

## Jean des Murs's Quadrivial Pursuits: Introduction

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### **Abstract**

This article serves as the introduction to a special issue on the intellectual activities of Jean des Murs, a mathematician, astronomer-astrologer, and music theorist active in France in the first half of the fourteenth century.

### **Keywords**

Jean des Murs; fourteenth century; quadrivium; University of Paris; history of music; history of astronomy; history of mathematics

## A Life Devoted to Numbers

The decades prior to the outbreak of the Black Death were a period of significant and dynamic change in the way Latin Christians approached the mathematical disciplines traditionally grouped together under the rubric of the *quadrivium*. This seemingly bold statement is relatively uncontroversial in the case of music, where the term *Ars nova* denotes a number of advances in musical notation coupled with new theoretical and compositional attitudes towards polyphony. It holds true, moreover, for mathematical astronomy, where the years around 1320 saw Latin astronomers embrace a new set of computational tables, the so-called Alfonsine Tables, which were appreciated by their users as furnishing superior results compared to their predecessors, and whose parameters and theoretical assumptions would lay the foundations for astronomical calculation well into the sixteenth century.

Jean des Murs (or Johannes de Muris), a native of the diocese of Lisieux in the Duchy of Normandy, is unique among the quadrivial writers of this period in that he successfully managed to inscribe himself into both of the developments just mentioned. In music, he stands as the single most influential theorist of the fourteenth century, as witnessed by the wide dissemination enjoyed by his *Musica speculativa* (1323/25), the description of a new mensural notation system in the *Notitia artis musicae* (1319), and the diffusion of this notational system through the highly influential *Libellus cantus mensurabilis secundum Johannem de Muris*.<sup>1</sup> In astronomy, he deserves credit for writing the earliest preserved analysis of the then-new Alfonsine Tables (the *Expositio intentionis regis Alfonsii circa tabulas ejus* of 1321),<sup>2</sup> whose accuracy he sought to demonstrate by empirical means. As with other astronomers active at the time, the ‘Alfonsine’ way of doing things inspired Jean des Murs to explore new ways of casting astronomical tables, the most influential example being his *Tabule permanentes* for the calculation of true syzygy (i.e., the exact time when the

Sun and Moon are in conjunction or opposition).<sup>3</sup> A highly skilled calculator and mathematical jack of all trades, Jean also compiled a voluminous textbook on the art of reckoning, the *Quadripartitum numerorum* (1343),<sup>4</sup> which is famous for containing a tantalizing anticipation of the concept of decimal fractions.<sup>5</sup> Together with his work on practical geometry, *De arte mensurandi* (1344),<sup>6</sup> the *Quadripartitum* reflects his familiarity with the writings of Archimedes, which he was the first Latin mathematician to cite or use since their translation from Greek in 1269.<sup>7</sup>

His many accomplishments notwithstanding, Jean des Murs continues to occupy little to no space in the grander narratives of European intellectual history. Experts in medieval mathematics, astronomy, or music, will no doubt be familiar with him and some of his exploits in the respective part of the quadrivium. To the mass of historians, however, the French mathematician remains an obscure or entirely unknown figure, and attempts to create something like a synthetic overview of the man and his oeuvre have been few and far between.<sup>8</sup> As of 2018, a number of key texts remain unedited, while others have never been studied in a systematic way, leaving ample room for further investigations into Jean des Murs's scientific contributions and the institutional and intellectual contexts that enabled them.

To create some new building blocks in support of this general direction of research was one of the declared goals of a one-day workshop entitled *Jean (Jehan) des Murs: Quadrivial Science in the Fourteenth Century*, which took place on Thursday, 15 June 2017, at All Souls College, Oxford. The event brought together musicologists, historians of astronomy, and other experts interested in Jean's learned activities, all of whom were encouraged to communicate their results across disciplinary boundaries and thereby contribute to a greater integration of current and future scholarship on this important fourteenth-century figure. Six of the papers presented at this occasion are assembled, in

expanded and revised form, in the present issue of *ERL*. The purpose of the following pages is to contextualize each of these contributions and highlight their points of convergence by offering a brief survey of the state of research on Jean des Murs's work in different areas of the quadrivium.

### **Jean des Murs and His Library**

Prior to the 1960s, the possibility of drawing up anything resembling a biography of Jean des Murs depended for the most part on the contents of his known works as well as on the colophons in their various manuscript copies. A watershed moment came in 1962 with Guy Beaujouan's discovery of an extensive set of autograph notes in the margins of MS El Escorial, Real Biblioteca de San Lorenzo, O.II.10, which offered a wide range of hitherto unavailable information as to Jean's whereabouts between *c.* 1312 and 1344 as well as the intellectual networks and social circles he used to move in.<sup>9</sup> Following Beaujouan's announcement of his discovery, it was the American scholar Lawrence Gushee who used the new evidence to update Jean des Murs's biography in a seminal article of 1969.<sup>10</sup> A collaboration between Gushee and Beaujouan, who planned to publish a transcription of Jean's notes in the Escorial codex, was promised at the time,<sup>11</sup> but has never come to light.

In her contribution to this special issue, Laure Miolo draws on one of the most revealing parts of these notes, a list of book loans on fols. 223v and 225v, to shed new light on Jean's personal library as well as his connections to other scholars in and outside Paris. Miolo combines her study and edition of this unique document with a survey of all extant codices that still contain traces of Jean's handwriting. Aside from a small number of manuscripts that are likely to have been in his private collection, the bulk of these codices once belonged to the Collège de Sorbonne, an institution to which Jean des Murs maintained

close ties during the 1320s and 1330s and whose loan and chained libraries offered one of the richest collections of scientific texts available at the time. Miolo's analysis of the marginalia in these medieval books offers fascinating insights into the reading habits of a fourteenth-century scholar, who studied texts pen-in-hand as he expanded his knowledge in the areas that occupied him for most of his adult life: music, astronomy-astrology, arithmetic, and geometry. Some of this material gives us a clearer view than hitherto available of his career-spanning interest in certain areas, especially astrology. In addition, Miolo's article sheds light on Jean's management of his personal library, and the ways in which he facilitated the transmission of his own works to subsequent generations of scholars.

## Music

Next to Boethius's *De institutione musica* and Guido of Arezzo's *Micrologus*, the third most widely copied music theory treatise of the Middle Ages was the *Libellus cantus mensurabilis secundum Johannem de Muris* (c. 1340-50).<sup>12</sup> Extant in at least 53 manuscripts,<sup>13</sup> this treatise summarizes the revolutionary theories for measuring musical time first proposed by Jean des Murs in book 2 of his *Notitia artis musicae*, a work most likely written in 1319. Though subject to some accretions, the essence of the new art of notation (*ars nova*) first outlined in *Notitia* book 2 held sway until the sixteenth century. His aim, in this work, was straightforward and ambitious: whatever can be sung ought to be able to be written down by a knowledgeable musician using the figures of music notation.<sup>14</sup> By the middle of the fourteenth century, within Jean des Murs's lifetime, a substantial repertoire of French *ars nova* music compositions had been written--many by Jean's friend and contemporary, Philippe de Vitry (1291-1361), and by the French poet-composer, Guillaume de Machaut (c.

1300-1377)--that fully exploits the potential of his new system for measuring and notating duration in music.

The 1320s, however, was a period of development and experimentation, and not without controversy. Jean references both a ‘rising dispute’ and an ‘invidious critic’ of his music theory.<sup>15</sup> Foremost among his critics was Jacobus, author of the seven-volume *Speculum musicae*, who takes him and other contemporaneous theorists to task for their ‘unnecessary novelties’.<sup>16</sup> Three of Jean’s mensural theory treatises appear to date from the 1320s: *Notitia* book 2, the ‘Nine Conclusions’ appended to the *Notitia*, and the *Compendium musicae practicae*. These treatises document his mensural theories at various stages of their development, and at different levels of detail, and were probably written for quite different audiences. Karen Desmond’s contribution to this special issue examines the content of a possible fourth mensural treatise by Jean des Murs that probably also dates from this important decade. Preserved as the second of three books on music (the first and third deal with speculative music theory and discant, respectively) in a single manuscript source, this little studied (and, as yet, unedited) treatise perhaps represents an intermediate stage between the more theoretical presentation of *Notitia* book 2 and the more practical emphasis of the *Compendium*.

*Notitia* book 2 had the title ‘Musica practica’. Equally important to students and teachers of medieval theory, however, was the subdiscipline of speculative music theory (*musica speculativa*), which dealt with the fundamental principles of music (musical ratios, consonances, the monochord divisions, and so on). Book 1 of Jean’s *Notitia* focussed on these topics, as did his *Musica speculativa secundum Boetium*, a work on Boethian theory copied in at least 44 manuscripts,<sup>17</sup> and extant in at least two versions dating from 1323 and 1325. While we do not know for certain whether it was used at the University of Paris while Jean des Murs was at the Collège de Sorbonne,<sup>18</sup> the *Musica speculativa* was certainly used

as a required textbook in the new Eastern European universities in the later fourteenth and fifteenth centuries.

This work, to a greater extent than Jean des Murs's other music theory treatises, demonstrates the interconnectedness of his quadrivial training and interests. Elżbieta Witkowska-Zaremba's essay in this volume analyses the set of nineteen diagrams included in the 1323 version of *Musica speculativa* (version A) that Jean indicated would 'greatly please mathematicians'.<sup>19</sup> She argues that these diagrams, in their visual representation of mathematical theorems and operations invoked in the text, must be understood as absolutely integral to the analytical narrative presented by Jean des Murs. In this way, their role differs from the more usual *aide-mémoire*, instead successively building from the numerical abstractions of the Pythagorean system to the depiction, in Jean's final monochord diagram (*monochordum auctoris*), of actual sounds discernible by the sense of hearing.

### **Astronomy / Astrology**

In contrast to Jean's works on music, which have nearly all been made available in modern editions, a sizeable part of his astronomical output must still be consulted in manuscript. This holds true in particular for his contributions to computational astronomy in the guise of various tables, which he typically cast for a start in 1321, regardless of their actual year of composition.<sup>20</sup> Most of the tables created in his wider Parisian milieu relied for their parameters on the so-called Alfonsine Tables, which appear to have reached the city on the Seine not long before 1320 through as yet undisclosed channels.<sup>21</sup> Besides recasting these tables in ways that were supposed to render them more user friendly, Jean and his colleagues were also engaged in facilitating their practical use by supplying them with instruction manuals known as canons.

His own contribution to this genre was written at the Collège de Sorbonne in 1339. Philipp Nothaft offers a preliminary study of this unedited text, which can be used to shed light on two core aspects of Jean des Murs's work as an astronomer: (i) his interpretation of the Alfonsine precession model and length of the tropical year; and (ii) his methods of calculating lunisolar syzygies and eclipses. A comparison of the *Canones* with earlier works from Jean's pen shows that his approach to finding the time of true syzygy did not remain stable, but changed from one text to another. That such changes could be triggered by experience gained from eclipse observations is suggested by the calculations and observational notes preserved in the aforementioned Escorial codex, which stand out for their detail and quality.<sup>22</sup> In addition to this peek into Jean's working methods, Nothaft's analysis shows that he depended for part of his *Canones* on an earlier set of eclipse canons by the obscure astronomer John of Genoa, who appears to have been a member of the same Parisian milieu.

As difficult as it can sometimes be to recognize the intended readership behind works such as the *Canones tabularum Alfonsii*, the transmission of Jean des Murs's writings leaves little doubt that many of them found an appreciative audience. What is more, the man from Normandy offers no fodder for those who wish to see the history of science as a gallery of persecuted heroes and unrecognized geniuses. Whether he determined the latitude of Fontevraud Abbey at the behest of Abbess Aliénor de Bretagne,<sup>23</sup> received a benefice from Bec Abbey,<sup>24</sup> or observed an eclipse in the presence of Joan II, Queen of Navarre,<sup>25</sup> the available sources offer us enough glimpses to conclude that Jean des Murs interacted successfully with the ecclesiastical and political elites of his day and that his mathematical pursuits helped rather than hindered his societal advancement. His career reached its apex in 1344 when Pope Clement VI summoned him to Avignon to participate in a planned reform of the ecclesiastical calendar, of which Jean himself had been a vocal advocate. His role as



papal consultant is documented by the *Epistola super reformatione antiqui kalendarii*, which he co-authored in 1345 with Firmin de Beauval,<sup>26</sup> but also by two astrological prognostications that provide a striking reminder of the chief reason why mathematical astronomy was so strongly cultivated in fourteenth-century Europe: the alluring promise of reading the future in the stars.

Jean des Murs's pursuits and abilities as an astrologer receive fresh scrutiny in Jean-Patrice Boudet's contribution to this volume, in which he analyses and edits the prognostication Jean wrote for a series of conjunctions between the superior planets (Mars, Jupiter, and Saturn) expected for March 1345. Although its date and place of writing are nowhere clearly stated, Boudet makes a compelling case that Jean composed this text in late 1344 for the eyes of Clement VI, who had already seen a similar prognostication written by Levi ben Gerson, the great Jewish astronomer. The same pope was clearly the intended recipient of Jean's second astrological text, a letter interpreting the conjunctions of 1357 (Saturn and Mars) and 1365 (Saturn and Jupiter). Boudet argues that this text is likely to date from 1346 or 1347, as it seems to presuppose the outcome of the Battle of Crécy. In a way more pronounced than the previous prognostication for 1345, the letter for Clement looks at the influence of the stars on political affairs in a wholly non-fatalistic way, making it possible for the astrologer to advise princes or the pope on how to prepare for the future by forestalling dangers foretold by planetary conjunctions.

## **Mathematics**

Jean des Murs's principal contributions to fourteenth-century mathematics, the *De arte mensurandi* (c.1344) and the *Quadripartitum numerorum* (1343), were both written relatively late in his career, when he had already settled in Mezières-en-Brenne (Dept. Indres) as a

member of the local collegiate church. For evidence of his early interests in mathematical questions, we are dependent on a few shorter pieces that probably originated in the context of the Parisian arts faculty. These include the *Figura inveniendi sinus in kardaga*,<sup>27</sup> a short geometrical tract on sine computations, and the *Tabula tabularum* aiding sexagesimal computations.<sup>28</sup> These two texts are both connected to Jean's work as an astronomer. Two others texts from this early period, the *Arbor Boecii*<sup>29</sup> and the *Arithmetica speculativa*<sup>30</sup> instead function as abridgements and adaptations of Boethius's *De institutione arithmetica* in a university context. In contrast to the two first texts, they point prominently, though not exclusively, to the musical interests of Jean des Murs. These connections between his early works in arithmetic or geometry and his musical or astronomical interests are also present in some of his texts in the latter two disciplines, some of which develop mathematical ideas (e.g., the canons to the *Tabule permanentes* or the *Musica speculativa*). Guided by this evidence it is relatively easy to find traces of the musician and astronomer in the *De arte mensurandi* and the *Quadripartitum numerorum*.

This approach to the mathematical works of Jean des Murs is explored in Matthieu Husson's contribution through a focus on questions related to small quantities. His paper identifies the specific mathematical techniques Jean used to express, measure, and reckon with small quantities in both a musical and an astronomical context. While some obvious contrasts exist between the two contexts, deeper points of convergence emerge. Among them, the link between small quantities and the issue of incommensurability is particularly striking. They show that when difficult mathematical questions appear, either in a musical or astronomical context, the otherwise strong bond between music and arithmetic, on one side, or astronomy and geometry, on the other, could become looser. A second important point of convergence discussed by Husson is Jean's conception of the relation between mathematical arguments and the phenomena described in the natural sciences. His understanding of this

relation, which asserted the precedence of the physical and sensible aspects of objects or phenomena over their mathematical aspects, was established quite early in his intellectual career and remained stable in his later works. Jean des Murs relied on this conception to establish some of his innovations in music and astronomy.

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The diffusion and depth of Jean des Murs's quadrivial works as well as his contacts and patrons across a wide variety of institutional contexts--university, church, and court--position him as a key figure in fourteenth-century intellectual life. His working habits and the ways in which he approached particular problems--as evidenced by his many marginal annotations, management of his personal library, and his continual reworking and recasting of seminal issues in a variety of quadrivial contexts--provide historians with unusually detailed evidence to study his intellectual development over several decades. The fact that he made contributions to all branches of the quadrivium offers us a rare opportunity to analyse the relations between these four disciplines, and to see how training in one field could influence approaches to, and developments in, another. Another point worth making is that these interactions within the quadrivium took place in the then relatively new context of the *scientiae mediae*, whose individual disciplines, such as optics or the sciences of weights, could provide an impetus for renewed reflections on the use of mathematics in the study of natural phenomena.

The contributions in this special issue engage with these various questions, but also encourage further lines of inquiry, which would include, but are not limited to: the attribution and chronological order of Jean des Murs's treatises, the milieus in which he developed his research, and the reception and later readership of his work from the fourteenth well into the fifteenth century. It is our hope that cross-disciplinary research of the sort carried out by this

collective of authors can make further headway towards elucidating these areas and enable us to reveal the coherence and dynamism of Jean des Murs's quadrivium.

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<sup>1</sup> On the music theory of Jean des Murs, see Ulrich Michels, *Die Musiktraktate des Johannes de Muris* (Wiesbaden, 1970); Daniel Katz, 'The Earliest Sources for the *Libellus cantus mensurabilis secundum Johannem de Muris*' (Ph.D. diss., Duke University, 1989); Max Haas, 'Musik zwischen Mathematik und Physik: Zur Bedeutung der Notation in den "Notitia artis musicae" des Johannes de Muris (1321)', in *Festschrift für Arno Volk* (Cologne, 1974), 31-46; Dorit E. Tanay, 'Jehan de Meurs's Musical Theory and the Mathematics of the Fourteenth Century', *Tractrix* 5 (1993), 17-43; Tanay, *Noting Music, Marking Culture: The Intellectual Context of Rhythmic Notation 1250-1400* (Holzgerlingen, 1999); Frank Hentschel, *Sinnlichkeit und Vernunft in der mittelalterlichen Musiktheorie: Strategien der Konsonanzwertung und der Gegenstand der 'Musica sonora' um 1300* (Stuttgart, 2000), 81-3, 239-50; Christian Meyer, *Jean de Murs: écrits sur la musique* (Paris, 2000); Felix Diergarten, 'Omnis ars ex experimentis dependeat: "Experiments" in Fourteenth-Century Musical Thought', in *Experimental Affinities in Music*, ed. Paulo de Assis (Leuven, 2015), 42-59; Diergarten, 'Circa artis experientiam laborare: Spätmittelalterliche Musikunterweisung zwischen Wissenschaft und Handwerkslehre', in *Schüler und Meister*, eds. Andreas Speer and Thomas Jeschke (Berlin, 2016), 761-76, Karen Desmond, *Music and the moderni, 1300-1350: The ars nova in Theory and Practice* (Cambridge, 2018); and the contributions by Desmond and Elżbieta Witkowska-Zaremba in this volume.

<sup>2</sup> This text was edited by Emmanuel Poulle, 'Jean de Murs et les Tables Alphonsines', *Archives d'histoire doctrinale et littéraire du Moyen Âge* 47 (1980), 241-71. See also Matthieu Husson, 'L'astronomie alphonsine dans l'*Expositio intentionis regis Alfonsii circa tabulas ejus* de Jean de Murs', *Archives d'histoire doctrinale et littéraire du Moyen Âge* 78 (2011), 229-45.

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<sup>3</sup> Beatriz Porres de Mateo and José Chabás, ‘John of Murs’s *Tabulae permanentes* for Finding True Syzygies’, *Journal for the History of Astronomy* 32 (2001), 63-72; Richard L. Kremer, ‘John of Murs, Wenzel Faber and the Computation of True Syzygy in the Fourteenth and Fifteenth Centuries’, in *Mathematics Celestial and Terrestrial: Festschrift für Menso Folkerts zum 65. Geburtstag*, eds. Joseph W. Dauben, Stefan Kirschner, Andreas Kühne, Paul Kunitzsch, and Richard P. Lorch (Stuttgart, 2008), 147-60.

<sup>4</sup> Edition by Ghislaine l’Huillier, ed., *Le Quadripartitum numerorum de Jean de Murs: introduction et édition critique* (Geneva, 1990).

<sup>5</sup> George Sarton, ‘The First Explanation of Decimal Fractions and Measures (1585): Together with a History of the Decimal Idea and Facsimile (No. XVII) of Stevin’s Disme’, *Isis* 23 (1935), 153-244, at 169-70.

<sup>6</sup> Edition by H. L. L. Busard, ed., *Johannes de Muris, ‘De Arte Mensurandi’: A Geometrical Handbook of the Fourteenth Century* (Stuttgart, 1998).

<sup>7</sup> See Marshall Clagett, *Archimedes in the Middle Ages*, vol. 3.1 (Philadelphia, 1978), 3-123; Menso Folkerts and Barnabas Hughes, ‘The Latin Mathematics of Medieval Europe’, in *Sourcebook in the Mathematics of Medieval Europe and North Africa*, ed. Victor J. Katz (Princeton, NJ, 2016), 4-223, at 140.

<sup>8</sup> Two notable exceptions that current and future research can build on are: Max Lejbowicz, ‘Présentation de Jean de Murs, “observateur et calculateur sagace et laborieux”’, in *Méthodes et statut des sciences à la fin du Moyen-Âge*, ed. Christophe Grellard (Villeneuve d’Ascq, 2004), 159-80; and Emmanuel Poulle, ‘Les astronomes parisiens au XIV<sup>e</sup> siècle et l’astronomie alphoncine’, in *Histoire littéraire de la France*, vol. 43.1 (Paris, 2005), 1-54, at 5-35, although the latter focuses mostly on des Murs’s astronomical works.

<sup>9</sup> The discovery of these notes was first announced in Guy Beaujouan, ‘Histoire des sciences au Moyen Âge’, *École Pratique des Hautes Études: Annuaire*, IV<sup>e</sup> section (Sciences

historiques et philologiques), 97 (1964), 259-62. See also Beaujouan, 'Observations et calculs astronomiques de Jean de Murs (1321-1344)', in *Proceedings of the XIVth International Congress of the History of Science*, 4 vols. (Tokyo, 1975), 2:27-30, repr. as chapter 7 in Beaujouan, *Par raison des nombres: l'art du calcul et les savoirs scientifiques médiévaux* (Aldershot, 1991); Matthieu Husson, 'Exploring the Temporality of Complex Computational Practice: Two Eclipse Notes by John of Murs in the ms Escorial O II 10', *Centaurus* 58 (2016), 46-65.

<sup>10</sup> Lawrence Gushee, 'New Sources for the Biography of Johannes de Muris', *Journal of the American Musicological Society* 22 (1969), 3-26. See also Gushee, 'Jehan des Murs and his Milieu', in *Musik--und die Geschichte der Philosophie und Naturwissenschaften im Mittelalter: Fragen zur Wechselwirkung von 'Musica' und 'Philosophia' im Mittelalter*, ed. Frank Hentschel (Leiden, 1998), 339-71.

<sup>11</sup> Gushee, 'New Sources', 4 n. 6.

<sup>12</sup> See Katz, 'The Earliest Sources', 8-9. There are two textual traditions for the treatise--the unedited 'recensio minor', which is earlier and extant in only six manuscripts, and the 'recensio major', whose A and B versions were edited in Christian Berktold, ed., *Ars practica mensurabilis cantus secundum Iohannem de Muris: Die Recensio maior des sogenannten "Libellus practice cantus mensurabilis"* (Munich, 1999). The *Libellus* remained an influential text for fifteenth-century theorists: an important and extensive commentary dating from 1404 is that written by the Paduan mathematician, astronomer, and music theorist Prosdocimo de' Beldomandi (d. 1428). Lawrence Gushee characterizes the evidence for Jean des Murs's direct authorship of the *Libellus* as 'relatively weak'. See Lawrence Gushee, Matthew C. Balensuela, and Jeffrey Dean, 'Muris, Johannes de', in *Grove Music Online*. *Oxford Music Online* (2001), available at <http://www.oxfordmusiconline.com> [2 October 2018].

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<sup>13</sup> Katz, 'The Earliest Sources', 7.

<sup>14</sup> Jean des Murs, *Notitia artis musicae*, ed. Ulrich Michels, *Corpus Scriptorum de Musica* 17 ([Dallas, TX]: American Institute of Musicology, 1972), 94: 'Omne quod a voce recta, integra et regulari cantando profertur, debet sapiens musicus per notulas debitas figurare'.

<sup>15</sup> Jean des Murs, *Notitia artis musicae*, ed. Michels, 85.

<sup>16</sup> For Jacobus's *Speculum musicae*, see *Jacobi Leodiensis Speculum musicae*, ed. Roger Bragard (Rome, 1955-73). For Jacobus's criticisms of the *moderni*, see most recently Desmond, *Music and the moderni*.

<sup>17</sup> This number is according to Christoph Falkenroth, ed. *Die Musica speculativa des Johannes de Muris: Kommentar zur Überlieferung und kritische Edition* (Stuttgart, 1992), 5.

<sup>18</sup> The short course of music study required at the University of Paris focused on speculative music theory, with Boethius's *De institutione musica* books 1 and 2 as the official textbook. See esp. ch. 1 of Gilles Rico, 'Music in the Arts Faculty of Paris in the Thirteenth and Early Fourteenth Centuries' (D.Phil. diss., Oxford University, 2005), 14-75; Joseph Dyer, 'Speculative "Musica" and the Medieval University of Paris', *Music and Letters* 90 (2009), 177-204.

<sup>19</sup> Jean des Murs, *Musica speculativa* (Version A), Pars II, Propositio 5, 49-51, ed. Elżbieta Witkowska-Zaremba, *Musica Muris i nurt spekulatywny w muzykografii średniowiecznej* (Warsaw, 1992), 198: '... quae multum placent mathematicis'.

<sup>20</sup> José Chabás and Bernard R. Goldstein, 'John of Murs's Tables of 1321', *Journal for the History of Astronomy* 40 (2009), 297-320; Chabás and Goldstein, 'John of Murs Revisited: The *Kalendarium Solis et Lune* for 1321', *Journal for the History of Astronomy* 43 (2012), 411-37. On the significance of 1321 as Jean des Murs's 'banner year', see Karen Desmond's contribution in this volume.

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<sup>21</sup> The standard study on the early history of the Alfonsine Tables is José Chabás and Bernard R. Goldstein, *The Alfonsine Tables of Toledo* (Dordrecht, 2003). On the contentious question of the Castilian vs Parisian origin of these tables in their standard Latin version, see also Emmanuel Poulle, 'Les Tables Alphonsines sont-elles d'Alphonse X?', in *De astronomia Alphonsi regis*, eds. Mercè Comes, Roser Puig, and Julio Samsó (Barcelona, 1987), 51-69; Poulle, 'The Alfonsine Tables and Alfonso X of Castille', *Journal for the History of Astronomy* 19 (1988): 97-113; Poulle, 'Les astronomes parisiens'; John D. North, 'Just Whose Were the Alfonsine Tables?', in *From Baghdad to Barcelona*, eds. Josep Casulleras and Julio Samsó, vol. 1 (Barcelona, 1996), 453-475; Noel M. Swerdlow, 'Alfonsine Tables of Toledo and Later Alfonsine Tables', *Journal for the History of Astronomy* 35 (2004): 479-84.

<sup>22</sup> See on this point Bernard R. Goldstein, 'Medieval Observations of Solar and Lunar Eclipses', *Archives internationales d'histoire des sciences* 29 (1979), 101-56, at 103, who states that Jean des Murs 'probably gives the best observational data before the fifteenth century'. On Jean des Murs as an astronomical observer, see also Beaujouan, 'Observations'; John M. Steele, *Observations and Predictions of Eclipse Times by Early Astronomers* (Dordrecht, 2000), 137-39; Emmanuel Poulle, 'Mesures et astronomie au Moyen Âge', *Micrologus* 19 (2011), 73-87, at 80-86; Katharine Park, 'Observation in the Margins, 500-1500', in *Histories of Scientific Observation*, eds. Lorraine Daston and Elizabeth Lunbeck (Chicago, 2011), 15-44, at 29-31.

<sup>23</sup> MS El Escorial, Real Biblioteca de San Lorenzo, O.II.10, fol. 219v. See Gushee, 'New Sources', 14.

<sup>24</sup> G. Mollat, ed., *Jean XXII (1316-1334): lettres communes*, vol. 9 (Paris, 1928), 105 (no. 47525):

<sup>25</sup> MS El Escorial, Real Biblioteca de San Lorenzo, O.II.10, fol. 92v. See Gushee, 'New Sources', 15.



<sup>26</sup> For an edition of this text, see Chris Schabel, ‘John of Murs and Firmin of Beauval’s Letter and Treatise on Calendar Reform for Clement VI: Text and Introduction’, *Cahiers de l’Institut du Moyen Âge Grec et Latin* 66 (1996), 187-215. The background is discussed in C. Philipp E. Nothaft, ‘Science at the Papal Palace: Clement VI and the Calendar Reform Project of 1344/45’, *Viator* 46, no. 2 (2015), 277-302; Nothaft, *Scandalous Error: Calendar Reform and Calendrical Astronomy in Medieval Europe* (Oxford, 2018), 205-34. Two other works on calendar reform that have been attributed to Jean des Murs in the past are probably not by him. For editions of these, see Chris Schabel, ‘*Ad correctionem calendarii*... The Background to Clement VI’s Initiative? Text and Introduction’, *Cahiers de l’Institut du Moyen-Âge Grec et Latin* 68 (1998), 13-34; C. P. E. Nothaft, ‘The Chronological Treatise *Autores Kalendarii* of 1317, Attributed to John of Murs: Text and Introduction’, *Cahiers de l’Institut du Moyen-Âge Grec et Latin* 82 (2013), 1-89. On the latter text, see also Nothaft, ‘John of Murs and the Treatise *Autores kalendarii* (1317): A Problem of Authorship’, *Sudhoffs Archiv* 99 (2015), 209-29.

<sup>27</sup> Maximilian Curtze, ‘Urkunden zur Geschichte der Trigonometrie im christlichen Mittelalter’, *Bibliotheca mathematica*, 3rd ser., 1 (1900), 321-416, at 413-16.

<sup>28</sup> Copies include MSS Paris, Bibliothèque nationale de France, lat. 7401, pp. 115-124; Erfurt, Universitäts- und Forschungsbibliothek, Amplon. F. 377, fols. 35v-36r, 37r-38r; London, British Library, Add. 24070, fols. 64r-67r. A transcription of the text attested in the latter manuscript is found in Beatriz Porres de Matteo, ‘Les tables astronomiques de Jean de Gmuden: édition et étude comparative’ (PhD diss., École Pratique des Hautes Études, 2003), 635-42.

<sup>29</sup> Copies include MSS Erfurt, Universitäts- und Forschungsbibliothek, Amplon. F. 377, fol. 35v-36r; Paris, Bibliothèque nationale de France, lat. 16621, fols. 62v-64r. John Gmunden included a modified version of this text in his work.

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<sup>30</sup> H. L. L. Busard, 'Die Arithmetica speculativa des Johannes des Muris', *Scientiarum historia* 13 (1971), 103-32; but see also Rico, 'Music', 67 n. 179, who doubts the attribution to Jean des Murs.