tends the horizon to complex reticles and their applications. The depth and detail in which he describes the design and construction of various reticles for various uses are impressive. Biberman has contributed much to a field that is not generally well known or often used in the optical community, and his competence is radiated through the book by the many references to his own articles and patents, as well as to those of other inventors and contributors to the field. The optical engineer or optical physicist could learn important techniques of the technology by reading *Reticles in Electro-Optical Devices.*

Many technical people are probably not aware of the complicated reticle systems that are being used in optical devices for space and military applications. Biberman here reveals previously unpublished work of his own, describing important electro-optical techniques. The book does not mention the specific applications for the tracking and error-correction techniques, but the reader has the feeling that the military overtone is there. How many of these techniques are applicable to other electro-optical problem areas remains to be seen.

Early in the book, Biberman develops straightforward, simple choppers, epiescotisters, and reticles for simple problems. As the book progresses to more and more complicated devices, the applicability of reticles receives more emphasis, and their use in certain areas such as information processing is treated. The book benefits from the confinement of reticle fabrication to a chapter of its own and from the relegation of highly mathematical treatments to appendices. It will no doubt become a useful reference for students and workers in the field.

ROBERT J. POTTER
Xerox Corporation,
Rochester, New York

The Crust and Mantle of the Earth

The Earth beneath the Continents. A volume of geophysical studies in honor of Merle A. Tuve. JOHN S. STEINHART and T. JEFFERSON SMITH, Eds. American Geophysical Union Monograph No. 10, Washington, D.C., 1966. 683 pp., illus. $16.50. NAS–NRC Publication 1467.

This compilation of 43 papers is dedicated to Merle A. Tuve on the occasion of his 65th birthday and his retirement as director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, after 40 years of association with that organization. At its inception, the volume was planned as a unified presentation of the results of the Lake Superior seismic experiments of 1963 and 1964. These experiments, directed toward investigation of the properties of the earth's crust and upper mantle in the anomalous Lake Superior region, entailed observations of seismic waves generated by some 130 explosions in the lake. Charge weights ranged from 250 pounds to 10 tons, the majority of the shots being at about 1 ton. Papers dealing specifically with the Lake Superior program and with geological, seismic, gravity, and magnetic studies constitute about half the volume. The other contributions are the result of the decision to dedicate the volume to Tuve, at which time the scope of the book was necessarily broadened to accommodate contributions from his many friends and colleagues.

Most of these additional contributions treat geophysical topics similar to the Lake Superior seismic studies, that is, estimation of the structure and composition of the upper 50 to 100 kilometers of the earth from observations of seismic waves generated by special explosions and from analyses of gravity and magnetic data. A few articles bear little relation to the general topic. Although this will introduce problems in accessibility of these particular articles, the varied content enhances the interest of the volume.

The introductory papers present the geology of the Lake Superior area, with gravity and magnetic data and interpretations. Lake Superior lies at the northern end of the prominent Midcontinent Gravity High, a belt of positive Bouguer anomalies which form one of the largest gravity features in North America. The area is a syncline filled with some 5 kilometers of sediments over as much as 10 kilometers of lavas and intrusives of the Keweenawan sequence.

Several papers present interpretations of the data accumulated in the explosion program. The complexity of the data and their structural implications are striking. There is general agreement that the data indicate an anomalously thick crust, more than 50 kilometers, and high crustal velocities under the lake over an area some 500 kilometers long. Such crustal thicknesses were previously found only associated with mountain roots, as with the Sierra Nevada. Thicknesses in surrounding areas of central North America are about 40 kilometers. The third section of the volume contains reports of similar crustal investigations in several other areas. In addition, there is an excellent summary article, by James and Steinhart, of the general method of explosion seismic studies, with recent advances, difficulties, sources of error, and many references. This paper is recommended to anyone seeking a critical review of the method with its worldwide application and results.

The last two sections of the volume contain varied fare for the reader. Under headings of Theory, Earthquakes, and Instruments and Synthesis and New Methods in Structural Studies, one can find reports on earthquakes in Peru or on the spatial variations in tidal gravity fluctuations or on seismograph design. Several articles warrant specific mention. Bullen presents a compact summary of ray theory formulas commonly used in seismic travel time studies. Both flat and spherical earth forms are given. Woolard presents his isostatic gravity anomaly map of the United States with an excellent summary of data-reduction methods and discussion of the results, with several cross-continent profiles illustrated. Ringwood and Green comment on the petrological nature of the stable continental crust and the implications of assumptions for water-vapor pressure. The concept of a gabbroic lower crust is dismissed and a possible explanation of the evolution of the anomalous crust in the Lake Superior area is presented.

This book contains many excellent contributions. Its acquisition will normally be prompted by a high level of interest in either the crustal explosion seismology technique in general or in the Lake Superior problem specifically. For both these interests, it is perhaps the most complete compilation available. Unfortunately, this overall specialization will tend to limit the accessibility of the many excellent but more general papers. All geophysicists should at least peruse the volume—something is there for everyone.

THOMAS V. MCEVILLY
Department of Geology and Geophysics, University of California, Berkeley