curs in the distillation of a mixture of changing composition. This generalization, sometimes referred to as the Gibbs-Konowalow rule, states that a liquid mixture corresponding to a minimum or maximum of vapor pressure at any specified temperature has the same composition as the vapor with which it is in equilibrium.

By far the most important principle enunciated in this wonderfully comprehensive paper, however, is that commonly known as the "phase rule." The Dutch physical chemist, Roozeboom, was the first to recognize the value of this principle in connection with the study of heterogeneous systems, and it is to him that we owe the familiar simplified statement of the theorem as well as numerous illustrations of its applications. The phase rule, as is well known, defines the conditions of equilibrium in a heterogeneous system by the relation between the number of coexisting phases and the number of components constituting the system. It may be briefly stated as follows: A system will be in equilibrium when the number of degrees of freedom is equal to the number of components less the number of phases increased by 2. It may be of interest to mention that Gibbs was the first to employ the term "phase" to signify a discrete portion of matter in which the smallest visible particles are all exactly alike, and which is, therefore, separated in space from every other homogeneous, but dissimilar portion of matter.

The importance of the phase rule in the realm of theoretical chemistry is to-day fully recognized. It has furnished a valuable basis for the classification of closely allied chemical compounds and has proven a trustworthy guide, both in the discovery of new substances as well as in the determination of the range of their stability. Its practical importance is attested by the fact that it forms the basis of modern metallography. The variation of the engineering properties, such as tensile strength, ductility, etc., with varying concentration and varying thermal treatment, can only be satisfactorily elucidated with the phase rule as a guide. The application of the phase rule to the metallurgy of iron and steel furnishes one of the most striking illustrations of its value. The phase rule has proven of inestimable value in connection with the interesting investigations upon minerals and rocks which have been in progress for some years at the Geophysical Laboratory in Washington, while in the ceramic arts and in the manufacture of glass it is destined to play an increasingly important rôle.

In 1879, Gibbs published a paper, "On the vapor-densities of peroxide of nitrogen, formic acid, acetic acid and perchloride of phosphorus,"[5] and a few years later he wrote a series of letters to the secretary of the electrolysis committee of the British Association on "Electrochemical thermodynamics."[6] These papers, together with those previously mentioned, comprise all of his contributions which have a direct bearing upon the science of chemistry.

Besides Gibbs's remarkable achievements in the domain of mathematical physics, he won equally great distinction in the realm of pure mathematics. In his lectures on mathematical physics he became aware of the need for a vector algebra by means of which the complex space relations, so frequently encountered in the study of the theory of electricity and magnetism, could be adequately expressed. To meet this requirement he developed a system of vector analysis for the use of his students. This was at first printed in pamphlet form, but subsequently Professor Gibbs, somewhat reluctantly, consented to its formal publication.

Between the years 1882 and 1889 he published five papers dealing with the electromagnetic theory of light which are regarded by physicists as remarkable for the entire absence of special hypotheses as to the connection between matter and ether.

Professor Gibbs's last work, entitled, "The elementary principles of statistical mechanics," published in 1902, is a masterly exposition of the methods available for the study of systems endowed with several degrees of freedom. This work is said to have opened new vistas to students of mathematical physics.

At the time of his death, in 1903, Professor Gibbs was engaged in the preparation of some additional chapters on heterogeneous equilibrium for a collected edition of his contributions to thermodynamics.

He was the recipient of many honors from learned societies and universities both at home and abroad. Among the societies and academies of which he was a member, or a correspondent, may be mentioned the Connecticut Academy of Arts and Sciences, the National Academy of Sciences, the American Academy of Arts and Sciences, the Royal Institution of Great Britain, the Cambridge Philosophical Society, the Royal Society of London, the Royal Prussian Academy of Berlin, the French Institute, the Physical Society of London, the Bavarian Academy of Sciences and the American Mathematical Society. He received honorary degrees from Williams College, and from the universities of Erlangen, Princeton and Christiania. In 1881 he was awarded the Rumford Medal from the American Academy of Boston, and in 1901 the Copley Medal from the Royal Society of London.

In 1910 a medal was founded in his honor by the Chicago Section of the American Chemical Society to be awarded annually for the best paper or address presented before the section.

[5] *Am. Jour. Sci.* [3], 18, 277, 371 (1879).

[6] Rep. Brit. Assoc. for 1886, p. 388; for 1888, p. 343.