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Joel Kaye, *Economy and Nature in the Fourteenth Century: Money, Market Exchange, and the Emergence of Scientific Thought*. Cambridge Studies in Medieval Life and Thought, 4th series, volume 35. Cambridge, U.K. and New York: Cambridge University Press, 1998, 2000 (pb). x + 273 pp. Notes, index, and bibliography. \$64.95 U.S. (cl). ISBN 0-521-57276-2; \$22.95 U.S. (pb). ISBN 0-521-79386-6.

Review by Laura A. Smoller, University of Arkansas at Little Rock.

A quarter of a century ago, John Murdoch asked, "How and why did the near frenzy to measure everything imaginable come about in the fourteenth century?" (p. 3). Joel Kaye thinks he knows the answer. The thesis of Kaye's important volume, now reissued in paperback, is that the emergence of a "proto-scientific" worldview among scholars at the universities of Oxford (with the so-called Merton School or Oxford Calculators) and Paris in the thirteenth and fourteenth centuries is best explained not by the culture or curriculum of the university itself, but by the emergence of a money economy in the society surrounding the university. In particular, Kaye urges that the marketplace provided scholars with an example of a self-regulating system that produced equality through willed inequalities (the crossed desires of seller and buyer) and that necessitated an acceptance of estimation and latitude in prices. In short, the marketplace modeled a new system that eventually overthrew the Aristotelian conception of nature as an *ordo rerum* maintained by an active ordering intelligence.

In so arguing, Kaye places himself squarely within recent trends in the history of science that move beyond the older "internalist" focus on textual traditions and the pedigrees of ideas to an awareness of the social setting of scholars and ideas. In particular, he takes inspiration from the work of Michael Wolff, who links Peter John Olivi's formation of the concept of *impetus* to his economic analysis of *capitale* and his experience of commercial society. In addition, Kaye's book stands among a number of recent works that recognize what Murdoch, again, has termed the "unitary character" of late medieval thought,^[1] such as Joseph Ziegler's study of the interconnections between the medical and religious writings of Arnald of Vilanova.^[2] For the scholars Kaye discusses—men such as Godfrey of Fontaines, Henry of Ghent, Peter John Olivi, John Duns Scotus, Geraldus Odonis, Walter Burley, Richard Kilvington, Jean Buridan, and Nicole Oresme—both wrote about economic matters and "made significant and forward-looking contributions in the area of natural philosophy" (p. 7). Kaye's method, in the absence of a "smoking gun" proving that the experience of a monetized marketplace influenced "proto-scientific" thought, is to point out "verbal and formal similarities" (p. 9) in these authors' writings on economic theory (ch. 2-5) and on natural philosophy (ch. 6-7). To establish these similarities, Kaye analyzes his texts according to six conceptual categories (of his own invention) that he finds in both economic and scientific writings of the period (p. 11).

He begins, however, with a chapter detailing both the economic world of fourteenth-century Europe and the involvement of Oxford and Paris scholars in that world. More than simply rehearsing the details of the rise of a money economy in medieval Europe, Kaye focuses on such disruptions as the repeated revaluations of French coinage beginning with Philip IV as revealed in French royal *ordonnances*. These frequent recalls of coins, greatly resented by the French populace, were accompanied by public listings of proportional equivalences between the old and the new money and helped prepare the way, Kaye will argue, for concepts of relativity as well as a generalized awareness of an international gold and silver market that dictated prices for those metals despite the best royal efforts to control them. The experience of famine and grain shortage, too, Kaye argues, helped to bring home the point that "the market" and the law of supply and demand established prices—not the kings of France and England, who tried, in such times, to set them. Most importantly, Kaye insists that the Paris and Oxford scholars he describes were not simply observers of the late medieval economy but were active participants therein. He stresses that masters at Paris and at Merton College, Oxford, were intimately involved in the financial dealings of their respective schools. Nicole Oresme, for example, as grand master of the College of Navarre at the University of Paris in 1356, kept the college's books at a time during which there were fifty-one mutations of the coinage in a five-year period. At Oxford, Thomas Bradwardine was not just involved in university administration but was also attached to the household of Richard de Bury, Bishop of Durham and one-time treasurer and chancellor of England. Administration both gave scholars valuable insights into the workings of the marketplace and "encouraged the habit of translating qualitative grades into quantitative terms" (p. 36), a hallmark of the natural philosophy of the Merton School.

Chapters 2 through 5 detail the ways in which scholastic authors attempted to make sense of the new monetized economy in their economic theory. In chapter 2, Kaye analyzes one key source for medieval economic theory, Aristotle's treatment of money and exchange in the *Nicomachean Ethics*, book V, ch. 3-5, as presented in medieval Latin translation, particularly that of Robert Grosseteste as revised in the mid-thirteenth century. Already in the *Ethics*, money and exchange are described in mathematical terms, facilitating comparisons with the world of natural philosophy. Kaye describes two forms of justice that Aristotle dubs "distributory" and "directive," types of justice that involve the assigning of rewards in geometrical and arithmetical proportions, respectively. In the first, rewards are distributed unevenly, in proportion as the receiver deserves them. In the second, a judge intervenes after an uneven exchange to bisect the line of loss and gain and to redistribute goods so that each side receives an equal share. Equally important is the concept of *contrapassum* or reciprocity, which Aristotle says governs exchange and which he illustrates through a "figure of proportionality:" a square with crossed diagonals reproduced in many medieval manuscripts of the *Ethics*. Such exchanges bound society together in what Kaye sometimes calls a "social geometry." Money, in Aristotle's analysis of exchange, serves as a medium, a measure of all things that makes incommensurable things commensurable by serving as an index of human need. Price, in Aristotle's schema, is a dynamic and relativistic concept. According to Kaye, however, the "textual weight" (p. 50) of Aristotle was not enough to propel scholastic thinkers to embrace relativism in economic and scientific thought; rather, the social setting of a monetized society provided that push.

Chapters 3 through 5 address scholastic development of Aristotle's ideas about money and exchange, both in the earliest commentaries on the *Ethics*, by Albertus Magnus and Thomas Aquinas, and in thirteenth- and fourteenth-century discussions of what Kaye dubs "economic liceity" (p. 79), namely

questions about the definitions of usury and the just price. Far from a rehearsal of intellectual trends already outlined by John Noonan and John Baldwin,^[3] Kaye's chapters focus on the move from "a static, arithmetical model based on knowable values and knowable points of equality to a geometric model of equalization based on approximate values, proportional requital, and variable line-ranges of adequation; from an equality rooted in individual judgment to an equality viewed as the product of a supra-personal system" (p. 80). These patterns of thought are all ones Kaye identifies as features of the new "proto-scientific" natural philosophy of the fourteenth century, as well. Thus, in the case of usury, there is a move from a sense that any amount returned over the amount lent constitutes usury to a new enumeration, largely based on Roman law, of cases in which interest might legitimately be charged. In the case of the just price, Kaye traces a transition from the concept that there is a knowable, fixed point that demarcates the just price to the acceptance—in authors like Olivi, Odonis, and Buridan—that the just price lies along a latitude (a key term) of prices and that the mechanism of the market itself (including price fluctuations with changing supply and demand) produces a just price in the absence of any external regulator. The experience of the marketplace itself, Kaye claims, spurred scholastic thinkers to their acceptance of estimation and relativity in their analysis of usury and the just price.

In chapters 6 and 7 Kaye relates scholastic economic theory to the emerging "proto-scientific" mentality of the fourteenth century, a mentality which expressed itself above all in a near mania for quantifying and measuring all sorts of things, including qualities such as whiteness, goodness, and heat. This quantification of qualities flew directly in the face of Aristotle, who had taught that qualities could not be treated as continua or as divisible and that one could not make comparisons across species. In the fourteenth century, however, the so-called "additionist" analysis of qualities developed at Merton College saw qualities as composed of small particles whose "intension" or "remission" could be measured in terms of latitude (the same term used by Olivi and Scotus to describe the just price) along a continuum. Having analyzed the degree of intension of a given quality, one could compare it to the degree of intension of another quality, as, for example, the Oxford scholar John Dumbleton did. In other words, one could compare incommensurables (such as whiteness and heat) through a third term (degree of intension), just as money served as the measure for the exchange of incommensurable goods. In the closest Kaye comes to producing a "smoking gun," he cites a passage by Jean Buridan commenting on Aristotle's *Physics*: although Aristotle says one cannot compare across species, that is exactly what happens in exchange through the medium of money (p. 196).

In chapter 7, Kaye continues his survey of the scientific writings by authors whose economic ideas he has already discussed. He cites Nicole Oresme's geometrical representation of qualities inhering in subjects in his *Tractatus de configurationibus qualitatum et motuum*, relating the figures Oresme describes in his treatise to Aristotle's oft-reproduced "figure of proportionality." Kaye also notes that Oresme's famous treatise on the incommensurability of the heavenly motions includes a lengthy debate between Arithmetic and Geometry, which Geometry wins, defending uncertainty and the use of irrational numbers, showing the same degree of comfort with estimation and approximation seen in the new understanding of the just price. Ending with a discussion of relativity among fourteenth-century natural philosophers, Kaye relates such "forward-looking" notions as Jean Buridan's description of a constantly shifting center of gravity for the earth and Oresme's and Buridan's discussion of the probability that the earth turns on its axis to the experience of the depersonalized, relativistic mechanism of the marketplace.

Despite the absence of any direct proof of the link between the experience of monetization and fourteenth-century natural philosophy, Kaye builds an impressive circumstantial case for his thesis. I am, on the whole, convinced that his authors' acquaintance with the economic life of their own times did play into their analysis of money and economic theory and that those ideas, in turn, had much in common with the new trends in natural philosophy in the fourteenth century. Kaye offers plausible explanations, such as Christian squeamishness about money and the distrust of sense experience as a source of *scientia demonstrativa*, for the fact that these authors do not mention money in connection with the strikingly similar models they adopt in natural philosophy. I am not sure, however, that Kaye's is the only answer to the question he seeks to resolve. If the experience of the marketplace was so crucial to engendering new modes of thought, then why is his account not studded with scholars from the precocious economic centers of northern Italy and the Hanseatic towns?

Nonetheless, Kaye provides a provocative case for the argument that the new commercial economy influenced scholastic thought on many angles. Those familiar with the world of fourteenth-century natural philosophy will probably benefit the most from this book, for the sections on economic thought are most revealing in the light of the work of the fourteenth-century calculators, which Kaye touches on in his final chapters. Now that Kaye's book is available in paperback, it should be required reading for any graduate student studying the medieval economy, economic theory, or the history of medieval science. He crosses intellectual boundaries with ease and clarity while posing a new twist in the search for the roots of modern science.

NOTES

[1] John E. Murdoch, "From Social into Intellectual Factors: An Aspect of the Unitary Character of Late Medieval Learning," in John Murdoch and Edith Sylla, eds., *The Cultural Context of Medieval Learning*, Boston Studies in the Philosophy of Science, 26 (Dordrecht and Boston: D. Reidel, 1975), pp. 271-348, cited by Kaye at pp. 3-4.

[2] Joseph Ziegler, *Medicine and Religion c. 1300: The Case of Arnau de Vilanova* (Oxford: Clarendon Press; New York: Oxford University Press, 1998).

[3] John Noonan, *The Scholastic Analysis of Usury* (Cambridge, Mass.: Harvard University Press, 1957); John W. Baldwin, *The Medieval Theories of the Just Price: Romanists, Canonists, and Theologians in the Twelfth and Thirteenth Centuries*, Transactions of the American Philosophical Society, 49, pt. 4 (Philadelphia: American Philosophical Society, 1959).

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