volve about the earth as satellites or to escape the earth entirely and travel in interplanetary space. The thin metal skin of such a rocket would be exposed to meteorite impact for relatively long periods of time. This paper describes a preliminary attempt to estimate the probability of a metorite hit and the amount of penetration by meteorites of different sizes if a hit should occur.

It is found that for meteorites large enough to present a perforation hazard the probability of a hit is negligibly small, particularly if the time interval considered is not excessively large. Further improvements in the results would require more accurate data of meteorite frequency as a function of size, a more accurate theory of the penetration of metal plate by small, high speed particles, and a consideration of the effects upon the penetration process of the heat generated during impact. G.G.

Probability that a Meteorite Will Hit or Penetrate a Body Situated in the Vicinity of the Earth. By G. Grimminger. *J. App. Phys. 19: 947, October 1948.*

### Infrared Detector

Since infrared or heat radiation of wavelength longer than about one micron cannot be detected by visual or photographic means, physicists, besides pushing development of standard radiation detectors such as thermopiles and bolometers, have roamed far afield in their attempts to find new and more sensitive infrared detectors. One of the far fields they have been exploring is low temperature phenomena. Superconducting bolometers have been developed recently in the Johns Hopkins Cryogeny Laboratory. (A superconductor is any substance that suddenly loses all its resistance when cooled down close enough to absolute zero.) A strip of the superconductor columbium nitride is cooled by liquid hydrogen to about fourteen degrees absolute and held at the center of the one-twentieth-degree temperature interval in which its transition from normal (i.e., about one ohm) to zero resistance takes place. Properly connected in an electric circuit and exposed to minute quantities of radiation, it becomes an extremely sensitive resistance thermometer.

This paper describes the superconducting bolometer's sensitivity and compares it with that of other radiation detectors. Not only is its sensitivity outstanding but its low temperature characteristics also make it unique as a tool for examining the as-yet-unexplored field of emission spectra from materials at room temperature, a field which may have important uses in biological analysis. N.F.

The Infrared Sensitivity of Superconducting Bolometers. By Nelson Fuson. *J. Opt. Soc. Am. 38: 845, October 1948.*

### Crystal Defects

A simple ionic crystal is one having its ions arranged periodically in three dimensions. According to classical theory, such a structure of polarizable ions should have dielectric or electrical insulating properties independent of frequency, with very low losses, at radiofrequencies. However, a real crystal exhibits many departures from this ideal lattice arrangement. These defects are either in the form of ions out of place, with accompanying vacant sites (Frenkel defects), as in silver chloride, or in the form of equal numbers of vacant positive and negative ion sites (Schottky defects), as in the alkali halides.

The DC conductivity of simple ionic crystals has been studied extensively. However, as the experiments described in this paper show, AC excitation produces an unexpected effect, attributed to a jumping of the positive ions to vacant sites under the influence of the applied field. The jumping is observed as a relaxation process, producing a very small change in the dielectric constant and an associated peak in the dielectric loss which is readily measurable. Using silver chloride and alkali halides that were heat-treated to introduce a relatively large number of lattice defects, the dielectric loss and constant were measured first over a range of frequencies at fixed temperature and then over a range of temperatures at fixed frequency. From resulting data it was possible to calculate the number of moving defects in the sample, the activation energy for diffusion of the positive ion in the crystal, and ultimately the activation energy for defect formation. These values are of considerable importance in studying the nature of the defects, as well as the process of diffusion which takes place by means of the defects and also color centers arising from the trapping of an electron at a vacant negative ion site. R.G.B.

Low Frequency Dispersion in Ionic Crystals. By R. G. Breckenridge. *J. Chem. Phys. 16: 959, October 1948.*

### Light Helium

The natural occurrence of a helium isotope of atomic weight 3 was observed in the Berkeley cyclotron in 1939 by Alvarez and Cornog, who showed that its abundance was very low compared with that of the normal helium atom of atomic weight 4. It was shown in 1946 at the University of Minnesota that the isotope was not nearly as rare as first reported, so that its abundance could be measured conveniently with a mass spectrometer.

A high resolution, high sensitivity mass spectrometer made possible studies leading to the separation or enrichment of the isotope, opening up two new fields of research. First, $He^3$ is the third lightest and thus one of the very simplest nuclei occurring in nature. Hence its existence in separated quantities will make possible studies of its nuclear properties so that more will be learned about the interaction between protons and neutrons and other light particles. Second, it has been shown that $He^3$ has markedly different properties from $He^4$ at liquid helium temperatures. Its availability enlarges the scope of low temperature investigations.

Thermal diffusion is particularly effective in separating molecules that have a large percentage difference in mass and that act like hard spheres in collisions. For this reason it appears to be a method peculiarly adapted to the enrichment of $He^3$ in helium. Accordingly, a small