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## ASTRONOMY AND MUSIC IN THE MIDDLE AGES: THE *LIBER INTRODUCTORIUS* BY MICHAEL SCOT

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According to an eminent medievalist, "Michael Scot may be regarded as the leading intellectual in Western Europe during the first third of the thirteenth century"[1]. Born in Scotland in about 1175, he probably studied at Oxford and Paris. In 1217 one hears of him in Spain, at Toledo, where he worked as a translator of Arabian texts. In 1220 his presence is noted at Bologna in Italy. From there he went to Sicily, in the service of the Emperor Frederick II who had gathered round him a famous court of scientists and artists. Michael Scot died, it seems, in 1235, and his fame lasted in Italian culture from Salimbene[2] to Dante[3].

His principal work is the *Liber introductorius*, which has come down to us in various versions that are not always very clear and correct, probably because the author himself worked on the treatise many times without being able to come to a definitive edition[4]. The treatise was composed at the request of the Emperor Frederick II, and is a compendium of astronomy for the use of students[5].

The most general reason for which references to music are made in a text on astronomy may be that the two sciences were both part of the system of the seven liberal arts, which Michael Scot lists, associating them with the seven planets of the solar system: grammar with the Moon, dialectic with Mercury, rhetoric with Venus, arithmetic with the Sun, music with Mars, astronomy with Jupiter, and geometry with Saturn[6]. This way of associating the liberal arts with the heavenly bodies was very common in medieval culture and appears, for example, in Dante too[7].

[1] L. Thorndike, *Michael Scot* (London 1965), p. 1.

[2] Salimbene de Adam, *Cronica*, ed. G. Scalia (Bari 1966), p. 515: "De Michaele Scotho, qui fuit bonus astrologus..."; see also p. 525, 749, 774.

[3] Dante Alighieri, *La Divina Commedia*, Inferno, XX, 115-7, ed. N. Sapegno (Verona 1957), p. 237:

"Quell'altro che ne' fianchi è così poco,
Michele Scotto fu, che veramente
de le magiche frode seppe il gioco"

[4] L. Thorndike, "Manuscripts of Michael Scot's Liber introductorius" in *Didascaliae. Studies in honor of Anselm M. Albareda* (New York 1961), p. 425-47. The manuscript Munich, Staatsbibliothek, Clm 10268, (here indicated with the letter **M**), a codex of Italian origin from the early 14th century, was used for the present study.

[5] **M**, 1 r a : "Incipit prohemium libri introductorii quem edidit Michael Scottus astrologus Frederici imperatoris Romanorum et semper augusti quemque ad eius precem in astronomia leviter composuit propter scolares"

[6] **M**, 29 v a : "Artes scripture sunt 7, causa planetarum 7, que sic eis attribuuntur: gramatica lune, dialetica mercurio, rethorica veneri, arismetrica soli, musica marti, astronomia jovi et geometria saturno"

[7] Dante Alighieri, *Il Convivio*, II, 13, ed. G. Busnelli, G. Vandelli (Florence 1954), p. 191-2: "...una comparazione che è ne l'ordine de li cieli a quello de le scienze... A li sette primi rispondono le sette scienze del Trivio e del Quadruvio..."

In particular, also, a strong link existed between astronomy and music, as they both formed part of *mathematica*, a term used to indicate the four disciplines of the traditional *Quadrivium*[8].

However, as music receives a far wider and more penetrating treatment than other disciplines in the *Liber introductorius*, one may suppose that Michael Scot was specially acquainted with, and interested in, this art. Throughout the work, in fact, one can find observations, perhaps the fruit of personal experiences, which show the attention the author paid to the musical life of his times. For example, he remembers that the *lira* or *sanphonia* is the instrument with which poor students earn their living, going from door to door playing and begging[9]. Other observations on the difficult life of the musician and player of musical instruments, and his very low social position at the time[10], can be found in the section of the treatise dedicated to astrology. As the constellation under which a man is born influences his destiny, those who are born under constellations representing musical instruments are generally destined to become players. In this way, those born under the *Lyra* do humble work: they are fowlers, fishermen, tailors or players, but in any case they will never be rich and will not have much good fortune[11]. In the same way, those born under the sign of the *Figura sonantis canon* will be able, nonetheless, to have an enjoyable life playing their instruments, but will always form part of the poorer people, and never of the rich[12].

Michael Scot also seems to have been perfectly aware of Italian musical practice and its terminology as it was in his times. He recalls, for example, the *cantus fractus* referring to a type of music which lies outside the traditional rules of liturgical song[13]. Salimbene, in fact, uses the term *cantus fractus* to counterpose the term *cantus firmus*[14]. Moreover, Michael Scot also suggests a technically precise explanation of the term *fractus*. By listing the intervals of the scale, he places a tone between F and G, but

[8] **M**, 17 r a : "mathematica iterum dividitur in arismetricam, musica ɔ, geometriam et astronomiam"

[9] **M**, 43 v b : "lira aut sanphonia pertinet ad scholares pauperos, quia si bene utantur, acquirit sibi victum ... ut patet experimento uniuscuiusque qui vadit ostiatim pulsando"

[10] W. Salmen, *Der fahrende Musiker im europäischen Mittelalter* (Kassel 1960).

[11] **M**, 82 r a : "Lira est instrumentum pulsatile ex cordis .... Natus in hoc signo falacem fortunam habebit, quoniam erit aucupator, piscator et ideo secundum omnem fortunam aucupatorum et piscatorum semper erit fortunatus. Item natus in eo erit sartor et pulsator instrumentorum cantatorum, magus, iocosa persona, ingeniosa, sapiens, pauper potius quam dives, vanam fortunam habens ac sibi sepe falacem"

[12] **M**, 82 v : "Figura sonantis canon ... Conceptus vel natus sub isto signo semper letam ducet vitam ... cum pulsatione eorum instrumentorum et erit plus pauper quam dives et tamen bene vestitus ibit". The drawing of the *Figura sonantis canon* from **M**, 82 v a is reproduced by F. Boll, *Sphaera. Neugriechische Texte und Untersuchungen zur Gechichte der Sternbilder* (Leipzig 1903), p. 274; see also p. 273-5, 439-49, 540-3.

[13] **M**, 42 r b : "quod cantus est absque regula artis et ideo fractus appellatur"

[14] Salimbene de Adam, *op. cit.*, p. 264: "... melior cantor de mundo tempore suo in utroque cantu, scilicet firmo et fracto ..."; see also p. 262, 804.



adds that *frangendo*, that is, "breaking" this interval, a semitone can be obtained: an evident allusion to F♯[15]. Therefore *cantus fractus* could indicate the frequent use of semitones in the contrapuntal voice (a sort of anticipation of the chromaticism of Marchetus de Padua) with respect to the traditional diatonicism of the *cantus firmus*.

Apart from occasional observations, two whole chapters of the *Liber introductorius* are dedicated to music. The first, entitled *De notitia armonie sive celorum 7 orbium in celo*, deals strictly with the relationships between music and astronomy, by expounding the traditional theory of the harmony of the spheres. The second, entitled *De notitia totius artis musice*, is, instead, a real treatise on music; in it are collected all the principal notions on the musical theory of the time in all its various cultural and practical aspects: definitions of music, its classifications, legends on its invention, division of the monochord, and rules for the liturgical chant expounded in the form of a dialogue between the master and his disciple. Michael Scot only quotes two authors: Boethius and Guido[16], but this is probably a symbolic reference to the two most important *auctoritates* in the fields of theoretical music and practical music respectively; Franco does the same thing in the preface to his treatise[17].

Michael Scot inserts among technical information a whole series of analogies between astronomical and musical phenomena. These insertions probably form his original contribution in the treatise, and are therefore particularly interesting. Some analogies deal with the number of elements making up music. As the astronomical system is based on the seven days of the week, in the same way the musical system is based on seven notes, and these are indicated by the first seven letters of the alphabet[18]. As the moon goes through its greatest cycle every nineteen solar years, so the musical scale is made up of nineteen sounds which the pedagogues of the time taught by the articulations of the left hand[19]. Michael Scot adds that the *sinistra manus* was used and not the right, again with reference to the moon which was considered a "sinister" planet, as it was more mobile than the others and constantly opposed to the sun, like a bad wife to her husband[20].

[15] **M**, 41 v b : "A tonus, B semitonus, C tonus, D tonus E semitonus, F tonus, G tonus, licet frangendo F et G semitonus"

[16] **M**, 42 r b : "ut ait Guido et Boetius ... non laudatur apud Boetium et Guidonem"

[17] Franconis de Colonia *Ars cantus mensurabilis*, ed. G. Reaney, *Corpus Scriptorum de Musica* 18, 1973, p. 23 : "... theorice præcipue Boetius, practice vero Guido monachus ..."

[18] **M**, 41 r b : "sicut annus regitur per septem planetas et dies ebdomade sunt septem quibus continue volvitur annus tam solis quam lune, ita per septem literas alphabeti volvitur musicalis cantus et notatur"

[19] **M**, 38 r a : "et sic in annis solaribus numero 19 luna complet suum annum maiorem que per illius esse habetur notitia nostri cantus, et sic noster cantus non potest variari ultra 19 terminos et hii termini reperiuntur in sinistra manu"

[20] **M**, 38 r a : "causa est quod luna ponitur pro planeta sinistro, eo quod est magis vaga ceteris et semper soli in omnibus contradicit tamquam adversa uxor coniugi"

Other analogies refer to the structure of the musical system. Thus, the notes ascend progressively in the scale, beginning with gamma ut, as the heavenly bodies are progressively distant from the earth, beginning with the moon[21]. And in the same way that the planets are capable of movement, and moving in the sky, periodically come into conjunction with the others, so musical notes harmonize with each other[22]. And again, as the celestial system has a sky which is motionless, called *firmamentum* with respect to the other skies which are mobile, so in polyphony there is one voice which does not move, called *cantus firmus* with respect to the others which move[23]. Here, Michael Scot refers expressly to the execution of an *organum* in which one voice seems to rest immobile while others ascend and descend until the final union[24]. A description of polyphony, very similar to this, can be found later in Dante[25].

The most original and interesting analogies, however, are those which Michael Scot poses between the astronomical system and the system of musical notation adopted in his time. As the planets are arranged at different distances one from the other, so the musical notes are predisposed at different intervals from each other; these intervals are represented concretely by the lines drawn on the page: there are generally four of them (in the same way that there are four elements making up the universe), and they can be written either in red alone, or in red, yellow and lead (that is, incised with a metal instrument); the notes are arranged on these lines and between them[26]. The author also points out that, as physical life is regulated by the presence of two heavenly bodies, the sun indicating the day and the moon the night, so musical writing is regulated by the presence of two coloured lines: a yellow line placed immediately above the text to be sung, like the moon near the earth, and a red line

[21] **M**, 37 v a : "Gamaut in luna, are in mercurio, bemi in venere, cefaut in sole, desolre in marte, elami in iove, effaut in saturno, gesolreut in 8a spera ..."

[22] **M**, 41 v b : "Et sicut planete quandoque coniunguntur non semper in una parte celi sed in diversis tam infra terram quam supra terram, ita note nostre musice coniunguntur"

[23] **M**, 38 r a : "et sic dicitur cantus firmus et nomen assupsit a firmamento celi" This seems to be the oldest appearance of the term *cantus firmus* and it must be added to the somewhat later evidences collected by W. Frobenius, "Cantus firmus" in *Handwörterbuch der musikalischen Terminologie* (Wiesbaden 1971), p. 1.

[24] **M**, 42 r b : "Patet autem hoc per cantum organi, qui cum vox firme sonet nec vage motum faciat sive reddat, omnes voces soni mutabiles arsis et thesis sibi finaliter referunt"

[25] Dante Alighieri, *La Divina Commedia*, Paradiso, VIII, 17-8, ed. cit., p. 875:
"e come in voce voce si discerne,
quand'una è ferma e l'altra va e riede"

[26] **M**, 37 v b — 38 r a : "et ad similitudinem illorum planetarum note musicales sunt vario intervallo per differentiam spatij 4 linearum, in signum 4 elementorum, que linee sunt in carta pertente, aut de rubeo tantum aut de rubeo et zallo atque plumbino, et omnes 4 fiunt spatijs equalibus et super eas et inter eas sunt note cantabiles, id est modo una hic modo alia illic"



higher up, like the sun farther away from the earth[27]. The parallel is more precise still, since, as in the musical system the two notes D and E are placed between the yellow line of C and the red line of F, so in the celestial system there are two planets: Mercury and Venus between the moon and the sun[28]. A theory dear to medieval culture can be seen in this analogy: Dante, for example, compares the sun and the moon with the two greatest spiritual and temporal powers, the Papacy and the Empire respectively[29]. With regard to the coloured lines, the musical notes are arranged as variously as the stars are strewn in the sky; moreover, again with reference to the lines, the notes seem to move with the same characteristics as the natural elements: some rising like air and fire, some descending like water and earth[30]. At first sight, therefore, a page of music seems to create an impression of confusion and uncertainty, as the notes are strewn here and there, high and low; instead, it is precisely this apparent confusion, this variety of positions which produces the beauty of song and the sweetness of consonance in music, in the same way that the apparent dispersion of the celestial bodies in the universe really implies a rational order[31]. Thus, Michael Scot gives new concreteness to an old concept of musical theory: in fact, there is now not only *musica mundana* and *musica humana*, but also *musica instrumentalis* in its most material manifestation, that is, notation, to represent an "Idea of World Harmony"[32].

[27] **M**, 41 v a : "Duo enim sunt colores quibus fiunt linee in musica et per consequens manifestius cognoscitur omnis neuma, id est nota. Causa est propter solem et lunam, quia sicut per solem regnantem in superiori spera dies cognoscitur et per lunam et eius speram nox existere, ita per consimile color crocum primo ponitur, id est iuxta textum ut luna iuxta terram, et supra ponitur cinabrum ut sol"

[28] **M**, 41 v a : "re et mi ascendendo ... ut inter solem et lunam non sunt nisi due spere, scilicet mercurii iuxta lunam et altius veneris iuxta solem"

[29] Dante Alighieri, *Monarchia*, III, 4, ed. P. G. Ricci (Verona 1965), p. 232: "Dicunt ... quod Deus fecit duo magna luminaria — luminare maius et luminare minus — ut alterum preesset diei et alterum preesset nocti: que allegorice dicta esse intelligebant ista duo regimina: scilicet spirituale et temporale"

[30] **M**, 42 v a : "Et super hos terminos et in eorum spatiis componuntur note diverse in signum vocum simile stellarum aspersarum per totum firmamentum ... Unde per tales lineas et spatia linearum est motus gradualis scalarum, scilicet ascensionis et descensionis. Et sic vocum alie habent suum pondus ad sursum ut aer et ignis, et alie ad deorsum ut aqua et terra"

[31] **M**, 38 r a : "et sic note notate in certo loco elevatione et depositione videntur ad locum erratice et inpedibiles cum sint ita asperse. Sed notandum est quod non errant nec errorem inducunt homini scienti, ymo ex tali varietate locorum in quibus sunt adnotate pulcritudinem et dulcedinem suavis consonantie in sonoritate cantus adducunt rationabiliter et presentant mirifice, ut planete et stelle in celo figuram signi nobis representantes tali aspersione, et hec est causa quare imus planeta tantum distat ab alio et una stella ab alia, sciendo quod omnia spatia ex omni parte continent rationem sue mensure"

[32] L. Spitzer, *Classical and Christian Ideas of World Harmony* (Baltimore 1963).