of Illinois in its regional economic province—the Upper Mississippi Valley—and in the nation, and also the technologic requirements of the new era upon which we have entered. Even in the darkening days of the depression in 1931 the state aided the Survey with increased appropriations to set up chemical and physical laboratories of research in temporary quarters and to extend its field inquiries in both geology and geophysics.

The last session of the General Assembly appropriated $1,946,000 for three wing additions to the Natural Resources Building, affecting both the Geological Survey and Natural History Survey, and an additional $165,000 for two additions to the Geological Survey's applied research laboratory to provide for large-scale investigations of the industrial minerals of the state, for experiments in petroleum recovery methods, and for preparation rooms and storage.

The Geological Survey and its two sister divisions, the Natural History Survey and the Water Survey, are divisions of the State Department of Registration and Education, and their policies, programs, and appointments are under the control of the Board of Natural Resources and Conservation. This Board is composed of the director of the Department, who is chairman, ex officio; the president of the University of Illinois, member ex officio; and specialists in the fields of geology, chemistry, engineering, biology, and forestry, most of whom are senior members of the faculties of the University of Chicago and the University of Illinois.—*M. M. Leighton,* Chief.

Letters to the Editor

Inactive by Internal Compensation

Prof. Noller's quandary (*Science,* 1945, 102, 508) concerning the rotatory compensation in meso compounds has, I suppose, perplexed teachers of stereochemistry as well as their students ever since the simplification was introduced that mirror images constituted the forms of enantiomeric pairs. This trick, of course, like the hydraulic analogy applied to electrical phenomena, has its limitations, which one is likely to forget during repeated usage.

The lecturer often uses his hands to illustrate nonsuperposability as well as mirror imagery but may forget to remind the student that not only are symmetrical objects both superposable and mirror images as well, but also that the test can apply only to configurations fixed with respect to some reference point. Thus, a shadowgraph of one's ''asymmetric'' hands, like stereographic projection formulas, does not illustrate configurational opposites unless it is understood that a reference point (*i.e.* the backs of the hands) is conventionally arranged.

In view of the student's ultimate introduction to modern concepts of optical rotatory power, this writer proposes that the qualitative concepts of these theories might profitably be introduced at the beginning of stereochemical instruction. Thus, by reference to Fig. 1, it can be shown that the arbitrary alphabetical order, b c d, indicates for the upper tetrahedron a counterclockwise sequence with respect to the fourth substituent, a. The lower tetrahedron exerts an opposite effect on the light beam owing to a clockwise sequence, b c d, with respect to a. Since these refractions are equal and opposite, it can in truth be said that meso compounds are optically inactive owing to internal compensation.

By contrast, the enantiomeric form shown in Fig. 2 can be analyzed from any arbitrary tetrahedral face, say a c d, with respect to the fourth substituent, b, as counterclockwise for both the upper and lower tetrahedrons. The refractions thus are in the same direction and support one another, to result in an optically active form.

Furthermore, if one substituent is hydrogen, the configuration can be assigned relative to glyceraldehyde, or to lactic acid by reference to such lists as that devised by R. E. Marker (*J. Amer. chem. Soc.,* 1936, 58, 976), thus to prepare the student for quantitative evaluations such as those of Born and of Kuhn, or the semiquantitative absolute configurational assignment of Boys (see Gilman's *Organic chemistry,* p. 1779).

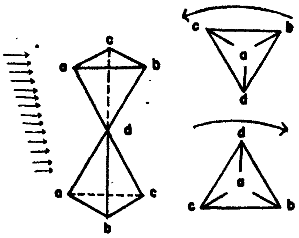

FIG. 1. Meso-form.

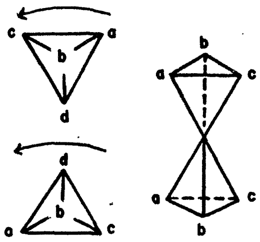

FIG. 2. d,l-form.

Confusion for the student can indeed be avoided by advising him that enantiomerism is not a chemical phenomenon. This is further useful for his realization that enantiomerism is not bound by the fundamental concept of reversibility essentially inherent in every chemical change, and thus that a study of racemization can be superposed on any chemical process as an absolute and independent evaluation of that process.

If enantiomerism is thus defined and divorced from configurational chemical isomerism, then the hitherto unknown isomers, which Prof. Noller points out may be expected if α,β-dibromo,-α,β-diiodosuccinic acid is synthesized, should be recognized as chemical individuals in their own right, since their molecular volumes, dipole moments, and reactivities of functional substituents will be different.

There will indeed be two possible meso-forms, but both of them will be optically inactive. Likewise, three chemically different isomers, because of restricted rotations, may be predicted for the d,l modification, but the optical rotation will be identical for all three.

When such isomers are isolated, it will be wise for stereochemists, in order to avoid confusion, to designate them by some other nomenclature than the already-specific terms ''geometric isomer'' or ''diastereoisomer.'' Perhaps the term ''restriction isomer'' would be applicable.

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Relation Between the Diamagnetic Susceptibilities of Ions in Solution and in the Crystalline State

The diamagnetic susceptibilities of ions both in solution, X_s, and in crystalline state, X_c, were determined by G. W. Brindley and F. E. Hoare (*Trans. Faraday Soc.*, 1937, 33, 268). Their data were considered as very reliable by V. C. G. Trew (*Trans. Faraday Soc.*, 1941, **37**, 476). Recently I have found a simple relation existing between the values of X_s and X_c which can be expressed as follows:

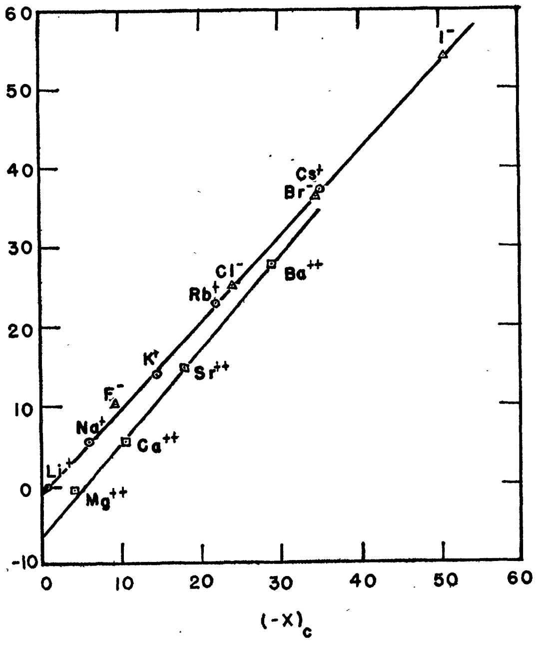

Fig. 1

$$(-X)_s = a_1(-X)_c - b_1$$

where $a_1 = 1.09$ and $b_1 = 1.0$ for alkali and helide ions and 1.15 and 5.8, respectively, for alkaline earth ions with the exception of beryllium. The ionic susceptibilities are expressed in 10^6 c.g.s. units/gram-ion. The average deviation of calculated X_s from observed X_s is ± 0.3 for univalent ions and ± 0.4 for divalent ions. The relation is shown in Fig. 1.

The equation of ionic susceptibility is found to be similar to an equation of ionic volume (*J. Chin. chem. Soc.*, 1942, 9, 46): $V_s = a_2V_c - b_2$, where V_s is the apparent volume of an ion in an infinitely dilute solution and V_c is the crystalline state as calculated from Pauling's ionic radius. Interpretation of the first equation with its bearings upon the nature of ionic solution will appear in the *Journal of the Chinese Chemical Society* (Vol. 12, No. 2).

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A Comment on Discoveries in the Vitamin A Field

Some time ago (*Science*, 1945, **101**, 183) I published a note on the use of Super-Filtrol as a new reagent for Vitamin A. Subsequently I was taken to task by several workers who pointed out that the blue color formed by Vitamin A on acid earths of various types had been previously discovered. This has now assumed the character of a race to see who can find the earliest discoverer of the phenomenon. Currently in first place is E. Lester Smith (*Science*, 1946, **103**, 281), who dates the discovery in 1923 by Takahashi and Kawakami. Other contenders over the past year have been Meunier, Emmerie and Engle, and Kobayashi and Yamamoto (see *Science*, 1946, **103**, 175, for references).

As the unintentional starter in this race, I cannot help but find it amusing that three out of the four authors who have championed prior investigators were just as ignorant of the work to which Dr. Smith refers as was I, the one toward whom their comments were directed.

I had not intended to rise in rebuttal in this matter, but noting that Dr. Hickman has replied to Dr. Smith's comment on his work, I feel encouraged to speak myself. Permission to publish the work I reported had been withheld until two years after the work had been done. By that time, I was working elsewhere, and in another field, and had no time to go into an extensive literature search. I did not feel that any harm or discourtesy would be done to possible prior workers inasmuch as I made no claims for discovering the general phenomenon. My paper was entitled ''A new reagent for vitamin A'' and was merely intended to report that I had adapted a specific acid earth to a field assay for the vitamin. I felt this to be a useful contribution which might prove of value to others in the field. I have been pleased to have this verified by the rather surprising number of requests for reprints which I have received.

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