Comments and Communications

Geologic Age from Metamict Minerals

Advances in the determination of the age of geological materials depend on the improvement of existing techniques and the development of new methods. The idea discussed below may be the basis of another absolute age method.

Studies of the isodesmic multiple oxides (i.e., those multiple oxides in which all cation-anion bonds have similar strength) of the type $A_mB_nO_{2(mn)}$, where A = U, Th, rare earths, Ca, Na, etc. and B = Nb, Ta, Ti, etc., have shown partial or complete absence of internal crystal structure while displaying macroscopic crystal faces. They may thus be said to be in the metamict state. (A metamict mineral is defined as a noncrystalline pseudomorph of the original mineral.) It has also been shown that in other cases the internal structure is preserved. Muegge (Centralblatt f. Mineralogie 1922, pp. 721–739 and pp. 753–765) has shown that heating metamict gadolinite—i.e., gadolinite which yields no x-ray pattern—converts the isotropic mass into an anisotropic material with a crystal structure identical with that of nonmetamict gadolinite. Similar behavior has been noted for other minerals of the group described above (Dana's System of Mineralogy, 7th Ed. Vol. I., John Wiley and Sons, 1944) and especially for the mineral microlite. Important minerals of the group which may occur in the metamict state also include pyrochlore, fergusonite, formanite, euxenite, polycrase, eschynite, priorite, samarskite, and betafite. It appears that zircon may also be metamict. If age determination by this method is practical it is of considerable importance, since zircon can be separated from most granites.

A recent survey of the isodesmic multiple oxide group by differential thermal analysis at Columbia University (unpublished) has shown that the return to the crystalline state proceeds at a definite temperature with a considerable evolution of heat. It seems plausible to assume with previous authors that these minerals were originally crystalline, and that destruction of the crystal lattice has taken place since their formation through alpha bombardment from the uranium and thorium in the lattice.

If this is the true mechanism, it follows that the amount of destruction of the lattice is affected by (1) the inherent stability of the given mineral structure, (2) the total alpha activity of the mineral, and (3) the time that has elapsed since the formation of the mineral. If the first two variables can be specified and if the degree of destruction of the lattice can be quantitatively measured, then the age is uniquely determined.

The amount of disorder created by alpha bombardment of the lattice can be measured by means of thermal analysis, since the area under the exothermic peak on the thermal record will be proportional to the amount of heat generated in the specimen upon returning to the crystalline state. For a particular mineral type the strength of the bonds, and hence the stability, will be essentially constant for all specimens. Some variation in the substituted cations should produce only a second order effect. The total alpha activity could be determined either by direct alpha counting or by uranium and thorium analyses. A knowledge of the damage done to the lattice and the alpha activity of the mineral should therefore permit estimation of the age of the particular specimen. It should be pointed out, however, that in a given specimen the rate of destruction of the lattice must decrease with time. Thus, for materials which are completely metamict, it would be possible to determine only a minimum age. In many geological applications, however, even information of this nature would be very useful.

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Correction

In our article "Mesons Produced by the Cyclotron" (Gardner, E. *et al.* *Science*, 1950, **111**, 191) there is a typographical error on page 196 in the table near the top of the page. The first entry in the right-hand column reads 28.8 and should read 26.8.

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A Modified Schiff's Solution

In connection with the article by J. Alexander, K. S. McCarty, and E. Alexander-Jackson (*Science*, 1950, **111**, 13), I should like to call attention to my paper "A Modified Schiff's Solution" (*J. Amer. chem. Soc.*, 1922, **44**, 1834).

There are some additional facts in this paper which might be of interest to the readers of *Science*.

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Dramamine

The use of Dramamine in the prevention and therapy of motion sickness (Gay, Leslie N. and Carliner, Paul E. *Science*, 1949, **109**, 359; Strickland, Benjamin A. and Hahn, George L. *Science*, 1949, **109**, 359) and in the treatment of the nausea and vomiting of pregnancy (Carliner, Paul E., Radman, H. Melvin, and Gay, Leslie N. *Science*, 1949, **110**, 215) has attracted widespread attention. Although some of the procedures employed in these studies have been criticized (Tyler, David B. *Science*, 1949, **110**, 170), the results provide at least preliminary evidence of the efficacy of this treatment. However, it has come to the writer's attention that these papers have