DISPERSOIDAL INVESTIGATIONS ON SELENIUM. I.

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Concerning the Influence of the Oxygen and the Carbon Dioxide Present in Air on the Formation of the Dispersed Phase of Selenium when Selenium Solution in Hydrazine Hydrate are poured into Water, Alcohol and Glycerine. Many researches have already been made on the formation of colloidal selenium solutions by pouring into water the selenium solutions in hydrazine hydrate. J. Meyer[1] explained the reaction of the formation of colloidal selenium as follows: ". . . . . Ganz analog wie das Selen verhält sich auch der Schwefel gegen Hydrazine-hydrate,

$$3NH_2NH_3OH + 3S = 2H_2NNH_3SH + H_2NNH_3SO_3H$$
$$6NH_2NH_3OH + 3S = 2(H_2NNH_3)_2S + (H_2NNH_3)_2SO_3 + 3H_2O.$$

. . . . . Beim starken Verdünnen dieser Lösungen erhält man nun kolloide Schwefel- und Selen-Lösung. Die Abscheidung der beiden Elemente ist darauf zurückzuführen, dass die oben gegebenen Reaktionsgleichungen nun von rechts nach links verlaufen . . . . ." A. Gutbier[2] and his collaborator studied also the method of the synthesis of colloidal selenium in aqueous and in alcoholic media.

Experimental. In the following table (this covers only one part of my experiments) are briefly described several experiments showing that the formation of colloidal selenium solutions is dependent principally on the influences of the oxygen and the carbon dioxide present in air.

Conclusion. In an atmosphere of nitrogen any formation of colloidal selenium solution is not to be observed on pouring selenium solutions in hydrazine hydrate into either water, alcohol or glycerine.

I wish to express here to Prof. P. P. von Weimarn my sincere gratitude for providing me with the theme for these investigations.

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(1) Meyer, *Ber.*, **46** (1913), 3.
(2) Gutbier, *Ber.*, **47** (1914), 466; *Koll.-Zeitsch.*, **30** (1922), 103.

Table

Medium	In the absence of air; in an atmosphere of nitrogen	Influences of other gases than nitrogen		
		Air	Oxygen	Carbon dioxide
Water	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. H_2O In an atmosphere of nitrogen, no colloidal selenium solutions are formed; but a clear brown solution is obtained.	0.05 c.c. $Se^{2\%}_{H.H.}$ ← 20 c.c. H_2O (In an atmosphere of nitrogen). When air is passed through the clear brown solution obtained, a brick-red colloidal selenium solution is formed.	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. H_2O (In an atmosphere of nitrogen). When oxygen is passed through the clear brown solution, a brick-red colloidal solution of selenium is produced.	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. H_2O (In an atmosphere of nitrogen). When carbon dioxide is passed through the clear brown solution, a brick-red colloidal selenium solution is formed.
Alcohol	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. C_2H_5OH In an atmosphere of nitrogen, certain selenium compounds do not dissolve readily in alcohol and there results a dark-brown turbid suspension.*	0.3 c.c. $Se^{2\%}_{H.H.}$ ← 20 c.c. C_2H_5OH (In an atmosphere of nitrogen). When air is passed through the above dark-brown turbid suspension, it is transformed into a brick-red colloidal selenium solution, which appears blue in transmitted light.	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. C_2H_5OH (In an atmosphere of nitrogen). When oxygen is passed through the above turbid suspension, a brick-red colloidal selenium solution is formed.	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. C_2H_5OH (In an atmosphere of nitrogen). When carbon dioxide is passed through the above turbid suspension, a dark-red colloidal selenium solution is obtained, which appears blue in transmitted light.
Glycerine	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. $C_3H_5(OH)_3$ In an atmosphere of nitrogen no colloidal selenium solution is formed; but there results a clear brown solution.	0.3 c.c. $Se^{2\%}_{H.H.}$ ← 20 c.c. $C_3H_5(OH)_3$ (In an atmosphere of nitrogen). When air is passed through the clear brown solution obtained, there is formed a brick-red colloidal solution of selenium.	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. $C_3H_5(OH)_3$ (In an atmosphere of nitrogen). When oxygen is passed through the clear brown solution obtained, a brick-red colloidal selenium solution results.	0.2 c.c. $Se^{2\%}_{H.H.}$ ← 40 c.c. $C_3H_5(OH)_3$ (In an atmosphere of nitrogen). When carbon dioxide is passed through the clear brown solution, there is slowly formed a brick-red col oidal selenium solution.

In this table under $Se^{2\%}_{H.H.}$ is designated a 2% selenium solution in hydrazine hydrate.

* By the experiment is shown that the precipitate in the above suspension is decomposed by water containing CO_2 and O_2 from the air. The decomposition is accompanied by the formation of a colloidal selenium solution. After the dissolution of selenium in hydrazine hydrate, the solution was evaporated to dryness under reduced pressure in an atmosphere of nitrogen. To the dry residue obtained, absolute alcohol was added always in the nitrogen atmosphere. After the lapse of a day, the alcohol was filtered off and the residue on a filter paper was washed three times with alcohol, and water, containing CO_2 and O_2 from the air, was added. As a result of the addition of water, the residue suffered decomposition; the dispersed particles of selenium passed through the filter and there was obtained a beautiful, stable colloidal selenium solution of a brick-red colour.