these splendid opportunities might well be made available for the holders of such fellowships as I have suggested.

These fellowships should not be restricted to the purely scientific branches. What better place than Washington for historical research? Where else than in the Department of Labor with such a division as the Children's Bureau could certain social problems be studied to better advantage? Yet it is probable that the majority of such fellowships would be in connection with the scientific activities of the government. For that reason it is from our national scientific societies that the initial impulse for a movement leading to the establishment of such an institution must come.

G. F. Ferris

SPECIAL ARTICLES

THE TERM "INVERSION"

The diversity among the phenomena which are referred to by the term "inversion" is so great that at present the word has lost any precise meaning which it may have had in the past. The organic chemist uses it when discussing the behavior of the allotropic forms of a substance and also when alluding to that well-known single-phase phenomenon, the inversion of cane sugar; while the inorganic chemist generously uses it to denote, in addition to the meanings already referred to, such a phenomenon as an incongruent melting. The writer is not an organic chemist and therefore does not wish to criticize the terminology used by the organic chemists, but feels in duty bound to protest against the present use of the term "inversion" by most inorganic chemists.

When an inorganic chemist hears the term "inversion" used, he invariably associates it with phenomena like the change of rhombic to monoclinic sulfur[1] or phenomena like the thermal dehydration of sodium sulfate decahydrate.[2] The first use of the term is, I think, a very satisfactory one, but for the second type of phenomena a different term should be employed, since otherwise there can not but result an overlooking of the important temperature interval which characterizes this type of "inversion" in systems of three or more components. The term "transition," now used synonymously with "inversion," could well be confined to phenomena of the second class mentioned above.

The distinctive feature about an inversion such as that of rhombic to monoclinic sulfur is the fact that the inversion temperature is a fixed point[3] at constant pressure regardless of the complexity of the system, provided no solid solutions are formed, whereas in the case of the transition of sodium sulfate decahydrate to the anhydrous salt the transition temperature is dependent, in addition, upon the composition of the whole system. Thus both hydrated and anhydrous salt can coexist in the presence of suitable liquids over a wide range of temperatures. The change of transition temperature by the addition of a third component is not an isolated phenomenon but rather an example of one of the types met with most frequently in phase rule studies of complex systems.

On the theoretical side Bancroft[4] has pointed out as a corollary of the theorem of Van Alkemade[5] that in ternary systems at constant pressure involving no solid solution the temperatures at which two solid phases can coexist in the presence of a suitable liquid will rise as the composition of the liquid approaches the side line, *i. e.*, will be a maximum in the binary system. In other words, in a system such as sodium sulfate: water: sulfuric acid, the temperatures at which the solid phases, sodium sulfate and sodium sulfate decahydrate, can coexist will rise as the liquid becomes less acid and be a maximum when the solution contains no free acid.

With this corollary in mind, the effect of

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[1] Findlay, "Phase Rule," page 34 (1908).

[2] *Ibid.*, p. 138.

[3] The variable inversion temperature of cristobalite (SiO_2) found by C. N. Fenner, *Am. J. Sci.*, 36, 331 (1913), is a phenomenon of unstable equilibrium and is hence excluded from this discussion. discussion.

[4] "The Phase Rule," W. D. Bancroft, p. 149 (1897).

[5] *Z. physik. Chem.*, 12, 371 (1893).

adding a component to the systems under discussion may be deduced. In the first case suppose we had both rhombic and monoclinic sulfur coexisting, and suppose, keeping the temperature and pressure constant, we added another component. The total quantity of crystalline sulfur would probably be changed but the crystalline sulfur remaining (if any) would consist of crystals of both the rhombic and monoclinic forms. In the second case suppose we had a saturated solution of sodium sulfate and sodium sulfate decahydrate and, again keeping the temperature and pressure fixed, we added a third component. The sodium sulfate decahydrate would promptly disappear and only a saturated solution of the anhydrous salt, together with anhydrous salt, would be left. This will probably appear clearer after a discussion of the diagram given in Fig. 1.

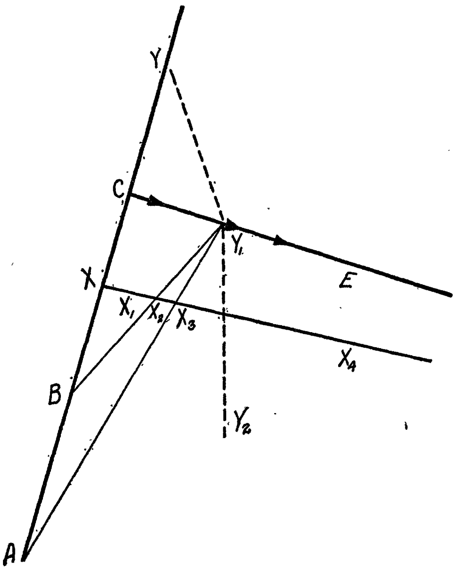

FIG. 1.

Let B in Fig. 1 represent the composition, on one of the side lines of a three-component triangular diagram, of a hydrated salt, and A the composition of the anhydrous form. CE represents the boundary line between the fields of A and B and the temperature falls from C to E as shown by the arrow. Now suppose we take a saturated solution of B in contact with crystals of B, with total composition represented by X and with the composition of the solution represented by Y. The isotherms (saturated solutions of A and B) on the concentration diagram are shown by the lines running from Y to Y_1 to Y_2. If now to X we add the third component the total composition will vary along XX_4. While the total composition varies from X to X_2 the hydrated salt will persist, and while the total composition varies from X_2 to X_3 both salts and the solution Y_1 will be obtained, but when the composition passes X_3 only the anhydrous salt and a solution will be obtained.[6]

Enough has been given, I think, to demonstrate the essential differences in the character of the phenomena under discussion and I would suggest[7] that the term *inversion* be restricted to phenomena like the change of rhombic to monoclinic sulfur, and the term *transition* to phenomena similar in type to the dehydration of sodium sulfate decahydrate, and that in cases in which the composition of all the phases concerned may be represented by simple chemical formulas, the word *dissociation* be employed.

In conclusion I should like to draw attention to a distinction made by Findley[8] between transitions in the solid state and melting point phenomena. He states:

> The transition point, however, differs in so far from a point of fusion, that while it is possible to supercool a liquid, no definite case is known where the solid has been heated above the triple point without passing into the liquid state. Transformation, therefore, is suspended only on one side of the melting point. In the case of two solid phases, however, the transition point can be overstepped in both directions, so that each phase can be obtained in the metastable condition.

This has been interpreted by many to mean that a crystalline substance can not exist even

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[6] See Roozeboom, "Die Heterogenen Gleichgewichte," III., part 1, page 190.

[7] Writers like Findlay and W. C. McC. Lewis use the words "transition," "inversion," and "transformation" synonymously, while Bancroft in denoting such phenomena uses the word "inversion" almost exclusively.

[8] "The Phase Rule," p. 37.

momentarily at temperatures above its melting point. Such an interpretation is untrue since this phenomenon has been observed by several investigators[9] with materials such as the minerals quartz and albite, which, while in the process of melting, may exist for some hours at temperatures above their true melting points. Correctly interpreted, Findlay's distinction holds good for cases of true metastable equilibrium, in which no change of phase is in progress, and which are the cases he evidently had in mind.

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September, 1919

ORGANIZATION OF THE AMERICAN METEOROLOGICAL SOCIETY

[Objects: The advancement and diffusion of the knowledge of meteorology and climatology; and the broadening of their applications in public health, agriculture, engineering, aeronautics, industry and commerce.]

Since the publication of the original announcement in Science, August 22, 1919, pp. 180–181, several thousand circulars have been distributed among prospective members. Up to December 1, 470 had indicated their desire to join the society when organized. Roughly, the percentage make-up of these is as follows:

1. Weather Bureau	37
2. Cooperative observers of the Weather Bureau	6
3. Army, Navy and other government people professionally interested in meteorology.	8
4. Business men, farmers, engineers and others professionally interested in meteorology	8
5. Teachers and students	16
6. Canada	2
7. Latin America	3
8. Amateur meteorologists (not classed above) includes those formerly engaged in meteorological work	20
Total	100

Of the whole number 40 per cent. are professional meteorologists. Many have urged strongly that the practical applications of meteorology be emphasized and that special efforts be made to interest engineers, business men, shippers, farmers, fruit growers, aviators and others whose work is closely dependent on the weather. Those who study merely for its scientific interest will have much to gain from association with those who apply meteorology in the conduct of their business. Two leading views expressed concerning the type of organization are:

(1) That the society should be popular in nature in order to get as many as possible interested in the scientific aspects and applications of meteorology and climatology, and in this way to advance the science by united effort and funds to promote research, and (2) that the society should be strictly scientific, and have rigid qualifications for membership, so that the professional meteorologists can by close personal contact cooperate in research to the best advantage. These two views may not be incompatible if the society when organized welcomes as a member any one who is interested in the aims of the society, and elects from among the members, fellows, as a recognition of eminence in meteorology or climatology. It is generally agreed that all members and fellows should have the same privileges and pay the same dues. The council of the society would, naturally, be composed almost of fellows. Thus, the affairs of the society would be directed by its scientists, with the close backing of a large body of interested members.

Dues must be sufficient to pay current expenses of issuing a periodical leaflet of news, notes, queries, etc., but they must not be burdensome for the large group of underpaid government employees and teachers who are interested. If more than 500 members are procured, dues of $1 per year would probably be sufficient. Much has been said in favor of an endowment fund, and, as some have suggested, also library, instrument, scholarship, and building funds. To procure endowment, the society will probably be incoporated

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[9] A. L. Day and E. T. Allen, "The Isomorphism and Thermal Properties of the Feldspars," Publication No. 31 (1905) Carnegie Institution of Washington. J. B. Ferguson and H. E. Merwin, *Am. J. Sci.*, 46, 417 (1918).