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- Dal 1978 -

THE CIRCULAR HARMONIC SYSTEM - C.HA.S. ®

. We look at a mount, we seek its peak .

To the efforts of those who have worked to develop a harmonious distribution of semitone frequencies, I would like to add part of the results of my research.

Intuition and abstract reflection, experimentation and empirical observation, conducted over 25 years, have all contributed to a new theory underlying a new practice.

I present these findings to piano technicians, piano tuners, musicians, musicologists and lovers of music, to those genuinely interested in research and to anyone who may find them worthy of attention.

The approach described below overcomes, in my opinion, limitations which have emerged from previous temperaments. It illuminates obscure areas and reflects the highest degree of harmonicity.

. Clash to clay , concrete to abstract .

In a logical and demonstrable way, the Circular Harmonic System positions semitone-sounds within a taut and precisely-defined “Form”, in a self-sustaining arrangement that is free of imprecision.

In any set, the degree of interconnection and interdependence between its elements – in our case, its harmonicity – is determined by its level of coherence and congruence; the greater these are, the more complete and integral the set is.

We can imagine a set of notes or semitones, and render it in a variety of ways. If we want to reassemble a set of 88 sounds in close harmonic relationship, we need to adopt a system of temperament.

Various systems have been used in the past, all based on numerical relationship between only two notes, but their limits are well-known.

The System described here is original: it concerns a dynamic-tensorial, multi-centric, inter-modular, and scalar temperament. In accordance with its defining features, I have called it “Circular Harmonic System – c.ha.s.® (Sistema di Temperamento Formale Circolare Armonico).

. About 12^{th} root of 2 Equal Temperament .

. Vacuum Jar Vase .

Today's 12^{th} root of 2 Equal Temperament suffers from a specific shortcoming; this is the direct consequence of two arbitrary decisions that created a systemic deformity, and gave rise to an incomplete approach.

12^{th} root of 2 Equal Temperament, although constituting a system, takes one frequency as a starting point and develops a sequence of twelve semitones on top of it. These semitones are distributed horizontally, to serve a single keystone-coordinate, the octave. This interval was considered to be tensionless (beat-less), with a frequency that was exactly double the first starting- point frequency.

The 2:1 octave scale's approach possibly developed as a result of the strong appeal of a pure octave: a vibrating string touched at its mid point does indeed produce an octave. But the evidence was "forced", to fit the theory.

The 2:1 octave, like the sequence of twelve semitones leading to the double octave, was simply mistaken. The octave may indeed be pure and therefore free of tension, but this does not mean that, in combination with other sounds, it will be more harmonious. It is known that intonation disparities, if slight, do not upset the ear or diminish harmonicity.

Difficulties soon arise with 12^{th} root of 2 Equal Temperament because of both its lack of reliable coordinates, and its inappropriate basis which deprives the octave of tension: in reality, the interval +1∩+13 has its natural, proportional progression.

The pure 2:1 octave lacks elasticity and starves intervals of space.
The difficulties increase even more for intervals larger than an octave, beyond the threshold of the twelve semitone.

Just as a kite, edge to the wind, flutters and loses height, so starved sounds can fall with their partials into ever deeper confusion.

12^{th} root of 2 Equal Temperament can only reproduce the cramped arrangement of its first 12 semitones – merely copying them; it is then obliged to resort to dangerous acrobatics to repair the resulting inconsistencies and diminished harmonicity. This is one of the reasons why today's piano tuners are still forced to turn to "the compromise".

Although mathematically acceptable, 12^{th} root of 2 Equal Temperament compresses the scope of the +1∩+13 module and establishes a distorted method of proceeding on a wider scale. Thus it is incomplete and misleading.

. THE CIRCULAR HARMONIC TEMPERAMENT SYSTEM .

. Mute and new the lone key .

It is not always appropriate to double the 13th frequency's value. On a piano we play 88 notes. For intervals larger than an octave, there is no way to develop a base sequence of 12 semitones and contemporaneously obtain both a pure octave and a progression of larger intervals which is coherent, in the sense that the tension of each interval is univocal and proportional.

The proof of this can be seen in the clear need to compromise and make adjustments, more or less haphazardly, which inevitably distort the relationship between fundamentals and the harmonicity of the whole.

This does not occur with the Circular Harmonic Temperament System described below.

This System is circular because it is inspired by both the spiral form of increasing frequency-tension (conical tension increases) and the circular nature of relations between key-coordinate intervals.

It is harmonic because the partials indicate how much to increase the tension of the set of fundamentals.

It is formal since the whole reveals a neat, multi-dimensional Form, that unerringly frees superlative units of sound.

A linear zero-beating-octave alone is not able to order semitones because it does not take account of the tension curves which all intervals can express with their beats progressions.

C.ha.s. is a beating-whole system: it enables each sound or semitone to sustain the harmonic endowment of every other sound and it allows each interval, whether sounded chromatically or in any other sequence, to be fully justified.

It is a system that requires no compromise. On the contrary, it requires that the key-coordinate intervals be faithfully respected, as they indicate how to distribute frequencies and beats with exact precision.

This System's "Form" emerges whenever the harmonic conditions of coherence and congruence are (re)created; in other words, when harmonic proportion is obtained, not only in their algebraic frequencies progression, but in the tension (beat) expressed by any interval.

Two notes, when they combine their harmonic attributes, form and hold together a small whole. And each sound constitutes another tiny whole which both acts and reacts, ready to co-produce and guarantee all the information necessary and sufficient to temper the Circular Harmonic Form. Its intrinsic quality is that every sound both gives and takes meaning from the greater 88-sound whole.

. The Harmonic Site .

. Infinite centres , infinite arcs .

In the sound produced by a string in tension we distinguish a strong note, the so called fundamental.

This fact has conditioned the treatment of frequencies: it has back-grounded the relationship of tension between two sounds of differing frequency, a rhythmic tension expressed by partials and observable in pulsating “beats”.

Since beats pulsate rhythmically we can use them as pace-revealers, the indicators required to achieve our proportional beat-Form.

There is another important, observable and related phenomenon, which can be described to as “propensity” to beat, and referred to as the Harmonic Site.

. UEG N NUT - TUN N GEU .

. NEU G NUT - TUN G UEN .

. TEN U UNG - GNU U NET .

. ENU T NUG - GUN T UNE .

. GET N UNU - UNU N TEG .

Simply moving syllables of the word “unguent” we can produce new phonemes with diverging tensions.

Two sounds can combine their partials frequencies and carry potential euphonic tension.
It is possible to make extremely slight variations to the frequency of one of the two consonant sounds and remain within an area of tolerance, the harmonic site, where beats do not form.

If we move towards the edges of this area, we find well-ordered partials, ready to sound and generate tension. If we stretch the frequencies beyond the threshold of consonance, the beats travel first in slow circles, then faster and faster.

They appear initially as a small eddy, making a slow loop-motion, where the natural partial sounds “ m U O A E I I E A O U m ” succeed each other. Then they accelerate as we stretch the two consonant frequencies. Still further apart, they accumulate to form a maelstrom of sound, mixing fundamentals and partials in chaotic fashion.

. Hear Beat . , . Pull Sound .

An individual sound travels as a stable whole until the energy originally acquired is exhausted.

In this form, it expresses its fundamental and some of the partials which qualify it; many other partials remain latent in the harmonic site.

This site will open up only to certain “pass” frequencies. Two sounds, with the right pass frequencies, will interact and free their latent partials. The resulting harmonic quality will either enhance the fundamental sound, sustain it and enrich it with colour; or deaden it into an incoherent and chaotic compound.

It appears that the harmonic site, with its unique ability to store partials, can be managed: as a result, it is possible to add or subtract tension on each key-interval, as the order of Circular Harmonic Form requires.

. Key-intervals .

Pairs of semitone-sounds, or intervals, generate tension and blend together according to their frequency. Those that may be perceived by the human ear can be treated as key-coordinates intervals.

If we move away from the 2:1 octave approach, it is possible to deal with seven key-coordinates or key-intervals within two octaves. Like the incremented octave, they all have their own tensorial progression: the third, the fourth, the fifth, and the sixth within the octave; the tenth, the twelfth and the fifteenth in the +24 semitones compass.

. Tensor Agents .

Thus the third, fourth, fifth, sixth and octave intervals, and the tenth, twelfth and fifteenth intervals are tensor agents, or tensor intervals, and each has its own progression. As we shall see, they also have the quality of reversibility. These key-coordinates draw and restore the beats-curves for Circular Harmonic Form.

. Tensorial Ligatures .

. Contain Versus in Versus Release .

An octave delimits an arc and determines two fields: one internal and one external. Adding one note we compose two more intervals that may be situated entirely within an octave, or outside and across the octave's boundaries.

Hence the premise becomes: sound +1 and sound +13, marking the inner and the outer field; then the relevant semitone-sound, either inside or outside the octave.

In other words, an interval within an octave determines a second interval within that octave. The same applies for intervals larger than an octave. Every interval, inside or outside the octave, has its consecutive interval.

Therefore a note has at least two tensorial ligatures, and an octave not only determines another octave; it is a firm, tensive lock for any other interval.

Moreover, if we take one interval and its consecutive interval within an octave, we find that the interval of a major third (first note – third – octave), if reversed or read inversely, produces a minor sixth. Vice versa, a sixth, inverted, finds a minor third. A fourth produces a fifth, and vice versa.

The sequence “first – fourth – octave” (sounds +1, +6, +13) obtains, from right to left, the sequence “octave – fifth – first” (+13, +6, +1). The sequence “first – fifth –octave” (sounds +1, +8, +13) obtains, from right to left, the sequence “octave – fourth – first” (+13, +8, +1).

An augmented forth, at the exact centre of an octave, mirrors itself. In the note-sequence +1, +7, +13, +19, +25 the octave occupies, in turns, the exact centre. For this reason each note, in the 88 whole, must be in turn considered as the “centre” of one octave.

We have come a long way from the octave’s single ligature (cf. Eq. Temp.). There appear to be five tensive ligatures determined by the intervals in the sounds arc, +1∩+13:

- the first note ties, with the octave, the augmented fourth, the centre;

- the major third ties, with the octave (and its centre), the minor sixth;

- the fourth ties, with the octave, the fifth;

- the fifth ties, with the octave, the fourth, the two been specular;

- the sixth ties, with the octave, the minor third.

What space is left for compromise? None.

From a first sound-centre, the generator, we obtain the octave, its new tensorial centre and two fields.
From simple, univocal and rigorous tensorial proportion of three intervals in chromatic sequence, the harmonic 88-sound whole will spring.

Inversion presents us with incontrovertible evidence: each note has five tensorial ligatures to the right and five ligatures to the left, for two octaves in succession, equal to an arc of +24 semitones.

Towards the right: major third, fourth, fifth, sixth, octave. Counter-wise: minor third, fourth, fifth, minor sixth, octave.

An approximate, imprecise semitone disrupts the tensions of five intervals in the arc of an octave, the tensions of ten intervals in an arc of two octaves, and so on.

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This, I believe, fully describes the approach of Circular Harmonic System – c.ha.s.®, and its dimension; how each sound can exchange harmonic proportion and meaning, and can act as "interval proportional tensor", from the narrowest interval to the broadest; and why the incremental ratio must be extended beyond the octave.

Many temperaments have been developed on the basis of semitone +12, mistakenly established as a constant 2:1 ratio. In a radical departure from this approach, the Circular Harmonic System – c.ha.s.® grows from the concept of dynamic and beating affinity in the 88-sound whole.

The euphonic quality of this beating-whole system exalts the synergic potential of each individual sound, memory and trace of the "Circular Harmonic Form".

- Translated by Liz Poore -