Robinson. Foreword by **Joseph Needham.** xxiv + 480 pp., bibls., index. Cambridge: Cambridge University Press, 1998. $115.

With the publication of Volume 7, Part 1, of *Science and Civilisation in China* we have reached the concluding volume, but by no means the end, of one of the greatest works of transcultural synthesis of the twentieth century. Joseph Needham's masterpiece, chronicling the scientific and technical achievements of the world's oldest continuous civilization, has by now illuminated almost every aspect of the intellectual history of East Asia.

Only in China have systematic logical definitions and reflections been developed on their own and on the basis of a non–Indo-European language. Christoph Harbsmeier's work examines the relationship between Chinese language and Chinese logic with an unprecedented depth and breadth of reference. Harbsmeier addresses the following questions: What are the basic logical and linguistic features of the literary Chinese language that enabled it to serve as a medium for scientific discourse? What strategies of argumentation and proof were employed by the ancient Chinese? What, if any, were the logical theories advocated by the ancient Chinese before Chinese science and logic felt the impact of Western philosophy?

Harbsmeier discusses in detail the grammatical features of the Chinese language that allow statements and their negations to be framed, causal relations to be described, and terms to be defined. The categorical and grammatical suppleness of the Chinese language—which Harbsmeier likens to the flexibility of Shakespearean English (pp. 125–127)—certainly allows the same word to appear in many grammatical guises, but, as Harbsmeier argues (p. 143), this "organic" suppleness does not necessarily result in a lack of precision.

When he moves on to discuss grammatical and logical complexity, it seems to me that Harbsmeier does begin to fall into the "translation trap." He is surely aware of this possibility when he writes, of the alleged vagueness of literary Chinese, "The problem arises only when we feel obliged to match the expression with an English expression" (p. 149). Yet he concludes from, among other evidence, his detailed comparison of a section of the *Protagoras* in the original Greek with its Chinese translation, that "classical Greek and Latin show a much greater systematic ability unambiguously and transparently to articulate logical and grammatical complexity than [. . .] Chinese" (p. 172). Surely we should ask, Does a given passage in Chinese convey the meaning unambiguously to an informed *Chinese* reader? In most cases the answer would seem to be "yes." It may well be that the translation of philosophical ideas from Chinese into Latin is often easier than vice versa (pp. 170–171). It remains to be proven that Chinese, at least in dealing with *scientific* ideas, is at any disadvantage with respect to Western languages merely because the latter have a greater capacity for syntactic complexity.

The two golden ages of logic in China were the Warring States Period (fifth to third century B.C.) and the period of Chinese Buddhist logic (seventh to eighth century A.D.). Among the noteworthy figures of the Warring States Period were the sophist Gongsun Long (ca. 320–ca. 250 B.C.), who famously claimed that "a white horse is not a horse," and the Later Mohist logicians, who developed a highly sophisticated system of definitions and propositions and made important contributions to the study of optics and mechanics. The Chinese Buddhists, however, used their logical techniques primarily to achieve religious goals. Overall, the achievements of the Chinese logicians of both periods show that literary Chinese was indeed capable of providing the necessary subtlety and precision for their ideas to be expressed.

Harbsmeier's important study covers vast spans of time and of intellectual endeavor: a short review cannot do justice to its richness, wit, and erudition. It deserves its key place in Needham's final monument to Chinese science and civilization.

DAVID WRIGHT

Jo Ellen Barnett. *Time's Pendulum: The Quest to Capture Time—From Sundials to Atomic Clocks.* xii + 340 pp., illus., figs., bibl., index. New York/London: Plenum Trade, 1998. $27.95.

Time's Pendulum is vastly more ambitious in its scope and sophisticated in its methodology than *Longitude,* but Jo Ellen Barnett shares with Dava Sobel a desire to cash in on the millennium frenzy, a whiggish confidence in the triumphant advance of science through individual genius, and a cliché-ridden style that publishers like to describe as poetic. Her book includes only two photographs of timepieces but reproduces one of them—John Harrison's H4, the instrument that both Barnett and Sobel claim solved the longitude problem—twenty-seven times as a full-page decorative motif. *Longitude* brought wel-

come publicity to the history of science, but its errors and old-fashioned approach justified the inevitable academic sniping at a best-selling book. Longer, more technical, and lacking the appealing myth of the unappreciated working-class hero, *Time's Pendulum* will probably be less commercially successful, although it offers readers a far deeper analysis.

Barnett provides an extremely competent and lucid presentation of the information contained in more scholarly historical and scientific texts about the measurement of time. The book's two sections, "The Time of Day" and "The Time of the Earth," are both organized chronologically as exciting narratives of discovery treating, respectively, clocks that mark out the passing of time in the present and those that measure time back into the earth's past. Barnett insists on the importance of giving as much weight to the cultural beliefs influencing ideas about time as to scientific knowledge: thus the second of her two photographs shows a French Revolutionary watch, whose face with its two juxtaposed numbering systems (one that divides days into ten, the other into twenty-four, hours) graphically demonstrates the flexible length of an "hour."

"The Time of Day," which constitutes almost two-thirds of the volume, starts with sundials but moves swiftly forward to mechanical clocks and the imposition of regulatory equal hours on communities formerly governed by the rhythms of nature. Here, as throughout her book, Barnett includes illustrated and clear descriptions of technical innovations such as the verge-and-foliot escapement and the fusee, but she also explores religious attitudes. Her excellent account of our modern economy's origins in the commercialization of time emphasizes the centrality of Christianity: orthodox Muslims apparently are still forbidden to mortgage their houses, because God's years are not for sale. The discussion of John Harrison serves as the pivotal point of Barnett's four-thousand-year-long tale of chronometrical progress; Barnett then switches to the worldwide unification of time systems. She vividly depicts the importance of railways and the suppression of local resistance to standardization, but she draws mainly on American examples, without considering either the earlier European calendrical reforms or the ways in which time synchronization, air travel, and electronic communications have remedied the isolation through time of remote countries such as Australia.

The second part of the book, "The Time of the Earth," opens with the Judeo-Christian change from cyclical to linear models of time but is more densely scientific than the first section: Barnett interlaces her account of the discovery of radioactivity with material on geology, fossils, and human evolution. Harrison, the impoverished autodidact inventor of a revolutionary timekeeper, is counterbalanced by James Hutton, celebrated here as a wealthy intellectual farmer, the unsung hero of a temporal revolution rivaling the Copernican. Striding rapidly through three centuries, Barnett describes techniques for estimating the age of the earth as well as those devised to measure the comparatively minuscule period of human life.

Barnett begins and ends by quoting Saint Augustine's assessment of the impossibility of explaining time. This sober theme is threaded through her text, but her own attempts to pin time down philosophically are marred by her colloquial and jocular style. Nevertheless, this book successfully describes methods and reasons for measuring time, and its comprehensiveness refreshingly distinguishes it from standard histories of horology.

PATRICIA FARA

Reuben Hersh. *What Is Mathematics, Really?* xxiv + 343 pp., frontis., figs., bibl., index. Oxford/New York: Oxford University Press, 1997. $35.

What then is mathematics, really, according to Reuben Hersh? It is a human activity carried out in society, something that has developed historically. In his preface Hersh states that these facts are obvious common knowledge that philosophers have ignored. Thus he describes his book as a subversive attack on traditional philosophies of mathematics. An attack it surely is; Hersh has very few kind words for philosophers of mathematics. It is less clear, however, that such a broadside will be effective enough to be subversive.

There are two parts to the book. In the first, programmatic part Hersh offers criteria by which to assess any proffered philosophy of mathematics together with a quick glance at such familiar topics as the nature of proof, infinity, and invention versus discovery. The longer second part presents a history of so-called mainstream philosophy of mathematics from Pythagoras to the present. Pages 251–316 contain notes and comments on a variety of topics organized under headings such as "Logic," "Geometry," and "Calculus." These are not notes in the sense of footnotes, and although some of the material is