

The viscosity of any liquid containing asymmetric molecules can be made to show a temporary viscosity-fall during flow because of molecular orientation in the flow stream. Castor oil, for example, appears to have a constant viscosity coefficient for rates of shear up to 5,000 sec.⁻¹ yet at a rate of shear of 250,000 sec.⁻¹ its viscosity is reduced by about 25 per cent. The apparent viscosity over a wide range of rate of shear has a falling characteristic with a point of inflexion, the curve bending upward when an appreciable proportion of the pressure-volume energy is converted into kinetic energy and when turbulent flow takes place. The viscosity of a liquid containing large asymmetric molecules, as in an oil thickened with polymer, which has suffered a permanent viscosity loss through severe shearing, is more sensitive to temperature change than that of the liquid at low rates of shear. On the other hand, when a liquid suffers a temporary viscosity reduction its viscosity-temperature coefficient is smaller while a shearing stress is being applied than when the stress has been removed.

The complexity of the flow behaviour of solutions of some polystyrenes at high dilution was emphasized by Dr. P. P. Rutherford (University College of North Staffordshire), who showed that with a capillary-type viscometer anomalous $\eta sp/c$ and $\ln \eta r/c$ values were obtained at the highest dilutions. Upswings in the graphs were observed when these values were plotted against the concentration over the range 0.2–0.4 gm. of polystyrene (mol. weight less than 40,000). The concentration at which these upswings occurred depends on the intrinsic viscosity or molecular weight, the temperature and the kind of solvent used. The flow times for the dilute solutions left in contact with powdered glass for several months were found to be almost unaltered, indicating that adsorption effects on the viscometer walls are negligible. Before an explanation of the anomalies is offered further work is necessary not only on viscosity measurements of fractionated polystyrenes of low molecular weight but also by the measurement of light scattering, density and other properties in the low concentration range.

At the first World Petroleum Congress held at the Imperial College of Science and Technology, 1933, the opinion was expressed by Dr. Guy Barr of the National Physical Laboratory that the international standardization of viscosities should be made with viscometers of known characteristics, as these are much less likely to change than standard viscosity oils.

This view is at present maintained by both the British Standards and Institute of Petroleum viscosity committees, and in a short report by Mr. W. O. Jennings (National Physical Laboratory) and Dr. E. W. J. Mardles (chairman of the Institute of Petroleum Viscosity Panel) it was shown by results obtained at the National Physical Laboratory that the average change in the constant of four master viscometers over the period 1953–58 was no greater than +0.01 per cent.

Information from observation books at the National Physical Laboratory indicated the satisfactory working of the standard methods. The report using these results gives the method of establishing a series of reference viscometers on the basis of the agreed viscosity value of water. The accuracy of the method was assessed by cross checking with other laboratories.

The meeting discussed the various factors by which high precision is attainable and in particular the difficulty of using the quadratic equation, $v = Ct - B/t$ where v is kinematic viscosity, C the viscometer constant, t time of flow and B the coefficient of the kinetic energy of efflux, B being known to be variable. The standard methods indicate ways and means of avoiding the use of B or obtaining a working value for it by calculation.

The experimental determination of term B can conveniently be made, as shown in the report, by first obtaining the value for C , using a flow time not less than 1,200 sec.; then, with a flow time of about, but not less than, 200 sec., evaluating B from the equation $B = Ct^2 - vt$, where t is the short flow time and C the constant already obtained.

L. A. Steiner (Viscosity Panel, Institute of Petroleum) described a series of experiments showing the variation of the coefficient B under different conditions of experiment. Using sets of viscometers of the same design but with one variant, namely the capillary diameter, the true constants could be ascertained by a graphical method. It was shown that the variation in the coefficient B could be explained partly by end effects, the shapes of the entry and exit ends of the capillary affecting the results; part of the efflux energy is recovered during the filling of the bulb.

The meeting included the exhibition of some new viscometers and equipment, and was concluded by a visit to the viscometry, chronometry and thermometry sections of the National Physical Laboratory on June 7.

E. W. J. MARDLES

THE BRITISH GELATINE AND GLUE RESEARCH ASSOCIATION

THE fifteenth meeting of the Research Panel of the Association was held on June 12, with Dr. G. R. Tristram (University of St. Andrews) in the chair. The meeting was well attended and was followed by demonstrations and discussions in the Association's Laboratories at 2a Dalmeny Avenue, London, N.7.

The meeting commenced with a review by Prof. A. Neuberger (St. Mary's Hospital Medical School, London), with the title "General Aspects of the Metabolism of Collagen". Prof. Neuberger outlined the development of the use of radioactive amino-acids in studies of the laying down and turnover of collagen, and the part which the soluble collagens play in this. He also

described work showing the inability of an animal to make use of free hydroxyproline (and hydroxylysine) in collagen synthesis, the hydroxyproline being formed at some stage by the hydroxylation of bound proline.

Drs. N. M. Green and D. A. Lowther (St. Mary's Hospital Medical School) gave a paper "Biosynthesis of Collagen", describing their recent researches. In these they have made use of tissue slices obtained from the connective tissue tumour formed when carrageenin is injected under the skin of a guinea pig. Two problems were studied: the first, the conversion of proline into collagen-bound hydroxyproline, and secondly, the precursor relationships

between the soluble collagens together with the search for other collagen-like precursors in the cells.

The microtomed tissue slices were incubated in a Krebs medium, which included radioactive proline, for 4 hr. at 37° C. under oxygen. After washing, they were ground and the soluble collagens extracted. The results showed that, in all the purified collagen fractions, the radioactivity of the hydroxyproline was comparable with that of proline, showing that it was derived from the radioactive proline in the medium. In addition, the collagen soluble in neutral salt showed a very much more rapid incorporation of radioactivity than acid-soluble collagen, which in turn showed greater activity than the insoluble collagen. The addition of free hydroxyproline to a culture did not lead to a reduction in the ratio of radioactive hydroxyproline to radioactive proline, while the addition of radioactive hydroxyproline to a medium free of radioactive proline showed no significant incorporation into the collagen. Changes in ratio of specific activities for collagen, hydroxyproline and proline with incubation time, in the presence of radioactive proline, suggest that hydroxylation occurs before incorporation into the protein. Further experiments, in which subcellular fractions were isolated from the tissues, showed that collagens soluble in neutral salt are present in certain fractions. It was suggested that there is a continuous series of collagens of decreasing solubility, of which neutral salt-soluble and acid-soluble collagens are two arbitrary fractions.

A lively discussion followed the paper, and a vote of thanks was proposed by Mr. S. Henson (William Oldroyd and Sons, Ltd.) and seconded by Dr. J. E. Eastoe (Royal College of Surgeons).

A number of analytical techniques were included in the demonstrations at the laboratory. In each

instance, part or the whole of the determination was carried through for each group of visitors. Mr. A. A. Leach described his modified Neuman and Logan technique for hydroxyproline determination. Mr. W. G. Cobbett and Dr. A. W. Kenchington demonstrated tyrosine estimation by ultra-violet absorption and by a modified colorimetric method. Dr. G. Stainsby showed how the biuret method could be applied to estimating gelatine concentrations, and Mr. J. T. Taylor carried out the Kodak test for the setting time of a gelatine solution. Mr. A. M. Kragh showed the powerful action of gelatine and glue as flocculation and filtration aids, when used in the correct conditions.

Much interest was aroused by the demonstration by Dr. A. Courts of the properties of a form of soluble collagen which can be isolated from collagenous tissues after they have received pretreatments of the type used in gelatine manufacture (for example, a cold alkaline soak). Substantial percentages of the collagen could be solubilized in this way using 0.1 M citric acid as solvent. The solution was very viscous but, on warming to 43° C., a rapid conversion to gelatine occurred, and the viscosity fell more than 40-fold to a normal value for gelatine. It was possible to precipitate the soluble collagen as fibre by the same procedures as applied to acid-soluble collagens from native tissues. It appears clear that bonds formed when the collagen became insoluble have been broken, enabling the original structural units to be dissolved.

Also on show were equipment for fractionation (W. B. Langston), small-scale gelatine extraction (F. W. Wainwright and A. P. Williams), and the use of XE 97 resin for the separation of gelatine components by the method of G. E. Russell (Ilford, Ltd.) (A. A. Leach). A. G. WARD

NUMERICAL WEATHER FORECASTING

THE methods of numerical prediction by electronic computer of the atmospheric pressure field now being investigated are based on finite difference approximations to the differential coefficients in the equations of motion. It is required to forecast the variation with time of the height h of an isobaric surface, and the differential coefficients of this quantity occur in the equations.

Starting with a set of values of h at the grid points of a map, the finite-difference approximations can be computed from more than one set of combinations of the values. The effects of using different combinations have been examined in the numerical forecasting research unit of the Meteorological Office, and the results are published in a recent paper entitled "Experiments in Numerical Integration", by E. Knighting, D. E. Jones and Mavis K. Hinds (*Quart. J. Roy. Meteor. Soc.*, 84, 91; 1958).

The quantities which have to be computed are the Laplacian $\frac{\partial^2 h}{\partial x^2} + \frac{\partial^2 h}{\partial y^2}$ and a Jacobian $J(h, \zeta)$, where ζ

is the vertical component of the vorticity, which in turn is expressed as a function of the Laplacian.

The grid points are arranged in square sets. One basic set of grid points is that of the eight points at

the centre, corners and mid-points of the sides of a square. These are numbered 0 at the centre, 1, 2, 3, 4 at the mid-points of the sides—with the easternmost point of this set 1, northern 2 and so on counter-clockwise—and 5, 6, 7, 8 at the corners—with the north-east point 5 and the north-west point 6 and so on as before. Then one finite-difference approximation to the Laplacian is:

$$(h_1 + h_2 + h_3 + h_4 - 4h_0)/a^2$$

where h_i is the value of h at point i and $2a$ is the length of a side of the square. Another approximation is:

$$(h_5 + h_6 + h_7 + h_8 - 4h_0)/2a^2$$

Similar, more elaborate combinations apply to the Jacobian.

The authors describe the results of using these different combinations on actual meteorological situations, one of which is the great north-westerly gale of January 31, 1953, which led to the North Sea floods of the following night. Considerable differences are found to occur between the maps of the predicted pressure distributions according to the particular combinations employed. These differences occur even in the centre of the large area dealt with, though that