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

thermal diffusion plant with a twenty-four-foot cylindrical tube section followed by an eight-foot hot wire section was built to test the efficacy of the method. The characteristics of the plant were studied under various conditions and compared with theory. Excellent agreement with theory was obtained for the cylindrical section but the hot wire column showed discrepancies not as yet understood. In any event, the plant has proved effective in producing small amounts of highly enriched He^3. For example, with an expenditure of 16.6 kilowatts of power, fourteen standard cubic centimeters of helium can be produced per day in which the isotope has been enriched twenty thousand times, the concentration going from one ten-millionth to one five-hundredth. Little difficulty should be encountered in producing the pure isotope by this method and work is progressing in this direction. It is hoped that, by extending the size of the present pilot plant and using it either alone or in conjunction with one of the low temperature methods of separating He^3, much larger amounts of this very valuable isotope will become available. A.O.C.N.

Concentration of He^3 by Thermal Diffusion. By B. B. McInteer, L. T. Aldrich, and Alfred O. Nier. *Phys. Rev. 74: 946, October 15, 1948.*

Seeing Stars by Day

A number of years ago it was realized that daytime celestial navigation of long range airplanes was desirable and would be aided by the use of stars. Therefore the possibilities of seeing stars in the daytime were investigated. One element of the problem was known—the optics of a telescope such as magnification and lens design; at least two elements were unknown—the ability of the eye to see points of light in fields of various brightnesses, and the brightness and polarization of all parts of the sky for all altitudes of the observer for all altitudes of the sun. The two unknown elements were worked out (*J. Opt. Soc. Am. 36: 480, 1946; 37: 78, 1947*), and it was then merely a matter, as described in the present paper, of fitting all the elements into a connected pattern, deriving the answers, and testing some of the answers from the surface and from an airplane. It was found that an observer at ten thousand feet with clear air overhead could see stars brighter than the second magnitude in favorable portions of the dayl'ght sky when using a well-designed fifteen-power telescope. A polarizing attachment was of some aid, but color filters were either of no help or were harmful. The telescope had to be in a relatively vibrationless mounting and the observer, by means of precomputation, had to know approximately where to look. He often had to spend a considerable time in search even though the star was in his field of view, because the threshold sensitivity of the eye for a point source decreases rapidly with the distance from the center of the fovea. R.T.

The Visibility of Stars in the Daylight Sky. By R. Tousey and E. O. Hulburt. *J. Opt. Soc. Am. 38: 886, October 1948.*

BOOKS *Continued from page 25*

Scientific Magic

AFTER DINNER SCIENCE. By Kenneth M. Swezey. 182 pp. Whittlesey House, McGraw-Hill Book Company, Inc., New York City, 1948. $3.00.

For boys and girls whose first taste of science is the magic of it, and for their elders who still feel that way about it, this well-illustrated book gives a number of glass-tumbler-and-raised-eyebrow experiments which demonstrate some principles of physics and chemistry. The equipment necessary is not always too hard on mother's crockery and silverware, although occasional experiments demand trips to the local chemist's shop.

Handbook

HANDBOOK OF SCIENTIFIC AND TECHNICAL SOCIETIES AND INSTITUTIONS OF THE UNITED STATES AND CANADA. Fifth Edition. Bulletin of the National Research Council No. 115. 371 pp. National Research Council, National Academy of Sciences, Washington, D. C., 1948. $5.00.

Anyone who wants to locate a society on bird-banding or numismatics—or who simply wants to know the date the American Institute of Physics was founded—will find the information in this latest edition of a very useful handbook. It lists 1,302 organizations in the United States and 166 in Canada, all carefully indexed by classification of their activities, purposes, research funds, medals, prizes, and publications.

Books Received

POWER SYSTEM STABILITY, Vol. 1, Elements of Stability Calculations. By Edward W. Kimbark. 355 pp. John Wiley & Sons, Inc., New York City, 1948. $6.00.

WARTIME COLLEGE TRAINING PROGRAMS OF THE ARMED SERVICES. By Henry C. Herge. 214 pp. The American Council on Education, Washington, D. C., 1948. $3.00.

ELASTICITY AND ANELASTICITY OF METALS. By Clarence M. Zener. 170 pp. The University of Chicago Press, Chicago, Ill., 1948. $4.00.

DIGEST OF LITERATURE ON DIELECTRICS, Vol. 11, prepared by the Committee on Chemistry and Physics, Conference on Electrical Insulation. 94 pp. National Research Council, Washington, D. C., 1948.

ELECTRICAL MEASUREMENTS IN THEORY AND APPLICATION. Fourth edition. By Arthur Whitmore Smith. 371 pp. McGraw-Hill Book Company, New York City, 1948. $4.25.

SPHERICAL HARMONICS. Second revised edition. By T. M. MacRobert. 372 pp. Dover Publications, Inc., New York City, 1948. $4.50.

INTRODUCTION TO APPLIED MATHEMATICS. By Francis D. Murnaghan. 389 pp. John Wiley & Sons, Inc., New York City, 1948. $5.00.

DESIGN OF CRYSTAL VIBRATING SYSTEMS. Revised second edition. By William J. Fry, John M. Taylor, and Bertha W. Henvis. 182 pp. Dover Publications, Inc., New York City, 1948. $3.50.

REPORT OF A CONFERENCE ON STRENGTH OF SOLIDS held at the H. H. Wills Physical Laboratory, University of Bristol, on July 7–9, 1947. 162 pp. The Physical Society, London, 1948. 25*s.*, postage 8*d.*

OUTLINES OF PHYSICAL CHEMISTRY. By Farrington Daniels. 713 pp. John Wiley & Sons, Inc., New York City, 1948. $5.00.