ABSTRACT

The deformability of the red blood cell was analysed into viscous, elastic and geometrical components and shown to be unidentifiable as a single measurable physical property. The measurement of deformability was then attempted in three ways.

Capillary traversal times of red blood cells were measured as an index of deformability. Osmotic swelling was shown to decrease deformability. Suggestions were made for overcoming the technical difficulties so as to allow for routine use of the method. The method seems to have considerable potential for investigating the effects of changes in deformability on flow in the micro-circulation.

The relaxation time associated with recovery of shape (and orientation) of red cells was measured as an index of deformability. The results suggest that the recovery of shape is very rapid, < 1 s, and that thereafter the relaxation is of orientation and the cell behaves as a rigid disc. The method appears not to be useful.

Measurements of apparent viscosity, shear rate, and cell volume fraction were made for suspensions of red cells and elastic and viscous parameters obtained based on modelling of the red cell as a liquid drop and as a viscoelastic sphere. The viscoelastic sphere theory was found to be a better description of red blood cell rheology than the liquid drop model, which was found to be unsuitable. Values

of bulk cell viscosity and cell rigidity were obtained.

The optimal hematocrit method was also employed and in this last method, microviscometry was used to extend the measurements to diseased states. No significant differences between samples from normal and diseased subjects were observed.

It was found that the red cell is very fluid; the theory of red cell suspension viscosity undeveloped; and the accuracy of low viscosity microviscometers insufficient to measure small changes in viscosity.