by Petr Daněk

Johannes Kepler and *Harmonices mundi libri V*

Hans von Aachen, likely a portrait of Johannes Kepler (early 17th century)

Prague around the year 1600

Historian Petr Daněk presents an introduction on the music theory writings of Johannes Kepler, one of the great Renaissance Humanists to have worked at the court in Prague.

In my experience, anyone can converse on the weather, politics, and music. And they often do. All that is required is to learn a few relevant technical terms, adopt some universally entrenched clichés, and tune it all up to the melody of topical social discourse, and you can join any discussion. On the subject of music, one can speak in a manner that no one understands, as the terminology is overly technical, detached from everyday reality, and an analysis of the topic is too complex for the general public. This issue does not only concern egocentric graphomaniacs – it also affects serious thinkers. Sometimes, even the ideas of original and innovative writers are swallowed up by the rush of the times, only to resurface – in the more fortunate cases – in different eras and new contexts. This is certainly true for Johannes Kepler's writings on music. His ideas on music and the harmony of the world remain challenging even today. However, this does not mean they should be forgotten, especially since they are part of the intellectual landscape of Renaissance Prague.

Johannes Kepler (1571–1630) is regarded as the founder of modern astronomy, and he also penned nearly eight hundred horoscopes. During his lifetime, he was primarily celebrated as a mathematician. He is of interest to us particularly through his treatise *Harmonices mundi* (1619), which he conceptualised and began writing during his tenure

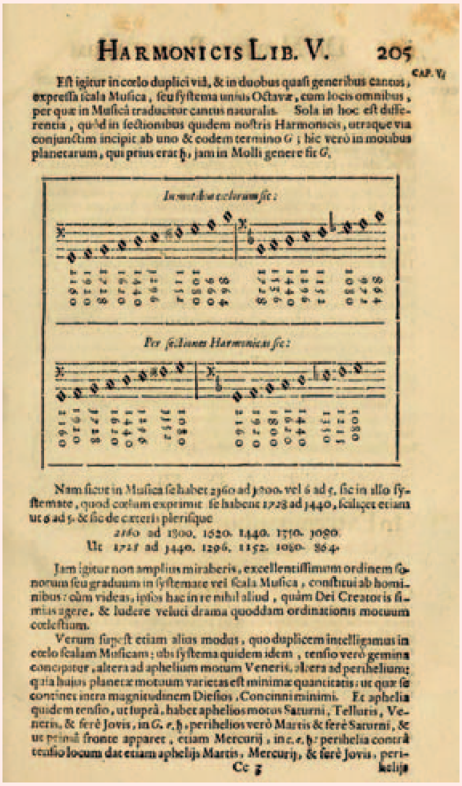
IO. KEPLERI
HARMONICES MUNDI
LIBER V.

DE HARMONIA PERFE-
CTISSIMA MOTUUM CŒLESTIUM,
orumque ex ipsidem Eccentricitatum, Semidiametrorumque &
Temporum periodicorum.

LINCII AVSTRIÆ
Excudebat Johannes Plancus,
ANNO M. DC. XIX.

Title page of Harmonices mundi Libri V, Johannes Plancus, Linz 1619

in Prague under the patronage of Holy Roman Emperor Rudolph II (1552–1612). The title is usually translated as *The Harmony of the World*. This important work provides a detailed account of Kepler's development of a theory popular with mediaeval neo-Platonist philosophers, which posited that musical harmony is reflected in the positions of the planets. Kepler expands on these ideas by considering music as an analogy for all ordered existence. For centuries, music theory had offered astronomers and philosophers a plausible explanation for the arrangement of the celestial bodies. Kepler updated this theory by asserting that celestial harmony is determined not only by the positions of the planets but also by the relationships among the distances between the planets and the Sun, and the planets' orbital periods. He believed that the planets all occasionally – and perhaps not since the time of creation – "sing" together in perfect harmony. All five books (or rather chapters) of Harmonices mundi are connected by Kepler's assertion that the world was created by God according to specific geometrical models, which are also reflected in archetypal musical harmonies. Today, Kepler's position in music is considered to be that of a unique theorist of early modernity who applied ancient concepts of celestial harmony (the music of the spheres) to contemporary astronomy. But in contrast to mediaeval thought on celestial harmony, which was metaphorical in nature, Kepler identified a genuine physical dimension of harmonic relationships in the movement of the planets. Unlike the medieval understanding of celestial harmony, which was based on monophonic music in its conception of *musica humana* and *musica instrumentalis,* Kepler drew from a knowledge of early modern polyphony. This is why his cosmic music is polyphonic and can therefore be expressed mathematically. This distinction is crucial: in his interpretation of the cosmos, all the planets sing and are in motion. Including the Earth. Our planet, Kepler claims, is characterised by the semitone motion Mi-Fa-Mi. Harmonices mundi, an original work of music theory, was created during the High Renaissance. It therefore comes as no surprise that the text encompasses astronomy and mathematics along with influences from the Kabbalah, hermetic practices, alchemical practices respected at the time, and various magical visions. At the court of Rudolph II in Prague, these streams of thought primarily found support among devotees of the occult, with whom Kepler maintained close personal contact. However, he also studied music theory. It is evident that he read the ancient theoretical writings, particularly those of Ptolemy and Boethius, and he was skeptical regarding Pythagorean tuning, which remained a contentious topic in the 16th century. Among the musical theorists of the Renaissance, he also explored the treatises of Nicolaus Listenius, Giovanni Artusi, and Vincenzo Galilei. He was in personal contact with the German music theorist, composer, and astronomer Sethus Calvisius. Kepler's treatise, however, is not merely a testament to theoretical considerations of music; practical music also plays a significant role in his arguments, particularly in topics related to tuning and harmonic relationships. In his attempt to use music notation to represent the planets of the heliocentric system, Kepler employed methods used in the composition of polyphonic music of his time. The highest authority for him were the motets of Orlando di Lasso. He repeatedly calls upon Lasso's motet "In me transierunt". Kepler connects contemporary polyphony with his attempts to notate the songs of the planets according to heliocentric astronomy. The incipit of "In me transierunt" is composed of the same solmisation syllables



HARMONICIS LIB. V. 205

CAP. V.

Eſt igitur in cœlo duplici viâ, & in duobus quaſi generibus cantus, expreſſa ſcala Muſica, ſeu ſyſtema unius Octavæ, cum locis omnibus, per quæ in Muſicâ traducitur cantus naturalis. Sola in hoc eſt differentia, quòd in ſectionibus quidem noſtris Harmonicis, utraque via conjunctim incipit ab uno & eodem termino G; hic verò in motibus planetarum, qui prius erat ♮, jam in Molli genere fit G.

Nam ſicut in Muſica ſe habet 2160 ad 1800, vel 6 ad 5, ſic in illo ſyſtemate, quod cœlum exprimit ſe habent 1728 ad 1440, ſcilicet etiam ut 6 ad 5. & ſic de cæteris pleriſque

2160 ad 1800. 1620. 1440. 1350. 1080

Ut 1728 ad 1440. 1296. 1152. 1080. 864.

Jam igitur non amplius miraberis, excellentiſſimum ordinem ſonorum ſeu graduum in ſyſtemate vel ſcala Muſica, conſtitui ab hominibus: cùm videas, ipſos hac in re nihil aliud, quàm Dei Creatoris ſimias agere, & ludere veluti drama quoddam ordinationis motuum cœleſtium.

Verum ſupereſt etiam alius modus, quo duplicem intelligamus in cœlo ſcalam Muſicam: ubi ſyſtema quidem idem, tenſio verò gemina concipitur, altera ad aphelium motum Veneris, altera ad perihelium: quia hujus planetæ motuum varietas eſt minimæ quantitatis: ut quæ ſe continet intra magnitudinem Dieſios, Concinni minimi. Et aphelia quidem tenſio, ut ſuprà, habet aphelios motus Saturni, Telluris, Veneris, & ferè Jovis, in G. e. ♮. perihelios verò Martis & ferè Saturni, & ut primâ fronte apparet, etiam Mercurij, in c. e. ♮: perihelia contrà tenſio locum dat etiam aphelijs Martis, Mercurij, & ferè Jovis, perihelijs

Cc 3

Harmonices mundi, De motibus planetarium, p. 205

HARMONICIS LIB. V. 207

CAP. VI

mnia (infinita in potentiâ) permeantes actu: id quod aliter à me non potuit exprimi, quam per continuam ſeriem Notarum intermedia-

rum. Venus ferè manet in uniſono non æquans tenſionis amplitudine vel minimum ex concinnis intervallis.

Atqui ſignatura duarum in communi Syſtemate Clavium, & formatio ſceleti Octavæ, per comprehenſionem certi intervalli concinni, eſt rudimentum quoddam diſtinctionis Tonorum ſeu Modorum. ſunt ergò Modi Muſici inter Planetas diſpertiti. Scio equidem, ad formationem & definitionem diſtinctorum Modorum requiri plura, quæ cantus humani, quippe intervallati, ſunt propria: itaque voce quodammodò ſum uſus.

Liberum autem erit Harmoniſtæ, ſententiam depromere ſuam: quem quiſque planeta Modum exprimat propiùs, extremis hic ipſi aſſignatis. Ego Saturno darem ex uſitatis Septimum vel Octavum, quia ſi radicalem ejus clavem ponas G, perihelius motus aſcendit ad ♮: Jovi Primum vel Secundum: quia aphelio ejus motu ad G accommodato, perihelius ad ♭ pervenit: Marti Quintum vel Sextum: non eò tantùm, quia ferè Diapente aſſequitur, quod intervallum commune eſt omnibus modis: ſed ideò potiſſimùm, quia redactus cum cæteris ad commune ſyſtema, perihelio motu c aſſequitur, aphelio ad f alludit: quæ radix eſt Toni ſeu Modi Quinti vel Sexti: Telluri darem Tertium vel Quartum: quia intra ſemitonium ejus motus vertuntur; & verò primum illorum Tonorum intervallum eſt ſemitonium: Mercurio verò ob amplitudinem intervalli, promiſcuè omnes Modi vel Toni convenient: Veneri ob anguſtiam intervalli, planè nullus: at ob commune Syſtema, etiam Tertius & Quartus: quia ipſa reſpectu cæterorum obtinet e.

Tellus canit MI FA MI [illegible]

CAPUT VII.

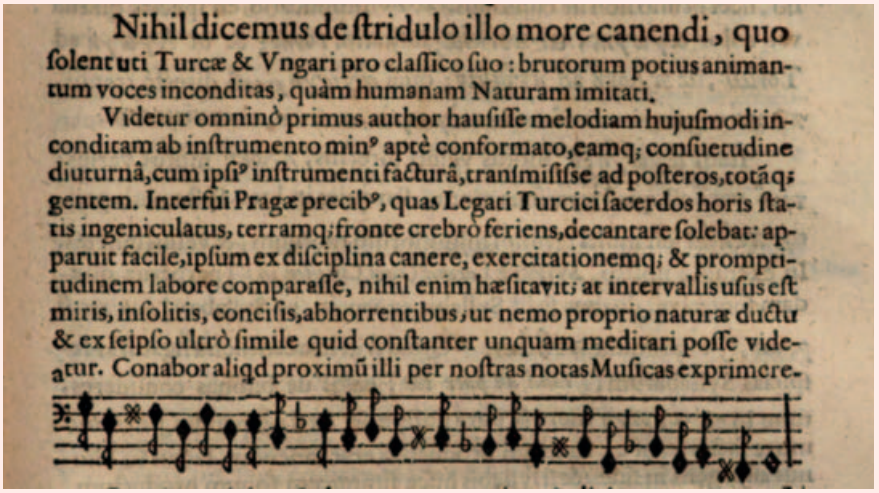
Harmonias univerſales omnium ſex Planetarum, veluti communia Contrapuncta, quadriformia dari.

NUnc opus, Urania, ſonitu majore: dum per ſcalam Harmonicam cœleſtium motuum, ad altiora conſcendo: qui genuinus

Dtto, p. 207

as Kepler's song of the Earth (Mi-Fa-Mi), which he considers a site of "destitution and starvation", and whose melody corresponds to the Phrygian modality of Lasso's motet of "lamentation".

The text of Harmonices mundi, however, is not a work of music theory as we know it from other early modern theorists. While music is discussed, the majority of the work consists of neo-Platonic meditations on the ratios between the sides of polygons, regular polyhedra (which are extensively illustrated throughout the text), and a unique polemic with the English Rosicrucian Robert Fludd. The third book is dedicated to harmonic relationships and ratios in music. This book, however, secured its place in history by virtue of containing Kepler's definition of the third law of planetary motion. Kepler, it appears, was extremely myopic and therefore could not conduct practical astronomical observations himself. Consequently, he formulated his third law of planetary motion based on data he obtained from Tycho Brahe in Prague. Additionally, he contemplated the movement of planets in another dimension: he believed that the astronomical observations of his time could validate a belief that has persisted in philosophical thought since antiquity: that the universe resonates in accordance with the principles of music. His interpretation of the harmony of the world seeks to support the profound idea that the world, the human psyche, and music are all governed by the same principles. On another level, he reiterates this perspective by asserting that the same harmonic proportions express various aspects of the organisation of the universe. Kepler encountered music in the spirit of Württemberg Protestantism throughout his childhood, both in elementary school and at church, and later as a theology student at the monastery in Tübingen. His foundational music theory handbook was the Dodecachordon, a treatise by Heinrich Glarean. Music also played a significant role during his first professional appointment as a teacher of mathematics and rhetoric in Graz. This city, partly due to the presence of Habsburg Archduke Charles II, who was based there, embraced the new Italian music of the High Renaissance. After his arrival in Prague in 1600, following an invitation from the imperial astronomer Tycho



Nihil dicemus de ſtridulo illo more canendi, quo ſolent uti Turcæ & Vngari pro claſſico ſuo: brutorum potius animantum voces inconditas, quàm humanam Naturam imitati.

Videtur omninò primus author hauſiſſe melodiam hujuſmodi inconditam ab inſtrumento minº aptè conformato, eamq; conſuetudine diuturnâ, cum ipſiº inſtrumenti facturâ, tranſmiſiſſe ad poſteros, totâq; gentem. Interfui Pragæ precibº, quas Legati Turcici ſacerdos horis ſtatis ingeniculatus, terramq; fronte crebrò feriens, decantare ſolebat: apparuit facile, ipſum ex diſciplina canere, exercitationemq; & promptitudinem labore comparaſſe, nihil enim hæſitavit; at intervallis uſus eſt miris, inſolitis, conciſis, abhorrentibus; ut nemo proprio naturæ ductu & ex ſeipſo ultrò ſimile quid conſtanter unquam meditari poſſe videatur. Conabor aliqd proximũ illi per noſtras notas Muſicas exprimere.

The description and transcription of a muezzin's song as heard by Johannes Kepler in Prague, Harmonices mundi, De Proportionibus, p. 61

Brahe, Kepler had the exceptional opportunity to engage with some of the most accomplished examples of Mannerism across various fields of art and science. However, Kepler was not uncritical of these impulses in Prague. He was unequivocally sceptical of the Kabbalah and held a disdain for all forms of esotericism, partly because they conflicted with his own interpretation of the depiction of the universe. At that time, he had developed a keen interest in the tuning of musical instruments. Although he was likely a regular attendee at court masses, where the compositions of imperial composers were performed, as well as at other social events that were accompanied by music, the only reference to Prague's musical life in *Harmonices mundi* was a curiosity: the ceremonial music of a priest/muezzin who had come to Prague as part of a Turkish envoy's entourage. Kepler attempted to transcribe the priest's singing using period Western notation to illustrate the unnatural intervals he employed. He was captivated by the priest, noting that he used "practiced and smooth mannerisms; he did not hesitate at all, but employed remarkable, unusual, curtailed, and hideous intervals, such that it seems no one, guided appropriately by nature and his own free will, could regularly consider such things. I will attempt to use our musical staff to express something akin to this music." He regarded the muezzin's expression as closer to signal music. Kepler remained in Prague until the death of Emperor Rudolph II. He then departed for Linz, where he taught at a gymnasium despite still holding the title of imperial mathematician. It was also in Linz that he completed Harmonices mundi, and the treatise was published in Latin in 1619.

Over the following centuries, Kepler's conception of the harmony of the world became somewhat outdated. Its content and originality were overshadowed by his significant contributions to mathematics and astronomy, particularly the laws of planetary motion mentioned above and works such as *Mysterium Cosmographicum* (written in 1596, published in 1621), *Astronomia nova* (1609), and *Tabulae Rudolphinae* (1627), among others. His original interpretation of the harmony of the cosmos was primarily referenced as the work of a thinker who continued a particular line of thought about music that traced back from the Pythagoreans, through Ptolemy and Boethius, and all the way to Nicholas of Cusa. It was not until the 20th century that his ideas regained serious attention. Hermann Hesse adapted Kepler's concepts in his cult novel *The Glass Bead Game*, where he explored their relationship to Eastern musical theories. German composer Paul Hindemith made Kepler the subject of his 1957 opera *Harmonie der Welt*, as well as an eponymous symphony composed six years earlier. However, these are merely the most prominent symbols of interest in Kepler's *Harmonices mundi*. It has inspired numerous other interpretations and has been expertly translated into both German and English. These interpretations vary in ideological background and foundation, and they also differ based on the writer's field of interest and level of expertise.