that this conference represents an innovation. To paraphrase P. B. Weisz's remarks (p. 247) this book is unique because it describes a joint conference of physicists, who have been thinking about the cloud of electrons inside the semiconductor surface, and chemists, who have been occupied with the cloud of gases outside that surface. Both physicists and chemists have met at the surface and the results are enlightening and stimulating. As G. Schwab (p. 295) says in concluding his paper: "One more gap between physics and chemistry has been closed, leaving both shores in a reinforced state."

There is a short subject index and a longer author index. Numerous graphs and figures adequately support the strictly technical text. The book is highly commendable; it is a good compilation of diverse theoretical and experimental aspects of the timely subject of semiconductor surfaces.

**Differential Equations Applied in Science and Engineering.** By Harold Wayland. 353 pp. D. Van Nostrand Co., Inc., Princeton, N. J., 1957. $7.50. *Reviewed by Walter Gautschi, National Bureau of Standards.*

This is an elementary text on ordinary and partial differential equations, prepared mainly for use in undergraduate courses in applied science and engineering. By means of instructive examples the author has succeeded in presenting a clear picture of the several steps which are involved in describing a physical situation in terms of differential equations and in ultimately solving these equations. Although the emphasis lies on formal techniques the author is careful either to state the underlying theoretical facts without proof or to give references to more extensive texts if more advanced mathematics is involved.

After a short introductory chapter there follows a chapter on vector algebra and vector analysis. Concepts such as gradient, divergence, curl are introduced in their coordinate-independent form. A rather careful treatment is given to the derivation of explicit expressions in various coordinate systems.

The proper subject of the book is taken up in Chapter 3 with a short account of special first-order differential equations and general remarks on linear $n$-order equations. Among the latter, those with constant coefficients are treated in more detail. Use is made of differential operators. The important case of linear second-order equations is dealt with in the following two chapters. There is a brief summary of the usual classification of singularities and the power series expansions associated with them. The theory is applied to two typical examples: Bessel's and Legendre's differential equation. Several properties of Bessel functions, modified Bessel functions, and Legendre functions are developed.

While boundary value problems, as they occur in classical mathematical physics, have occasionally been considered before, the main attack on these problems is launched in Chapter 6 and extends through Chapter 7.

The tactical approach is essentially always the same, consisting in the separation of variables in the basic partial differential equation and the use of Fourier expansions (or more general orthogonal expansions) to take care of the boundary conditions. Among the problems treated are: the vibration of strings, square and circular membranes, linear and spherical heat conduction, and diffusion problems (with an application to the diffusion of neutrons in a nuclear reactor), flow of incompressible fluid, electrostatic fields, and sound propagation. There is a final chapter on integral transform techniques.

Although the practical side of the subject is stressed throughout the book there is no treatment of numerical integration of differential equations.

More than 300 problems are included in the text, ranging from formal mathematical exercises to advanced problems in physics and engineering. For about half of them the answers are given at the end of the book. There is also a list of about 50 papers to provide suggestions for more advanced reading in this field.

**Magnetohydrodynamics.** By T. G. Cowling. 115 pp. Interscience Publishers, Inc., New York, 1957. Clothbound $3.50; paperbound $1.75. *Reviewed by R. B. Lindsay, Brown University.*

This is the fourth in the series of Interscience *Tracts in Physics and Astronomy* edited by R. E. Marshak. Each constitutes a brief review of research progress in some field of recent interest.

Magnetohydrodynamics is a good example of a domain whose theoretical basis has been known for a long time, since it is simply a combination of the well-known equations of electromagnetism and hydrodynamics. In earlier days, however, there seemed little available in the way of experimental evidence to correspond to theoretical prediction. Interest in the subject waxed when it became clear that magnetohydrodynamic effects which are relatively small in terrestrial laboratories may well be considerable on the cosmic time and space scales. During the last few years the subject has returned to earth, so to speak, with the realization of its possibilities in the carrying out of thermonuclear reactions on earth for the peaceful production of large quantities of energy.

As the name implies, magnetohydrodynamics deals with the motion of an electrically conducting fluid in the presence of a magnetic field. Thus, for example, in a fluid of negligible electric resistance, the lines of force of an imposed magnetic field act as if they were "frozen" into the fluid, so that motion transverse to the lines carries them with it. This has numerous consequences, including the inhibiting of turbulent flow by the imposition of magnetic fields of high intensity. It is thus possible to produce equilibrium states in which mechanical forces are balanced by magnetic stresses. The author presents several applications of this state of affairs in cosmic physics, including sun spots, solar prominences, and filaments in nebulae.

It may be shown that a small disturbance from equilibrium in a conducting fluid subjected to a uniform magnetic field is propagated as a wave along the lines of force of the field, with velocity directly proportional to the field intensity and inversely proportional to the square root of the density. Such a wave is known as a magnetohydrodynamic wave, and the author discusses several illustrations, including experimentation on such waves in mercury and liquid sodium. In stars, waves of this kind can appear in the form of torsional disturbances. Another significant application presented by the author is the dynamo theory for the explanation of the magnetic field of the earth and other rotating cosmic bodies. A final chapter is devoted to the magnetohydrodynamics of ionized gases, a subject more thoroughly dealt with indeed by Lyman Spitzer in another tract in the series.

This small volume serves a very useful purpose in bringing together in very clear fashion theoretical material of value to both physicists and astronomers.

**Les Rayons Cosmiques.** By A. Cachon, A. Daudin, L. Jauneau. 117 pp. U. of France Press, Paris, France, 1957. Paperbound. *Reviewed by Manuel Sandoval Vallarta, University of Mexico.*

This is a brief popular account of the most important aspects of cosmic-ray research since 1912. After a historical outline, there are six chapters on experimental methods, primary radiation, hard and soft components, unstable particles, intensity variations, and the origin of cosmic rays, followed by a short conclusion and an appendix on disintegration theory. There is at the end a brief bibliography of seven titles, not all of them of elementary level.

On the whole the book is informative, well developed, well written, and reasonably up to date. This reviewer may be pardoned if he confesses that he would have liked to see a better presentation of the geomagnetic effects. For instance on p. 84 it is stated that "atmospheric absorption varies with geographic latitude" and that therefore the sea level latitude effect is largely masked by atmospheric absorption. The longitude effect is mentioned only once in the concluding chapter without any reference to its origin, and hardly anything is said on the azimuthal effect.

The book will prove valuable to the general reader who wishes to keep up to date on a fascinating chapter of modern physics.

## Books Received

ELECTRICITY AND MAGNETISM. By B. I. Bleaney and B. Bleaney. 676 pp. Oxford U. Press, New York, 1957. $10.10.

PHYSICAL PROPERTIES OF CRYSTALS: Their Representation by Tensors and Matrices. By J. F. Nye. 322 pp. Oxford U. Press, New York, 1957. $8.00.

THE PHYSICS OF FLOW THROUGH POROUS MEDIA. By Adrian E. Scheidegger. 236 pp. The Macmillan Co., New York, 1957. $14.00.