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## ► To cite this version:

Valérie Nunes-Le Page, Frédéric Billiet. The Past Has Ears at Notre-Dame: interactions between archaeoacoustics and musicology for new interpretation proposals for the polyphonies of Notre-Dame. *Musiktheorie - Zeitschrift für Musikwissenschaft*, 2022, *Virtuelle Klängräume der Vormoderne*, 2022 (1), pp.64. hal-03778963

**HAL Id: hal-03778963**

**<https://hal.science/hal-03778963>**

Submitted on 16 Sep 2022

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**The Past Has Ears at Notre-Dame:**

interactions between archaeoacoustics and musicology for new interpretation proposals for the polyphonies of Notre-Dame

Abstract : The PHEND Project examines musical practices in Notre-Dame of Paris Cathedral from the time of its construction until today. Were the architectural modifications of this building the cause or consequence of the rise of the Notre-Dame School polyphonies at the end of the XIIth century? We propose to show how the interaction between scientific disciplines informs performers about the compositions and their interpretation from the perspective of acoustic data. The spatial organization of the cathedral at that time, the intended audience and the reverberation of the sound, for example, inform us about the number of singers for specific pieces, their ability to develop more and more virtuosic polyphonies and the composers' purpose. Because of the still very important oral tradition at this time, experimentations with singers and acousticians reveal possibilities for which written sources lack sufficient detail.

Since its construction, the Gothic cathedral of Notre-Dame de Paris has become the emblematic place of musical creation in Europe, which historians have called the "Notre-Dame School". The new musical forms were undoubtedly developed during the period of the building's construction<sup>1</sup>, but specialists agree that a large part of the organa and conduit repertoire of Notre-Dame was composed between 1160 and 1225<sup>2</sup>.

Exceptional documents testify to the musical activity during this period and it is possible to think that the spectacular development of Parisian polyphony at the end of the 12th century coincided with the organisation of the liturgy in the new choir inaugurated in 1182<sup>3</sup>. The decrees of Notre-Dame Cathedral, promulgated in 1198 and 1199 by Bishop Eudes de Sully, attest to the practice of two, three and four voices for the responsorial chants of the mass and the offices as well as for the *Benedicamus Domino of Vespers*. In addition, texts that describe musical practices admired throughout Europe attract our attention for our research project The Past Has Ears at Notre-Dame (<http://phend.pasthasears.eu/>)<sup>4</sup>, such as the very famous treatise *De mensuris et discantu*, better known as the *Treatise of Anonymous IV*, the work of an English scholastic, written in Paris around 1275.

To support the musicological part of the project, researchers have at their disposal several notated manuscripts containing polyphonies created and sung at Notre-Dame de Paris<sup>5</sup>. Reconstructions of the very famous *Magnus liber organi* of Notre-Dame de Paris<sup>6</sup> and other manuscripts containing conduits and motets allow today's performers to sing this polyphony in 2, 3 or 4 voices<sup>7</sup> but not always in the best conditions and without knowing the acoustic qualities of the place of creation.

Furthermore, the studies on the representations of singers in musical iconography carried out within the MUSICONIS program (<http://musiconis.huma-num.fr/>)<sup>8</sup> will give a more precise idea of the polyphonic devices in the choir of Notre-Dame and the Gothic cathedrals<sup>9</sup>. The aim here is to gain a better understanding of the number of singers and vocal tessituras, the location in the choir around the lectern or in the stalls, the direction of the voices towards the chevet, and the materials that can modify the propagation of sound. The analysis of serial images of vocal practices in Notre-Dame and other religious buildings gives good indicators, but understanding the interplay of sound that always exists between singers and the acoustics of the space, even more apparent in the case of experimental polyphony. At Notre-Dame de Paris in the 13th century, many polyphonies were constructed from the liturgical *cantus firmus* and the upper voices were added according to rules of counterpoint that were adapted to the resonance of the place. Certain echo or imitation formulas were retained from these sound experiments and the most beautiful achievements are undoubtedly those copied in the famous manuscripts<sup>10</sup>.

All this knowledge gathered on polyphonic practices at Notre-Dame must therefore be tested in an acoustic, virtually reconstituted<sup>11</sup>. The singers of the "Rue des Chantres" ensemble<sup>12</sup> have been asked to perform a few characteristic works in a recording studio, and the researchers are working to install these polyphonies in the

acoustics that are as close as possible to the conditions in which they were performed at the time the works were created<sup>13</sup>.

Here is the first choice to make the experiments for PHEND with “Rue des Chantres”: with polyphonies from one to four voices.

\* 1 voice: *Advenisse parisius* Répons. Paris, Bibliothèque Sainte-Geneviève, Ms 1283, ff. 47v-48, XIIIth c. (3rd quarter).

\* 2 voices: *In preclare Genovefe* Hymne. Paris, Bibliothèque Sainte-Geneviève, Ms 1283, f. 40, XIIIth c. (3rd quarter).

\* 3 voices : *Ave Maria* - Antoine Brumel (ca. 1460-1512/3) 3 voices Motet. Bologne, Museo internazionale e Biblioteca della musica, Ms Q.17, ff. 2v-3, ca. 1490.

\* 4 voices: *Viderunt omnes* - Pérotin (active, late 12th c. - early 13th c.) Organum quadruplum. Florence, Biblioteca Medicea-Laurenziana, Pluteus 29.1, ff. 1-4, ca. 1250; Paris, Bibliothèque nationale de France, Ms latin 1112, f. 20, ca. 1225.

The "musical rhetoric"<sup>14</sup> described and commented on in *Anonymous IV* and other theoretical texts, can be sought by modifying certain parameters of sound reverberation. The study underway with acousticians also seeks to show the difference in sound propagation between a Romanesque church of the same type as the first roman cathedral of Paris, and this new building that replaced it in the 12<sup>th</sup> century. Measurements taken in similar buildings should provide some insight into the transition from plainsong, sometimes accompanied by a drone or a parallel organum, to highly virtuosic polyphony.

The question also arises as to the very significant reverberation that we now see in Gothic churches and which should make these polyphonies muddled. Their development, encouraged by a clergy that devoted a lot of resources to them (training and maintenance of singers), tends to prove that they should, despite their complexity, sound clear.

It is then that we realize the richness and profusion of the decorative elements that were part of the very layout of these buildings. Curtains, fences, rood screens, furniture (stalls, objects, statues, etc.) are widely described in the images, in the chapter's sources (inventories, account books, etc.) and, with the presence of numerous canons and choirboys, must have considerably reduced the phenomenon of resonance<sup>15</sup>.

Another aspect of the perception of the music is that the polyphony was only intended for the members of the chapter, gathered in the choir. The target audience for this repertoire was therefore mainly those who practiced it, both at services and during masses. Later, when the construction of the nave was completed, the intense activity in the cathedral meant that liturgical music could only be heard as a kind of ambient soundscape, concentrated in the chevet and covered by the sounds of people moving around the cathedral and the constant activity around the chapels where many low masses were said, important sources of income for the clergy.

All this information is collected from soundscape archaeologists, architects and art historians<sup>16</sup>. Such information allows us to advance towards a better understanding of the different musical moments of the liturgy. These new elements clarify the place of the singers for certain pieces, whether they are antiphonic or polyphonic, calling upon the whole schola or only a small group of virtuoso singers.

To verify these hypotheses, the acousticians, in close collaboration with art historians, are seeking to create sound models into which they can insert the voices of an ensemble of singers recorded in an anechoic chamber (a recording absent of any room reflections)<sup>17</sup>.

The difficulty was to find the best configuration for recording the voices so that they could be positioned in different parts of the church, acoustically reconstructed according to the criteria of the time. This is unmeasured

music, and the sound recording configuration must account for the fact that the performers must be able to hear and listen to each other very carefully. By creating these acoustic renderings, models and digital simulations, the acousticians, informed by the group of researchers on the practices and contexts of liturgical chant and especially the growing use of polyphony, will be able to propose plausible hypotheses as to the evolution of the musical and environmental sound that resounded in and outside Notre-Dame from its construction until the fire of 2019. Acoustic measurements made in 1987 and 2013 within the cathedral, compared with similar measurements in other churches of the same type, confirm the reliability of the exercise<sup>18</sup>. The discussions raised by the recording sessions within the team of singers and musicologists during the first working sessions brought to light the importance of placing the singers within the choir space, specifically in the stalls and around the lectern, as well as their number and the tempi, all imposed by the acoustics. The transitions between *organum duplum* and polyphony, singing in Romanesque churches and the virtuosity that accompanies the Gothic era remain to be investigated, with interviews planned with singers and leaders of medieval and liturgical music ensembles in order to gather their practices and points of view. The historical landmarks chosen during the project will illustrate important moments in the history of the Paris cathedral. Thus, a work by Antoine Brumel (v. 1460-1512/3) has been chosen for the end of the 15th century and the completion of the major transformations of the cathedral: Motet à 3 voix *Ave Maria*, ca 1490<sup>19</sup>. This will be followed by historical events such as the marriage of Louis XIII, the coronation of Napoleon, the restoration by Viollet-Le-Duc and finally the conditions prior to the fire in 2019. Each will be illustrated by key works of their time. We hope that these different approaches to a musical event, at a given time, will enable scientists of all disciplines as well as performers to better understand, link and restore these repertoires which have evolved in parallel with the aesthetics and function that society wished to attribute to its heritage in each period.

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<sup>1</sup> Musical examples and technical analysis in Guillaume Gross, *L'organum à Notre-Dame de Paris au XIIIe siècle. Étude sur les modes d'élaboration d'un genre musical*, 2 vols, doctoral thesis, Université François-Rabelais de Tours, 2004, 730 p. Cf: Les débuts de la polyphonie à Paris: les premiers organa parisiens, studied by Wulf Arlt and Hans Oesch (eds.), Forum Musicologicum III, Winterthur, Amadeus Verlag, 1982, pp. 93-163 (Basler Beiträge zur Musikgeschichte, 3). See also, "Observations sur les origines de l'École Notre-Dame", in Michel Huglo, Christian Meyer and Marcel Pérès (eds.), *Aspects de la musique liturgique au Moyen Âge. Actes des Colloques de Royaumont*, 1986-1987-1988, Paris, Créaphis, 1991, pp. 152-158.

<sup>2</sup> Richard Hoppin, *La musique au Moyen Âge*, Liège, Mardaga, 1991, p.256.

<sup>3</sup> Cf. Rebecca Baltzer, "The geography of the liturgy at Notre-Dame of Paris", in Thomas Kelly (ed.), *Plainsong in the Age of Polyphony*, Cambridge (Mass.), Cambridge University Press, 1992, pp. 45-64.

<sup>4</sup> PHEND Team: Brian FG KATZ, Director of Research CNRS, leader of the PHE and PHEND projects, Béatrice Caseau, Frédéric Billiet, Dany Sandron (Sorbonne University), Mylène Pardoën (CNRS), Jean-Marc Lyzwa (CNSMDP)

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<sup>5</sup> The main documents referring to this practice in organo, vel triplo vel quadruplo were published in 1932 by Jacques Handschin: *Zur Geschichte Notre-Dame*, Acta Musicologica, 4, 1932, pp. 6-14. See more recently Craig Wright, *Music and Ceremony at Notre-Dame de Paris, 500-1500*, Cambridge (Mass.), Cambridge University Press, 1989, pp. 239-243 and 369-370; Guillaume Gross, "Chanter en polyphonie à Notre-Dame de Paris sous le règne de Philippe Auguste : un art de la magnificence", Presses Universitaires de France | "Revue historique", 2006/3, p.611.

<sup>6</sup> Mark Everist, *French Thirteenth-Century Polyphony: Aspects of Sources and Distribution*. New York and London: Garland, 1989. Mark Everist was visiting professor at Sorbonne University in 2021.

<sup>7</sup> Edward H. Rosner (ed.), *Magnus liber organi de Notre-Dame de Paris. Les quadrupla et les tripla parisiens*,

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vol. 1, Monaco, L'Oiseau-Lyre, 1993, pp. XIX-XXV, Everist, Mark (ed.) (2002) *Les organa dupla, Florence, Biblioteca Medicea-Laurenziana, pluteus 29.1: les organa de la messe, II (Magnus liber organi, 4)*, vol. 4, Monaco. Éditions de l'Oiseau-Lyre followed by other volumes.

<sup>8</sup> Musical Iconography project, directed by Frédéric Billiet:  
<https://www.iremum.cnrs.fr/fr/base-de-donnees/musiconis>

<sup>9</sup> Valérie Le Page: *La représentation du chant dans l'iconographie musicale au Moyen Âge / The representation of singing in musical iconography in the Middle Ages*, PhD project in musicology at Sorbonne University (2020-2025).

<sup>10</sup> See also the copies of these repertoires in the manuscripts of Firenze, Biblioteca Medicea-Laurenziana, ms. Pluteus 29.1; London, British Library, Ms. Egerton 2615; Montpellier, Bibliothèque Interuniversitaire Médecine, ms. H 196; Herzog August Bibliothek Wolfenbüttel 1, cod. Guelf. 628 Helmst; Madrid, Biblioteca Nacional, ms. 20486

<sup>11</sup> B. F. Katz, S. Le Conte, and P. Stitt, "EVAA: A platform for experimental virtual archeological-acoustics to study the influence of performance space," in *Intl Sym on Room Acoustics (ISRA)*, (Amsterdam), Sept. 2019 ; N. Eley, S. Mullins, P. Stitt, and B. F. Katz, "Virtual Notre-Dame: Preliminary results of real-time auralization with choir members," in *Intl Conf 3D Audio (I3DA)* ; B. F. Katz, J.-M. Lyzwa, and D. Poirier-Quinot, "La Vierge 2020 : Reconstructing a virtual concert performance Through Historic Auralisation of Notre-Dame Cathedral," in *Intl Conf 3D Audio (I3DA)*, ([url](https://youtu.be/83QClpt3hyU)). video: <https://youtu.be/83QClpt3hyU>.  
B. N. Postma and B. F. Katz, "Creation and calibration method of virtual acoustic models for historic auralizations," *Virtual Reality*, vol. 19, no. SI: Spatial Sound, pp. 161–180, 2015, doi:[10.1007/s10055-015-0275-3](https://doi.org/10.1007/s10055-015-0275-3).

<sup>12</sup> Ensemble Rue des Chantres: Christian Ploix, Erwan Piquet, Vincent Pislar, Renaud Tripathi. Some of these singers are graduates of the Master d'Interprétation des Musiques Anciennes (MIMA) at Sorbonne University.

<sup>13</sup> Elizabeth Randell Upton, *Music and Performance in the Later Middle Ages. The New Middle Ages*. New York: Palgrave Macmillan, 2013.

<sup>14</sup> Guillaume Gross, "La *repetitio* dans les *organa* quadruples de Pérotin : nature rhétorique de l'organisation du discours musical", *Musurgia*, 8, 2001, pp. 7-29.

<sup>15</sup> Mark Everist, "Music and Theory in Late Thirteenth-Century Paris: The Codex Paris, Bibliothèque Nationale f. lat. 11266". *Royal Musical Association Research Chronicle* 17 (1981), pp. 42-64.

<sup>16</sup> Mylène Pardoën " Les oreilles à l'affût ! Restitution of a soundscape: work of the imagination or search for authenticity?", *Silences et bruits du Moyen Âge à nos jours - Perceptions, identités sonores et patrimonialisation*, L'Harmattan, Paris, 2015, pp. 145-160; Dany Sandron, *Notre-Dame de Paris: histoire et archéologie d'une cathédrale (XIIe-XIVe siècle)*, Paris, CNRS, 2021.

<sup>17</sup> Mullins, S., Le Page, V., De Muynke, J., Canfield-Dafilou, E. K., Billiet, F., and Katz, B. F. G. (2021). "Preliminary report on the effect of room acoustics on choral performance in Notre-Dame and its pre-gothic predecessor". *J Acous Soc Am*, 150(4): A258.

<sup>18</sup> B. N. Postma and B. F. Katz, "Creation and calibration method of virtual acoustic models for historic auralizations," *Virtual Reality*, vol. 19, no. SI: Spatial Sound, pp. 161–180, 2015, doi:[10.1007/s10055-015-0275-3](https://doi.org/10.1007/s10055-015-0275-3). B. N. Postma and B. F. Katz, "Perceptive and objective evaluation of calibrated room acoustic simulation auralizations," *J Acoust Soc Am*, vol. 140, pp. 4326–4337, Dec. 2016, doi:[10.1121/1.4971422](https://doi.org/10.1121/1.4971422). B. F. G. Katz and A. Weber, "An acoustic survey of the Cathédrale Notre-Dame de Paris before and after the fire of 2019," *Acoustics*, vol. 2, pp. 791–802, Nov. 2020, doi:[10.3390/acoustics2040044](https://doi.org/10.3390/acoustics2040044). SI: Historical Acoustics.

<sup>19</sup> Motet à 3 voix *Ave Maria*, Bologne, Museo internazionale e Biblioteca della musica, Ms Q.17, ff. 2v-3, ca. 1490.