gram for studying radiation methods is underway in the Bureau's high-temperature laboratory. The basic data required include a knowledge of the energy levels of the various molecules, free radicals, and atoms that occur in hot gases and flames, the transition probabilities, and the line widths. Three phases of the program are currently being investigated. These are (1) the study of the relative intensities of lines in the visible and ultraviolet spectra of simple flames, (2) the determination of transition probabilities and line widths under conditions of thermal equilibrium, and (3) the analysis of infrared spectra of flames and the investigation of methods of determining temperatures from them.

At low temperatures (below 90°K) NBS research on thermometry has two major objectives: first, the determination of thermodynamic temperatures by means of a gas thermometer and, second, the development of convenient, sensitive, and reproducible secondary thermometers which can be calibrated by means of the gas thermometer. Resistance thermometers constructed of the semiconducting elements, silicon and germanium, have proved to be extremely sensitive. While satisfactory reproducibility still remains a problem, results of initial tests have been quite promising.

Temperatures in the range from approximately 4° to 1°K are obtained by controlling the pressure on a bath of liquid helium, and the relation between the vapor pressure of helium and the temperature is used to determine temperatures. Below this range, another method of both attaining and measuring temperatures must be used (the lowest limit attained by reducing the pressure on the helium is approximately 0.7°K). The method of adiabatic demagnetization of paramagnetic salts proposed by Giauque and Debye in 1926 is used to achieve these low temperatures. During the past year, equipment has been constructed and installed at NBS which is designed to permit investigation of the properties of these paramagnetic salts which serve as low-temperature thermometers. No effort has been made to set a low-temperature record, but the paramagnetic salt has been used to cool liquid helium to 0.02°K in order to investigate its properties at these extremely low temperatures.

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Books

Electronic and Ionic Impact Phenomena. By H. S. W. Massey and E. H. S. Burhop. 669 pp. Oxford University Press, London, England, 1952.

At a time when interest in electronic and ionic phenomena in gases is on the increase, this compendious and authoritative volume is most welcome. Here at last is a review of the experimental results and an outline of the theoretical calculations in the field of electronic and ionic collisions done the past thirty-odd years, presented in readable form by two authorities in the subject.

The large amount of material is organized logically, starting with electronic impacts with atoms, the measurement of total cross sections, then the results for elastic and inelastic impacts; this quarter of the book terminating with an outline of the quantum theory of such collisions and a comparison between theory and measurements. After a similar discussion of electronic collisions with molecules there is a chapter on electron impacts with surfaces of solids and one on electronic collisions involving radiation, bremstrahlung, etc. Next comes a chapter on the collision between atoms and one on the passage of ionic or atomic beams through gases. Finally there are chapters on the impact of ions and atoms on surfaces and on recombinations.

The book appears quite complete in its coverage of these complex phenomena. The references to the original papers seem to be inclusive. There are several bibliographies on special subjects and an adequate author and subject index. The volume will be a necessity to anyone working in this field.

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Civil Defense in Modern War. By Augustin M. Prentiss. 429 pp. McGraw-Hill Book Company, Inc., New York, 1951. $6.00.

Civil defense, although long recognized as a necessity in countries which have undergone aerial attacks, was until very recently considered virtually an academic issue in the United States. The appalling vulnerability of our cities and industrial centers to modern bombing planes and guided missiles capable of delivering atomic bombs is painfully evident at the present time, however, and as a result progress is being made toward the establishment of an effective civil defense program. A great deal of information both on what is to be expected from modern weapons and on how to combat their effects is presented in *Civil Defense in Modern War*. In the words of General Prentiss, the purpose of the book

is "to analyze the capabilities and limitations of modern air power; to examine the effects of the new modes of scientific warfare and particularly ABC [i.e., atomic, bacterial and chemical] weapons; and to discuss the various defensive measures that should be taken to cope with this danger, including an outline of the civil defense organization that will be required for this purpose."

Much of the material presented is not new; however, its collection into a convenient volume is certain to be of great assistance in its utilization. This book is not in any sense a manual for civilian defense workers, and makes no such pretension. Rather, it is designed as a reference for national, state, and local government and volunteer officials concerned with civil defense and for others such as building and plant managers whose work involves only incidentally the protection of personnel in the event of an attack. For this reason over a third of the book is devoted to a description of modern air warfare and the various destructive agents (chemical, incendiary, bacterial, and atomic) that it can employ. The remainder consists of a discussion of the principles of protection against these agents and an outline of an adequate civil defense organization. Not the least of the good features of *Civil Defense in Modern War* is the extensive bibliography that is appended, which, although not complete, includes almost all the significant works on the subject and supplements the text admirably.

While there is an enormous amount of detail provided on a variety of pertinent topics (for instance, shelter specifications and organization of the various emergency services) there seems to be surprisingly little information on radiological defense techniques. Although it is true that the importance of this subject was greatly overestimated at one time, it still remains of great concern. However, the reviewer is probably prejudiced on this point, and Prentiss' book can certainly be recommended as an able and comprehensive study of modern civil defense and its practical application in the United States.

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Radio Spectrum Conservation. A Report of the Joint Technical Advisory Committee of the Institute of Radio Engineers and the Radio-Television Manufacturers Association. 221 pp. McGraw-Hill Book Company, New York, 1952. $5.00.

No parallel has been drawn in this volume, although there might have been, to compare the present congestion of the radio-frequency spectrum with the form of congestion marked by skyrocketing urban population increases and by the constant adaptation of new technological requirements within makeshift city structures inherited from a horse-drawn society. The expansion of cities, and of the radio spectrum as well, has been a step-by-step process of satisfying new needs as they arise. The cities have grown taller and have burrowed underground and the radio spectrum has been lengthened, but the demands placed on both are increasing at an alarming rate. Whatever fate may be in store for cities, it is apparent that careful attention is at least being accorded the dangers threatening radio communication.

Formed almost five years ago by joint action of the boards of directors of the Institute of Radio Engineers and the Radio-Television Manufacturers Association, the technical advisory committee responsible for the present report has assembled and digested a large amount of information relating to the development of radio communications and to the very difficult international problem of radio spectrum allocations. The report itself includes a survey of the pertinent historical facts, summaries of the present state of knowledge of the several regions of the spectrum, specific suggestions aimed at ensuring better use and regulation of radio facilities, and an extensive bibliography of the material in the field.

Since 1903, when the first International Radiotelegraph Conference was held in Berlin, numerous domestic and international conferences have taken place and a large number of regulatory provisions have been adopted. The limiting factor in any long-range planning attempts, however, has always been that certain frequencies were already in use and therefore were unavailable for new services. Additional frequency allocations thus had to be fitted in as conveniently as possible somewhere along the remaining portions of the usable spectrum. This procedure has prohibited the establishment of an idealized allocation pattern. Needs arising from the vast and varied technological developments of the past several decades have seldom been anticipated, and in any case, allocations at each stage have had to conform to the performance characteristics of available equipment. The resulting situation of confusion is further complicated by economic and political considerations which limit the possibility of altering the established pattern of allocations.

While extensions of the upper-frequency limit of the radio spectrum have provided room for the expansion of established services and the introduction of new ones, the report observes, the end of such extensions now seems to be in sight. In this connection it is pointed out that certain of the more recently available bands either are technically unsuitable for many existing services or require considerable investments in new equipment before they will become usable.

The thesis of the present report is that the radio spectrum is a public domain of limited extent which differs from water power, forests, and certain mineral resources in that it cannot be conserved under a static policy based on extrapolation from past demands. What is really needed, says the advisory committee, is a technically and economically sound program of "dynamic conservation" which will set up a procedure for changing allocations as new services of great value appear and as older ones lessen in value. The broad implications of this proposal are explored with some pa-