Rolf Maedel

JOHANNES KEPLER'S "HARMONY OF SPHERES" from today's (musical) point of view

More than 11 years ago I lectured on the above topic at the Institute for Basic Musical Research of Salzburg "Mozarteum" Academy of Music.

In addition to the following description I presented a tape recording of the anacoustical transposition of the planets' proportions. With the help of Ing. Hanel we succeeded in realizing both a static "average" model and a dynamic model of the eccentric orbital data. We transferred the 9 planets known into today's instrumental pitch range of approximately 7 octaves. One period (i.e. one revolution of Pluto of appx. 249 years) was completed in four minutes. Both sound level and timbre remained out of consideration (A tape of this recording can be found at the Institute) Almost one year later, an American LP (YALE/IBM, LP 1571) was published, covering the sounds of only those 6 planets known around 1600, adding the other three (UR, NE, PL) as rhythmical pulses. The period was equal to one side of the LP, which was of advantage for the perception of sound details, but did not favor the overall impression.

Generally, however, the total impression on the listener is similar (This LP, too, is available at the Institute).

What Kepler himself might have said about the recordings made almost 400 years later, may be expressed in the following quotation from "Harmonices Mundi":

"So, all these celestial movements are nothing but an eternal wonderful polyphonic song, understandable only spiritually, not through sounds and walking over disharmonies of tension as if it were sliding over SYNCOPATIONES or CADENTIAS as Man imitates in the natural sequence of harmonies. It leads to certain prescribed CLAUSULAS and defines the six links of its chains and through their notes the limitlessness of time without bias.

And now it is not further strange that Man–as always trying to imitate the wonderful works of his Creator–at last has invented the polyphonic song, unknown to our ancestors. For now he is able to playfully reproduce the eternity of the Worlds` duration in the short moment of an hour through an artfully interwoven composition of several voices, and to feel his Lord's delight, the Creator's delight in his works, when in a wonderfully lovely play of the senses an imitation of the godly tonal structure passes by."

And further:

"There may result the harmonic consonances of two asters each, maybe not at the limit points of their motion, but in an intermediary area …For, as (e.g.) SA moves from G to H and even higher, JU from h to d and further., so between JU and SA may result such harmonies as define the octave, the third, or the fourth …"

(Follow MA and ME, the latter–for its cycle of only three months–being able to form all harmonies with all planets). "ER and VE, on the other hand, limit these possibilities of consonance" (Lack in Harmony!).

"But should at last three planes unite for a sound of three, one has to calculate in many more relations (MA, ER, ME).–"Consonances of four will sound afew in centuries., and of five one in 10,000 years. But that all 6 (planets) unite in harmony, is an event hiding in the eternal distance of time," (cf. tables No. 3 and 5).

Now, the idea of a "Harmony of Spheres" has been conveyed to us since the time of the ancient Greeks (in 300 B.C., Aristarchos closed a development from Pholoiaos via Heraklitos, a development that should be taken up again only around 1500 A.D. by Kopernikus).

But it was Kepler who concentrated on the old teachings about the "Celestial Harmoniies"; for him they were the basic principle of all his research and–practically as a by-result–lead to those three laws, without which our present understanding of the world would not exist. From the volume V of "Hamonices Mundi" (completed in Linz in 1618), 1 will later on quote Kepler's preface to the decisive tables–written after having dismissed many faulty approaches (for 17 years): All proportions quoted have been calculated in CENT*. But before, some of Kepler"s values for earlier recordings:

table 1

Tafel 1

	V (max/min) *V (max/min)*	2-facher Wert *double value*	Sonnen-abstand *distance to Sun*	täglicher Wert *daily value*
SA :	193 c	386 c	198 c	202 c
JU :	168	335	167	179
MA:	324	649 (folg. Tafel)	322	320
ER :	58	116	62	62
VE :	23,5	47	23,9	24,5
ME:	722	1444	737	733
	NB) 1)		NB) 2)	

NB) 1): "l knew that the proportions of the presumable movements are the double of the proportion of motion on the eccentric."

NB) 2): "It need not be considered, how far every single planet is distant from the Sun, nor which is the orbit it makes in one day. What has to be considered is the size of the angle of the daily motion of every planet made in relation to the Sun, or the size of the arc traced through in a day on the ecliptic. "

* 100 CENT = tempered halftone
1200 CENT = one octave.
By shifting the decimal point for two positions, the integer yields the 12 tempered halftones (on the piano), e.g. minor third = 3,00 HT, major third = 4 HT etc.

"As for the daily path of the planets as such, their proportions must be the same as with the distances, only other way round.

But if we consider the extreme convergent or divergent ways of two planets each, we see a lot less of harmony than before, when we considered the arcs."

"But what do the harmonies between the ways mean? Who will ever perceive these harmonies?

Two things there are, that present the harmonies of Nature, Light and Tones. When the senses (eye or ear) has perceived this species, it separates the melodious from the non-melodious, be it by instinct, or through astronomical or harmonical deliberation."

But then, there are no tones in the sky.

Thus, only the light is left.

If the light is to teach on its own, obviously there must be SENSE in it. So it will be the SENSE of the whole Universe that is present in the harmonies of all planets. For the way, leading from observations via the great detours of geometry and arithmetics via the proportions of the orbits and everything else, to these dimensions, is A too long for any natural instinct, for the stimulation of which one might consider useful the introduction of harmonies.

In the following table, the astronomy of Tycho Brahe gives us the daily movements of planets in their orbits, "the way they would appear for an observer on the Sun":

table 2

Tafel 2

Vergleich: Abstandsproportionen in Cent
Comparison: the proportion of distances in Cent

Tycho-Werte *Values by Tycho*		Moderner Satellit *Values by modern satellite*
1045	SA	1049 c
2125	JU	2126 c
729	MA	729 c
559	ER	561 c
1080	VE	1082 c
	ME	

Bei einem Hörgrenzwert von 4 C ist die Genauigkeit der Tycho-Beobachtungen erstaunlich!
Considering the perceptional limit of hearing at about 4 C, the exactness of Tycho's calculations is remarkable!

Kepler could jubilate:

"At first glance, the sun of Harmony broke through the clouds with all his glamour!"

To him, this was the Supreme Order of simple and clear relations between numbers, letting the musically useful intervals emerge from an endless continuum. As we have seen, Kepler was well aware of the discrepancies, but he adjusted them to suit his desires!

Today, we have a new term for the tolerance in intervals: "Hearing in place".

Furthermore, todays' greater exactitude in measuring and test methodology have shaken the imaginations of the Renaissance: Tendencies towards extended hearing, deviation through the density of voices, the speed of sound sequences, volume and timbre; as well as the enlarged sequences of harmonies have great influence on our experience of sounds.

Nevertheless, the old theory of proportion is still a necessary device for orientation, which has been expressed also in the works of H. P. Hesse (of the Mozarteum Institute), regardless of many forebodings expressed within the most modern theories of hearing!

table 3

Tafel 3

KEPLER-TAFEL in Cent* umgerechnet

Tagesbögen (Aphel/Perihel) der Planeten von der Sonne aus

Planet	Tycho-Werte (A/P)	Kepler-Deutg. (A/P)	Kepler-Kommentar	Differenz
SA	106'/135' = 418,7c	108'/135' = 386,3 c 5/4NTZ	etwas mehr als Gr. Tz.	+32,4 c (1/6Ton)
JU	270/330 = 347,4c	275/330 = 315,6 6/5klTz	etwas mehr als Kl. Tz.	+ 31,8 c
MA	1474/2281 = 642,3	1521/2281 = 701,6c 3/2 QUI	erheblich weniger als QUI	-59,3 c
ER	3423/3678 = 124,4c	3448/3678 = 111,8c 16/15HTn	etwas mehr als HTn. (1/2 Ko)	+12,6 c
VE	5690/5857 = 50,1c	5690/5927 = 70,6c 25/24 KlChr	kleiner als alle melod. Intv.	-20,5 c
ME	8940/23040 = 1472,9c	9840/23640 = 1517,4 12/5 KlDez	eher eine KlTz als ein Glh	-44,5 c

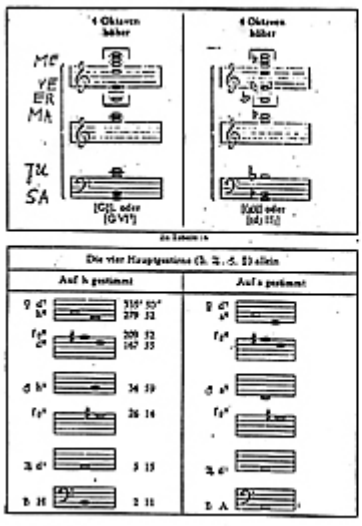
Tagesbögen zwischen 2 verschiedenen Planeten

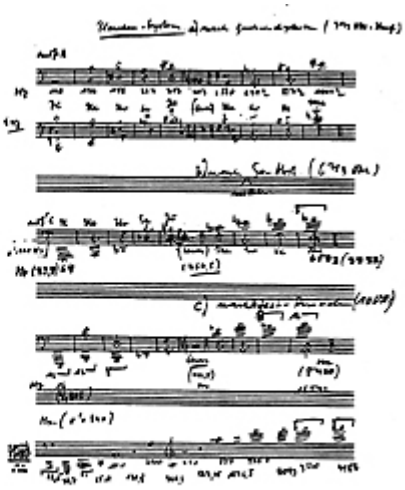
JU-P SA-A	1966 c	1902 c 3/1 Duodez.	1/3 Ton zu tief
JU-A SA-P	1200 c	1200 c 2/1 Okt	exakt!
JU-A MA-P	3694 c	3600 c 8/1 3 Okt	1/2 Ton zu tief
JU-P MA-A	2705 c	2716 c 24/5 klTz über 2 Okt	+1/2 Komma
MA-P ER-A	703 c	702 c QUI	genau
MA-A ER-P	1469 c	1516 c 12/5 klDez	1/4 Ton zu hoch
ER-P VE-A	755 c	814 c 8/5 dkl5x	1/3 Ton zu hoch
ER-A VE-P	930 c	884 c 5/3 dGSx	1/4 Ton zu tief
VE-P ME-A	898 c	884 c 5/3	-1/2 Ko
VE-A ME-P	2421 c	2400 c 2 Okt	- 1 Ko nahe

KEPLER-TABLE, converted in Cent*

Kepler also used the principle of major and minor modes as defined since Zarlino in his planetary proportions:

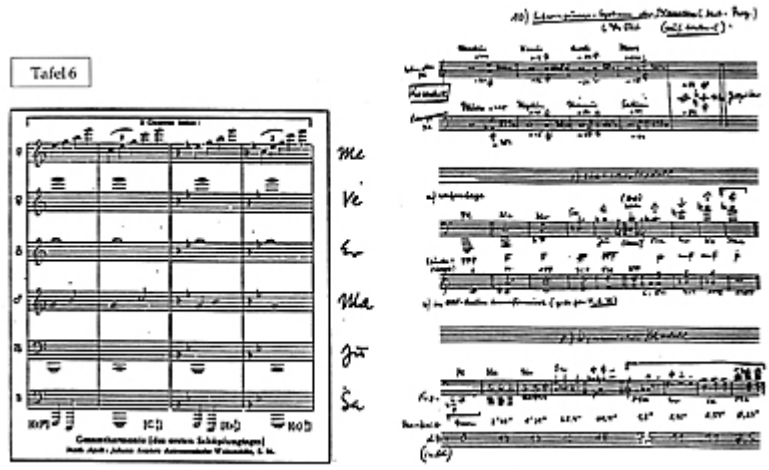
Ab SA (A) = Major/Ab SA (P) = minor (cf. tables 5 and 6).





Modelle der Bandproduktion am Mozarteum

Tafel 5



Finally, a table of today's data of orbits (a hypothetical trans-plutonian planet (since 1970) has not been considered):

table 4

Tafel 4

	I Umlauf (J.) *Revolution time (years)*		II mittl. Sonnen-Abstand (Mio km) *Average distance from Sun (Million km)*		III mittl. Bahngeschw. km/sec. *Average orbit speed (km/sec)*	
PL	248,35	= 710 C	5920	= 475 C	4,74	= 235 C
NE	164,79	= 1166	4500	= 779	5,43	= 389
UR	84,01	= 1614	2870	= 1210	6,80	= 606
SA	29,46	= 1575	1427	= 1049	9,65	= 524
JU	11,86	= 3168	778,4	= 2126	13,06	= 1064
MA	1,881	= 1094	227,94	= 729	24,14	= 365
ER	1,0	= 641	149,598	= 561	29,8	= 281
VE	0,6125	= 1624 C	108,21	= 1082 C	35,05	= 541 C
ME	0,24084		57,91		47,9	
	= 10 Oktaven (ca. Hörbereich) *i.e. appx. range of hearing*		= 6 2/3 Okt. (Instrumentalumfang) *i.e appx. range of instruments*		= 3 3/1 Okt. zw. Griechisch (2 Okt.) und Renaissance (4 Okt.) *i.e. between Greek (2 oct)* *and Renaissance (4 oct)*	

[Translator's note: The author's abbreviations are used in the English text throughout:

PL= Pluto, NE=Neptune, UR= Uranus, SA= Saturn, JU= Jupiter, MA= Mars, ER= Earth, VE= Venus, ME= Mercury. A= Aphel, P= Perihel

Okt= Octave, Tz= third, QUI= fifth, Sx= sixth etc.]