(i) that the theory be invariant with respect to coordinate and λ-transformations, (ii) that it be transposition-invariant (that is, that the equations read from right to left are equivalent to those read from left to right), and (iii) that the equations have the greatest possible "strength." The "strength" of a system of equations is a new concept introduced by Einstein, which measures the extent to which the equations determine the field variables. In contrast to the concept of a Cauchy problem, which requires the singling out of a direction of continuation, the definition of strength treats all four coordinates on the same footing.

We do not yet know whether Einstein's nonsymmetric field theory, or any other "unified field theory" proposed so far, will have a place in the physical theories of the future. Very possibly the time is not ripe for progress in this field. But anyone who sincerely believes in the organic unity of nature will be impressed by the program of unified field theory as an important approach toward the recognition and understanding of that unity. The last book by Albert Einstein represents an extremely significant contribution to this quest.

PETER G. BERGMANN
Department of Physics,
Syracuse University

L'Evolution de la Lithosphere. I, Pétrogenèse. Henri Termier and Genevieve Termier. Masson, Paris, 1956. 654 pp. Illus. Cloth, F. 8800; paper, F. 8000.

This is the second volume of the *Traité de Géologie* by these authors. The first part was published in 1952, and two more volumes are promised. Petrogenesis is divided into two parts: "Generalities," of 9 chapters (264 pp.), and "Problems of petrogenesis," 13 chapters (335 pp.)

Starting with a brief resumé on the constitution of matter (including a periodic table), the authors consider the gaseous material from which solids are supposed to have condensed. Here the tectites, iron, stone-iron, and lastly the stone meteorites are discussed. The ideas of Urey on the origin of the earth, the build-up of the primitive atmosphere, the birth of water and the accumulation of the oceans, and the beginning of life, are also discussed. These first three chapters are a sort of introductory containing mostly theory. In chapter 4 the lithosphere is introduced, and the authors consider the effect on the crust of cosmic and ultraviolet rays and how photosynthesis and oxygen reduction produce energy. Terrestrial magnetism and gravitation lead naturally to a discussion of isostasity with stable and unstable areas, buckling and orogenies. These, along with thermodynamics, give us regional metamorphism, volcanism, and the formation of granite.

Starting with Laue's work in 1912, the internal structure of crystals has been under investigation, giving us more and more insight into molecules and atoms. The authors state that the "tetra coordinates of silicon is one of the fundamental characteristics of the Lithosphere," and that the silica and aluminum make up the upper part of the lithosphere, the sial of E. Suess. The classification of Green of (i) metals or conductors, (ii) the sulfurs or nonconductors, (iii) the OH groups, (iv) the hydrogene, (v) the silicates, and (vi) natural gases, is given. In chapter 6 the displacement and diffusion of matter in the lithosphere by various means, along with the various imperfections of crystals, are considered.

Chapter 7 deals with minerals from the glasses to the rare earths. Chapter 8 discusses geochemistry and considers the organic as well as the usual inorganic side of earth chemistry. Carbon comes in for careful consideration, especially the isotopes C^{12}, C^{13} and C^{11}, as well as C^{14}. Chapter 9 gives the age of the universe as about 6000 million years and the age of the earth as about 3500 million years, considered from some nine different radioactive approaches.

Under "Problems of petrogenesis," chapter 1 gives us the interinfluence of the terrestrial and meteoritic processes of the geologic evolution of the crust. The zones of weakness, both parallel and at angles to the directions of orogenesis (chapter 2), are followed (in chapter 3) by a synopsis giving succession of the phenomena with the tectonic phases and geosynclinal phases following through stages of deformation, sedimentary deposits, volcanism, metasomatism, petrogenesis, and occurrence. These chapters serve to localize the rocks in time and space.

After reviewing the mode of occurrence (chapter 4), the chemical classification, mineralogical occurrence, chemical-mineralogical classification, the C.I.P.W. classification as modified by Lacroix, Niggle's classification, and statistical methods, the authors give a simplified genetic classification of (i) rocks supersaturated with silica, (ii) rocks saturated with silica, (iii) rocks not saturated with silica, but with feldspathoids, (iv) ultrabasis rocks, and (v) charnockites, anorthosites and lamprophyres. Chapter 5 examines the magmas from various points of view and includes a table showing a series of continuous and a series of discontinuous changes supposed to go on in the liquid material. Next, in chapter 6, volatile, fluid parts, gases, waters, and mineralizing fractions lead naturally to volcanism. In chapter 7 some seven types of volcanic activity are listed. The contribution of geosynclines to the sima occupy chapter 8.

Chapter 9 is a long one and deals with metamorphism, pneumatolytic metasomatism, and hydrothermal metasomatism, running the gauntlet from granite pegmatites to evaporates. Here are introduced the authors' idea of "fronts," sorts of zones of combat between different materials in the crust. The numerous ideas are documented by numerous examples largely from the authors' experiences, but the vast literature is drawn on to bolster their ideas. The problems of granite fill chapters 10 and 11. Finally, chapter 12 discusses convergent rocks (in the biologic sense of convergent), and the last chapter tells of the aberrant rocks.

Throughout the book, the authors consider the importance of the atomic structure of the minerals and the crystal fabric. The influence of gravitation on crustal material is pointed out, and the authors consider metasomatism of the first order in identification and transformation of petrographic types. They favor the progressive differentiation of the sial at the expense of the sima and feel that some petrographic types have a plural or convergent origin.

In all, it is a very detailed study; each chapter, and even some subdivisions, has its own bibliography, sometimes running well over 100 titles. The amount of material covered makes it slow reading, but the book is well worth the effort. The figures and tables are clear and effective. The plates are well chosen and are placed at appropriate places in the text. The style is more literary than that of most geologic textbooks, and it is clear and very much to the point. Certainly all petrographers, mineralogists, and geologists should study it, for there is much to be derived from it, and it is a fitting volume of *Traité de Géologie.*

E. WILLARD BERRY
Department of Geology,
Duke University

Geometrical Optics. L. C. Martin. Philosophical Library, New York, 1956. 215 pp. $7.50.

This is an interesting and well-written treatise covering the elementary problems of geometrical optics, with the addition of some short chapters on diffraction and photometry.

In the first chapter, "The laws of geometrical optics," the author discusses the refraction and reflection laws and basic concepts, such as tangential and sagittal focus, real and virtual images, and the Smith-Helmholtz relation coordinating transverse and angular magnification.

The second chapter covers the first-

order approximation theory—that is, paraxial optics. Unfortunately, the author, like most textbook writers, considers it as a special case of a collineation. (This concept was shown by Allvar Gullstrand in 1907 to be in contradiction to optical laws, especially the law of Malus.) The author develops in this chapter the well-known formulas for the position of object and image in thin lenses, thick lenses, and general optical systems.

The third chapter, "Optical instruments," deals with the basic types of instruments, their paraxial data, and the chromatic axial aberrations (longitudinal and lateral).

Chapter 4 deals with the wave nature of light, elementary problems of diffraction, and the resolution of optical instruments. The optical sine theorem of Abbe is also discussed.

Chapter 5, "The observation and recording of images," discusses the elementary properties of the human eye and the use of spectacles, whereas Chapter 6, "Photometry," discusses problems of illumination, the radiation diagram of light sources, and photometry.

The last chapter discusses the third-order aberration figures.

Numerous short appendixes deal with the vectorial form of the refraction law, with depth of focus, with some dispersion formulas, and with the derivation of Euler's formulas for the light path in nonhomogeneous media.

Examples are given at the end of each chapter. The book is clearly written and is a very good elementary introduction to the subject.

M. HERZBERGER
Research Laboratories,
Eastman Kodak Company

The Systematic Identification of Organic Compounds. A laboratory manual. Ralph L. Shriner, Reynold C. Fuson, and David Y. Curtin. Wiley, New York; Chapman & Hall, London, ed. 4, 1956. 426 pp. $6.

The excellent features of this popular laboratory manual are well known, and the present review will be concerned only with a comparison of the third (1948) and fourth editions.

Perhaps the most conspicuous innovation is the introduction of a chapter (8) on "The use of spectroscopic methods for functional group determination." The chapter is concisely written and at the level of the student for whom the textbook is designed. Six classification tests (Chapter 2), of doubtful value, have been omitted. The suggestions for the examination of the literature have been improved, and ample warning is given concerning the reliability of certain formula indices. Some parts of Chapter 6 ("The solubility classes") have been largely rewritten. The discussion on "Generalizations from solubility data" has been simplified and placed on a more rational basis, even within the present limitations of solubility theory. A much needed section on "Electronic effects on acidity and basicity" is included. The treatment of amphoteric compounds remains unsatisfactory.

Although Chapter 7 ("Application of classifications tests") retains its general aspect, it is evident that considerable attention has been given to the chemical details of the classification tests (note experiment 2). The new approach is best illustrated in experiment 21 (silver nitrite solution test), in which a rather comprehensive discussion of the theory of replacement reactions is presented. No significant change has been introduced in the 15 sets of problems. Some of the more abstruse examples were omitted, but no new problems were added. This textbook has gained considerably in its new edition.

FAUSTO RAMIREZ
Department of Chemistry,
Columbia University

Books Reviewed in The Scientific Monthly, August

Science and the Course of History, P. Jordan, translated by R. Manheim (Yale University Press; Oxford University Press). Reviewed by I. B. Cohen.

Celebrated American Caves, C. E. Mohr and H. N. Sloane (Rutgers University Press).

Viral and Rickettsial Diseases of the Skin, Eye, and Mucous Membranes of Man, H. Blank and G. Rake (Little, Brown). Reviewed by H. Koprowski.

The Navajos, R. M. Underhill (University of Oklahoma Press). Reviewed by D. F. Aberle.

Chemical Calculations, H. V. Anderson (McGraw-Hill). Reviewed by F. J. Llewellyn.

The Thirteen Books of Euclid's Elements, translated from the text of Heiberg with introduction and commentary by T. L. Heath (Dover).

Atlas of Paleogeographic Maps of North America, C. Schuchert (Wiley; Chapman & Hall). Reviewed by E. W. Berry.

Geology: Principles and Processes, W. H. Emmons, G. A. Thiel, C. R. Stauffer, and I. S. Allison (McGraw-Hill). Reviewed by H. R. Gault.

New Books

Basic Chemistry of Textile Colouring and Finishing. 191 pp. $6. *Basic Chemistry of Textile Preparation.* 197 pp. $6. S. R. Cockett and K. A. Hilton. Philosophical Library, New York, 1956.

The Chemistry and Mode of Action of Plant Growth Substances. Proceedings of a symposium held at Wye College (University of London), July, 1955. R. L. Wain and F. Wightman, Eds. Academic Press, New York; Butterworths, London, 1956. 312 pp. $9.50.

The Fighting Cheyennes. George Bird Grinnell. University of Oklahoma Press, Norman, 1956. 453 pp. $5.

The Classification of Lower Organisms. Herbert F. Copeland. Pacific Books, Palo Alto, Calif., 1956. 302 pp. $7.50.

A Handbook for the Identification of Insects of Medical Importance. John Smart. Chapters on fleas by Karl Jordan and on arachnids by R. J. Whittick. British Museum (Natural History), London, ed. 3, 1956. 303 pp. £2.

Flow of Gases through Porous Media. P. C. Carman. Academic Press, New York; Butterworths, London, 1956. 182 pp. $6.

A Dictionary of English Domestic Architecture. A. L. Osborne. Philosophical Library, New York, 1956. 111 pp. $6.

Asymptotic Expansions. A. Erdélyi. Dover, New York, 1956. 108 pp. Paper, $1.35.

An Essay on the Foundations of Geometry. Bertrand A. W. Russell. Dover, New York, 1956. 201 pp. Paper, $1.50.

Experiment and Theory in Physics. Max Born. Dover, New York, 1956. 43 pp. Paper, $0.60.

Electrical Interference. A. P. Hale. Philosophical Library, New York, 1956. 122 pp. $4.75.

Annual Review of Plant Physiology. vol. 7. Lawrence R. Blinks, Ed. Annual Reviews, Stanford, Calif., 1956. 456 pp. $7.

Illustrations of the Huttonian Theory of the Earth. John Playfair. Facsimile reprint, with an introduction by George W. White, of 1802 edition published by Cadell and Davies, London and William Creech, Edinburgh. University of Illinois Press, Urbana, 1956. 528 pp. $4.50.

Mechanical Vibrations. J. P. Den Hartog. McGraw-Hill, New York, ed. 4, 1956. 436 pp. $9.

Hydrodynamics. Hugh L. Dryden, Francis D. Murnaghan, H. Bateman. Dover, New York, 1956. 634 pp. Paper, $2.50.

Chromosome Botany. C. D. Darlington. Allen & Unwin, London, 1956 (order from Macmillan, New York). 186 pp. $2.75.

Health for the American People, a Symposium. Presented 21 Nov. 1955. Massachusetts Memorial Hospitals Centennial Celebration. Little, Brown, Boston, 1956. 105 pp. $1.

Some Clinical Applications of Electroneurophysiology, Especially Electrodiagnosis and Electromyography. Sidney Licht, Ed. Elizabeth Licht, New Haven, Conn., 1956. 272 pp. $10.

Secret Enemy. The story of a disease. James Cleugh. Thomas Yoseloff, New York, 1956. 273 pp. $5.

J. C. Poggendorff Biographisch-Literarisches Handworterbuch der Exakten Naturwissenschaften. vol. VIIa (two sections), pt. 1, A–E. Rudolph Zaunick and Hans Salie. Akademie, Berlin, 1955. 256 pp. DM. 12 per section.