peaked around the turn of the century and was now in terminal decline. People had become dangerously addicted to philosophical novelties and had thus become "mere naturalists" (p. 188), compounding their mistakes by attacking traditional, hard-won erudition. Radical reformers such as John Dury, who had called for a complete overhaul of the university system, had the "spirit of a pure fanatick, or ignorant zealot" (p. 191). Alongside what he took to be the pernicious pointlessness of the new learning, Casaubon railed against the current obsession with "method." The stupidity of reliance upon such inventions, he thought, was as if one built a bridge to cross a tiny river and then used the same contraption to traverse the ocean. Dury, Hobbes, Glanvill, Comenius, and above all Descartes lauded the benefits of their vaunted methods, but Casaubon thought Pierre Gassendi (despite his unfortunate predilection for Epicurus) the only one of the moderns worth reading. The *cogito* of the *Meditations* was absurd and showed its author to be an antisocial enthusiast, since men were supposed to renounce their natural reason and their senses: "rare inventions to raise the expectation of the credulous, & in the end to send them away pure Quacks, or arrand Quakers" (p. 152). Different intellects required different instruments, and to attempt the Procrustean feat of tailoring one method to all minds was inhuman. Ultimately, there could be no shortcuts in obtaining the sort of knowledge that was adequate for salvation.

This is a fascinating and highly important text, ably edited and well produced. Its appearance in paperback should also make it more accessible to a student audience. As a cogent defense of the traditional curriculum against its puffed-up critics, Casaubon's letter deserves to be set alongside and compared with contemporary statements on education such as those of Samuel Hartlib, Obadiah Walker, and John Locke.

ROB ILIFFE

Gottfried Wilhelm Leibniz. *Hauptschriften zur Versicherungs- und Finanzmathematik.* Edited by **Eberhard Knobloch** and **J.-Matthias Graf von der Schulenberg.** With commentaries by **Eberhard Knobloch, Ivo Schneider, Edgar Neuburger, Walter Karten,** and **Klaus Luig.** Foreword by **J.-Mathias Graf von der Schulenberg.** xii + 686 pp., illus., figs. Berlin: Akademie Verlag, 2000.

This collection of Leibniz's writings on the mathematics of insurance and finance, only about half of which have been previously published, appeared on the occasion of the 250th anniversary of the Landschaftliche Brandkasse Hannover (established in 1750), through the initiative and with the support of the Versicherungsgruppe Hannover. (Hannover was the city in which Leibniz died and with which the later stages of his career as philosopher and statesman were closely associated.) Historians of mathematics and law, as well as economic and social historians, are indebted to the initiators and the editors of this compilation for a well-produced and thoughtfully edited volume that provides a fascinating look at the early history of probability and statistics, the finances of the early modern state, the interactions of mathematics and jurisprudence, and early Enlightenment visions of the well-policed (in the early modern sense) civic order.

The volume presents fifty documents in the original language of composition, accompanied by facing German translation in the case of French and Latin originals, under four headings: "Fundamental Thoughts on Insurance"; "Discounting, Rebates, Interest"; "Annuities, Pensions, Life Insurance, and Life Expectancies"; and "Financial Establishments and Businesses." Leibniz's calculations and diagrams are also reproduced; color photographs of the original manuscripts not only prompt admiration for the editors' skills at decipherment but also show how Leibniz thought with pen in hand—striking out failed solutions, sketching and calculating in the margins, beginning an attempted solution anew. Appendixes include a glossary of technical Latin terms (mathematical and legal) employed by Leibniz, an index of names (including dates, brief identification, and relevant works), a subject index to the documents, and a brief bibliography. Commentaries on the historical, mathematical, legal, and financial background of the documents follow. Readers who are not seeking a specific work would be well advised to begin with Eberhard Knobloch's clear and succinct overview of the documents.

From the standpoint of the history of probability and statistics, what is perhaps most interesting about the documents pertaining to insurance is how small a role these then-new mathematical enterprises played in Leibniz's more practical schemes. Yet Leibniz helped pioneer the early "calculus of hazards" and promoted the gathering of demographic statistics (as in the case of the Breslau data on which Edmond Halley's life table was based). In the case of insurance against fire and water damage, calculations of risk were not based on either observed frequencies of such accidents or a priori assumptions about the distribution of probabilities. Instead, Leibniz suggested fixed contributions, preventive measures such as dikes, and a fire brigade (Doc. I.3, pp. 15–19). In the case of life annuities and other contracts based on life expectancy, Leibniz did introduce probabilistic considerations, but in opposition to statistical ones. So, for example, even though he was aware that the chances of dying differed for young children and adolescents, men and women, soldiers and officials, he swept aside these empirical details in favor of a wholesale assumption that the chances of dying in any given year between the ages of zero and eighty were equal (Doc. III.9, p. 419).

The majority of the documents date from the 1680s, when Leibniz had entered the service of the dukes of Brunswick-Lüneberg in Hannover as councilor, technical consultant, librarian, and historian. The selection and classification of the documents as presented in this volume are not of course Leibniz's own, but the numerous repetitions of ideas and calculations that cut across these writings on diverse subjects suggest that Leibniz himself saw the problems of insurance, annuities, compound interest, and state finances as linked. How Leibniz understood these connections emerges most strikingly in a 1682 list of "Questions of Political Calculation [*Calculi politici*] Concerning Human Life, and Related [Topics]" (Doc. III.15, pp. 520–523), which reads as a combined blueprint for political arithmetic, cameralism, political economy, improving agriculture, and rational management in the Enlightenment mode. Items to be calculated range from "Comparison of deaths and births" to the "Relation between gold and silver and other metals" to the "Planting of potatoes." Although Leibniz would have been familiar with the private financial initiatives in insurance against damage by fire and water in England and the Netherlands, he steadfastly recommended that such undertakings be the province of a provident state (along with the sale of annuities, an employment agency, and numerous other projects, including what sounds like the ancestor of the department store (Doc. I.1, p. 6): "A store or warehouse, where one can find everything at a cheap price . . . a splendid way to animate people and help them nourish themselves." Here we see Leibniz the project maker, who was as much a spiritual contemporary of Daniel Defoe as of Christiaan Huygens and Isaac Newton.

LORRAINE DASTON

Johannes Kepler. *Optics: Paralipomena to Witelo, and Optical Part of Astronomy.* Translated by **William H. Donahue.** xvi + 459 pp., illus., figs., tables, bibl., indexes. Santa Fe, N.M.: Green Lion Press, 2000. $55.

With the translation of Kepler's *Optics: Paralipomena to Witelo, and Optical Part of Astronomy,* William Donahue has performed an invaluable service for the English-speaking historian of science. Kepler's *Optics* is one of the most important optical works ever written. His success at analyzing the properties of light geometrically had a substantial influence on Descartes's optics specifically and on seventeenth-century natural philosophy generally. Kepler's *Optics* also contains the striking discovery that the retinal image is inverted (Ch. 5), an innovative treatment of conic sections (Ch. 4), and a very interesting history of solar eclipse observations (Ch. 8). The clear significance of Kepler's *Optics* makes it all the more remarkable that this is the first complete translation of it into any language. Now the English reader can study not only Kepler's obviously important optical discoveries but also questions like the relationship between Kepler's theology and his optics and the influence of Neoplatonism on his thought.

Shortly after Tycho Brahe's death in 1601, Kepler inherited Brahe's extensive observations and his position as imperial mathematician. Before his death Brahe had been working on observations of Mars. Kepler, in continuing with the project, solved the problem of Mars and introduced his first two planetary laws. These results were published in 1609 in the *Astronomia nova* (also translated by William Donahue: *New Astronomy* [Cambridge, 1992]). While studying Mars, Kepler also wrote the *Optics* (first published in 1604). Several astronomical problems required optical solutions; Kepler cited two problems as the most pressing (*Optics,* pp. 5–6). First, atmospheric refraction posed particular difficulties for determining positions with the kind of accuracy Brahe made possible and Kepler required. Second, when one observes the image of a solar eclipse cast on the wall of a *camera obscura,* the moon appears to shrink. Stephen Straker argues ("Kepler's Optics: A Study in the Development of Seventeenth-Century Natural Philosophy" [Ph.D. diss., Indiana Univ. 1970], Ch. 1) that Kepler's solution to the optical paradox raised by the *camera obscura* laid the foundations for his revolutionary optics.

In addition to resolving observational problems in astronomy, Kepler's optical discoveries influenced the way he conceived of dynamical