Books

Basic Methods in Transfer Problems—Radiative Equilibrium and Neutron Diffusion. By V. Kourganoff with the collaboration of I. W. Busbridge. 281 pp. Oxford University Press, London and New York, 1952. \$7.00.

This book deals with the mathematics and, to a somewhat lesser extent, the physical foundation of a restricted form of the Milne problem, i.e., the problem of the steady-state flow of radiation in a stellar atmosphere. The atmosphere is treated as infinitely deep, stratified in homogeneous, plane-parallel layers, devoid of energy sources, and in local thermodynamic equilibrium (or purely scattering). Scattering, if present, is assumed isotropic. Many of the results are applicable to the steady-state efflux of neutrons from a (nonabsorbing and nonmultiplying) scattering medium of large dimensions; and, in turn, some of the mathematical methods described were developed in neutron diffusion studies.

Chapter I discusses the physical foundations of radiative transfer, the definitions and interrelations of various quantities in the theory, the derivation of the equation of transfer and of the Milne integral equations, and their interpretation for neutron-transfer problems. Chapter II is concerned mainly with derivation of a large number of mathematical relations containing the integral operators of the Milne equations and the Laplace transformation.

The next four chapters, comprising the main part of the book, deal with the integrated radiation (i.e. integrated over frequencies) in the grey case. Here the absorption coefficient is assumed independent of the frequency of the radiation at each point; this is the case to which the Milne equations apply and to which the neutron problem is equivalent, for monoenergetic neutrons. All the principal methods (including approximate ones) that have been used for calculation of the Milne problem are collected together and discussed in detail. Chief among these are: the Milne-Eddington approximations, the spherical harmonic method, the method of discrete ordinates (Wick, Chandrasekhar), variational methods, and exact methods (primarily that of Wiener and Hopf), and the work of the Montreal group (Placzek, Seidel, Marshak, Mark and Lecaine) on neutron diffusion.

Chapter VII treats the general nongrey stellar atmosphere, still under the assumption of local thermodynamic equilibrium of the matter. The discussion is somewhat sketchy, presumably because of the great complexity of the subject, but there are numerous references to the literature.

To have so many different approaches to the problem presented in so much detail, and with such a wealth of formulae, has advantages and disadvantages. It is an advantage, for example, that the many quantities which various workers have used to characterize radiation fields are defined and given physical interpretations in the first chapter, and that the physical assumptions inherent in their use are set forth there. The encyclopedic coverage of the work that has been done is also an advantage. On the other hand, the casual reader may find that differences in motivation, generality, etc. among the different approaches are sometimes obscured by so much detail. For example, in Chapter VI, *Methods Giving Exact Solutions,* there is a lengthy discussion of work of the Russian astrophysicist Ambarzumian and its relation to the Wiener-Hopf method. The impression is given that Ambarzumian has found a competitor to the Wiener-Hopf method for obtaining the exact solution. It appears, however, that this is not so—that Ambarzumian has merely transformed Milne's first equation into another (and nonlinear) integral equation. This integral equation appears to be better suited to numerical calculation than most other forms of the theory; this fact is, of course, very good to know, but one has the feeling that it could have been stated more succinctly, and that it hardly belongs in a chapter on exact solutions.

For applications to neutron diffusion, a few omissions are regrettable. In the discussion of the spherical harmonic method, the restrictions to a flat atmosphere, isotropic scattering, absence of sources, absence of absorption or multiplication, are unfortunate, and not really necessary, from the neutronic point of view. Perhaps even more serious conceptually is the restriction of the Wiener-Hopf method to the case of nonabsorbing, nonmultiplying media.

Two appendices give formulae and tables (for the most part not previously published) relating to special functions occurring in the theory, such as the functions obtained by applying the Milne and Laplace operations to general exponential integrals, the functions

$$M_0(\tau),\ N_0(\tau) = \int_1^\infty e^{-\tau t} \ln\,(t \pm 1)\,\frac{dt}{t},$$

and the integrals

$$\int_0^\infty E_n(t)E_m(t)dt.$$

There is a six-page bibliography.

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Marx and Science. By J. D. Bernal. 48 pp. International Publishers, New York, 1952. \$1.00.

According to the blurb, "J. D. Bernal, the world-renowned English Crystallographer, analyzes and pays tribute to Marx's contribution to mathematics, technology and the natural sciences". Though there is no doubt that Marx was a great scholar with a keen insight into many problems of his day, it cannot well be maintained that he added anything to the sciences. Marx himself, writing about mechanics, is quoted as stating that "'the simplest technical reality demanding perception is harder to me than to the biggest blockheads'." Marx's principal interest in science was its relation to society, not the contents of science itself. Engels' assertion, as quoted on page 25, is now almost a platitude and an understatement when he claims that "'If society has a technical need, that helps science forward more than ten universities'." But this holds only for techniques and not for science itself. Warfare especially has had a tremendous effect on the development of important techniques ever since Archimedes, who was probably the first physicist employed by the armed forces. The wartime atomic bomb project and, even more so, radar gave rise to many new methods of physical observation: for example, the measurement of short time intervals was improved by several orders of magnitude. For instance, practically no advance was made in our knowledge of the atomic nucleus. After the war, the new techniques were applied to unravel the structure of the nucleus, to produce new elementary particles, to build billion-volt accelerators. It is hard to see how these aims fill a material need of society, but they do increase our knowledge of the universe. This pursuit of science is in direct conflict with Marxist ideas since "'Science must not be a selfish pleasure. Those who are so lucky as to be able to devote themselves to scientific pursuits should be the first to put their knowledge at the service of mankind'."

The last ten pages of Bernal's booklet contain the usual criticism of the capitalist world, implying that everything is so much better in the USSR. Let us just quote a few examples and add the obvious rebuttals. "In capitalist countries the scientists are now directly controlled by governments, or by monopolies, and often in a peculiarly unpleasant way" (p. 37). Bernal fails to tell us who controls the scientists in Russia, who are not even allowed to write letters to their western colleagues. In western Europe the universities, the source of almost all progress in science, have always been government institutions.

"As galling to the individual scientist is the effect of secrecy . . . . the ideas of free research and free publication are gradually being eaten away, ..." (p. 37). Bernal knows very well that all basic scientific research is completely and freely published in the western countries; secrecy applies only to techniques directly connected with warfare. In contrast, not a single paper on nuclear experimentation (except for experiments on a prewar scale) has been published by Russian scientists though it is certain that they must now have the proper facilities since they have already produced atomic bombs. Does Russian freedom of science not allow "contributions to the understanding of nature" to which "under capitalism science is limited" (p. 43)? "In a socialist state", Bernal writes, ". . . science falls naturally into its place as the normal means of improving productivity in a continuous and progressive way" (p. 43).

"Science . . . acquired the character and methods of thought of the upper classes of class-divided society" (p. 44). "In the Soviet Union . . . scientists are drawn from the working people . . ." (p. 45). This will be appreciated by the multitude of American students who have to work their way through college.

". . . under capitalism . . . all scientific activity is retained in the hands of a small and quasihereditary class" (p. 45). In reality very few of our scientists come from academic families. It is just in scientific circles that we find all classes and all economic strata represented and working together.

I cannot think of any better anti-communist propaganda than the writings of this type of Marxist, to whom Marxism has become an infallible dogma, causing him to distort facts in the usual manner of intolerant bigots. If the Voice of America would just quote Bernal to our Russian colleagues, saying that we keep all science secret (more *Physical Review* subscriptions go to Russia than to England) while they have complete freedom, it might bring home to them the tragic plight under which they are living and trying to work.

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Mesons. A Summary of Experimental Facts. By Alan M. Thorndike. 242 pp. McGraw-Hill Book Company, Inc., New York, 1952. $5.50.

The present reviewer was impressed by the correctness and honesty of the title of this book. It is precisely a summary of experimental facts about mesons. Alan Thorndike has reviewed the literature on mesons and has produced a small, compact volume comprising the most important experimental data on mesons as of the end of 1951. He has, of course, drawn from work in cosmic rays as well as from high-energy machines. Written partly using the historical approach and partly the logical approach, it is a nonmathematical, descriptive book easily read and enjoyed.

This book is a valuable addition to the literature of high-energy physics for at least three reasons. First, it is clearly an excellent book for the beginning graduate student who is seeking a good knowledge of mesons and their importance to elementary particle physics. Second, it is just the type of book from which those physicists not primarily in the related fields of high-energy nuclear physics and cosmic rays can acquire a systematic knowledge of mesons easily, without concentrated effort. And third, it has gathered together experimental data and references valuable to the workers in meson physics.

The chapter headings without further amplification give a good brief summary of this book. Chapter 1, entitled *Evidence for the Existence of Mesons,* is followed in order by *Properties of Cosmic Ray Mesons, Artificially Produced Mesons, Decay of Mesons, Inter-*