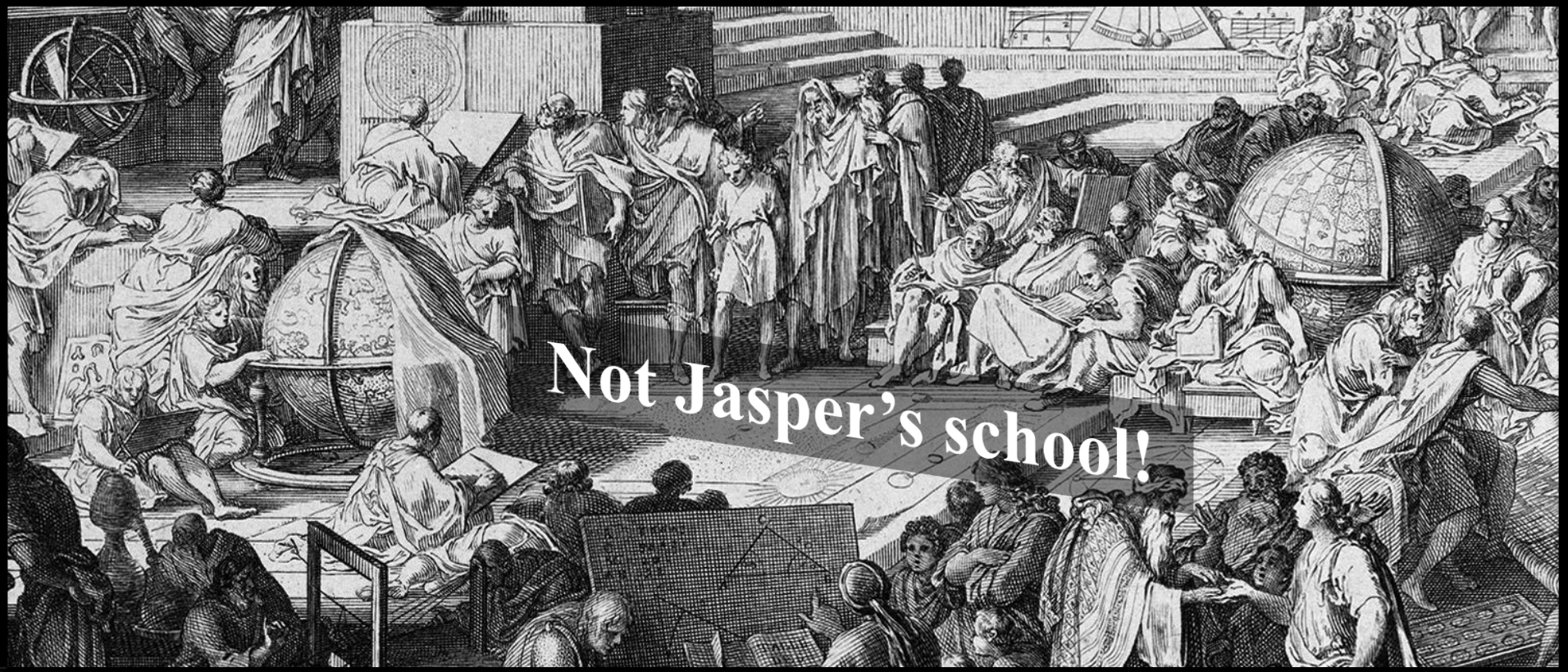
The changing relationship between music and astronomy; or what they didn't teach Jasper at school



detail of astronomy section of Sébastien Leclerc's *L'Académie des Sciences et des Beaux-Arts* (1698)

R.A. Rosenfeld, RASC & CASCA Archives

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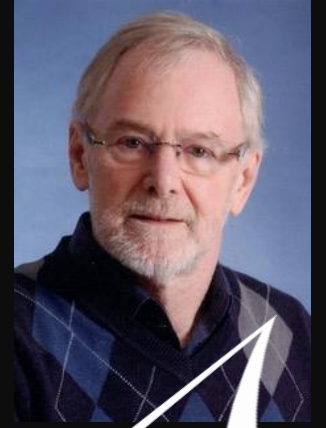
common narratives & expectations…

- "Modern" science begins in the 16th century.
- In the main a cooperatively cumulative enterprise, gradualist, punctuated by expected & unexpected εύρηκα! moments.
- Over time the practice of "real" science becomes more and more like the science we do.
- In the "scientific Revolution" and the "Enlightenment" the heroes of science & their lasting achievements finally begin to receive their full due in the wider culture—*or do they? Can this be seen in music? An interesting way to assess this is through aspects of two venerable ideas…*



Good beginnings…

to…

…the glorious present!

I. *Music of the spheres*

Baltimore, Walters Art Gallery, MS W.73, fol. 5r, saec. XII^{ex}

Ratios between basic musical intervals (*e.g.*, octave 2:1, perfect 5th 3:2, perfect 4th 4:3, major second 9:8, minor second 256:243), are the basic ratios found throughout the phenomena of nature, such as the planetary spheres. As planets and fixed stars move in their courses, they produce those proportions/intervals, which may, or may not be audible to humans. In modern terms, it's an early version of a theory of "everything" family of models. Abundant disagreements on specifics. Origins 6th-century BC? Cicero (before 43 BC): **"a concord of tones...carefully proportioned intervals, caused by the motion of the spheres…[mortals] are unable to hear it… Gifted men, imitating this harmony on stringed instruments and in singing, have gained for themselves a return to this region**".

II. *Quadrivial education*

Rheinisches Landesmus-eum Trier Neumagen ca 180-185

The mathematical disciplines of the seven liberal arts: geometry, arithmetic, astronomy, and music. They were a second tier of basic education for anyone with aspirations to formal elite education. Perhaps with an origin in the 5th century BC, it came into its own in late-antiquity (5th century AD-), & when universities were formally established these mathematical arts along with their trivial (language-arts) brethren formed the basis of undergraduate education. The attenuated influence of the liberal arts can still be detected in modern university structures (but, according to some scholars, the quadrivium disappeared from a formative role in university education by the early 16th century). **If you were educated during the years *ca.* 500 AD to *ca.* 1500 AD, you had most likely studied both astronomy & music at some level.**

So, what happens in Europe between ca. 500 AD to ca. 1500 AD…

- Science happens, including astronomical observations, & improvements in astronomical instrumentation (*e.g.*, adoption of the astrolabe, invention of the cross-staff, the *quadrans novus*, clocks, improved equatoria, & improved accuracy in scale division), planetary theory, & tables.
- Music is composed, performed, and *written*—by the 9th century there are useful notation systems, which continue to be developed, such that we have a staggeringly large amount of decipherable medieval music in manuscript, despite attrition.
- Virtually all the people working in astronomy, were also the people for whom music was part of their professional vocations—monastics & clerics.
- The result**? From *ca.* 1100–*ca.* 1400 many astronomical terms, including some quite specialized ones, end up in the texts set to music, often used allegorically. Some technical astronomical texts are given musical settings. Sophisticated pieces in praise of musicians who are also astronomers are written**.
- One of the outstanding researchers advancing astronomy in the first half of the 14th century, Jean de Murs, is also one of the chief theorists in establishing the *ars nova*, which would become the dominant musical style of his (and the subsequent) period. Philippe de Vitry, possibly the most influential composer in the early establishment of the *ars nova*, borrows astronomy texts from de Murs. *By analogy, it's as if Pierre-Simon de Laplace & Ludwig van Beethoven, or Einstein & Stravinsky, were the same person!*

London, British Library, MS add. 24189, 15r, ca.1410-ca.1420

What almost *never* happens is the production of music celebrating current scientific triumphs, or music directly stating a close relationship between itself and astronomy, or exploring astronomical themes, or celebrating contemporary astronomers.

When astronomy is set to music, it is nearly invariably in the guise of the late-antique cosmology, myth, biblical cosmology, **or satires making fun of astronomers, often calling them astrologers. No significant pieces in praise of astronomers are written**:

• Antonio de Literes, *Los elementos* (1704-1705)—the classical 4 elements , dawn & time, astrological influences , & some classical harmony of the spheres in a political allegory

•André Cardinal Destouches & Michel Richard Delalande, *Les élémens* (1721; 1725)—ancient mythology with "modern" courtly obeisance

•Jean-Féry Rebel, *Les élémens* (1737)—the classical 4 elements, although omitting (or rejecting?) Aristotle's 5th element; shows no sign of the scientific advances of Boyle (1661) and his followers

•Baldassare Galuppi, *Il mondo della luna* (1750)—Goldoni libretto (1750), *opera buffa* featuring the duping of an astrologer/astronomer

•W.A. Mozart, *Il sogno di Scipione*, K. 126, 1772—text of late-antique neo-Platonist cosmology

•Giovanni Paisiello, *Il mondo della luna* (1774-1792)—Goldoni libretto (1750), *opera buffa* featuring the duping of an astrologer/astronomer

•Joseph Haydn, *Il mondo della luna* (1777)—Goldoni libretto (1750), opera buffa featuring the duping of an astrologer/astronomer —& at least ***six*** other 18th-century settings besides those listed here—*ouch!*

•Joseph Haydn, *The Creation* (1797-1798)—biblical account based on *Genesis* and Milton's *Paradise Lost* (1667; 1674)

•There are rare exceptions , such as John Christopher Smith's *The Seasons* (1740)—based on James Thomson's Newtonian poem of 1726-1730, and G.J. Werner's *Die Jahreszeiten* (1748), with its possible portrayal of the Sun's yearly course along a heliometer.

There *is* a persistent echo of the harmony of the spheres as analogy, and tool…

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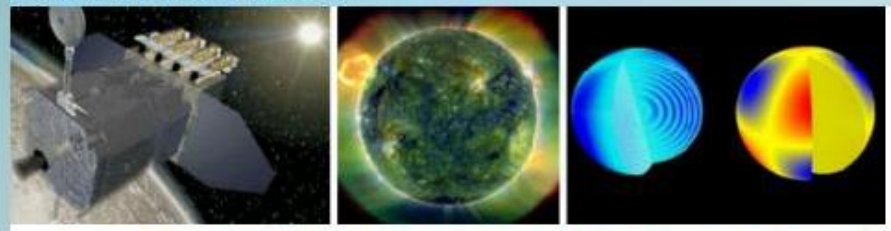
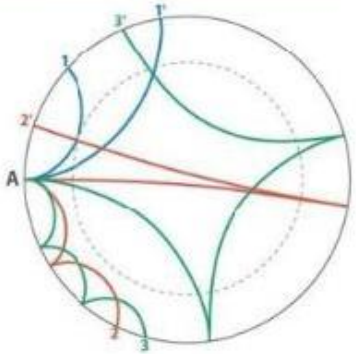
Solar and Stellar Interiors



Research: the physics of the interior of the Sun and Sun-like stars

Helioseismology: A powerful Tool in Solar Physics to study the Interior of the Sun

Millions of modes of vibration, excited by solar convection, enable astrophysicists to see inside the Sun, just as geophysicists can probe the internal structure of the Earth thanks to earthquakes. Over the past twenty five years, helioseismology has produced a considerable number of discoveries in solar, stellar, and fundamental physics. Helioseismology has provided by far the most precise tests for the theory of stellar structure and evolution, implying, in particular, a revision of the standard model of particle physics to solve the solar neutrino problem. Today, the most exciting aspect of helioseismology is the search for clues regarding the origin and variability of the Sun's magnetic field, possibly the most important unsolved problem in solar physics. The general belief is that the dynamo process, whereby magnetic field lines are stretched and twisted by internal shearing motions, causes the solar magnetic cycle. Helioseismology is our only hope to confirm this paradigm by mapping internal mass motions, structural asphericities, and their temporal variations. Thanks to fifteen years of helioseismic observations from the SOHO spacecraft (a very successful collaboration between ESA and NASA) and the ground-based network GONG, helioseismology has already provided some important results, revealing regions of rotational shear in the Sun's interior, solar-cycle variations in the rotation rate, and mysterious quasi-periodic changes at the base of the convection zone.



The next advances are expected to come from local helioseismology, which provides 3D views of the solar interior. Local helioseismology is based on the interpretation of the two-point correlations of the oscillations observed at the solar surface. Although still a developing science, it has already pinpointed a mechanism for the latitudinal transport of the magnetic flux that could determine the eleven-year period of the solar cycle. Detailed 3D maps of subsurface flows

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Hymn to the Sun, Mesomedes, 2nd century AD, court musician to the emperor Hadrian

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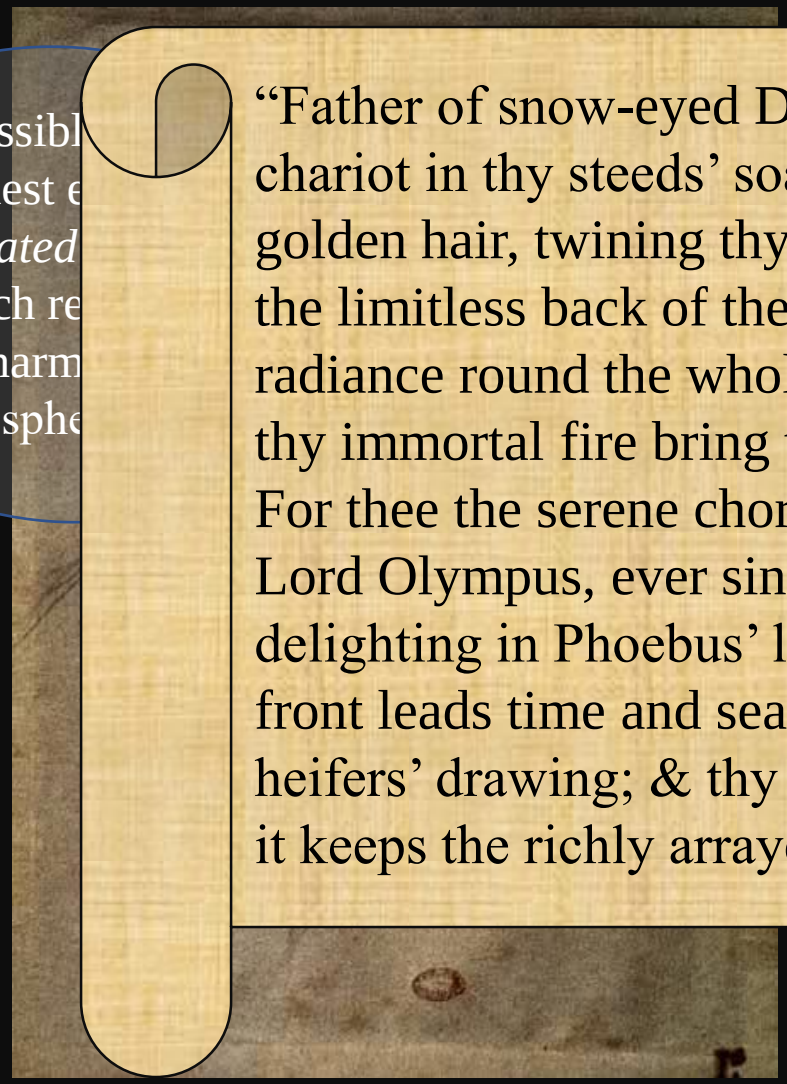
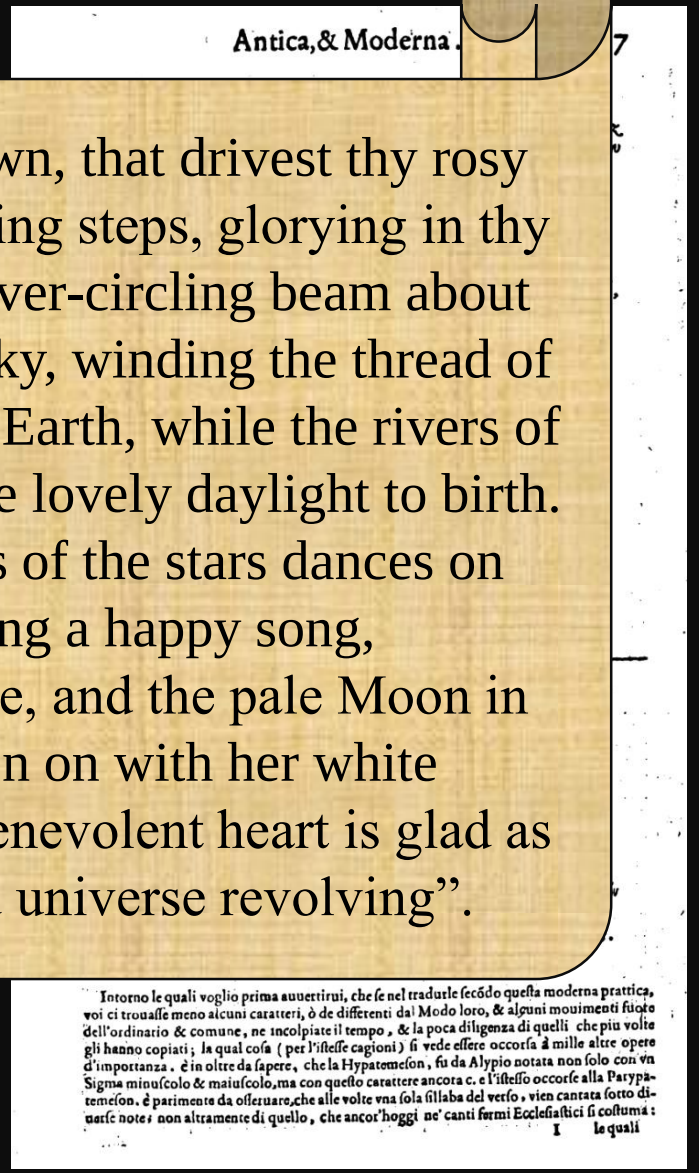
“Father of snow-eyed Dawn, that drivest thy rosy chariot in thy steeds’ soaring steps, glorying in thy golden hair, twining thy ever-circling beam about the limitless back of the sky, winding the thread of radiance round the whole Earth, while the rivers of thy immortal fire bring the lovely daylight to birth. For thee the serene chorus of the stars dances on Lord Olympus, ever singing a happy song, delighting in Phoebus’ lyre, and the pale Moon in front leads time and season on with her white heifers’ drawing; & thy benevolent heart is glad as it keeps the richly arrayed universe revolving”.



Firenze, Biblioteca Marucelliana, Disegni H 18, Ottavio Leoni, “Galileo Galilei”, 1624



Vincenzo Galilei, *Dialogo... della musica antica et della moderna* (Firenze: G. Marescotti, 1581), p. 97

Apollinis eclipsatur—Zodiacum signis—In omnem terram, Bernard de Cluny, *ca*. 1350 AD

Apollinis eclipsatur: The light of Apollo will never be eclipsed, as he is aided by the two times six signs which illuminate, with the art of harmony, the basilica peopled by that multitudinous college of musicians. In its ranks excel Johannes de Muris, by his many varieties of colours; Philippe de Vitry, from whom come many great acts; Henricus Helene, who is well versed in the order of scales diversely arranged; Dionysius Magnus and Regaudus de Tiramonte, who both drank from the spring of Orpheus; Robertus de Palatio, known for his unbridled deeds; Guillaume de Machaut, who rejoices in poetry; Egidius de Murino who sings with Garinus, known in Soissons; Arnaldus Martinus, the perennial nightingale; Petrus de Brugis, Gaufridus de Barilio, whose voices reach from this world to the heavenly throne. May all these be rewarded for their glory. ***Zodiacum signis***: The signs illuminate the Zodiac, shining brilliantly with the harmony of Phoebus, clearly assisted by their music; their triple light is equalled by the Pythagorean number, the solid foundation laid by Boethius. B[ernard] of Cluny, illuminated with the energies of practical art and theory alike, is recommended to all because of these salutary things: through the triple material of music he gives advice on names. ***In omnem terram***: Their fame goes forth throughout the entire world.

Its top two voices have 360 syllables, one for each degree of the ecliptic; nice!

London, British Library, MS Karley 334, f. 106r, 2nd quarter 15th century

polytextual motet using astronomical/astrological imagery in praise of leading musicians, some of whom were astronomers

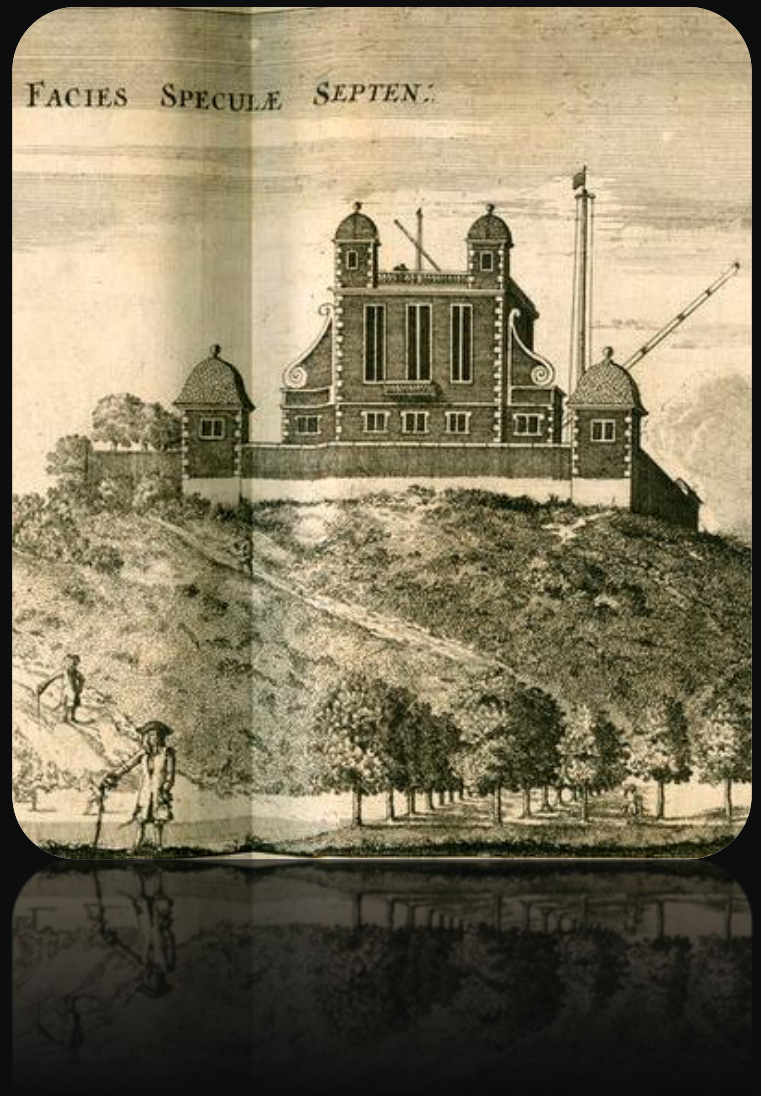
l'Armonia delle sfere harnessed to courtly flattery for the 1589 Medici wedding—Cavalieri, Ballo del Granduca/Aria di Fiorenza

Prominent state spectacle presenting a late-antique neo-Platonist cosmology (in which, incidentally, the young Galileo may have performed as a lutenist!).

London, Victoria & Albert Museum, E217-1942, Bernardo Buontalenti, design for *La Pellegrina*, primo intermedio, *l'Armonia delle sfere*, pub. 1590

...and the Royal Observatory at Greenwich?

Are the dedicated spaces in which astronomy happened reflected in music? Some of the settings for "Enlightenment" science were certainly of architectural distinction, such as the monumental *bâtiment Perrault* of the *Observatoire de Paris* (1667-1672), & Flamsteed House of the Royal Observatory, Greenwich (1675-1676). Greco-Roman temples & palaces—real & imaginary—were part of the landscape in opera & other musical forms of the time, but the palaces of contemporary



science were rare. I know of only two possible musical reflections of the settings for astronomy of the "Scientific Revolution" & the Enlightenment "L'observatoire" from Chédeville's *Les Idées françoises*, op. X (ca. 1745), a piece so insipid one hopes it *doesn't* refer to the Paris Observatory, & "Greenwich Park" from the 1709 edition of Playford's Dancing Master, which may—or may not—refer to the Greenwich Observatory.