of ball hardness measurements is made. A general expression for Rockwell ball hardness numbers in terms of the Meyer constants n and b is given. It is shown that the theoretical results are in agreement with experimental results. The conversion of Meyer and Brinell hardness numbers to Rockwell hardness numbers is discussed.

AUTHOR.

2261. Some extensions of elementary plasticity theory.

F. EDELMAN AND D. C. DRUCKER. *J. Franklin Inst.*, 1951, **251**, 581

A detailed investigation is presented of yield or loading criteria, for work hardening materials, which lead to constant strain ratios under increasing stress when stress ratios are maintained constant. The experimenter is given a choice of incremental stress-strain theories with which results of simple or complicated combined loading tests may be correlated. These theories are dealt with in order of increasing complexity and, at the same time, increasing capacity to represent experimentally established phenomena. The objective is the use of the mathematically simplest theory which will provide the desired flexibility in the analysis of experimental data. Loading functions of isotropic as well as anisotropic types are examined, among them those depending explicitly on stress alone and those depending on both stress and plastic strain. In the latter cases only those functions are investigated in which plastic strain appears to the first order. The predicted results of some basic tests are examined for several loading criteria.

AUTHORS.

2262. The forces on an elastic singularity.

J. D. ESHELBY. *Phil. Trans. A*, 1951, **244**, 87.

2263. Dislocation in thin plates.

J. D. ESHELBY AND A. N. STROH. *Phil. Mag.*, 1951, **42**, 1401.

2264. A new surface viscometer.

W. E. EWERS AND R. A. SACK. *Nature*, 1951, **168**, 964.

2265. Contribution to the thermodynamics of plastic deformation.

N. S. FASTOV. *Dokl. Akad. Nauk, SSSR*, 1951, **78** (2), 251.

Kachanov's equation developed for an infinitely slow deformation process is transformed mathematically into an expression for the free energy of a body whose deformation goes on at a finite velocity. It is claimed that equations obtained ultimately for (1) the relationship between the fluidity limit and the maximum elastic deformation on the one side; and (2) the relationship between stresses, and the amount of deformation and the velocity of plastic deformation, as well as the appearance of the creep curve, qualitatively agree with experimental data.

SCI. ABSTR.

2266. Photography at sea of propeller cavitation.

J. W. FISHER. *Engineering*, 1951, **172** (4480), 729.

The state of cavitation of ships' propellers has been inferred in the past from cavitation-tunnel tests. Conditions in such tunnels and in the open sea are very different so allowances have to be made when interpreting the data obtained in tunnels. In the present paper the author describes the technique adopted to examine a ship's propeller under working conditions and a series of flash photographs shows the extent of cavitation at different running speeds. Comparison of these data with tunnel experiments made it

possible to find the conditions under which the latter were comparable with actual running in the open sea. C.C.M.

2267. Defects of accepted elasticity theory.

O. FOPPL. *Schweiz. Arch. angew. Wiss. Tech.* 1951, **17**, 171. *In German.*

The fundamental assumptions made in the three different strain-stress relationships of elastic theory are discussed with the aid of simple examples. SCI. ABSTR.

2268. The measurement of the Young's modulus of metals and alloys by an interferometric method. I. The Young's modulus of Ni-Cu alloys.

T. FUKUROI AND Y. SHIBUYA. *Sci. Rep. Res. Inst. Tohoku Univ. A*, 1950, **2**, 748.

2269. Influence of shear on the dielectric constant of liquids.

B. L. FUNT AND S. G. MASON. *Canad. J. Chem.*, 1951, **29**, 848.

The authors investigate whether molecules which, in addition to being geometrically asymmetric, are electrically asymmetric show a change of dielectric constant when subjected to shearing forces. A coaxial rotating cylindrical condenser with a gap of 0.05cm was used. Decrease in dielectric constant under shear was observed for polar polymers (e.g., polyvinyl acetate and cellulose acetate) in polar and nonpolar solvents. Polystyrene and polyisobutylene showed no changes of dielectric constant under shear. Large changes in dielectric constant at low rates of shear occurred in carbon black suspensions with complicating effects owing to large concentrations. R.S.

2270. The elasticity of porous media.

F. GASSMANN. *Mitt. Inst. Geophys. E. T. H. Zürich*, 1951 (17), 23pp. *In German.*

Differential elasticity is defined in terms of increments of stress and strain, the moduli depending on the average strain. The elasticity of the porous medium is described in terms of the elastic properties of the frame and those of the medium filling the pores with suitable simplifying assumptions. The results are generalized for an anisotropic frame. SCI. ABSTR.

2271. Finite extension and torsion of cylinders.

A. E. GREEN AND R. T. SHIELD. *Phil. Trans. A* 1951, **224**, 47.

2272. Ultrasonic investigation of elastic constants of iron silicate gels.

A. M. GRIVASTAVA. *J. Phys. Colloid Chem.*, 1951, **55** (9), 1446.

An ultrasonic pulse technique, based upon the total reflexion of the incident waves at certain angles, is developed to evaluate the elastic constants of gelatinous substances. The method is claimed to have an accuracy better than 1%. The elasticities of iron silicate gels are determined at different frequencies and temperatures, and at different ages after formation of the gel. The author advances views on the structure of the gel based on the data derived in this work. G.E.B.

2273. Modifications in resistance to fatigue of vulcanized natural rubber as a result of swelling.

V. E. GUL', T. V. DAROZHINA AND B. A. DOGADKIN. *Kolloidnyi Zh.*, 1951, **13**, 339.

The rubber is swollen in vaseline and also in dibutyl phthalate. Stress-strain curves are given. G.W.S.B.

2274. The deformation and ageing of mild steel. III. Discussion of results.

E. O. HALL. *Proc. Phys. Soc. Lond., B*, 1951, **64**, 747.

2275. Contact stresses and deformation in a thin elastic layer.

M. HANNAH. *Quart. J. Mech. Appl. Math.*, 1951, **4** (1), 94.

Mathematical treatment of a problem of considerable importance in industrial rheology, e.g. in drafting textile fibres through steel rollers. The system is taken as one of generalized plane stress with given displacement conditions on the inner boundary and subject to pressure by a body of a given shape on the free face. P.M.

2276. Some psychological aspects of craftsmanship in diaryng.

R. HARPER. *Occupational Psychol.*, 1950, **24**, 230.

A survey of work on subjective assessments of "body" of cheese and a description of carefully controlled experiments to compare "firmness" of pairs of rubber cylinders by handling. Improved technique and especially shorter tests modify Scott Blair and Coppen's early finding (*Proc. Roy. Soc.*, 1939, **85OB**, 109) that dairy workers show no special acuity. Dairy students and instructresses are definitely superior to psychology and other students under conditions of test. Discusses psychological significance of individual subjects' fluctuations.

G.W.S.B.

2277. Theories of viscosity applied to ionic liquids.

B. S. HARRAP AND E. HEYMAN. *Chem. Rev.*, 1951, **48**, 45.

The main rough viscosity theories are reviewed in the light of new data on 12 molten salts. The Batchinski-Macleod type of formula, $\eta = B/(v-b)$, is obeyed quite well and the B values are consistent with the view that B is proportional to the size of the flow unit. A similar result, $\rho = A/(v-b')$, holds for the resistivity. Eyring's equation, $d\ln(v\eta)/d(1/T) = T\ln(v\eta/hN)$, is not well satisfied. Further ideas of Eyring and of Grunberg and Nisan are examined with the help of collected data on ΔE_{visc} , ΔE_{vap} , ΔH_{fus} and the "work of cohesion," $W_c = 4.78 \times 10^{-8} \gamma V^{2/3} N^{1/3}$. In most comparisons CdCl_2 appears as exceptional because of complex formation in the liquid state. AgCl is also exceptional, but the reason for this is not known. The viscosities and the values of ΔE_{visc} are given for a number of ionic mixtures—particularly for those whose molar volumes are linear functions of composition. For the latter class, Macleod's expression for the viscosity of the mixture is well verified.

SCI. ABSTR.

2278. Internal friction of cold worked single crystals of copper.

R. R. HASIGUTI AND T. HIRAI. *J. Appl. Phys.*, 1951, **22**, 1084.

2279. Formula for creep curves of metals.

R. R. HASIGUTI AND T. OWADANO. *Nature*, 1951, **168**, 706.

2280. The application of viscosity increments to the study of two problems in the behaviour of casein.

H. G. HIGGINS AND J. F. HAYES. *Aust. J. Appl. Sci.*, 1951, **2**, 368.

Methods are described of determining the shape factors of relatively symmetrical protein molecules at high dilution by means of viscosity measurements. Viscosity data are applied to two problems in the behaviour of casein. The action of rennet on casein increases the molecular symmetry, apparently disposing of the possibility of an unfolding of the polypeptide chains, but the change is too small to be interpreted as proteolytic cleavage of any major component. In concentrated alkaline dispersions capable of developing into rigid irreversible gels, the changes in symmetry of the casein molecule again appear insufficient to represent any profound structural modification. AUTHOR.

2281. Fluid flow in ducts with a uniformly distributed leakage.

J. F. HOLDSWORTH, F. W. PRITCHARD AND W. H. WALTON. *Brit. J. Appl. Phys.*, 1951, **2**, 321.

2282. The stretching and relaxing of polyethylene.

R. A. HORSLEY AND H. A. NANCARROW. *Brit. J. Appl. Phys.*, 1951, **2**, 345.

2283. Note on the boundary layer on a rotating sphere.

L. HOWARTH. *Phil. Mag.*, 1951, **42**, 1308.

2284. The boundary layer in three-dimensional flow. II. The flow near a stagnation point.

L. HOWARTH. *Phil. Mag.*, 1951, **42**, 1433.

2285. **On the asymptotic behaviour of viscous fluid flow at a great distance from a cylindrical body, with special reference to Filon's paradox.**
 ISAO IMAI. *Proc. Roy. Soc. A* 1951, 208, 487.

2286. **Creep of annealed and cold-drawn high-purity copper.**
 W. D. JENKINS AND T. G. DIGGES. *J. Res. Nat. Bur. Stand.*, 1951, 46, 272.

2287. **Creep in initially green wooden beams.**
 R. S. T. KINGSTON AND L. D. ARMSTRONG. *Aust. J. Appl. Sci.*, 1951, 2, 306.

Beams of initially green mountain ash (*Eucalyptus regnans* F. v. M.) were loaded to various fractions and multiples of the design stress. The loads were maintained for long periods to study (I) the increase in deflexion with time, and (II) the incidence of failure under these conditions. Measurements were made of the recovery occurring after these beams were unloaded. Beams were also tested under periodic loading. It has been demonstrated that the deflexion of beams under load increases, but, in general, at a diminishing rate, for at least 1 year; if, however, failure commences during this period, deflexion continues at an increasing rate. For stress between 12 and 200% of the design stress for select grade material, the average increase in 1 year was three to fourfold, in some cases reaching sixfold or over. A number of beams loaded to 200% of design stress failed in periods of from 1 week to over 9 months under load. All beams loaded to 300% of design stress failed within a few months. The effect of shear stresses, recovery after removal of the load, and the effect of periodic loading have also been discussed.

AUTHORS.

2288. **Equations of motion of an incompressible elasto-viscous medium.**
 E. V. KUVSHINSKIĬ. *J. Exp. Theor. Phys.*, USSR, 1951, 21, 88. *In Russian.*

On the basis of two equations expressing the rheological laws of an incompressible elasto-viscous medium (Reiner—Ten lectures on theoretical rheology) derived according to Maxwell's hypothesis, equations are derived for the motion of such a medium. An analysis is made of cases where these equations can be simplified. The analysis shows that for small stresses, where only the linear rheological law applies, the elasticity of the medium manifests its characteristic form only for unsteady processes. In the case of steady flow, with certain reservations, the elasto-viscous medium is displaced according to the laws of the hydrodynamics of viscous liquids.

SCI. ABSTR.

2289. **Poiseuille functions.**
 H. A. LAUWERIER. *Appl. Sci. Res.*, 1951, A3, 58.

In this paper the Whittaker functions occurring in Poiseuille flow problems are studied in detail. Four functions analogous to the Bessel functions J, Y, I and K are introduced. Various convergent and asymptotic series representations are derived.

AUTHOR.

2290. **Free longitudinal vibrations of rubber and tissue strips.**
 R. W. LAWTON AND A. L. KING. *J. Appl. Phys.*, 1951, 19, 1340.

2291. **Distribution of dislocations in static equilibrium.**
 G. LEIBFRIED. *Z. Phys.*, 1951, 130, 214. *In German.*

Considers the problem of the distribution of dislocations under the influence of a strain field of force (and the analogous problem of the distribution of electrical line charges under the influence of an electric field). Various types of two-dimensional distributions are considered and the problem reduced to the solution of an integral equation of the form

$$\int_{-a}^{+a} \frac{D(x)dx}{x - \xi} = f(\xi), \text{ the general solution of which is known.}$$

SCI. ABSTR.

2292. The measurement of the flow properties of a pseudo-plastic with a concentric cylinder viscometer.

C. G. LINDQUIST AND W. C. SIERICH. *J. Coll. Sci.*, 1951, 6, 33.

The rate of shear across the annular gap tends to a constant as the clearance approaches zero. Using inner cylinders of different radii and keeping the shear stress at either the inner or outer cylinder wall constant, the shear stress rate of shear curves can be extrapolated. Curves for 5% methyl cellulose are given. SCI. ABSTR.

2293. Stability of viscous motion between parallel planes for finite disturbances.

D. MEKSYN AND J. T. STUART. *Proc. Roy. Soc. A*, 1951, 208, 517.

2294. Studies of the cross-linking process in gelatine gels. II. Static rigidity and stress relaxation.

M. MILLER, J. D. FERRY, F. W. SCHREMP AND J. E. ELDRIDGE. *J. Phys. Colloid Chem.*, 1951, 55 (8) 1387.

Measurements are made on gelatine gels at a concentration of 59.2 g/l and a number average molecular weight of 34,000, of static rigidities, stress relaxations and reverse stress relaxations. The effects of temperature and thermal history of the gels are studied. The static rigidities were identical with the dynamic rigidity, measured at several hundred cycles per second. The stress relaxation data were obtained on gels remelted and maintained for 1 hour at 37°C before cooling to the temperature of test and ageing; the results showed elastic mechanisms with relaxation times between 10^3 and 10^6 seconds, increasing temperature shortening the times. Increasing time of ageing before applying the stress shifts the distribution to longer times. During relaxation the rigidity was unchanged, or increased slightly, indicating that the dissociated bonds form again corresponding to unstrained conditions. The data on reverse relaxation indicated that the newly formed bonds were similar to the original bonds. The form of the distribution function of relaxation times is considered. G.E.B.

2295. Secondary stresses in viscoelastic flow.

M. MOONEY. *J. Coll. Sci.*, 1951, 6, 96.

Theoretical equations are developed for secondary stresses in a shearing viscoelastic fluid. The final equations predict pressure effects to be expected in rotating viscometers of cylindrical, plate and conical form. AUTHOR (ABR.)

2296. The viscosity of a concentrated suspension of spherical particles.

M. MOONEY. *J. Colloid Sci.*, 1951, 6, 162.

Einstein's viscosity equation for an infinitely dilute suspension of spheres is extended to apply to a suspension of finite concentration. The argument makes use of a functional equation which must be satisfied if the final viscosity is to be independent of the sequence of stepwise additions of partial volume fractions of the spheres to the suspension. For a monodisperse system the solution of the functional equation is $\eta r = \exp\left(\frac{2.5\phi}{1k-\phi}\right)$, where ηr is the relative viscosity, ϕ the volume fraction of the suspended spheres, and k is a constant, the self-crowding factor, predicted only approximately by the theory. The solution for a polydisperse system involves a variable factor, λ_{ij} , which measures the crowding of spheres of radius r_j by spheres of radius r_i . The variation of λ_{ij} with r_i/r_j is roughly indicated. There is good agreement of the theory with published exptl. data.

B.C.R.A.

2297. Rupture of oxide films during repeated sliding.

A. J. W. MOORE AND W. J. MCG. TEGART. *Aust. J. Sci. Res.*, 1951, 4, 181.

When copper specimens are subjected to repeated sliding, non-metallic particles are included below the surface. They are derived from the rupture of oxide films during sliding. On annealing at temperatures near the melting point of copper, the particles coalesce but prevent grain growth of the copper. The relation of these facts to the layers formed by polishing is discussed briefly. AUTHOR.

2298. **The rheological properties of some soap-oil systems.**

G. B. MOSES AND I. E. PUDDINGTON. *Canad. J. Chem.*, 1951, **29**, 996.

Using an extrusion plastometer the flow properties of sodium, lithium and aluminium soaps in hydrocarbon oils have been measured over a range of temperature, concentration and rate of shear. Increases in thixotropy are ascribed to swelling of the soap crystals; the tacky surfaces produced by the swelling causes increased agglomeration.

E.W.J.M.

2299. **The mechanical properties of metals.**

N. F. MOTT. *Proc. Phys. Soc. Lond.*, B 1951, **64**, 729.

2300. **Measurement of the elastic constants of silicon single crystals and their thermal coefficients.**

H. J. MCSKIMIN, W. L. BOND, E. BUEHLER AND G. K. TEAL. *Phys. Rev.*, 1951, **83**, 1080.

2301. **The synthesis of elastic dislocation fields.**

F. R. N. NABARRO. *Phil. Mag.*, 1951, **42**, 1224.

2302. **The interaction of screw dislocations and sound waves.**

F. R. N. NABARRO. *Proc. Roy. Soc., A*, 1951, **209**, 278.

2303. **A recording torsion pendulum for the measurement of the dynamic mechanical properties of plastics and rubbers.**

L. E. NIELSEN. *Rev. Sci. Instrum.*, 1951, **22**, 690.

2304. **The influence of the moisture content of flour on the physico-mechanical and colloidal properties of doughs.**

B. A. NIKOLAEV, V. P. ANTONOVA AND L. S. BEGANSKAYA. *Kolloidnyi. Zh.*, 1951, **13**, 366.

Doughs prepared from flours at 10% and 16% moisture were tested with a farinograph (measures work of mixing), an alveograph (pressure and maximum size of bubble) and amylograph. Dough from 10% moisture flour is inferior in all respects to that from 16%.

G.W.S.B.

2305. **Effect of strain rate on the plastic deformation in aluminium single crystals.**

H. NISHIMURA AND J. TAKAMURA. *Mem. Fac. Engng Kyoto Univ.*, 1951, **13**, 1

A study, by electron microscope and X-ray methods, of the fine structure of the slip bands in 99.9% pure electrolytically polished specimens for loading rates between 0.0126 and 56.9 g/mm²/sec and total strain of around 5%. Specimens subjected to a slow rate of strain generally showed (1) wider slip bands; (2) wider spacings between slip bands; (3) fewer sets of active glide planes and (4) more pronounced X-ray asterisms than did specimens subjected to a fast strain rate. The slope of the slip band itself relative to the specimen surface decreased with an increase in the width of the slip band. Only for the higher rates of strain was the slip band composed of many narrow glide lamellae. For all strain rates submicroscopic fine slip lines were observed between the normal slip bands. Slip bands were readily produced at a fine notch line scratched, before straining, on the surface of a specimen perpendicular to the bands, but were absent near to a similar line scratched along the direction of the bands. An oblique line had no marked effect on the slip band behaviour.

SCI. ABSTR.

2306. **The effect of sound waves on the ascending velocity of air bubbles in viscous liquids.**

H. NØDTVEDT. *Beretn. Michelsens Inst. Vidensk.*, **12**, 13 pp. (No. 5, 1948).

Small-scale experiments have shown that the properties of very viscous liquids (e.g. molten glass or Canada balsam) are changed if sound energy is introduced. In the present work it is shown that air bubbles in Canada balsam ascend with a velocity up to four times

that of the original state when the sound energy is about 0.05 watt/cm^2 at a frequency of 9.3 kc/s. Clusters of small bubbles collapse into one larger bubble under the influence of sound waves. SCI. ABSTR.

2307. The motion of an elastico-viscous liquid contained between coaxial cylinders. I.

J. G. OLDROYD. *Quart. J. Mech. Appl. Math.*, 1951, 4, 271.

The theory of periodic and steady states of motion of the liquid is considered, when the viscous and elastic properties of the material at small rates of shear are measured by a viscosity coefficient and two relaxation times. AUTHOR (ABR.)

2308. The crystallographic aspect of slip in body-centred cubic single crystals. I. Theoretical considerations.

A. J. OPINSKY AND R. SMOLUCHOWSKI. *J. Appl. Phys.*, 1951, 22, 1380.

2309. Pulse-annealing for the study of relaxation processes in solids.

W. E. PARKINS, G. J. DIENES AND F. W. BROWN. *J. Appl. Phys.*, 1951, 22, 1012.

2310. The reinforcement of rubber by carbon black.

D. PARKINSON. *Brit. J. Appl. Phys.*, 1951, 2, 273.

2311. Firmness and whey-separation of milk yogourt.

J. W. PETTE AND H. LOKEMA. *Netherl. Milk and Dairy J.*, 1951, 5 (1) 27. In Dutch, English Summary.

Distance traversed in $7\frac{1}{2}$ min. by partly counterpoised falling steel ball is recorded as an inverse measure of firmness. Acidity and temperature (18°C) are controlled. Firmness is affected by stage of lactation and solid-matter content of milk (adjusted by addition of milk powder). Individual cow factor is also significant. Homogenization increases firmness. No close correlation is found between firmness and whey separation (syneresis). The latter is a serious problem, partly controllable by addition of CaCl_2 . G.W.S.B.

2312. Viscosity of neopentane.

M. K. PHIBBS. *J. Chem. Phys.*, 1951, 19, 1420.

Viscosity measured between -15° and 30°C . Comparison with data for other pentanes shows the importance of molecular shape on viscosity behaviour.

2313. Measuring viscosity of resins.

POSTANS LTD. AND M. H. M. ARNOLD. *Brit. Pat.*, 657, 696; *Paint Oil and Colour J.*, 1951, 120 (2770), 1161.

Liquid resin, e.g. alkyd, is withdrawn from the reaction vessel and circulated through a jacketed pipe line at a constant delivery rate. Pressure sensitive instruments on either side of a constriction of venturi tube type are connected to a differential measuring instrument. Pressure difference is proportional to the viscosity of the fluid. D.L.T.

2314. The significance of dispersion in colloidal systems.

J. PRYCE-JONES. *J. Oil Col. Chem. Assoc.*, 1951, 34 (377), 547.

A review of the various types of rheological behaviour of paints, characterized by deflexion/time curves, and their relation to the state of dispersion of the pigment in the medium. A plot of relative viscosity of suspension and medium, at different rates of shear, v. concentration of dispersing medium or dispersing agent gives some idea of the dispersion properties of the medium and the concentration of dispersing agent required to produce a system in which the relative viscosity is independent of shear rate. D.L.T.

2315. The nature of the static and kinetic coefficients of friction.

E. RABINOWICZ. *J. Appl. Phys.*, 1951, 22, 373.

2316. **Metallic transfer between sliding metals: an auto-radiographic study.**
E. RABINOWICZ AND D. TABOR *Proc. Roy. Soc. A* 1951, 208, 455.

2317. **Work hardening of mild steel by explosive attack.**
J. S. RINEHART. *J. Appl. Phys.*, 1951, 22, 1086.

2318. **Some experimental indications of the stresses produced in a body by an exploding charge.**
J. S. RINEHART. *J. Appl. Phys.*, 1951, 22, 1178.

2319. **Elastic energy of an ellipsoidal inclusion in an infinite solid.**
K. ROBINSON. *J. Appl. Phys.*, 1951, 22, 1045.

2320. **Plasticity of lubricating oils at low temperatures.**
P. I. SANIN. *Kolloidnyi Zh.*, 1951, 13, 117. *In Russian.*

Studies flow of oils in emptying capillary viscometer at constant pressure. For Newtonian fluids

$$\eta = \text{constant} \times \frac{p}{l} \frac{t}{\Delta l}$$

where p is pressure, l is length of column at time t at Δl movement of meniscus per sec. Curves plotted Δl vs t for both Newtonian and non-Newtonian systems. Advantages of the method are discussed. G.W.S.B.

2321. **Viscosities of solutions of linear polyamides in formic and sulphuric acid.**
J. R. SCHAEFGEN AND C. F. TRIVISONNO. *J. Amer. Chem. Soc.*, 1951, 73, 4580.

Viscosity measurements for several poly- ϵ -caproamides of molecular weight up to 26,000 indicated that the polyamides exhibit typical poly electrolyte behaviour.
E.W.J.M.

2322. **Double refraction of flow: numerical evaluation of extinction angle and birefringence as a function of velocity gradient.**

H. A. SCHERAGA, J. T. EDSALL AND J. O. GADD. *J. Chem. Phys.*, 1951, 19, 1101.

The theory of Peterlin and Stuart has been extended to cover a much wider range of velocity gradients than heretofore.

2323. **Mechanical ageing of hard drawn cut steel wires.**
F. SCHWIER. *F & G Rdsch.*, 1951, 32, 215.

Influence of time and temperature on mechanical ageing investigated. Under normal conditions of drawing, rapid ageing may occur; to avoid it, heat removal is important.

2324. **Creep and stress rupture as rate processes.**

I. S. SERVI AND N. J. GRANT. *J. Inst. Met.*, 1951, 1, 33.

Creep data for an Fe-Co-Cr-Ni- alloy reported by Grant and Bucklin (*Trans Amer. Soc. Metals*, 1950, 42, 720) are analysed according to the rate-process theory of plastic flow. The data indicate that the theory can be applied over only a limited range of creep rates. An empirical equation, which relates the applied stress and the temperature to the minimum creep rate, is suggested for the analysis of creep data.

This equation is valid only in the absence of structural instabilities. AUTHOR.

2325. **Elastic relaxation and structure of liquids. I. Ultrasonic absorption in some halogenated methylenes, ethanes and ethylenes.**

D. SETTE. *J. Chem. Phys.*, 1951, 19, 1137.

Ultrasonic absorption in some organic compounds whose structure is correlated in a simple way has been studied as a function of temperature to obtain information about the effect of structure on elastic relaxation phenomena. The results are complex. S.T.

2326. On the elastic relaxation in carbon disulphide: the temperature dependence of the ultrasonic absorption coefficient.

D. SETTE. *Ž. Chem. Phys.*, 1951, **19**, 1342.

The ultrasonic absorption coefficient for carbon disulphide as determined by different workers varies widely. To obtain further information measurements have been carried out at 30 Mc/sec. The temperature coefficient of absorption is a function of the temperature. S.T.

2327. Flow of visco-elastic dispersed systems through tubes and changes in the value of viscosity and critical shearing stress.

P. K. SHCHIPANOV. *Kolloidnyi Zh.*, 1951, **13**, 388.

An extension of author's earlier work (*ibid.* 1949, **11**, 363) on the hydrodynamic implications of the changes in viscosity and yield-value along the length of the tube, occurring as a result of the shearing. G.W.S.B.

2328. Efficiency and output of a butter churn with a stirrer.

V. SHUVALOV. *Molochnaya Prom.*, 1951 (5), 29.

On the principle of the dough farinograph, the work required to churn the butter by stirring is measured during the mixing process and is related to the fullness of the churn. At the time at which the butter is "made" there is a sharp break in the work-curve. Times corresponding to this break are plotted logarithmically against the proportion of the available volume of the churn actually filled with cream and, over a limited range, linear curves are obtained. Logs of "specific times" (i.e. time/weight of cream) are also plotted. The stirrer method of churning is regarded as satisfactory for creams having a fairly wide range of fat content. G.W.S.B.

2329. The development of methods for the measurement of clay consistency and a description of a new continuous measuring apparatus.

M. J. SINGER. *Klei*, 1951, **1** (5), 3.

The Dutch Ceramic Institute has developed an apparatus for measuring the consistency of clay. The device consists of a worm driven by an electric motor at a constant speed; this causes a continuous flow of clay through a barrel of large dia. with a right-angle mouth-piece at the end. At the point where the clay flow changes its direction by 90° there is a rubber membrane which is spring loaded from the outside. The pressure exerted by the clay on the membrane depends on its consistency and is indicated by the movement of the spring which is registered by a dial gauge reading to 0.01 mm. Since the membrane movement is not linear to the increase in pressure, and since the relative increase of the movement is higher with a low pressure than with a high pressure, the sensitivity is higher with soft than with stiff clays. One of the defects found in this apparatus was the formation of a cavity behind the membrane; clay accumulated in this cavity and was not carried forward with the main flow. This presented some difficulties, especially with clays of a consistency varying from stiff to soft. Another defect was the fact that the gauge did not give reliable readings. Another apparatus was therefore constructed, the drag exerted by the clay on a sphere suspended in the vertical mouth-piece being measured. B.C.R.A.

2330. Determination of elastic constants of gels by ultrasonic method.

A. M. SRIVASTAVA. *Proc. Nat. Acad. Sci. India*, 1949, **18** (2) 51.

The ultrasonic pulse technique developed herein is applied to the determination of the elastic moduli of four gels. The method is entirely new to this type of work and recommends itself because the determinations are quick, accurate and the sample is left undamaged after experimentation. The theories of gel formation have been analysed in brief and attempts are being made to correlate them with the elastic data obtained.

AUTHOR.

2331. Ultrasonic studies of gels.

A. M. SRIVASTAVA. *Indian J. Phys.*, 1951, **25**, 17.

Using an ultrasonic pulse technique the elasticities of gels have been obtained at four ultrasonic frequencies. The effect of temperature and age on the iron silicate gels has been studied. A brief discussion outlines the probable structure and mechanism of gel formation, maintaining that the ultimate units in a gel are groups of atoms producing an interlinked fibrous structure perfectly randomly oriented.

AUTHOR.

2332. On the stress-function approaches of Boussinesq and Timpe to the axisymmetric problem of elasticity theory.

E. STERNBERG, R. A. EUBANKS AND M. A. SODOWSKY. *J. Appl. Phys.*, 1951, **22**, 1121.

2333. Conditions satisfied by the expansion and vorticity of a viscous fluid in a fixed container.

J. L. SYNGE. *Quart. Appl. Math.*, 1951, **9**, 319.

2334. Analysis of the swimming of microscopic organisms.

G. TAYLOR. *Proc. Roy. Soc., A* 1951, **209**, 447.

2335. On the question of the nature of flow in structural systems. (Lubricating oils at low temperatures).

V. L. VAL'DMAN. *Kolloidnyi Zh.*, 1951, **13**, 327.

Complex curves are shown relating (variable) viscosity to rate of shear, the latter varying from 10^{-5} to 5 sec^{-2} .

G.W.S.B.,

2336. Resistance to deformation of metals at velocities 10^{-6} — 10^2 m/sec . III.

F. F. VITMAN AND N. A. ZLATIN. *J. Tech. Phys., USSR*, 1950, **20**, 1267. *In Russian*.

Results of experiments with Cu, Zn, Al and Sn confirmed the existence, in the range covered by the tests of variations of temperature and velocities, of 3 separate ranges of variation of these parameters within each of which one definite mechanism for the influence of velocity on the resistance to plastic deformation predominates. In post-recrystallization conditions of deformation the tests fully reproduced the conditions previously found in experiments with Pb and corroborated the equation representing them, viz. $H_K = H_{K0}(\dot{\epsilon}/\dot{\epsilon}_0)^{m(T-T_0)}$. On the other hand, in pre-recrystallization deformation of the soft metals mentioned the temperature relation was not fully brought out to satisfy the expression previously found for it, viz. $H_K = M(\dot{\epsilon} \exp N/T)^n$. The results of this test series, just as the previous experiments with Pb, showed that the kink on the characteristics of the deformation resistance v. speed at temperatures exceeding the recrystallization temperature corresponds for all the metals to approximately the same resistance value independent of speed and temperature.

SCI. ABSTR.

2337. The rheology of building materials.

A. G. WARD. *Chem. & Ind.*, 1951 (47), 1026.

2338. The variation of the Young's modulus of a ferrite (of Ni and Zn) with density.

L. WEIL. *Ann. Inst. Fourier*, 1950, **2**, 207. *In French*.

Resonance measurements using magnetostriction on annular test pieces of varying dimensions and densities suggest that the Young's modulus increases linearly, and rapidly, with increasing density.

SCI. ABSTR.

2339. Viscosity of dilute and moderately concentrated polymer solutions.

S. C. WEISSBERG, R. SIMHA AND S. ROTHMAN. *J. Res. Nat. Bur. Stand.*, 1951, **47**, 298.

The viscosities of three polystyrene fractions in three solvents were measured at two temperatures and two empirical equations (Martin and Baker) were used for the concentration dependence.

E.W.J.M.

2340. The moving Griffith crack.

E. H. YOFFE. *Phil. Mag.*, 1951, **42**, 739.

2341. Analogy between the rupture of methyl methacrylate and that of metals by fatigue.

F. ZANDMAN. *C. R. Acad. Sci. Paris*, 1951, **233**, 20. *In French.*

A brief statement of the observed stages leading to fracture, for different stress systems, using photoelastic methods. SCI. ABSTR.

2342. The folding endurance test. I. Statistical aspects.

O. ANDERSSON. *Svensk Papperstidning*, 1951, **54** (17), 591. *In English.*

Data obtained by the folding endurance test on paper are often difficult to assess because of the considerable deviation of individual results from the mean value. A statistical method of analysing the results is described.

2343. Effect of heat treatment on the bending strength and the elasticity of hard wood fibre board.

O. ANDERSSON. *Svensk Papperstidning*, 1951, **54** (17), 597. *In Swedish.*

2344. Strength properties of paper.

O. ANDERSSON. *Svensk Papperstidning*, 1951, **54** (15), 505. *In Swedish.*

Routine tests on strength data on sack paper of constant basis weight and the corresponding pulp from 300 days of production have been investigated statistically. There is a considerable difference between the properties of the sheets made in the paper machine and the laboratory sheet machine. Relationships between different strength properties of the same material are derived. The bursting strength is discussed in some detail and formulae for the stress distribution in the paper in the burst tester are derived.

P.A.T.R.A. (ABR.)

2345. Some factors affecting the stress-strain characteristics of paper. I. Influence of temperature.

O. ANDERSSON AND E. BERKYTO. *Svensk Papperstidning*, 1951, **54** (13), 437. *In English.*

The influence of temperature on the stress-strain characteristics of paper has been studied for a temperature range of -50°C to 150°C . The slope of the stress-strain curves and the tensile strength have both been found to decrease with temperature. Equations of the following form were fitted to all the data

$$\sigma = (A\epsilon + B\epsilon^2) + (C\epsilon + D\epsilon^2)t$$

where σ is the stress (kg), ϵ is the strain (% elongation), t is the temperature ($^{\circ}\text{C}$) and A, B, C, D are constants.

Similar empirical linear equations were fitted to the breaking stress and breaking elongation vs temperature data. Other relationships (e.g. Young's modulus with temperature) can be derived from them.

P.A.T.R.A. (ABR.)

2346. On the relationship between tensile strength and bonded fibre area of paper.

L. NORDMAN AND C. GUSTAFSSON. *Med. fran Industr. Centrallab. Teollisuuden Keskuslab. Tiedonantoja*, 94, *Helsingfors*. 1951, 21pp.

The increase in breaking length per unit increase in the bonded area has been determined for handsheets made from five different pulps after various beating times in a Valley beater. The changes in the bonded area for every pulp and every beating point have been achieved through variations in the wet pressure, and the changes have been determined through measurements of the variations in the scattering coefficient of the papers. The ratio between the increase in strength and bonded area seems to be fairly independent of the beating degree and wet pressure, but takes characteristic values for the different pulps. The possible existence of an "effective" and an "ineffective" bonded area is discussed. Some irregularities at low wet pressures can at least partly be attributed to systematical errors in the optical measurements.

P.A.T.R.A.