

GEL MINERALS (COLLOID MINERALS)

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Considering, then, only the dispersoids Nos. 4 and 5, the division made by A. A. Noyes, as follows, has been very widely accepted.

He distinguishes two sub-classes of colloidal mixtures: (1) That represented by an aqueous solution of gelatin, and (2) colloiddally suspended arsenious sulfide.

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| <p>SUBCLASS 1. Gelatinizes upon cooling or evaporation.</p> <p>Does not coagulate upon the addition of salts (electrolytes) unless in large amount.</p> | <p>SUBCLASS 2. Does not gelatinize upon cooling and if gelatinized by other means it does not redissolve upon heating. Gives an abundant precipitate upon the addition of a salt.</p> |
| <p>Have usually a lower surface tension than their pure dispersion-means.</p> <p>Viscous, gelatinizing colloidal mixtures, not coagulated by salts.</p> | <p>Surface tension practically unchanged. Electrical factors usually play a more important role here.</p> <p>Non-viscous, nongelatinizing but readily coagulable mixtures.</p> |
| <p>COLLOIDAL SOLUTIONS.</p> <p><i>Examples.</i> Proteins, gelatin, agar—agar, cholesterol, salicylic acid, metaphosphoric acid, hydroxides in concentrated solution, so-called gelatinous salts (sulfates, phosphates, carbonates, etc.) and some dyestuffs like "night-blue."</p> | <p>COLLOIDAL SUSPENSIONS.</p> <p><i>Examples.</i> Metallic sols, sulfide sols, many dyestuffs (Congo red) iron hydroxide in dilute solution.</p> |

Noyes⁹ in a presidential address delivered before the American Chemical Society in 1905, says: "In accordance with the general use of the term, colloidal mixtures are most simply defined as liquid (or solid) mixtures of two (or more) substances which are not separated from one another by the action of gravity however long continued, nor by filtration thru paper, but which are so separated when the liquid is forced thru animal membranes, the substances remaining behind being designated as colloids."

The following table shows the relative size of particles in true solutions, colloidal solutions, and colloidal suspensions.

TABLE I.

| 0.1 $\mu\mu$ | 1 $\mu\mu$ | 10 $\mu\mu$ | 100 $\mu\mu$ | 1000 $\mu\mu$ | 10 μ | 100 μ | 1 mm |
|----------------------------------------|----------------------|------------------------------------------------------------------------------|--------------|--------------------------------------------|----------|-----------|------|
| Ultramicroscopic Province | | Microscopic Province The particles have outlines which can be recognized. | | | | | |
| Quartz which does not settle. | | Quartz which settles. | | | | | |
| Oil Particles in Water | | | | | | | |
| Do not rise to surface | | | | Do rise to surface and form a scum | | | |
| Brownian Movements. | | | | | | | |
| Particles have a very lively movement. | | Slow movement. | | Particles have very little or no movement. | | | |
| Crystalloid solutions. | Colloidal solutions. | EMULSOIDS. | | SUSPENSIDS. | | | |

Primarily the mineralogist is concerned, not with the colloidal solutions and suspensions themselves, but with their product, namely, gels. It has been the customary thing among writers in English to call these minerals which have been believed to have been produced from colloidal solutions or suspensions "Colloidal minerals." The German writers, on the other hand, use the term "*Gelmineralien*," which, in the opinion of the writer, is much more appropriate.

⁹ *J. Am. Chem. Soc.*, 27, 85, 1905

"The gels of the mineral kingdom are the typical products of normal weathering processes, whether they present themselves in the silicate rock or in the oxidation zone of ore deposits under the influence of strong electrolytes."¹⁰

Gel minerals, then, are the products of oxidation, hydration, carbonation, and silicification in the zone of katamorphism, in the belts of both weathering and cementation. The one exception to this is the occurrence of gel minerals as the product of hot springs. We have, then, as Cornu pointed out, the following modes of occurrence:

- (a) The normal weathering products of rocks.
- (b) In the oxidized zone of ore deposits.
- (c) In hot spring deposits.

They are low temperature, low pressure, minerals, which accounts for their gel condition. The mammillary, botryoidal, reniform, stalactitic and rod-like shapes assumed are characteristic, and in large part the means of identifying them. "*Glaskopf*" of German writers is a useful descriptive term for material showing such structures. The imitative shapes are assumed when the development of the mineral has not been hindered for lack of space; when crowded the following structures also occur: Earthy (magnesite); soapy; and dendritic (stilpnosiderite, psilomelanite). In many cases drying cracks are found. Some, upon loss of water, will adhere to the tongue. This property is due to the fact that they are strongly hygroscopic. In a few cases they are actually found in a jelly-like condition in nature (opal, pitticite, plombierite).

Optically, gel minerals are usually isotropic, but often show double refraction due to strain (hyalite, chrysocolla). Those which have lost their water give the appearance of cloudy or turbid media. Aggregate and spherulitic structures sometimes occur. Under the microscope such gels are hard to identify with certainty.

Little seems to be known concerning the origin of these minerals and in this connection there is a large field for research. Chemical composition does not determine whether a substance goes into solution as a molecular dispersoid (true solution) or as a colloid. Wo. Ostwald points out that it is the different physical properties, such as solubility, which determine the variations in degree of dispersion. In nature, then, it is the physical condition under which gel minerals are produced which accounts for the fact that we find one and the same substance both as a crystalloid and as a colloid.

(To be continued)

¹⁰ Cornu, *Z. Chem. Ind. Kolloide*, 4, 16, 1909.