summary of existing knowledge about motion and regimen in glaciers, glacial erosion, genesis (though not stratigraphy) of glacial deposits, and effects of frost action in the ground.

This list is nonhistorical, and is perhaps better adapted to a geographic than a geologic curriculum. Nevertheless, its material is well selected, and it is primarily analytical rather than descriptive. The presentation is not didactic; it consists in large part of summaries of competing ideas about glacial processes, with a summary at the close of each chapter embodying guidance through the data and opinions discussed. Under some topics are outlined theories no longer accepted, along with more recent, better ones. This procedure has value for students, although its usefulness for reference is slight.

The authors display a good command of the literature—no inconsiderable feat in these days—and the work as a whole is about as up to date as the treatment of so broad a theme could very well be. Each chapter is followed by a generous list of references, by no means confined to publications by geographers.

The book is easy to read; the ideas are clearly and pleasantly expressed. Illustrations, though not abundant, are well selected, and, in this field at least, good text is worth more than the same space devoted to maps, diagrams, and photographs. The book should have appeal not only to students but also to nontechnical readers with curiosity about glaciers and how they act on the land.

R. F. FLINT
Kline Geology Laboratory,
Yale University,
New Haven, Connecticut

History of Astronomy

Vistas in Astronomy. Vol. 9, New Aspects in the History and Philosophy of Astronomy. First Joint Symposium of the International Astronomical Union and the Union Internationale d'Histoire et de Philosophie des Sciences, Hamburg, Germany, Aug. 1964. ARTHUR BEER, Ed. Pergamon, New York, 1968. xvi + 320 pp., illus. $22.

In August 1964, more than 80 scholars from 18 countries met at the University of Hamburg for the first joint symposium of the International Astronomical Union and the Union Internationale d'Histoire et de Philosophie des Sciences. This newest volume of the *Vistas in Astronomy* series is the (slightly augmented) record of that symposium.

As a first step in conveying the nature of its contents, it will be well to point out that the volume's subtitle, "New Aspects in the History and Philosophy of Astronomy," is somewhat misleading. The discussion is exclusively and explicitly concerned with "promoting progress in the study of the History of Astronomy." The discipline called Philosophy of Science is represented in only the most marginal way. What was apparently intended by the reference to philosophy of astronomy was that there should be some philosophizing about the goals and methods of research in the History of Astronomy; but, as B. Sticker complains in the introduction, the contributors showed little inclination to let down their hair and address themselves to "the tools of the trade rather than the products." While their reluctance will doubtless prove disappointing to some professional historians of astronomy, it has almost certainly resulted in a book that holds more interest for the lay reader.

As much as the symposium members might be accused of failing in the one rather esoteric respect, they responded enthusiastically to the more familiar task of presenting "new aspects in the history of astronomy." Easily the most striking feature of the book is the diversity among its constituent articles. The most exciting of these is O. Gingerich's outline of "Applications of high-speed computers to the history of astronomy." Clearly, the potentialities are enormous. In an interesting turn of the tables, A. Beer illustrates that the history of astronomy can itself be fruitfully applied as a tool in the "Astronomical dating of works of art." Among several good historiographical essays, F. Hammer's summation of the major "Problems and difficulties in editing Kepler's collected works" stands out not only because of the importance of its subject, but for its general relevance to the similar projects that certainly ought to be undertaken in the future. Running along more familiar lines are articles such as those by M. Hoskin and, especially, H. Dingle ("A re-examination of the Michelson-Morley experiment"), which provide excellent examples of sophisticated historico-philosophical analysis. Finally, there are the inevitable chronicles that still constitute much of the effort devoted to every branch of the history of science. Limited in intellectual content and pertinent primarily to the specific histories of various national cultures, they represent, at best, raw material that will eventually be integrated into the general history of astronomy, at worst, new aspects that will prove to be blind alleys for the discipline.

As one ought certainly to be able to expect from such an expensive volume, the production is superb. Among the more than a hundred photographs included are many beautiful reproductions of old astronomical instruments. The volume is even indexed. The one thing that can be said to be lacking is thumbnail sketches of the contributors, who are identified only by their academic titles. American readers will be happy to find that, although over two-thirds of the contributions are from continental scholars, virtually all of the articles are in English.

VICTOR E. THOREN
Department of History and Philosophy of Science, Indiana University, Bloomington

A Model of the Mind

The Nature of Human Intelligence. J. P. GUILFORD. McGraw-Hill, New York, 1967. xiv + 538 pp., illus. $14.75.

Nobody really understands the nature of human intelligence, but the impact of factor theory has made it clear that a simple IQ, as manifested in the Stanford-Binet or some other single index, is blatantly inadequate. Guilford's recent book summarizes the available evidence which has accumulated via multiple factor analysis—a method initiated by Spearman in 1904, reformulated as an application of matrix algebra by L. L. Thurstone in the 1930's, and further developed and given psychological substance by Guilford and others for the past 30 years.

Guilford's book is an elaboration of his structure-of-intellect (SI) model, which is an orthogonal, three-dimensional taxonomy of 120 elements or "factors" of intelligence. The three major axes of this periodic table of intellectual processes are Contents, Products, and Operations. Each element of this cube is a hypothesized factor, 82 of which have been empirically confirmed. Such factors occur at the intersections of the 4 by 5 by 6 matrix reproduced on the next page.

Guilford embeds this SI model in the context of information theory by re-