Such solutions do not depend on the charge of their particles for stability, but more likely on "chemical forces acting in true solubility" (Loeb).

This resemblance of a suspension of red cells to a lyophobe colloid casts a certain light on the nature of the suspended cells. The protoplasm of red cells consists of a semi-fluid jelly-like substance of the nature of a lyophile colloid, but the stability of a suspension of suspended particles of such nature would not react to electrolyte flocculation as does a suspension of red cells, whose stability has been shown to depend on electric charges. If, however, it is assumed that the surface of the cells is covered with an insoluble film of amphoteric character, the conditions which obtain in a red cell suspension are met.

Protein, when denatured, loses its lyophile properties so that the stability of a suspension of it depends on the electric properties of its particles, which are also amphoteric in reaction with H and OH ions. Ramsden has shown that many proteins are denatured in film formation, and Loeb has shown that genuine crystaline egg albumin loses its hydrophile properties and acts as a lyophobe colloid when it is deposited in a thin layer on collodion particles. Such protein coated particles resemble very closely a suspension of red cells in their flocculation by electrolytes and in their reaction with H and OH ions.

It is suggested that a denaturing of the proteins on the surface of the cell and the formation of a membrane would account for the properties of the cell suspension. The insolubility of this surface film would cause the stability of the suspension to depend on electric charges; the chemical nature of the film would account for its amphoteric properties.

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A study of the bi-refringence of agar agar.

By JOHN FIELD, 2nd, and C. L. ALSBERG.

[*From the Department of Chemistry and the Food Research Institute, Stanford University, Calif.*]

Many gels when subjected to strain become anisotropic. A film of gelatin or colloid dried on glass is anisotropic with one optical axis normal to the surface of the film.[1] With the removal

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[1] F. Weigert and H. Pohle, *Kolloid Z.*, 1921, xxviii, 153.

of the strain as by moistening the film, the anisotropy largely disappears. The writers undertook to determine whether or not in the case of agar agar this property is inherent in the colloid itself or exhibited by it only in the gel state. To this end anisotropy was looked for in agar that had been dried in the gel form and in agar that had been dried in the sol form.

To obtain dried agar gel for examination under the microscope, drops of agar solutions ranging up to one per cent were placed on glass slides and dried in a vacuum desiccator at room temperature.

To obtain agar preparations dried in the sol form, drops of the same solutions were dried in a thermostat at 35°. That the agar agar preparation used in this work exists in the sol form at this temperature appears from a study of the viscosity of the solutions as the temperature is lowered. At various temperatures above 34° there is very little change in the viscosity. At 34° the viscosity begins to increase at an extremely rapid rate. Gelation occurred between 34° and 30°.

Under the polarizing microscope the agar dried as a gel shows very strong bi-refringence. The preparations were decidedly anisotropic. With a selenite plate addition colors were obtained. With a plate of red of the first order placed between the nicols at an angle of 45° to the plane of the nicols, addition colors were obtained, blue when the striæ were parallel to the optical axis and yellow when perpendicular. With the test plate white of the first order, the striæ when parallel to the optical axis were faint yellow and when perpendicular, gray.

The agar dried as a sol showed but very faint bi-refringence, and this was limited to the periphery of the drop. The interior of the drop was free from even this very faint anisotropy. With the selenite plate colors appeared only at the periphery and were very faint but similar to those observed in the gel. When the film was cracked the edges of the cracks showed decided bi-refringence.

That the marked difference in the optical properties of the two forms of agar is not due to difference in the thickness of the layers examined is evidenced by the fact that the sol form showed no anisotropy at all over the greater part of the surface of the film. Whether the bi-refringence of the gel form is as great as above recorded when in drying it is not adherent to a support and hence is permitted to contract uniformly, is being investigated. That the two forms of dried agar have different structure is clear. Whether the removal of strains plays a rôle in the mechanism of the imbibition and swelling of gels, as well as in their behavior in some other respects, is under investigation.

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On the gelatinization by heat of wheat and maize starch.

By C. L. ALSBERG and O. S. RASK.

[*From the Food Research Institute and the Department of Chemistry, Stanford University, Calif.*]

By means of the Stormer viscosimeter it was found that during the gelatinization process the viscosity of wheat and maize starch suspensions in water increases gradually over a range of 25 to 30 degrees. Gelatinization is not a sharp transition point like the melting points of crystalline substances. It resembles more nearly the gradual softening processes of glass and other non-crystalline substances that show no definite melting points. This conception is consistent with the disappearance of anisotropy in the early stages of gelatinization. There is good evidence for the belief that the anisotropy of the starch grain is the result of strain. Heating in the presence of water, it is probable, destroys the anisotropy because it removes the strains. The process is analogous to annealing.

Possibly the gelatinization of starch is to be regarded in this wise: The starch gel first imbibes water. In this process strains are presumably removed and in consequence anisotropy disappears. When the starch gel has thus reached a certain degree of dilution by imbibition, it melts. If this is the course of events, it is not necessary to assume, as has been done so frequently, that the gelatinization of starch depends upon depolymerization. The conception of gelatinization here presented is in accordance with certain observations that are not readily explainable on the assumption that starch during gelatinization depolymerizes—using this term in a strictly chemical sense. These observations are: that sharply drying starch or thoroughly wetting it changes the gelatinization temperature; that gelatinization is incomplete unless adequate quantities of water are present; and that the rate of heating has a marked effect upon the gelatinization temperature.