which mention the Liapounoff theorems rarely distinguish between the "first" and "second" methods, nor does Letov's book clarify this. The "first" method allows the prediction under certain conditions of the stability of a nonlinear system on the basis of the roots of the linear approximating equation.

The "second" or "direct" method, originated in 1892 and applied to control in 1944, is the basis of this book. It provides that a system will be stable if a sign-definite function can be found which has a derivative that is also definite and of opposite sign. Although this statement is somewhat simplified, the method is strikingly powerful. The principal difficulty is finding an appropriate function.

This difficulty, and applications to various types of systems, are competently discussed by Letov. The book's strength lies in the author's research and knowledge of the work of others. Partly because of the phraseology and typography (lithographed in standard typewriter face), the book is not as readable as one might wish. More significantly, clearer illustrations might have been used; specifically, the phase plane is almost ignored in spite of the value this reviewer feels it has. Nevertheless, the serious student of nonlinear systems will want this unique text for its comprehensive presentation of Liapounoff's direct method.

The Structure of Science. Problems in the Logic of Scientific Explanation. By Ernest Nagel. 618 pp. Harcourt, Brace & World, Inc., New York, 1960. $7.50. *Reviewed by R. B. Lindsay, Brown University.*

SCIENCE has long been a happy hunting ground for philosophers, who have found in it a wealth of material on which to test their various points of view with respect to the nature of knowledge and logical reasoning. Books on the philosophy of science abound, some of them unfortunately written by philosophers whose grasp of science professionally has been rather limited. It is therefore a pleasure to welcome the present volume by the distinguished professor of philosophy at Columbia University. Professor Nagel is thoroughly at home in the various branches of science, both physical and biological, and his book will be illuminating to philosophers and scientists alike. Indeed the author insists in his preface that he hopes to reach a wider audience than the professional scholars, and from the clarity and cogency of his discourse, it is likely he will in some measure succeed.

Professor Nagel is concerned with an examination of the logical patterns manifested in the organization of scientific knowledge, and in addition the logical methods which seem to persist and show success in modern science. It is a very large subject and in the present volume the author limits his attention to the problems involved in the nature of scientific explanation. Another volume to appear later will take up the logical structure of scientific concepts and an

evaluation of the validity of the claim that the various sciences really add to knowledge.

The first six chapters (some 150 pages) provide a general discussion of scientific explanation without reference to the individual sciences. The author takes up such topics as science and common sense, patterns of scientific explanation, laws and theories, and the cognitive status of theories. The rest of the book, and by far the greater part, is devoted to a more detailed analysis of special sciences. Thus there are five chapters discussing the logical status of theories in physics and related mathematics, including a study of classical mechanics, space and geometry, and causality and indeterminism in physics. In the examination of classical mechanics, Newton's "laws" of motion come in for careful scrutiny. The author concludes that no brief and simple statement can be made as to their logical status. Here the reviewer is unable to follow him completely. In the formulation of Mach they become merely the postulates of one method of formulating the theory of mechanics. But this is a detail. The student of mechanics will profit much from the clear presentation of the logical problems presented by mechanics, too often overlooked in the teaching of physics.

There is an interesting chapter on mechanistic explanation and organismic biology in which the author concludes that no one has established the inherent impossibility of a physico-chemical explanation of vital phenomena. The last three chapters are devoted to methodological problems associated with the social sciences. This is a field of tremendous difficulty and one evocative of a wide diversity of opinion regarding its relations with natural science. But the author winds up on the optimistic note that the arguments against the possibility of the truly scientific approach in the social studies are by no means unanswerable.

This is a long, closely reasoned book. It can hardly be termed easy reading, but the scientist who is willing to give it close attention and weigh the author's words with care will certainly be rewarded for his pains.

BOOKS RECEIVED

Schwingungen. Eine Einführung in die theoretische Behandlung von Schwingungsproblemen. By Kurt Magnus. Vol. 3 of Leitfäden der angewandten Mathematik und Mechanik, edited by H. Görtler. 251 pp. B. G. Teubner Verlagsgesellschaft, Stuttgart, 1961. DM 29.80.

Solid State Physics. Advances in Research and Applications. Volume 12. Frederick Seitz and David Turnbull, eds. 459 pp. Academic Press Inc., New York, 1961. $16.00.

Basic Principles of the Tracer Method. Introduction to Mathematical Tracer Kinetics. By C. W. Sheppard. 282 pp. John Wiley & Sons, Inc., New York, 1962. $8.00.

Advances in Spectroscopy, Volume 2. H. W. Thompson, ed. 483 pp. Interscience Publishers, Inc., New York, 1961. $13.00.

Physics and Philosophy. The Revolution in Modern Science (reprint of 1958 ed.). By Werner Heisenberg. 213 pp. Harper & Bros., New York, 1962. Paperbound $1.40.

Problems in Quantum Theory of Many-Particle Systems. A Lecture Note and Reprint Volume. By L. Van Hove, N. M. Hugenholtz, L. P. Howland. 249 pp. W. A. Benjamin, Inc., New York, 1961. Paperbound $3.50.

Quantum Electrodynamics. A Lecture Note and Reprint Volume. By R. P. Feynman. 198 pp. W. A. Benjamin, Inc., New York, 1961. Paperbound $3.50.

S-Matrix Theory of Strong Interactions. A Lecture Note and Reprint Volume. By Geoffrey F. Chew. 182 pp. W. A. Benjamin, Inc., New York, 1961. Paperbound $3.50.

Quantum Mechanics, Volume 1. By Albert Messiah. 504 pp. North-Holland Publishing Co., Amsterdam, 1961. Distr. in US by Interscience Publishers, Inc., New York. $15.00.

Radiation and Waves in Plasmas. Symp. Proc. (Palo Alto, Calif., Dec. 1960). Morton Mitchner, ed. 156 pp. Stanford U. Press, Stanford, Calif., 1961. $4.50.

Linear Differential Operators. By Cornelius Lanczos. 564 pp. D. Van Nostrand Co., Inc., Princeton, N. J., 1961. $12.75.

Singularities of Linear System Functions. By Bernhard Gross and Elde Pires Braga. 90 pp. Elsevier Publishing Co., Amsterdam, 1961. Distr. in US by D. Van Nostrand Co., Inc., Princeton, N. J. Paperbound $4.00.

Contemporary Physics (Revised ed. of *The Rise of Modern Physics*). By C. F. Von Weizsäcker and J. Juilfs. Transl. from German by Arnold J. Pomerans. 150 pp. George Braziller, Inc., New York, 1962. $4.00.

Polyelectrolyte Solutions. A Theoretical Introduction. By Stuart A. Rice, Mitsuru Nagasawa, Herbert Morawetz. Vol. 2 of Molecular Biology, edited by Nathan O. Kaplan and Harold A. Scheraga. 568 pp. Academic Press Inc., New York, 1961. $16.50.

An Introduction to Theoretical Physical Chemistry. By Sidney Golden. 307 pp. Addison-Wesley Publishing Co., Inc., Reading, Mass., 1961. $9.75.

Ore Microscopy. By Eugene N. Cameron. 293 pp. John Wiley & Sons, Inc., New York, 1961. $10.50.

Symbols, Signals and Noise: The Nature and Process of Communication. By J. R. Pierce. 305 pp. Harper & Bros., New York, 1961. Text edition for quantity sale to schools and colleges only, $5.00.

Crystallometry. By P. Terpstra and L. W. Codd. 420 pp. (Longmans, Green) Academic Press Inc., New York, 1961. $12.00.

Classical Electrodynamics. By John David Jackson. 641 pp. John Wiley & Sons, Inc., New York, 1962. $13.00. College edition, $10.75.

Biographical Memoirs of Fellows of the Royal Society, Volume 7. 363 pp. The Royal Society, London, 1961. 30s.

Fundamental Formulas of Physics (reprint of 1955 ed.). Donald H. Menzel, ed. Vol. 1, 364 pp.; vol. 2, 377 pp. Dover Publications, Inc., New York, 1960. Paperbound $2.00 each.

Stochastic Service Systems. By John Riordan. 139 pp. John Wiley & Sons, Inc., New York, 1962. $6.75.

A Style Manual for Technical Writers and Editors. S. J. Reisman, ed. 15 chapters. The Macmillan Co., New York, 1962. $7.95.