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Thomas Bradwardine, « Traité des rapports entre les rapidités dans les mouvements » suivi de Nicole Oresme, « Sur les rapports de rapports ». *Introduction, traduction et commentaires* by Sabine Rommevaux

Paris: Les Belles Lettres, 2010. Pp. lxvi+190. ISBN 978–2–251–18109–7. Cloth €29.00

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Thomas Bradwardine's *Tractatus de proportionibus velocitatum in motibus* was published in a modern edition together with an English translation by H. Lamar Crosby [1955]. Nicole Oresme's *De proportionibus proportionum* was published with an English translation by Edward Grant in 1966 in the same University of Wisconsin Press series. Here Sabine Rommevaux has published French translations of the two works based on the editions by Crosby and Grant.

Bradwardine's *Tractatus de proportionibus* was adopted as a university textbook in England and on the Continent for the two centuries after its first appearance in 1328. Its impact certainly resulted in part from the fact that it gave a mathematically elegant expression to what Aristotle had said about the relations of movers, moved bodies, and velocities, but also because it contained a primer on the mathematics of ratios and proportions, useful introductory knowledge for undergraduate students. Oresme's work followed Bradwardine's but contained creative elaborations of its basic mathematics and applied Bradwardine's rule for the relations between forces and resistances, on the one hand, and the velocities they produce, on the other, to show that the motions of the planets are most probably incommensurable, thus undermining the basic premiss of astrology that when a given configuration of the planets is repeated their combined effect on Earth will be the same. (If the motions are incommensurable, the configurations will never be repeated.) At roughly the same time, Albert of Saxony composed his own *Tractatus proportionum*, covering the same subject matter more succinctly. In later periods,

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ISSN 1549–4497 (online)

ISSN 1549–4470 (print)

ISSN 1549–4489 (CD-ROM)

*Aestimatio* 8 (2011) 23–29

Albert of Saxony's shorter work was sometimes included, rather than Bradwardine's, in compilations of basic logical, natural philosophical, and mathematical texts for university students that sometimes also included works on the 'latitude of forms' descended from Oresme's *Tractatus de configurationibus qualitatum et motuum* (a work made available in a Latin text and English translation by Marshall Clagett in 1968 in the University of Wisconsin Press series).

On the basis of her extended studies of medieval and early modern theories of ratios, Sabine Rommevaux's mastery of Bradwardine's theory is considerably greater than that of Crosby in 1955 and somewhat beyond that of Grant in 1966; and so scholars may well want to consult her introduction and notes to this book as well as her forthcoming book, *Théories des rapports (XIIIe–XVIe siècles). Réception, appropriation, innovation* [2011]. The introduction to the book is clear and largely uncontentious. Whereas previous scholars have struggled with such controverted subjects as the role and significance of the concept of 'denomination' in medieval theories of ratios, Rommevaux states simply that the denomination of a ratio (when it exists) is the integer or integer plus fraction by which it is named, as the denomination of a double ratio is 2 and the denomination of a sesquialterate ratio, i.e., 3:2, is  $1\frac{1}{2}$ .

As far as I can see, Rommevaux's translations will be useful mainly for Francophone students who are not fluent in medieval scholastic Latin and who would find a French translation easier to read than an English one. For Anglophone readers, the existing English translations will be preferred even if they have a few imperfections.

In choosing French translations of Latin words, Rommevaux tries to avoid misleading cognates. For instance, she translates *velocitas* by the French *rapidité* so as to distinguish the medieval notion of *velocitas* from the post-Galilean notion of *vitesse* [ix n1]. While the point is frequently made that in modern physics velocity is a vector and not a simple magnitude, so that using the word 'velocity' may mislead those used to modern terminology, I question Rommevaux's comment that for most medievals *velocitas* was considered as a quality of motion or of the thing moved. For those authors like William Heytesbury and Richard Swineshead who followed William of Ockham's ontological minimalism, motion is not a qualitative form but instead simply a shorthand way of referring to a situation in which

something does not remain in the same place or position over a period of time. For Oresme himself, motion is not a quality but a mode. It seems to me that avoiding translations using words that have special connotations in later science is not as straightforward as Rommevaux seems to think. Would one not allow Aristotelians to say in translation that the heavens are made of the element ether (or aether) because in 19th-century physics the word ‘ether’ was repurposed to mean what carries light waves?

This debate about words has a striking instance in Rommevaux’s choice to write of what is commonly called ‘Bradwardine’s law of motion’ not as a law (*loi*) but as a rule (*règle*) because it does not have to do with a physical law in the sense understood starting in the 17th century [xii]. If I am not mistaken, this is letting Descartes be the arbiter of the meaning of ‘laws of nature’, despite the medieval use of the Latin phrase ‘*lex naturae*’ (‘law of nature’), for example, in Jean Gerson’s statement: ‘*Lex naturae est in rebus creatis regulatio motuum et operationum et tendentiarum in suos fines*’ [Oberman 1975, 425n47]. Similar questions might be raised about words for *force*. Rommevaux criticizes Marshall Clagett for his distinction between medieval dynamics and medieval kinematics on the grounds that dynamics presupposes a notion of force which is absent from Bradwardine’s treatise [xlvii n91]. While I would agree that the Calculators’ distinction between measures of motion with respect to cause and measures of motion with respect to effect does not map exactly onto the distinction between dynamics and kinematics (especially for alterations where qualitative forms are both causes and effects), Rommevaux’s translation policy leaves the student of 14th-century physics tongue-tied if no word whose meaning has evolved into something different can be used in describing their work. Moreover, changing what the texts literally say carves in stone the judgment that the ideas of these medieval authors were not in any way like those of 17th-century scientists.

Finally, coming at the difficulties of translation from the opposite direction, I wonder that Rommevaux, while being careful to avoid anachronism, simply uses the modern term *rapport* to translate *proportio*, when a modern *rapport* or ratio is normally identified with a rational number or fraction, whereas the medieval *proportio* as used by Bradwardine and Oresme emphatically was not but always remained a relation between two quantities.

But the value of this volume goes beyond the translations into French of the two texts (and little harm is done in translating *velocitas* by *rapidité*, when one knows that this has been consistently done). Rommevaux's notes identifying the sources cited by Bradwardine and Oresme provide interesting food for thought in themselves. For instance, the frequency with which Bradwardine cites Averroes' statements, the fact that he locates passages in Aristotle by the associated comment number in Averroes, and his seeming identification in places of Aristotle's view with that of Averroes, all seem to show the importance of Averroes' commentaries as background to Bradwardine.

Moreover, that Rommevaux compares Bradwardine's statements with those of Oresme on a series of topics may also cast new light on the concepts and purposes of the two authors. If Bradwardine drew upon preexisting theories of ratios and proportions to provide the grounding for his law, was his approach enabled by the fact that he used Campanus' version of Euclid's *Elements*, or by the pre-existing application of ratios in music, or by theories of ratios found in Arabic works translated into Latin such as Ahmed Ibn Yusuf's *Epistola de proportione et proportionalitate*? Bradwardine's mathematics of ratios makes most sense if one thinks only of ratios of greater inequality and if in compounding ratios one always deals with ratios having terms in common such that the middle terms are less than the greater extreme and more than the lesser extreme. For instance, one compounds  $A:B$  with  $B:C$  and with  $C:D$  to get  $A:D$ , where  $A > B > C > D$ .<sup>1</sup> In the mathematics of musical harmony, where one may add intervals between tones to get harmonies between more distant tones, one always continues to have the separate tone-producing strings, as when one string and another twice as long, struck together, produce the harmony of the octave. In such a situation, the relation of the two strings is the same whether one thinks of the shorter to the longer or of the longer to the shorter, i.e., thinks of 2:1 or of 1:2. Nicole Oresme, in order to extend Bradwardine's approach to compounding ratios to ratios of lesser inequality, proposes to reverse the relations between whole and part. Thus, in ratios of greater inequality, 4:2 compounded with 2:1 produces 4:1 and thus the whole 4:1 is greater than the parts 4:2 and 2:1. But in ratios of lesser inequality,

<sup>1</sup> On page xix, there is a misprint where  $C:D$  is repeated: Rommevaux intends  $(A:B) = (B:C) = (C:D)$ .

where 1:2 compounded with 2:4 produces 1:4, the result, 1:4 is less than the parts 1:2 and 2:4. Rommevaux has a sound discussion of Oresme's proposals on this subject, referring to an article by Paul Rusnock and criticizing earlier historians who represented Oresme's ideas using fractional exponents and who concluded as a result that Oresme's understanding was erroneous.

One issue that lurks in the background here is the interaction and relative importance for Bradwardine and Oresme of theories of ratios applied to numbers *versus* theories that apply to continuous magnitudes. The concept of 'denomination' is one that fits with ratios of integers, where there are names for ratios that draw upon names for numbers but not for ratios of incommensurable quantities, such as ratios between lines that are incommensurable with each other. In the end, Bradwardine's theory and his whole approach to ratios and proportions would be undermined by the choice to identify ratios with the denominations associated with them and by the choice to extend the concept of number to include rational numbers (fractions) and eventually real numbers. At that point, treating the compounding of ratios as addition, as Bradwardine and musical theory did, would become problematic.

Rommevaux began her serious study of ratios with a book on Clavius [2005], but Clavius represents the situation after the identification of ratios with a broader concept of numbers and after the rejection of the approach taken by Bradwardine and Oresme. More recently she has edited the questions of Blasius of Parma on Bradwardine's *De proportionibus*, but Blasius too, at least in one version of his questions, is someone who rejects Bradwardine's and Oresme's approach to the composition of ratios as addition.

Oddly, from my point of view, in discussing the *posteriorité* of the movement started by Bradwardine, Rommevaux moves from Bradwardine to Oresme and then to those who reject Bradwardine's approach, including Blasius of Parma, Giovanni Marliani, Alessandro Achillini, and then Clavius [lxiv], while forgetting about Richard Swineshead and John Dumbleton, who certainly must be counted among Bradwardine's most important heirs. To me, this appears to result from a certain bias toward the Continent, perhaps natural in a book whose *raison d'être* is French translations, but nevertheless an incomplete picture of what happened.

This book, then, while primarily useful to those who would like a French translation of the two works included, also provides a judicious interpretation of the meaning and significance of the two texts, which will be useful for future scholarly research. It is not the best source for the historical context. On the second page [x n4], it makes a silly mistake in stating that Bradwardine was a member of the order of Augustinian Hermits, whereas in fact he was a secular who may have held 'Augustinian' positions on some theological topics. I doubt the suggestion in the same note that Bradwardine's *De causa Dei* was the result of Bradwardine's teaching while Chancellor of St Paul's in London. For one thing, Bradwardine held that position only between 1337 and 1339, and the *De causa Dei* is far too long and complicated a book for much if any of it to have been delivered as lectures, even supposing that as Chancellor Bradwardine would have taught so advanced a course. I likewise doubt the assertion [xi] that Bradwardine's *De continuo* refuted mathematically the possibility that a continuum may be composed of indivisibles and thus closed a debate among Oxford masters that had been going on for several years. These, however, are minor points, easily ignored while concentrating on the mathematical content of the works on which Rommevaux's judgments are much more deserving of confidence. Thus, Rommevaux has here established a reliable picture of the work of Bradwardine and Oresme, which should be useful in working towards a wider historical overview, looking both earlier to Arabic and Latin as well as Greek works, and later to those who worked in the same tradition as Bradwardine and Oresme and to those who rejected it.

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