The precipitates produced by the action of water on the nitrate of Bismuth are all of the general formula Bi_2O_3, mN_2O_5, nH_2O; the composition of the solutions also may be expressed in terms of the same substances, Bi_2O_3, N_2O_5, and H_2O, which are henceforward termed the "components" of the System. The compositions of the precipitates and solutions might be expressed in terms of other groups of three,—elements, compounds, or mixtures—but three at least are necessary, and more than three are superfluous; if for example the elements Bi, N, H, and O, be selected, and the quantities of three of them in the solution be known, that of the fourth can be calculated from the stöchiometric relations.

The condition *sine qua non* for the application of the Phase Rule is that equilibrium be reached with respect to all reactions that occur in the system. There is only one sure sign of the attainment of equilibrium, namely, that the compositions of precipitates and solution are found to be independent of the order in which the components were mixed,—the composition of the precipitate must be the same whether $Bi(NO_3)_3$ be mixed with water, or Bi_2O_3 with dilute nitric acid, provided only that the same quantities of the three components be employed in each case. In other words, the quantities of the three components (together with the temperature and the pressure) are sufficient to define the state of the system.

Now, it can be shown by a simple algebraical argument[1] that if A, B, C, and D, be any four phases whatever, formed from the same three components, it is possible either

(i) to mix three of these, e.g., A, B, and C, in such proportions that the components are present in the mixture in the same proportions as they are in D, or

(ii) to prepare a mixture of A and B, and another of C and D in such proportions that the quantities of the three components are the same in both mixtures.

In other words, it is possible with these four phases to build up two systems identical with respect to the amounts of each of the three components, but differing in the nature and composition of the phases composing them, and the condition that the state of the system should be completely defined by the amounts of the components (and temperature and pressure) can be fulfilled only if one of these alternative systems changes spontaneously into the other; that is, if reactions between the phases

$$A+B+C=D \qquad\qquad A+B=C+D$$

[1] Van der Waals, quoted by Roozeboom, Rec. Trav. Chim. Pays-Bas **6** 265. (1887.)