ery plants are described. Perhaps too much emphasis is placed on the advantages of high-temperature and nonaqueous recovery processes, but this emphasis very probably reflects the author's interest in these methods.

Chapter 3 is a brief survey of the physiological effects of plutonium and the health physics aspects of handling plutonium. This chapter is marred by several errors, which may have occurred in translation. For example, on page 94 "two fatal cases of plutonium poisoning" are discussed. In the original reference [E. R. Russell and J. J. Nickson, "Distribution and excretion of plutonium," in *Industrial Medicine on the Plutonium Project* (1951), p. 256] it is clearly stated that plutonium was administered to incurably ill individuals and that death was due to other causes, *not* to plutonium poisoning. To my knowledge, there have been no cases reported to date of fatal poisoning by plutonium.

Chapter 5 is concerned with plutonium fuel technology, and chapter 6 with considerations of energy resources and of the economics of nuclear power. I am more familiar with the chemistry of plutonium than with reactor technology, but it appears to me that the advantages of fast breeder reactors using plutonium fuel are presented without adequate discussion of the contrary arguments and the significant problems of engineering and physics that are associated with fast breeders. Little attention is given to the thorium-232–uranium-233 breeding cycle. There is an interesting tabulation and comparison of 21 thermal and fast reactors that have been reported fueled with plutonium.

The quality of the translation is generally good, although there are numerous typographical errors and mistakes in punctuation that are distracting. The bibliography contains some 370 references of which approximately 25 percent cite Russian articles. The latest references are to articles published in 1961. There are more than 100 illustrations.

In summary, to one skilled in the field, this book will be of use only as an organized source of reference to the literature prior to 1961. To one seeking an introduction to the use of plutonium as a nuclear fuel, the book will be a useful starting point.

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Mathematics and Biology

A Modern Algebra for Biologists. Howard M. Nahikian. University of Chicago Press, Chicago, 1964. xii + 236 pp. Illus. $10.

As N. Rashevsky points out in the foreword, this is an exposition of certain topics in modern algebra (set theory, relations, probability, graph theory, semigroups, groups, and linear algebra) aimed toward the relational biology of Rashevsky, Rosen, and others. The bulk of the mathematical exposition, about 128 pages, is devoted to linear algebra—that is, to vectors, linear transformations, matrices, and determinants. Some 25 to 30 pages are used to sketch indications of applications. In most cases the applications are rather general, descriptive ones in which no precise problem of theoretical biology is stated or solved.

The swift exposition of sets, relations, elementary probability, and linear graphs (chapters 1 and 2) is on approximately the same level as *Finite Mathematics*, by Kemeny, Snell, and Thompson. Nahikian provides similar elementary problem material, with the addition of a little on computing the information-theoretic entropy of chemical reactions.

In chapter 3 there is a seven-page exposition of semigroups with unit (monoids), followed by a three-page "partial development" of a paper in which R. Rosen applies the structure theory of monoids to coding problems with respect to DNA. The extreme condensation leaves the mathematical and the biological expositions in unsatisfactory state. Chapter 4, an exposition of group theory, is probably too brief for a biologist who is being introduced to it for the first time. The celebrated Polya combinatorial theorem on the group of a graph is mentioned in conclusion, but without a statement of the theorem. No applications are indicated.

The only detailed mathematical exposition is in the linear algebra section—chapters 5, 6, and 7. Here the author goes somewhat beyond the special requirements of the applications that he has in mind. This exposition is precise and has numerous illustrative examples, although it is rather technical in both notation and language. Gaussian elementary row operations could have been used more, linear transformations and determinants less, to provide a simpler route to the indicated objectives. The principal indicated applications of matrices involve the matrix of transition probabilities for change of state, the matrix representation of a dominance relation, and the direct sum decomposition of the connection matrix of a neural network.

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History of Geology

Hydrogeology. J. B. Lamarck. Translated from the French (Paris, 1802) by Albert V. Carozzi. University of Illinois Press, Urbana, 1964. viii + 152 pp. Illus. $4.75.

Originally published in 1802, *Hydrogeology* is the geological magnum opus of the man now remembered principally as a forerunner of Charles Darwin. Lamarck hoped this work would revolutionize geology and mineralogy, although, as he was bitterly aware, some of his earlier publications had been greeted by almost universal silence. His hopes were frustrated once again, and, as Carozzi remarks, *Hydrogeology* "fell into oblivion almost immediately," is now barely known to geologists and historians of geology, and has become a bibliographical rarity.

Despite Lamarck's failure, this first English translation of *Hydrogeology* will surely be welcomed by geologists and historians. The title, it should be noted, is misleading, since the work deals with the significance of fossils, the formation of the earth's crust, geological time, and other topics commonly treated in the numerous "theories of the earth" produced during the 18th century. Lamarck's ideas, as one might expect, are often original and bear the stamp of a bold, speculative, and very strange mind. His discussion of the origins of mountains is a case in point: he observes, analyzes, reasons without observation, and finally, in chapter 4, rejects the theory propounded in chapter 1 and offers a substitute. Although his insights were often remarkable, Lamarck also rejected the ideas of many contemporaries, notably those concerned with chemistry, and *Hydrogeology* is thus a unique blend of brilliance and fantasy.