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The Divine Nexus of Music and Mathematics

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> According to both the ancients and their Christian followers, the order of the creation was love, bound together in a unity both mathematical and musical. Indeed, love, divine order, music and mathematics are simply the four different ways of saying the same thing. —E. Michael Jones [1]

> We are stardust,
> Billion year-old carbon.
> We are golden,
> Caught in the devil's bargain,
> And we've got to get back to the Garden. —Joni Mitchell

The contention of E. Michael Jones regarding "love, divine order, music and mathematics" is one that has resonated with philosophers, theorists, academics and artists dating back to the Sumerian culture of Mesopotamia, Confucius and philosophers of ancient Greece. The Greek concept of the *quadrivium*; the four realms of study as outlined by Plato, namely; arithmetic, geometry, music and astronomy, has been considered the necessary foundation for comprehensive liberal arts education. As the Greek neo-platonic philosopher Proclus (412-485 AD) explains:

> The Pythagoreans considered all mathematical science to be divided into four parts: one half they marked off as concerned with quantity, the other half with magnitude; and each of these they posited as two-fold. A quantity can be considered in regard to its character by itself or in its relation to another quantity, magnitudes as either stationary or in motion. Arithmetic, then, studies quantities as such, music the relations between quantities, geometry magnitude at rest, spherics [astronomy] magnitude inherently moving. [2]

The music-math nexus has fascinated theoreticians, philosophers, scientists and musicians for eons as evidenced by the numerous treatises by Pythagoras, Plato, Ptolemy, Boethius, Rameau, Kepler, Euler, Kayser and Einstein. Prior to the Greeks, the Sumerians of Mesopotamia utilized a tonal-arithmetical system (sexagesimal—based on the number 60) that linked specific pitches to numerical properties and specific gods. The idea that sound and music have mathematical properties as well as a spiritual dimension is no longer considered the residue of ancient mythologies. Joni Mitchell's iconic song alludes to the realms of astronomy, cosmology and religious thought in perhaps the most perspicaciously poetic utterance of her generation. Both Dr. Jones and Joni have expressed that which many believe to be sound dogma (pun intended.)

Divine Principle and *Unification Thought* postulate that there is an innate connection between the realms of science and metaphysics. The nexus of mathematics and music can be viewed ontologically as a manifestation of the principle of polarity, in that mathematical equations and formulae are associated with physical science whereas music is associated to the metaphysical realm of aesthetics. Though sound vibrations are invisible, they are quantifiable according to mathematic explications.

Dr. Sun Myung Moon often said that "music and religion go hand in hand." This is in accord with Kant's *Critique of Judgment*, in which he "situates the aesthetic experience and religious experience side by side, and tells us that it is the first, not the second, which is the archetype of revelation." [3] Likewise, *Unification Thought* posits that when experiencing beauty we become predisposed to transcendence. By experiencing beauty we become more conscious of our station in relationship to both God and

the natural world, and the true essence of our being is affirmed as well. Speaking to the issue of ontology expressed in its "Theory of Original Image" and the relationship between corporeal and incorporeal realities, *Unification Thought* states:

> If it can be shown that that the attributes of God are universally manifested in all things, then the truthfulness of the theory of the Original Image becomes ascertained. Hence, ontology, which deals with the attributes of all things, can be described as a theory that confirms, in visible terms, the attributes of the invisible God. [4]

With the advances in science and technology we now understand that the idea of the vast expanse of the cosmos being "the epitome of silence," a place of "utter stillness," is untenable. In his exhaustively well-researched book, *The World is Sound, Nada Brahma*, Joachim-Ernst Berendt avers that in their respective eras the concepts of the "music of the spheres" as espoused by Plato, or the "harmony of the world" as posited by Pythagoras and Kepler, were likely understood metaphorically. But now we are finding that these concepts have their basis in fact as proven by scientific discovery, and cosmic sound actually exists. As Berendt observes:

> In the prologue of *Faust*, Goethe wrote, "The Sun intones in ancient tourney, With brother-spheres, a rival song…" Goethe suspected that the sun "intones"; today we know it. [5]

It can be said with reasonable certainty that in the wake of advances in science, modern man's diminished capacity (or unwillingness) to perceive things in a spiritual way has resulted on our becoming obtuse in recognizing the *causal* dimension in relation to the primordial aspects of the phenomenal world. As we know, this was not always the case. Philosophers and theoreticians of antiquity placed a great deal of importance on these issues, and polemics regarding the cosmic origins of the created world often resulted in vitriolic debates and heated invective.

Pythagoras' Epiphanies

Whereas certain philosophers and physicists argued that air, water or fire were the primordial elements of the cosmos, Pythagoras contended that the basis of the physical universe was something quite apart from these "earthly" things. It was something more refined but having very definite attributes; "beyond sense, but a fulfillment of all man's perceptions. Through it, the hidden structure of the world became transparent." [6] For Pythagoras the primordial stuff of the universe was mathematics —numbers. His theories and insights regarding the production of sound and pitch relations have influenced theoreticians, composers, instrument builders, kings and the clergy from his time to this day.

The overtone series (the sequenced, vibratory oscillations that result in pitch production) as mathematically explicated by Pythagoras represents the sonic etymology of all music. The ramifications of his calculations as they pertained to the art of music would have major implications, as Pythagorean theory regarding sound production became the basis upon which composers and performers carried out their creative endeavors for eons. His epiphany about numbers being the stuff of the universe was not only germane to understanding the intervallic construction of overtone series, but as well, it was the gateway for astrophysicists and theorists to understand the "secrets" of the created world with greater clarity and vision.

In his essays on Romanticism, British political philosopher Isaiah Berlin points out that Greek culture in the classical age was based heavily on mathematics and the belief that there were absolute, unbreakable "axiomatic truths… from which it was possible by severe logic to deduce certain absolutely infallible conclusions." [7] Because "numbers don't lie," the Greeks believed that the cold realm of mathematics could lead to absolute wisdom and knowledge, which in turn could be used to order society in ways that could alleviate suffering, doubt, injustice, ignorance and vice.

Though the Greeks gave high priority to civic virtue, their path of attaining virtue was at odds with the Judeo-Christian ethos which was predicated on faith, parentalism, filial piety, the brotherhood of man, transgression, sin and atonement. This worldview, according to Berlin, would have been "totally unintelligible" to the Greeks. Though the Judeo-Christian tradition places importance on numerology, it is not the primary premise on which the tradition takes its cue.

Some two millennia after Pythagoras, Johannes Kepler's observations regarding universal harmony and universal math were especially notable. His theories were among the first to give scientific credence to what heretofore had been largely a matter of faith and mythology. His efforts, fusing scientific reasoning with astronomy, led to his three laws of planetary motion, and these were predicated on certain aspects of Pythagorean mathematics. Yet there was something deeply spiritual in his pursuit of a unified, all encompassing theory. In describing the precepts of harmonic proportions in his seminal work on the topic,

Harmonices Mundi, Kepler, a religious person, acknowledged that these proportions are infinite but asserts that there was a way to "polish them" and "attach names to them." This was an attempt to "construct a splendid edifice of the harmonic system or musical scale." As Kepler, a religious man, put it:

> Its construction is not arbitrary… not a human invention… but entirely rational and entirely natural, so much so that God Himself the Creator has given expression to it in adjusting the heavenly motions to each other. [8]

The Nexus of the Corporeal and Incorporeal

The notion that our ears are the "gateway" to our heart and soul is not at all an untenable proposition. Musicologist Julius Portnoy went as far as to say,

> Music is the releaser into the material world of a fundamental, super-physical energy from beyond the world of everyday experience... the voice of the priest within the realm of time and space becomes a vehicle for the energizing Voice of the Creator to manifest its forces through. [9]

Music as God's voice to us? Many have believed that. In fact, our ears are remarkable organs. In recent decades much as been ascertained with regard to hearing, cognition, neuroscience and psychoacoustics as research has advanced many insightful perspectives regarding music and effects on our psyche. Music theorist Hans Kayser points out that the ears are able "to perceive numerical quantity as well as numerical value," and this perceptive capability is fundamental to the listening experience as it pertains to music. Kayser explains:

> The ears not only recognize exact numerical proportions, that is, numerical quantities like 1:2 as an octave, 2:3 as a fifth, 3:4 as a fourth, etc.; at the same time they hear... values that they perceive as C, G, F, and so on. So the tone value fuses two elements into one unit: the element of sensing—the tone, that is—with the element of thinking, the numerical value. In this way sensation controls deliberation; or to put it differently: Our soul is thus capable of deciding on the correctness or incorrectness of an intellectual quantity.
>
> Conversely, the phenomenon of tone value also gives us the opportunity to develop proportions and numerical values in the realm of the psyche. [10]

Kayser also maintained that many of the things we find to be aesthetically beautiful in nature and art are predicated to varying degrees on the mathematical properties of Golden Section—that geometric ratio that fascinated the Greeks and was believed to be a godly design concept. Some musicologists believe that Mozart may have used this formulation in several of his works. Certain compositions of Eric Satie, Bela Bartok and Claude Debussy are thought to be based on the mathematic properties of the Golden ratio. Interestingly, the commercial drum manufacturers Pearl Drums and Tama have done research on the Golden Ratio and have incorporated their findings into their design concepts, with the intent of creating a favorable acoustic resonance in their percussion instruments.

Expounding on the concept of "sacred geometry," the 17th century mathematician Gottfried Wilhelm Leibinz considered music to be "a hidden arithmetic of the soul which does not know it is dealing with numbers." Yet the soul senses that it is being affected by this "hidden arithmetic" and that its feelings of "well-being… or discomfort" are the result of this "unnoticeable forming of numbers. [11]

What is remarkable is that all of this "tone value fusing" and cognitive processing happens instantaneously, resulting in sensations being imparted by music on the psyche in an immediate fashion. Biochemistry reveals that music releases the pleasure-producing neurotransmitter dopamine into our bodies, and this provides an addictive sensation that results in our craving for more stimulation. Though we are not fully aware of this phenomenon as it is occurring, we well aware of the affects on our being. The potential liability of focusing primarily on the formulaic aspects of music is that it tends to defeat music's ultimate justification; nevertheless, the idea that our ears are "hearing numbers" is a fascinating concept.

Speculating on the mechanics of String theory in relation to the vibratory aspects of sound and music, futurist and theoretical

physicist Michio Kaku opines that String Theory has quasi-musical properties that are similar to “musical notes on a tiny vibrating strings… Physics is nothing but the laws of harmony that you can write on vibrating strings… The universe is a symphony of vibrating strings. [12] To Kaku, these observations are more than mere analogies but have some scientific basis, and are not unlike Einstein’s speculations about God, music and cosmic geometry. Citing Kaku’s assertions, contemporary physicist and jazz musician Stephon Alexander asks rhetorically, “What is the mind of God that Albert Einstein eloquently wrote about for the last thirty years of his life? We now, for the first time in history, have a candidate for the mind of God. It is cosmic music.” [13]

Numerology

Historically the study of numerology has been associated with the occult, astrology, astronomy, the paranormal, the divinatory arts and New Age spirituality. However, the Judeo-Christian scriptures and theology are inextricably linked to numerology: The Trinity, Jesus’ 40-day fast, Jacob’s 21 years in Haran, the 40 day flood judgment, God rested on the 7th day, the 8 Beatitudes, Jesus’ 12 apostles and 72 disciples, the 12 gates of heaven, Jesus’ 3 temptations, the 12 tribes of Israel, the 120 years of Noah building the arc, the 3 archangels, the 3 wise men, Peter’s 3 denials, etcetera.

It is intriguing to note that these scriptural integers are the sum or products of 3 and 4. Certain Christian doctrine refers to the number 3 as being representative of heaven (the Trinity, Jesus resurrected on the third day, etc.), while the number is 4 representative of earth and nature (the four seasons, the four trade winds, the four directions.) Jewish prayers are often repeated in sequences of 3 and 7. Pythagoras believed that the number 3 was more significant that the number 2 due to the implication of a beginning, middle and end—the three stages of development cited in *Divine Principle*.

The “prime number” 5 also has distinct musical implications vis-à-vis the “circle of 5ths” in Western tonal theory. Perhaps not so coincidentally, Muslims offer prayers five times each day.

Whereas Pythagoras considered the number 3 to be of prime importance, ancient Chinese philosophy emphasized the relationship between polar opposites, hence the number 2 was of prime importance. The concept of polarity (yang/yin) is also highly evident in nature and music. A central tenet of ancient Chinese philosophy is that beauty is realized when any complimentary/polar opposites: intellectual and emotional, masculine and feminine, corporeal and incorporeal, etc., exist in a harmonized fashion.

If an individual can achieve harmony in mind and body, such a person is able to achieve inner peace and tranquility. This in turn would be a way to achieve “oneness” with the God (“the Great Ultimate”) and the cosmos, and thus attain a state of perfection—of harmonized relatedness to the world in which one exists. The Principle of Creation (Chapter 1 of the *Divine Principle*) speaks to the design of the created world being predicated on the harmonious relationships of polar opposites; male/female, physical/metaphysical, mind/body and content/form, to name but a few. (Consider that the word “individual,” literally means an undivided duality—presumably the harmonized duality of one’s mind and body.)

Numerology and Chinese Philosophy

The Chinese text *The Spring and Autumn Annals* of Lu Buwie, offers further insight into this concept:

> The origin of music lies far back in time. It arises out of *two poles* [emphasis added]: the two poles give rise to the powers of darkness and light. That from which all beings arise and in which they have their origin is the Great One; that whereby they form and perfect themselves is the duality of darkness and light. As soon as the seed-germs start to stir, they coagulate into a form. The bodily shape belongs to the world of space, and everything special has a sound. The sound arises out of harmony. Harmony arises out of relatedness. Harmony and relatedness are the roots from which music, established by the ancient kings, arose. [14]

This insightful verse touches on three important aspects of sound production from the ancient Chinese perspective: polarity, harmony and origin. For the ancient Chinese, the importance of relatedness as it pertains to the realization of any harmonious condition originated in a first cause, “the Great One.”

Chinese cosmology viewed mathematics, astronomy, astrology and science as interconnected, and as such placed great importance on the proper relationships. If Confucianism is about anything, it’s about relationships. This is affirmed by Rev. Moon’s assertions regarding polarity and harmony:

> All created beings in this world exist in pairs based on the ideal or reciprocity. That is why the number “two” is so necessary, from the smallest being to the greatest. In human beings, an individual’s mind and body must become one. Then husband and wife have to become one, and then the spirit world and physical world have to become one. [15]

There are those who consider numerology to be pseudo-mathematics, but nature tells us otherwise. Einstein, who played the violin and piano, posited that the laws of gravity are predicated on the idea that there exists a geometric the link to time and space. The acoustic principles of sound production are defined by mathematical ratios, and as philosophers and theorists of antiquity realized, mathematics is intrinsic to virtually every aspect of the natural world, including music—all music.

Plato's poetic myth of “the music of the spheres” with its implications of a universal, interconnected, cosmic geometry, along with the Pythagorean concept of “music as a microcosm,” were not unlike the philosophical tenets of Confucius, who posited that the underlying principles of music and sound production were governed by the same scientific and mathematical laws that governed the cosmos.

Europe and the Tonal Revelation

As mentioned, Einstein understood these relationships to be elemental and essential to the quest of “spreading moral and cultural understanding” in the pursuit of freedom. Though his approach was disputed, often in the most hostile fashion, the “sacredness of the goal” was not.

> All religions, arts and sciences are branches of the same tree. All these aspirations are directed toward ennobling man’s life, lifting it from the sphere of mere physical existence and leading the individual toward freedom. Both churches and universities, insofar as they live up to their true function, serve the ennoblement of the individual. [16]

With the decline of Rome and the ascendance of Christianity in Europe during the third and fourth centuries, the seeds that would blossom into the great art of the Western world were planted deeply into the fertile soil of religious faith and practice. Arnold Toynbee's assessment that the Church was “the chrysalis out of which our Western society emerged… [the] germ of creative power,” [17] attests to the role that Christian thought played in the development of Western culture in general, and musical theory, aesthetics and axiology in particular.

A central tenet of Greek philosophy, which came to the early Christian Church via Rome, specified that music was a medium that had connections to the forces of nature and possessed the power to affect human thought and conduct. This precept was assimilated into early church culture and reiterated in the writings of several Christian philosophers, most notably Boethius (ca. A.D. 480-524), St. Augustine (A.D. 354-430) and Thomas Aquinas (A.D. 1225-1274)

The evolution of music and its integration into liturgical practice throughout the Middle Ages gave rise to new attitudes about music and its purpose and function; most notably the idea that music was to be the “servant” of religion. For the church elders of early Christianity, music was deemed to be good only when it “opens the mind to Christian teachings and disposes the soul to holy thoughts.” [18] The church in the Middle Ages was highly concerned with the potentially corrupting elements of music, and as a result, certain factions within Church hierarchy were inimical to music in the church. The aesthetic beauty of music and its effects on the soul could not be denied. Still, the Christians of medieval Europe believed that the aspirations of spiritual fulfillment and redemption could possibly be hindered or obstructed by the pleasurable aspects of music, and this troubled even the most enlightened practitioners of the faith. St. Augustine’s timorous distrust of music not withstanding, the church would eventually see (or hear!) the benefit of music acting as an efficacious mediator between heaven and earth.

Tonality as Principled Revelation

In musical parlance, “tonality” refers to the codified system of pitch and chord relationships that results in a specific hierarchical syntax that induces *aurally perceived* stabilities and attractions. How various pitches relate and function is the essence of the Western tonal syntax and is in accord with *Divine Principle*.

The Renaissance in Europe was a time when creating art and music based on religious convictions and scientific principles (e.g., the settings of the Catholic mass by Josquin des Prez and Brunelleschi’s dome of the Florence Cathedral) was celebrated as a reflection of humankind’s ability to realize its fullest potential. Religion and science in the Renaissance were not considered mutually exclusive entities, but rather as correlative facets of the human experience that when conjoined and harmonized in

artistic endeavors could yield sublime artistic expressions of great beauty and meaning. In his exegesis on the history of musical tuning systems, Stuart Isacoff reminds us that “music’s prized proportions permeated not only the inner sanctums of the church, but workshops of great artists,” thus becoming “entangled in the world of scientific discovery.” [19]

As European composers during the Renaissance began to write music having greater linear complexity (polyphony), the natural by-product of this process was a vertical alignment of tones that possessed definite harmonic modalities. The evolution of harmonic syntax though the 15th and 16th centuries, along with the experiments in tuning and interval modification (temperament), led to the development of specific tonal theories which in turn gave rise to an ordered system of major and minor keys. They were polar opposites—a manifestation of yang and yin. As it was in the evolution of natural languages, the “rules” that govern this musical grammar grew out of the subconscious and were abstracted after usage, not before.

In his Harvard Lectures (1973), Leonard Bernstein referred to the major pentatonic scale as “humanity’s favorite scale.” This 5-note scale, “handed to us by nature,” is based on the first five *differing* pitches in a given overtone series, and is common to the music of Asia, Ireland, Eastern Europe and Africa. Diatonic tonality, a musical syntax predicated on a 7-note scale, evolved from the monophonic music of the early Christian church in Europe. Although this type of tonal centricity can also be found to varying degrees in the folk music of Asia, Africa and the Middle East, including the *maqam* (the 7-note Arabic scale), it came to its full flowering in Europe. The heptatonic ecclesiastical modes that evolved in the churches of medieval Europe were the antecedents of the diatonic scale. As music theory developed in the West, we find that the numerological properties governing the musical organization of sound and rhythm serendipitously reflected the numerology found in scripture. Was this purely coincidental, or was there an implicit mathematical design in the tonal equation?

The development of a tuning system in which “natural” intervals were modified proportionally into twelve equal parts within the aural span of an octave (equal temperament) allowed for greater innovation in the realm of composition. This, in turn, allowed composers, in their attempts to be more expressive, to create music rich in melodic and harmonic variation. Here again is a scenario in which mathematics affected the production of art in a significant fashion. It resulted in a creative “explosion, that immense boom of music in the Western world that numbers among the greatest phenomenon in the history of humankind.” [20]

By the Numbers

The diatonic major and minor scales, based on a specific sequence of intervals along with the use of triads (three pitches sounding either simultaneously or in a sequence based on each note of a scale), became the fundamental properties of Western tonality. When certain triads establish a subject-object relation within a given harmonic progression, an aural base, or “home” key center, can be perceived. How does all this relate to numerology? Consider the following numerological and relational properties of Western tonality.

There are two basic modalities: major and minor. The octave in Western music is divided into 12 equal parts (semitones). There are 7 pitches in the diatonic scale, with the 8th pitch being the start of a new octave—a “new beginning,” as referenced in the Bible. For example, circumcision in the Hebrew tradition was done on the 8th day after the male child’s birth. There are 7 “flat” major keys and 7 “sharp” major keys and each major key has its relative minor key; e.g., C-major and A-minor, G-major and E-minor. A relative minor scale starts on the pitch located a minor 3rd below its major antecedent; e.g., the pitch A is a minor 3rd lower than C. As previously mentioned, the basis of Western harmony is the triad, the vertical organization of 3 pitches. The number 7 is also evident in the overtone series—the physical principles that govern tone production—as the first two octaves based on any “fundamental” tone consist of 7 pitches (known as partials).

Tonality is also hierarchical and relational, in that the aural center of a particular modality can be determined only when two or more pitches or triads exist in a relationship. In the tonal syntax, a G-major triad, consisting of the pitches G-B-D, for instance, can serve one of four functions depending on the context in which it occurs. Those functions can be either primarily subjective (tonic or dominant) or objective (sub-dominant or sub-mediant.) Here, multiples of the numerals 3 and 4 are intrinsic to triadic function—a single 3-note chord (triad) being able to serve in four distinct functions based on its relationship to a specific key center. This is a musical manifestation of the “triple-object-purpose” as defined in *Divine Principle*, in which a particular subject can also be in the position of one of three other object positions based on shifting functions.

Musical architecture and form were also influenced by the evolution of the tonal syntax. The sonata form, a musical structure that was prominent in the 18th and 19th centuries, is a musical form that encompasses a dual-key tonal framework and has three distinct sections: the exposition, the development and the recapitulation. This tripartite musical structure reflects Pythagoras’ views regarding the number 3 and is a structural iteration akin to the “three stages of growth” (formation, growth, completion) cited in *Divine Principle*.

Examples of polarity, harmony and relatedness, as was expressed in the aforementioned ancient Chinese verse, are highly evident in Western tonal music. They include the polarity of major and minor keys, major and minor triads within those keys,

tonic and dominant harmonies, consonant and dissonant intervals, whole-tones and semi-tones, diatonicism and chromaticism. In addition to these tonal properties there are other polar opposites that come into play when creating or performing music: fast and slow tempos, long and short durations, high and low pitches, adjacent and non-adjacent tones, loud and soft volume, the volume getting louder (*crescendo*) and getting softer (*diminuendo*), tempo acceleration (*accelerando*) and deceleration (*ritardando*), bright timbres and dark timbres, duple meters (2/4, 4/4, 2/2) and triple meters (3/4, 6/8, 9/8), symmetrical meters (2/4, 4/4, 2/2) and asymmetrical meters (5/4, 5/8, 7/8).

When these polar characteristics are manifested in a harmonized fashion, music begins to take on attributes that reflect a divine expression. St. Paul opines in scripture (Romans 1:20), that God's invisible nature and deity can be clearly perceived in the created world; hence, music that embodies the characteristics found in nature can be said to have "godly" attributes.

Ontological Matters

There exists a common misconception that tonal music does not contain dissonance, when in fact it is the interplay between consonance and dissonance that creates, conveys and evokes emotion in tonal music. The overtone series in the physics of sound contains intervals that are both consonant and dissonant. It is the give and take between those intervals, and the chords in which they exist, within the syntax of tonality that through their tension and resolution gives tonal music its emotive and communicative power.

Hegel noted that although music is "non-representational," it nevertheless possesses definite structural and mathematic properties that serve its expressive function. He stated, "Music is architecture translated or transposed from space into time; for in music, besides the deepest feeling, there reigns also a rigorous mathematical intelligence." [21] Hegel surely would have viewed these various polar opposites as being in "conflict" with one another, but while Hegel emphasized conflict as the primary mode of attaining progress, the Chinese emphasized harmony and relatedness, as does *Divine Principle*.

Eduard Hanslik, the notable nineteenth century music critic and aesthetician, argued against "aesthetics of feeling" in his influential book, *The Beautiful in Music*. He put forth the proposition that emotion does not exist in the materials of music itself (pitch sets, rhythms, harmonic progressions, etc.). Though beauty arouses emotion and can "awaken feelings" in the listener, Hanslik, like Hegel, contended that music is non-representational in that musical materials have no emotional aspect to them. This attitude would seem to be the polar opposite of Schopenhauer, as well as Richard Wagner. Schopenhauer argued that music "does not express this or that individual or particular joy, this or that sorrow or pain or horror or exaltation or cheerfulness or peace of mind, but rather joy, sorrow, pain, horror, exaltation, cheerfulness and peace of mind as such in *themselves*, abstractly." [22]

Hanslik's proposition that individual musical materials (e.g., an isolated pitch or chord) in and of themselves contain no inherent emotional aspect may have some veracity. Music, however, is all about the sum of its parts and the effect on our psyche when those constituent parts are ordered in an artful fashion. Therefore, the juxtaposing of mathematical properties—frequencies, ratios, durations, velocity, decibels, meter—according to a specific syntactical codification of said properties, causes sensory stimulation resulting in a manifestation of beauty and meaning in music. Not to mention the release of dopamine!

When we consider the ontological aspects of the created world, from the macrocosmic dualities that fascinated the ancients to the microcosmic interactions that Max Plank brought to light via quantum physics, it becomes readily apparent that there is a design that governs the way in which the universe—and music—operates and evolves.

Countervailing Views

Some musicians view the evolution of the tonal syntax pertaining to and stemming from the establishment of equal temperament as artificial and "mathematically constructed," and quite apart from any natural or divine concordance. To be sure, tonality is a human construct, as are all attempts at systematizing the sphere of pitch production in the service of an artistic expression. Music theorist Ross Duffin argues that equal temperament, first utilized by J.S. Bach in 1722, has had a detrimental effect on music, and that most musicians have been inured to what he considers the ruinous effects that its near universal acceptance has caused. He attributes this scenario to "the recent evolution in musical performance and teaching, the result of decades of delusion, convenience, ignorance, conditioning and oblivion." [23]

If we take Professor Duffin's reasoning at face value, it could be extrapolated that Bach, Mozart, Beethoven, Wagner, Debussy and Mahler were all duped by the spurious concoction of temperament. But as Berendt construes, the division of the octave (a macro-interval) into twelve equal "subspaces" (micro-intervals) reflects Plank's quantum mechanics in that "effects can be produced only as a multiple of a smallest unit no longer open to further division." [24] This particular development, and the resulting concordance of science, aesthetics and imagination, was in no small measure why the aforementioned "explosion" of

tonal music occurred.

Microtonal music divides music into smaller intervals. The music of many non-Western cultures such as Indonesia, Japan, China and Korea (*pansori*) employ microtonal scales and pitch bending in significant degrees. The contemporary Chinese composer Tan Dun uses the microtonal influences of Peking Opera in his compositions.

European composers, such as Italian Renaissance theorist Nicola Vicentino, a student of an early tuning experimentalist, Adrian Willaert, employed a 36-note scale in his music and built a specialized keyboard instrument with six rows of keys that he called the *archicembalo* to realize his music. Twentieth century American composer Harry Partch divided the octave into as many as 43 intervals based on "just intonation" (as opposed to equal temperament) that required the creation of custom-made instruments and specialized notation to realize his compositions.

Though microtonal music is fairly common in non-Western cultures and in experimental music of the twentieth-century avant-garde, it has not supplanted tonality as a preferred syntax. This may be due to the aural properties of its quasi-dissonant modality, a modality that may not yield enough of a perceptible differentiation of tones, thereby creating aural indeterminacy. This in turn does not yield an aesthetic that would be considered appealing, beautiful or emotionally satisfying. [25]

Cosmic Math

Cosmic polarity in seen in "stars and elementary particles, plants and marine animals, crystals and leaf forms, male and female bodies and sexuality, cathedrals and cloisters, the structure of the earth." [26] This is evidence that the enlightened souls of antiquity and their modernist counterparts were onto the right stuff as they contemplated the primordial stuff and the grand design of the universe. The ontological proposition that the harmony and connectedness of various polar opposites, premised on the numerological properties found in nature, is what yields beauty and meaning in music—and life—seems fundamentally correct.

For many, this is music to the ears—literally and metaphorically, though no longer mythological. Moreover, as *Divine Principle* explains, numerology plays a significant role in matters of creation and restoration, and the nexus of music and mathematics is a reflection of intelligent design. As Unificationist theologian Dr. Young Oon Kim posited:

> It is in the transmoral dimension of aesthetic experience that beauty approaches God. All the laws from and within God—give and take, polarity, harmony—connect beauty from all cultures. And to the extent that they clearly amplify and substantiate God's nature they evoke a response of love and appreciation from man. Since God represents absolute love and freedom, beauty is never confined. [27]

Because *Divine Principle* stipulates that love and beauty are in the subject position in relation to the objective realities of law and science, it is important to understand what ought to be prioritized in the pursuit of a principled culture. The tendency of the human condition to gravitate toward that which satisfies our emotional and spiritual longings, rather than to study law and science, is an innate desire. This is not to diminish the significance of the physical realm, only to better understand this ontological actuality. Numbers matter, but only to the extent that they help us ascertain the physical, objective, properties of the cosmos.

Stephon Alexander reminds us that contemporary physicists are "very aware that their beautiful mathematical models fall short of describing what they see." Though Alexander concedes that these models fail to explain many of the eternal questions that we still seek answers to, especially with regard to aesthetics, spirituality and the purpose of life, he nonetheless asks a perspicacious question: "Could the cosmos, in fact, be a vast harmonic realization of vibrations?" [28] Recognizing that the concept of cosmic math vis-à-vis music has credibility, the answer could be: Yes!

We intuit that that which is observable via science does not completely satisfy our internal and/or spiritual needs. As *Divine Principle* avers, love, beauty and truth can fulfill those needs when understood according to their proper positioning and proportions. The divine nexus of music and mathematics can be seen as evidence of God's love as expressed through the beauty of music and God's truth as manifested through the lawfulness of mathematics. A divine nexus, indeed.

Notes

[1] E. Michael Jones, *Dionysos Rising: The Birth of Cultural Revolution Out of the Spirit of Music* (San Francisco: Ignatius Press, 1994,) p. 17.

[2] Proclus, *A commentary on the first book of Euclid's Elements*, xii, trans. Glenn Raymond Morrow (Princeton, NJ: Princeton University Press, 1992), pp. 29-30.

[3] Roger Scruton: *The Intelligent Person's Guide to Modern Culture* (South Bend, IN: St. Augustine Press, 2000), p. 31.

[4] *Essentials of Unification Thought* (Tokyo: Unification Thought Institute, 1992), p. 41.

[5] Joachim-Ernst Berendt, *The World is Sound, Nada Brahma* (Rochester, VT: Destiny Books, 1983), p. 59.

[6] Stuart Isacoff, *Temperament: The Idea That Solved Music's Greatest Riddle* (New York: Alfred A. Knopf, 2001), p. 7.

[7] Isaiah Berlin, *The Roots of Romanticism*, W.A. Mellon Lectures in the Fine Arts, edited by Henry Hardy (Princeton, NJ: Princeton University Press, 1999), pp. 2-3.

[8] Johannes Kepler, *The Harmony of the World*, translated by E. J. Aiton, Alistair Matheson Duncan and Judith Veronica Field (American Philosophical Society, 1997), p. 158.

[9] Julius Portnoy, as cited by David Tame in *The Secret Power of Music: The Transformation of Self and Society through Musical Energy* (Northamptonshire, England: Turnstone Press, 1984), p. 24.

[10] Hans Kayser, as cited by Berendt, *The World is Sound*, pp. 135-136.

[11] Berendt, *World is Sound*, p. 67.

[12] Michio Kaku, as cited by Stephon Alexander in *The Jazz of Physics: The Secret Link between Music and the Structure of the Universe* (New York: Basic Books, 2016), pp. 51-52.

[13] Alexander, *The Jazz of Physics*, p. 52.

[14] David Tame, *The Secret Power of Music: The Transformation of Self and Society Through Musical Energy* (Rochester, VT: Destiny Books, 1984), p. 39.

[15] Sun Myung Moon, *Cheon Seong Gyeong* (Seoul: Seonghwa Publishers, 2014), p. 687.

[16] Albert Einstein, *The Einstein Reader* (New York: Citadel Press, Kensington Publishing Corp., 2006), p. 7.

[17] Arnold Toynbee, *A Study of History* (London, 1935-39), I, pp, 57-58; cited by Donald J. Grout in *A History of Western Music* (New York: W.W. Norton, 1960), p. 32.

[18] Ibid., p. 31.

[19] Isacoff, *Temperament*, p. 7.

[20] Berendt, *The World is Sound*, p. 116.

[21] Willey Francis Gates, *In Praise of Music* (Philadelphia, PA: Theodore Presser, 1898), p. 110. G.W.F. Hegel as cited by Timothy A. Smith: *Fugue No. 15 by J.S. Bach*, p. 1. http://www2.nau.edu/tas3/wtc/i15s.pdf

[22] Arthur Schopenhauer, *The World as Will and Representation*, Volume I, edited by Judith Norman, Alistair Welchman, and Christopher Janaway (Cambridge: Cambridge University Press, 2011), pp. 287-290.

[23] Ross W. Duffin, *How Equal Temperament Ruined Harmony* (and Why You Should Care) (New York-London: W.W. Norton and Company, 2007), p. 16.

[24] Berendt, *The World is Sound*, p. 116.

[25] Studies in the realm of cognition and psychoacoustics, especially those of Fred Lerdahl (Columbia University) and Ray Jackendoff (Tufts University), suggest that our ears may be "hard-wired" in ways that are predisposed to tonality-based patterns. Complex music rooted in the tonal syntax, such as the contrapuntal music of Bach, is more easily perceptible than complicated and predominantly dissonant music predicated on non-tonal or atonal methodologies, such as Schoenberg's *Der Mondfleck*, which can confuse our hearing and cognitive processes. This aural confusion and the resulting "cognitive constraints" results in music that is highly indeterminate and exhibits little or no aesthetic appeal; music so rebarbative that it has the effect of creating alienation and estrangement between the artist and the audience rather than communion. Schoenberg, who authored some of the earliest examples of atonal music via his 12-tone method, admitted that "my music is not lovely."

[26] Ibid., p. 76.

[27] Young Oon Kim, *Unification Theology and Christian Thought* (New York: Golden Gate Publishing, 1975), p. 181.

[28] Alexander, *The Jazz of Physics*, pp. 83-84.