institute can sponsor tending towards the more intelligent utilization of the natural resources of the Turrialba Valley will be supported by the common people of Costa Rica, who are as a whole industrious and literate.

RAFAEL W. KEITH

SAN JOSE, COSTA RICA

SCIENTIFIC BOOKS

METEOROLOGY

Harvard Meteorological Studies, No. 6. Heat Transfer by Infrared Radiation in the Atmosphere. By WALTER M. ELSASSER, Harvard University, Blue Hill Meteorological Observatory, Milton, Mass. 106 pp. Appendix, bibliography and copy of the Atmospheric Radiation Chart, second edition. 1942.

THIS publication comprises three parts, more or less independent, namely: Part I, "Principles of Radiative Transfer." Part II, "Structure and Absorption of Infrared Bands." Part III, "The Measurement of Atmospheric Emission." Then follows the Appendix, descriptive of a mechanical computing device, the Bibliography and the Radiation Chart.

Students of atmospheric radiation have been under deep obligation to Dr. Elsasser for several years on account of his excellent chart. Making use of additional observations and reconsiderations the chart has now been recomputed, and has undoubtedly become a far more trustworthy representation of the complex problem of atmospheric radiation. The author calls attention, however, to the need of much additional observation to cover many doubtful matters in this difficult field.

Part I begins with a demonstration of Kirchhoff's principle: "The ratio of emission and fractional absorption in any direction of a slab of any thickness in thermodynamic equilibrium equals the black body intensity." To this reviewer the author's demonstration lacks something of completeness. He considers a constant temperature enclosure with totally opaque walls, and shows that the second law of thermodynamics requires that the transfer of energy from one wall to the opposite must equal the return. He says: "Therefore, the emission of a perfectly opaque wall is generally independent of the optical properties of the wall." Suppose one wall was of soot and the opposite wall was of polished silver. The emission of the soot would be many times as intense as the emission of the silver. But within the enclosure by reflection, supplementing emission, the flux from the silver is built up to be the flux from an absolutely black body, and the same holds to a minor extent with the soot. Had this point been established and made clear, the author could have passed logically to his statement in the next paragraph: "We call I_b the intensity of this beam which, in thermodynamic equilibrium, is just the black body intensity." From this statement the Kirchhoff expression $E/A = I_b$ follows at once, as the author shows.

The author continues in Part I with Schwarzschild's equation of radiative transfer and its integration under the particular conditions which prevail in the atmosphere. Planck's law connecting temperature and frequency, Stefan's fourth power law for total radiation are considered, and a valuable table follows representing for the black body the integration of radiation intensity by wave number and the change of intensity with temperature.

Transfer of monochromatic radiation, and of non-monochromatic radiation are treated mathematically, bringing in, of course, the important exponential principle of Bouguer and Lambert and the relation: "For isotropic radiation the flux [total over a hemisphere] is π times the intensity of a straight beam," and developing an important set of functions useful in radiation transfer problems including the so-called recursion formula. These mathematical steps lead on to the general transfer problem of the flux emitted by an atmosphere of arbitrary constitution, and the first mention of the Atmospheric Radiation Chart.

And now observation comes to the fore with its showing of the special radiative and absorptive properties of water vapor, carbon dioxide, ozone and the permanent gases oxygen and nitrogen. The application of these properties in the Radiation Chart and the use of the chart for particular problems is discussed. The reviewer, however, believes that ordinary users of the chart would have appreciated several completely worked-out numerical applications of it to specific examples from actual observations. Something of this, indeed, is given in Table 2, but more extensive numerical examples would be helpful.

Two aspects of absorption in spectral lines, namely, broadening under pressure and Doppler effects of motion, are found to be of some importance concerning atmospheric radiation problems, and are treated by the author at considerable length. Then comes the discussion of overlapping spectrum lines in band spectra, ending in the derivation of a formula for band absorption in the most general case. Following is a reference to the effects of pressure and temperature on absorption coefficients of the atmospheric constituents.

Water vapor, as is well known, presents a very difficult problem in atmospheric radiation and absorption. Rapidly falling off with altitude, presenting many bands of line structure, subject to rapid and large changes of quantity from day to day, affected by both pressure and temperature in its absorption, effective in both solar and terrestrial spectral ranges,

one might well fear that it would prove totally unmanageable in a chart. But several researches of great merit, referred to by the author in warm terms of appreciation, have furnished so considerable an experimental background that empirical formulae fairly representative of water vapor radiation and absorption have been derived. This part of the author's publication occupies 12 pages with several diagrams and tables.

Carbon dioxide and ozone compared to water vapor are simple problems and are briefly treated.

In Part III, instruments and methods for measuring radiation and absorption of atmospheric constituents are discussed at considerable length and with good discretion.

A brief description is given of the important instruments used for carrying out the extensive numerical calculations for the chart. Then follows a bibliography of 123 entries, and finally the highly valuable chart.

All those interested in atmospheric radiation researches will find Dr. Elsasser's publication timely and invaluable. No doubt as research goes on he will from time to time revise and improve it.

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SMITHSONIAN INSTITUTION

ANOXIA

Anoxia: Its Effect on the Body. By EDWARD J. VAN LIERE. xiii + 269 pp. Chicago: University of Chicago Press. 1942.

THE subject of oxygen deprivation, and its physiological and psychological effects, has assumed great importance in recent years in medicine and related fields. With the present war, this subject has become of increasing importance because of its role in high altitude flying in aviation. This timely review is more comprehensive than any other single work on this subject in the English language. It comprises a systematic presentation of the results of experimental studies in this field, arranged according to the physiological systems of the body.

Following a brief historical introduction, there is a short chapter dealing with the definitions of terms. The familiar classification of the various types of anoxia, according to Barcroft and to Peters and Van Slyke, is then given with a brief review of the physiology of respiration. The subject of cellular oxidation is but barely mentioned. Schmidt's classification of anoxia into the fulminating, acute and chronic varieties is then described. Here (p. 16) it should be pointed out that the term "chronic anoxia" should not be used in a sense almost equivalent to "chronic mountain sickness" as necessarily resulting in adverse symptoms. Permanent residents of high altitudes live in a condition of chronic or constant anoxia and most of them, at least up to a certain altitude, do not show signs or symptoms related to oxygen want. There follows a chapter on the experimental methods of producing anoxia. In appraising the various methods (p. 27) the author fails to bring out the fact that with the rebreather, the degree of anoxia progressively increases at such a rapid rate, and the duration of an experiment is therefore so short as to enable the subject to compensate for the effects by exerting extra effort for a short time until the final stages of deterioration. During the first World War, the rebreather tests resulted in a false impression as to the altitudes at which aviators could remain for any length of time and still maintain their physical and mental capacities. Experiments of longer duration reveal a much lower "ceiling" for the average pilot or unacclimatized subject.

The remaining chapters deal with the effects of anoxia on the various physiological systems, beginning with the morphology and chemistry of the blood, the circulatory system, with separate chapters on blood pressure and on the lymph. In the chapter on the effects of anoxia on the blood, the author points out the necessity for distinguishing clearly between "oxygen content" and "oxygen capacity" of the blood. He erroneously states, however (p. 52), that "In Keys's group the oxygen *content* of the blood increased an average of 25 per cent." It was actually the oxygen *capacity* which increased.

In several cases in which more than one factor is involved the author does not bring out the exact role played by each variable. Thus in his discussion of the changes in alveolar pCO_2, pO_2 and arterial O_2 content at high altitudes (p. 102), the author does not clearly distinguish between the effect of (a) increasing ventilation on lowering the alveolar pCO_2 and concurrently increasing the alveolar pO_2 and of (b) the Bohr effect, which leads to a greater O_2 content of the blood when the arterial pCO_2 is decreased but the arterial pO_2 is held constant. He tries to cover the whole situation merely with the Bohr effect, which *per se* has nothing to do with alveolar pressures.

The following chapters deal with mountain sickness, altitude sickness and acclimatization. In comparing the effects of acclimatization to oxygen want with acclimatization to carbon dioxide, the author states (p. 155) that certain similarities are to be expected since "in both cases there is some increase in tissue acidity." It is very questionable whether anoxia, unless it be of very serious degree, gives rise to tissue acidity; on the contrary, the increase in pulmonary ventilation results in "blowing off" of CO_2 and thus a decrease in acidity of the body fluids.

Probably the most complete and authoritative part