CHANGES IN THE HYDRATION OF THE SERUM COLLOIDS AS A GENERAL FEATURE OF DISEASE

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The importance for individual therapy of the blood changes investigated by J. E. R. McDonagh made it desirable to obtain more objective measures of some of them, especially the hydration of the proteins. Since this association of the water (more correctly salt and sugar solution) with the proteins is apparently only of a physical nature, the obvious chemical methods fail. The equation:

$$\frac{(1 + \phi) \text{ log. nat. } \eta/\eta_o)}{\phi \ (1 + \text{log. nat. } \eta/\eta_o)} = K$$

(in which η is the relative viscosity of the system; η_o the relative viscosity of the dispersion medium; ϕ the relative volume of the disperse phase; K a constant which depends on the nature of the dispersion medium, disperse phase and temperature) is valid for erythrocyte suspensions. It is also valid for a large majority of solutions (practically through their range of solubility), as well as for blood sera, but in these cases ϕ is a multiple of the concentration ($\phi = nc$). Consequently it is permissible to say that these solutions behave *as if* each unit of the solute occupied a space corresponding to η.

Both the η and the k vary in serial dilutions of different sera but are sufficiently interrelated to permit the equation:

$$n = \left\{ \frac{113}{c} - 1.52 \right\} \log_{10} n/1.015 - 0.66$$

which is valid for all the sera examined and for temperatures from 20° C. to 40° C. For instance a serum containing 7.5 per cent proteins and having at 40° C. a viscosity of 1.70, behaves according to the equation, as if each gram of its proteins occupied or influenced a space of 2.37 cc. Multiplying the n by the coefficient necessary to make it 100 in the average normal human serum, we obtain the VP Index. Thus, a VP Index of 120 means that the examined serum behaves *as if* each gram of its proteins occupied a space by 20 per cent larger than it seems to occupy in a normal serum. In an analogous way, if the concentration of all the colloids of the serum is expressed by their refractometric index, we obtain the VR Index. The VP Index is more sensitive to pathological changes, the VR Index more foolproof, because the determination of the refractometric index is simpler and more reliable than the protein determinations. The standard deviation of the VR Index in health is only ± 2.5 per cent (including the probable error of the method), while its range in disease was found to be from 82 to 157 in the 1500 examinations presented. These sera were obtained partly from the author's own patients with internal diseases, partly from all other branches of medicine, as other physicians gradually learned to value the results. In conjunction with other methods—and never without a clinical examination—they proved useful in revealing the presence of disease, in excluding some diagnoses and in a more precise statement of the therapeutic indications established by McDonagh. Heuristically, the method lead to an extension of the liver treatment to a group of patients who were not anemic but whose blood serum resembled that in pernicious anemia and to the recovery of a patient with the hitherto fatal combination of agranulocytosis with jaundice.