be an enormous difference in accuracy between points along the route and points even a mile or so off it, not to mention points 10 or 20 miles away. This fact must be constantly kept in mind by the compiler as he struggles to reconcile various surveys into a map.

The problems of chronometric longitudes are not much discussed in this book, which takes the point of view of the 1930's, when radio time signals became available. In some ways, this is unfortunate, since the most serious errors in the older surveys are often those in longitude, owing to the lack of accurate time.

The style of the book is lively, though marred by occasional Teutonisms. A theoretical example of carrying a survey across a wide expanse of marshy country suddenly develops into a galloping narrative as the reeds catch fire, the camels panic, and the whole caravan stampedes. The problem is intended to illustrate, and does illustrate, the extremely uneven nature of the problem and the resourcefulness required.

This book is recommended for those who must either make or use maps of areas where there is no topographic survey, and especially for those whose interest is in central Asia.

JOHN A. O'KEEFE
Army Map Service

Optics. The science of vision. Vasco Ronchi. Translated from the Italian and revised by Edward Rosen. New York University Press, New York, 1957. 360 pp. Illus. $10.

Vasco Ronchi, well-known among astronomers, amateur telescope makers, and those who must test optical devices for his grating test, announced in 1925, is director of the National Institute of Optics in Arcetri, Italy, a suburb of Florence. Much excellent optical research has been published from this center of Italian optics, and the workers at the institute enjoy a well-deserved reputation for scientific competence.

As the term is universally used today, *optics* embraces all but a very few phenomena associated with radiation, and such a discipline would exist without eyes to see. The term is a convenient carryall when the common characteristics of radiation phenomena are in question.

In this discursive, polemical book Ronchi proposes to limit the term to those aspects in which the eye—and the eye of sentient, sensing man only—is involved. This regressive step is made in all seriousness, and those limited parts of optics in which the eye is involved are carefully, logically, and clearly, though largely nonmathematically, explained and developed from a few principles. Ronchi characterizes the optics which to him constitutes the heart of the subject as "anthropomorphic optics," the same field that was understood until the 17th century to be all of optics.

Ronchi develops this viewpoint with great skill, but he inevitably produces a false impression of the richness of the discipline he is discussing. It is very doubtful that any idea of this fullness can be conveyed without detailed physical, physiological, and psychological explanations. For these there is no room in the book, and no hint that the old saw "the eye receives light, but the mind sees," has a profounder meaning than that exemplified in the "effigies," the mental constructs from sense data defined on page 70, and in the examples Ronchi discusses.

The position adopted by the author leads to some surprising conclusions, of which the most startling is in the following statement, taken from page 288: "The virtual image is purely a mathematical fiction. It may be useful as an intermediate solution in the study of complex optical systems. . . ." This is indeed unsound doctrine, unsupportable by any argument known to me, and refuted every time a man shaves the man in the mirror (virtual man, beard, and razor), or a woman powders the nose of the virtual woman with a virtual puff loaded with virtual powder, or an ametrope puts on his spectacles.

The book is well printed and bound, and the errors that I caught are relatively few in number. The translation is smoothly done, no traces of the original Italian remaining, unless it be in the unusual term *centric,* used for Airy disk, or *effigy,* the mental construct alluded to in a preceding paragraph. Lines 9, 10, 11 on page 231 seem to be an incomplete sentence; the figure illustrating astigmatism, on page 268, is unclear and misleading; and Fig. 20, on page 78, is inverted: the trochlear pulley is actually above the globe of the eye.

It is difficult to identify the intended reading public. As a textbook or a reference work, the book is limited in scope, and the controversial features would mislead the casual reader whose knowledge of physics or optics is an insufficient guide to the good that is in the book. The lack of any bibliographic references whatever makes impossible the verification of questioned statements and seriously impairs the value of the book. Nevertheless, I found it interesting reading.

The book falls into two parts. The first, of six chapters, constitutes approximately three-quarters of the volume and deals with the history of optics, elementary physiology of seeing, and the arguments centering around "anthropomorphic optics." The second part deals with wave motion. This section is notable for the clear physical arguments the author advances for the elementary wave phenomena he discusses. Very little mathematics is required to understand the arguments, though trigonometry and differential calculus are sparingly used.

ALLEN E. MURRAY
Bausch & Lomb Optical Company

Lectures on Rock Magnetism. Being the second Weizmann Memorial lectures, December 1954. P. M. S. Blackett. Weizmann Science Press of Israel, Jerusalem, 1956. 131 pp. Illus. $5.

In this engaging little book, P. M. S. Blackett reviews the present state of knowledge in a new and very active field of research. The abundance of data that is rapidly accumulating on the intensity and direction of the natural "permanent" magnetization of geologically dated rocks has shown that rock magnetism may become a powerful tool to trace the history of the earth's magnetic field and of the movement of land masses over its surface. Although he is one of the chief investigators in this field, Blackett has maintained an admirable objectivity in discussing the various controversial hypotheses that are being so avidly championed. The three chapters of the book—the general discussion of rock magnetism and its application, the description of the experimental work, and the synthesis of the recent results—are succinct and lucid expositions which are sufficiently complete to introduce any technical reader to rock magnetism and are "meaty" enough to be of interest to those already acquainted with it.

The first chapter is a review of the historical development of the subject and includes straightforward descriptions of how rocks acquire their magnetism, of the various mechanisms by which this magnetism can be reversed by physical-chemical changes, and of the observed reversals in rocks and their possible significance in terms of reversal of the earth's magnetic field.

The second chapter discusses the various laboratory measurements that can be made on rock and mineral samples and the pitfalls that are inherent in them. Blackett's conclusion is that much can be learned from such laboratory tests, but, because many of the mineralogical and chemical properties of the rocks change in the course of these tests, great care must be taken before the results are applied to natural phenomena.

The first part of the third chapter is a synthesis of the results of measurements of rock magnetism, throughout

the world, which relate to the movement of the magnetic pole and to the relative movements of land masses over the surface of the globe. Blackett's conclusion is that, although much work is needed, preliminary results indicate that there is no doubt that polar wandering and continental drift have both occurred in geologic times.

In the second part of this chapter the various observations of reversed magnetism are discussed, and their possible support of field reversal is considered. It is Blackett's conclusion that at the present time there is not sufficient evidence to support the hypotheses that the earth's field has, or has not, reversed.

The three appendixes to the main part of the book are new contributions and are, therefore, more technical and of interest primarily to workers within the field. With D. J. Sutton, Blackett has developed equipment for vibrating a specimen between identical pickup coils so that measurements can be made of the magnetizations of materials under different conditions of temperature and magnetic field. By measuring the distance that small grains jump to a cubic magnet of known strength, he shows how rough quantitative determination can be made of the remanent magnetization and coercive force of small grains. In the third appendix Blackett presents a new theory, with experimental confirmation to explain the irreversible change with rising temperature of the sign of magnetization of natural materials composed of magnetically hard and soft components.

With this small book Blackett has filled a great need for an objective review of the status of rock magnetism and its application to the study of polar wandering and continental drift. Geologists and others interested in these problems will find his clear and candid discussion a bright spot in the mass of recent publications on this subject.

J. R. Balsley

U.S. Geological Survey

Climate and Economic Development in the Tropics. Douglas H. K. Lee. Published for the Council on Foreign Relations. Harper, New York, 1957. 182 pp. $3.50.

This rambling, philosophizing, and poorly integrated little book seems to be more the amassed output of the whole study group of the Council on Foreign Relations than of its stated author, who acted as group *rapporteur*. Although ostensibly a scientific inquiry into its title subject, it is heavily larded throughout with obvious propagandizing for greater American support to underdeveloped tropical countries—the Point Four program of New Deal days. Douglas Lee greatly weakens his own contribution in the fields of animal and human adaptation to tropical climates by first castigating severely Ellsworth Huntington and his works on climatology and then stating, as his own summarized deductions, the very ideas Huntington had so ably presented and supported decades ago!

The book is divided into seven chapters: "Introduction," characterized chiefly by the author's uncertainty about whether to consider as tropical those countries lying within tropical latitudes or only those in the tropical lowlands of moist heat; "Tropical climates," in which his uncertainty persists; "Crop production," "Animal production," "Health and human efficiency," and "Industry," each with subsections on the "Effects of climate," "Circumventing the effects," "Complicating factors," "Required action," and "Preferential regions"; and "Prospect," which more or less summarizes the volume's contents and premises. The book carries no index, and textual references to works listed in the bibliography are at times vague and uncertain, except for those quoted in support of the author's main theses. Various types of data quoted in support of arguments that point up the need for American help to underdeveloped tropical lands are quite without scientific significance as presented.

After all his castigation of Huntington and the latter's "gospel of climatic determinism," Lee's final summations revert directly back to the central core of Huntington's theories on climatic dominance over human achievement: "When acclimatization is complete, there remains an increased disinclination for work which tends to reduce normal output. . . . Some reduction of mental initiative is probably the most important single direct result of tropical environments. Accuracy may be affected in poorly motivated persons, and the need for increased concentration may be felt as a strain."

The volume represents a frank attempt at scientific evaluation of its title subject for the Council on Foreign Relations, with its first major objective: ". . . to state the present position of our knowledge concerning the effects of climate upon tropical development, *so that policy makers, executives and scholars could be reliably informed*" (my italics). It is my considered opinion that Lee's "attempt to bring into focus some of the scattered fragments of information . . . ." fails to provide scientifically reliable evidence in support of his stated objective—"that policy makers, executives and scholars . . . be reliably informed."

Clarence A. Mills

University of Cincinnati

Some Principles of Energetics in Biochemical Reactions. Irving M. Klotz. Academic Press, New York, 1957. vii + 64 pp. Illus. $3.

The object of this small, 60-odd-page book is "to afford a reading knowledge of the language of thermodynamics" for the biologist who is without the mathematical background necessary for a study of the usual textbooks. One should say immediately that Irving Klotz has accomplished this in a very successful fashion.

After a brief introduction, the first two sections of the book are devoted to an exposition of the first and second laws of thermodynamics, with a minimum of mathematical treatment. In the next sections the concept of free energy is developed, and the relation between chemical potential and concentration is illustrated with a number of examples from the biochemical literature. The next section is concerned with the "high energy bond" so much talked of in contemporary biochemical circles. The final two sections are concerned with (i) a thermodynamic treatment of electrochemical reactions, osmotic pressure, and the ultracentrifugal measurement of particle weights and (ii) a brief consideration of some of the basic concepts of statistical thermodynamics.

The language is clear, the examples are apt, and the argument is logical. The book is recommended to the biologist who is without mathematics and to the medical student; it will serve as an admirable introduction to a more rigorous mathematical treatment of the subject.

E. A. Evans, Jr.

University of Chicago

New Books

Economic Development. Theory, history, policy. Gerald M. Meier and Robert E. Baldwin. Wiley, New York; Chapman & Hall, London, 1957. 607 pp.

International Astronomical Union, Transactions, vol. IX. Ninth general assembly, Dublin, 29 Aug.–5 Sept. 1955. P. Th. Oosterhoff, Ed. Cambridge University Press, New York, 1957. 802 pp. $15.

An Introduction to Automatic Digital Computers. R. K. Livesley. Cambridge University Press, Cambridge, England, 1957. 61 pp. $1.75.

H. A. Lorentz, Impressions of His Life and Work. G. L. De Hass-Lorentz, Ed. North-Holland, Amsterdam, 1957. 172 pp. $3.

Microwave Measurements. Edward L. Ginzton. McGraw-Hill, New York, 1957. 532 pp. $12.

Studies on Hysteria. Josef Breuer and Sigmund Freud. Translated from the German and edited by James Strachey in collaboration with Anna Freud. Basic Books, New York, 1957. 366 pp. $5.50.