

Cosmicizing Sound music – cosmos – number

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Abstract: *The compositional practice to be described in this article includes number and proportion as decisive factors for the problem of musical form. The role of number and proportion in my music is entirely dependent on the idea of music composition as cosmology, which has two aspects: the “scientific”, in which musical form is determined by formative principles or techniques, and the “contemplative”, which confers to the music an iconic relationship with mystical or mythic cosmologies such as those of the Pythagoreans and of ancient India Vedas and Vedanta. To better understand the context in which number and proportion relate to musical form in some of my works, I will first develop the ideas of composition as cosmology, composition as cosmogony, and spiral time. After this, I will briefly study the role of proportion in the temporal organization of a few key works, and conclude with some other general considerations concerning number and proportion in contemporary music. The idea of “cosmicizing sound” will surface naturally from the considerations about the poetics and aesthetics of my music.*

Keywords: *Compositional Processes. Formative Principles. Cosmology. Number and Music. Cosmology and Music.*

“(...)music is natural law as related to the sense of hearing.”

*“(...)and finally we have the impression
of being faced by a work not of man but of Nature.”*

Anton Webern

Number¹ and proportion take an important role in the compositional processes of my music, not as a simple and arbitrary “application”, but as an integral part of its poetics², in the sense that several aspects of the composition are shaped and structured by numbers, though *not only* by numbers, from the beginning of the creative process. A poetics, as described by philosopher Luigi Pareyson (1918-1991) in his *I Problemi dell’Estetica* (1966), “is a certain taste converted into a program of art, in which taste is understood as the whole spirituality of an epoch or of a person turned into expectation of art” ([37, p. 26]) Poetics encompasses everything that

¹This article presents the academic findings of a research stage concluded within the Research Project entitled “Ancient and Non-European Contents in 20th- and 21st Century Music Composition”, currently coordinated by myself within the Research Group “Processos Músico-Instrumentais”, in the Research Line “Processos Criativos em Interpretação e Composição Musical” of the graduate studies program PPGMUS, at the Universidade do Estado de Santa Catarina (UDESC).

²From the Greek *poiesis* – ποιησις, meaning the activity that brings forth something that did not exist before.

determines and defines the creative praxis of a composer, one part of which, in my case, is number and proportion.

Together with number and proportion comes also cosmology. In fact, the relationship between cosmology, number and music is a key feature in a music theory tradition that starts at the very beginnings of Western philosophical thinking, with Pythagorean philosophers, who conceived the universe as being organized by musical ratios, an idea that was called *musica mundis*, music of the spheres, one of the most important cosmological conceptions of Antiquity. The study of the relationship between musical ratios and the universe has persisted, in a way or another, even all the way into the 21st century, when, for example, physicists have associated cosmic microwave background to harmonious sound waves ([21, p. 44]).

This theoretical tradition linking music, number and cosmology reaches a moment of maturity in the 8th- and 9th- centuries Quadrivium, which developed through the educational ideas about music set up by Plato in chapter VII of his *The Republic*, Aristotle (384-322 B.C.E.), St. Augustine of Hippo (354 – 430) and Boethius (ca. 480 – 524). Arithmetic, Geometry, Music and Cosmology (or Astronomy) are the four mathematical disciplines of the Middle Ages that, together with the disciplines of the Trivium (Grammar, Logic and Rhetoric), formed the seven Liberal Arts required for the study of Theology and Philosophy. In this context, music is not discussed as a performance or compositional practice, but is seen as a contemplative science; music, as one of the mathematical disciplines of the Quadrivium is Number in time, while Arithmetic is Number in itself, Geometry is Number in space, and Astronomy is Number in space and time ([17, p. 34]:34).

This essay is an opportunity to focus on the role of number and proportion in the construction of the “musical building” (the whole form or macroform) of a few of my works. Probably, it is about musical architecture, but also describes the role of number and proportion in the production of a type of musical becoming that I call “spiral” because it consists of musical contents that evolve expanding or contracting, like a spiral. Construction and architecture are, in any case, only two aspects, among others, in the creative processes that generate music, more important in certain composers than in others³: definitely very important in Karlheinz Stockhausen (1928-2007), constructivism, and Iannis Xenakis (1922-2001), architecture, for example. While music cannot be reduced to constructivism and architecture, they sometimes require the fully focused attention from the composer, the performer, the listener, the musicologist, the theorist, or the student. Therefore, if other aspects—other than number, proportion, cosmology, architecture, form—are not mentioned here, it is because of the chosen focus, and not for lack of recognizing that the activity of composing music involves, at the same time, several kinds of creative processes that may be identified as intuitive, intellectual, emotional, planned, pre-determined, written (as derived from *écriture*), extemporaneous, improvisatory, experimental, systemic, symbolic, and so on.

The compositional practice to be described here does include number, proportion and a relationship with cosmology that takes spatial and temporal conceptions into the realm of music. To better understand the context in which number and proportion relate to musical form in some of my works, I will first develop the ideas of composition as cosmology and spiral time. After this, I will briefly study the role of proportion in the temporal organization of a few key works, and conclude with some other general considerations concerning number and proportion in contemporary music. The idea of “cosmicizing sound”⁴ will surface naturally from the following considerations.

³ Or, at times more important than at other times, for the same composer.

⁴ I decided to re-use the title, *Cosmicizing Sound*, which was first given to a Lecture I presented at the Institute of World Culture in Santa Barbara, California, on 21 August 2004. The text of that Lecture remained unpublished and, although some of its topics are discussed here, only a few fragments have been included, but modified, in the present, much larger article.

From the aesthetic point of view, the sense of beauty (or of aesthetic satisfaction) brought to music by proportion⁵ consists in the existence of a single organizing and ordering principle, and of the resulting structural relationships in action within this (micro) cosmos. Important for both poetics and aesthetics is to explore the interdependence between proportion and cosmology and the capacity both (proportion and cosmology) may have to provide coherence to music, a coherence that sometimes comes from outside the limits of music, bringing to the latter a specular or symbolic quality, in the sense that this music reflects a reality exterior to itself. This quality will be studied on the section about contemplative cosmology.

I. COMPOSITION AS COSMOLOGY

Having briefly considered this historical and theoretical background, and turning now to musical composition as a creative practice, it is natural to say that a composition, “piece” or musical work, seen as an object resulting from a creative process, is comparable to a microcosm, in fact, a musical *kosmos*, in all its integrated space-time constitution. The Greek term *kosmos* (κοσμος) means *order* and implies holistic ideas of totality and unity. It was applied to the world or universe for the first time by Pythagorean philosophers.

“*kosmos* does not signify primarily universe. Calling the universe by this name denotes already a particular kind of cosmological interpretation. The original meaning of *κόσμος* is all kind of order whatsoever. The mere fact that Neo-Platonism speaks of *κόσμος νοητός* (intelligible world), or that eventually the state in which reign justice and order— *εὐνομία καὶ δίκη* — is said to be a *κόσμος*, should prevent from interpreting the name, in its ancient and medieval use, according to the limited signification it has been given in modern times, especially under the influence of science.” ([1, p. 321], footnote 5).

Applied to music in the context of my composition, the term “cosmos” emphasizes that music is not just the sounds but also the order of sounds, the music’s own formative and ordering principles, and implies a more contemplative conception of the cosmos, according to “its ancient and medieval use”. For now, however, it is in the sense of cosmos as “all kind of order whatsoever” that I will focus my analogy between music composition and cosmology.

Already in the 1920s, Edgard Varèse (1883-1965) called his music “organized sound”. This statement clearly defines the difference between music and sound to be a question of order: he argues that “to stubbornly conditioned ears, anything new in music has always been called noise. But after all what is music but organized noises? And a composer, like all artists, is an organizer of disparate elements. Subjectively, noise is any sound one doesn’t like” ([43, p. 18])⁶. Luciano Berio (1925-2003), on the other hand, defines music with an apparently more open statement: “music is that which is heard with the intention of hearing music” ([5, p. 7]) (my translation). In reality, this statement is in no contradiction with Varèse’s “music as organized sound”, as the intention to hear music is, in itself, a form of sound organization, the act of making sense of a becoming of sounds. Even John Cage’s (1912-1992) attitude towards music composition denotes an extreme concern with order, with his indeterminate music always searching for chance procedures to determine ordering principles.

My compositions are microcosms that imitate the macrocosm (the universe), either by simply following the idea of composition as a cosmos and thereby creating their own “kinds of musical

⁵ “Proportion” will be used in the place of “number and proportion”, since proportion implies number, as it puts numbers in relationship.

⁶This quotation is from a lecture given by Varèse at Yale University in 1962.

order whatsoever”, or by imitation of actually existent *conceptions* or images of the macrocosm. In both cases, these conceptions may present a rich variety of roles assumed by number as one of the factors that generate musical phenomena. To explain all this is the goal of this article, but first, it is necessary to establish the meaning of a few important terms.

A cosmology, simply defined, is an image or conception of the cosmos; or, more exactly, “cosmology is the term for the study of cosmic views in general and also for the specific view or collection of images concerning the universe held in a religion or cultural tradition. (...) it relates also to inquiries in the natural sciences” ([6, p. 100]).

The creation process of a composition is, unfortunately, also called “composition” and, to avoid confusion, I will only refer to it as “the compositional process”, and reserve the word “composition” to the final microcosm resulting from the compositional process. In the same way, the word “cosmology” could refer to both the universe and the creation process generating this universe, but I will only use the word “cosmogony” to refer to the creation process, and reserve the word “cosmology” to talk about the structures and “laws of nature” that sustain the universe.

It would be fair enough to equate the idea of formative/organizing principles and codes with that of a compositional “system” or compositional technique or method. However, while referring to the composition in the neutral level⁷, it is preferable to speak about principles of immanent order, since this emphasizes the composition as cosmology. “System” is avoided here in favor of the notion of cosmology, which includes contemplative aspects—to be seen further ahead—that the idea of a system tends to exclude, due to its avoidance of anything exterior to itself.

As for “compositional technique” or “method”, due to the emphasis of “technique” on the action of a composer, these terms should be reserved for the compositional process, the musical cosmogony, that is, when speaking about the poietic level. Meanwhile, “formative principle”, although in Pareyson’s sense applies to the act of forming or shaping, should be reserved for the composition in the neutral level, because “principle” is not a composer’s action, but the cause of a phenomenon.

The analogy between composition and cosmology first came to me from the awareness that each musical style—and musical culture—has its own set of rules for creating music. These rules (principles of order) result in the way the music sounds, and reflect the way music is conceived and enjoyed. The obvious difference between how a classical Hindustani *rāga* and a Mozart symphony sound denotes two different modes of creation and poetics, of perception and aesthetics, of spirituality and corporeity⁸, of mind set and world view. I will use the term “cosmovision” (*Weltanschauung*) to join all these aspects together (mind/spirit/body set, world view, aesthetics and poetics) in a general large idea expressing that which conditions the way human beings act, think, behave, and exist in the world. Music poetics (musical making) belongs to the realm of human action. Cosmovision, in relationship to music, and applied to a whole culture or an individual composer, is

a great artistic imaginary which covers the composer’s (or culture’s) entire poetic, aesthetic and technical thought, as well as psychic life and capacity to produce meaning, including his image, perception, cognition and interpretation of the world and his mode of interaction with it. Cosmovision determines the contextuality⁹ that is observed in

⁷I am using Jean-Jacques Nattiez’s semiological tripartite approach to the discourse about music, by which the work (composition) can be studied from the point of view of the poietic level (the composer’s activity), the esthetic level (the listener’s activity), and the neutral level (the work itself). The latter “describes the immanent organization of the object, and is said to be neutral because not necessarily pertinent poietically or esthetically” ([35, p. 4]) (my translation).

⁸I mean spirituality very much in the sense given by Pareyson in his definition of poetics, given above, but not only: the soul (psyche) and spirit as integral parts of the human being, should not be forgotten in a discourse about music or its structure. Corporeity should include all physical and body aspects of making music, as well as one’s own body perception.

⁹ For a discussion of Milton Babbitt’s notion of contextuality, see more further ahead.

20th- and 21st- centuries musical compositions. ((...)) Cosmovation is the background which allows the formation of a cognitive perspective that generates contents, meanings, and worldly practices" ([27, p. 241]) (my translation).

Cosmovation is reflected in music because it determines the way music is practiced and conceived by a subject (an individual, a community). "Musical systems or languages are always more than organized sounds, vocabularies, and syntaxes. They are instances of the way a specific people understand and relate to the phenomenal world" ([4, p. 215]). It is in the sense of music as a reflection of a conception of the phenomenal world that musical systems or languages can be thought of as musical cosmologies, because a cosmology is just that: a conception of the phenomenal world. I will return to this point further ahead.

Because they contrast greatly with one another, collective cosmovisions that are farther distanced or isolated in space or time from one another (such as serial music and medieval plainsong, jazz and *maculelê*, Javanese gamelan and Romantic sonatas for piano, *candomblé* music and Lakota singing—the examples could go on forever...) are easier to be recognized as such than those that are closer to each other, such as Javanese gamelan and Balinese gamelan, Roman plainchant and Ambrosian chant, Romantic sonatas and Classical sonatas, serial music and free atonal music, *maculelê* and *maracatu*, American jazz and ECM jazz, *candomblé* music and Ewe drumming, Lakota singing and Inuit singing, etc. The latter examples are closely related but do not completely share the larger cosmovation they belong to, because they are less general. These musics, due to some particularities, became more distinct within the more general cosmovation and, therefore, they start to be considered as subcategories of the larger one. Otherwise, it would not make sense to distinguish, say, between the contemplative and slow Javanese gamelan from its sanguine and loud sibling, Balinese gamelan, for example. Their musical communities are smaller, i.e., their cosmovisions are no longer shared completely and collectively by so many people in a wider context, because there exist notable differences preventing them to be placed in the same large category, therefore the need for subcategories. This individualization process seems to be an effect of local ecology, kinship, derivation, or cross-fertilization that makes the matter all the more complex, enhancing the particular and individual, rather than the universal and collective.

In the Western world ¹⁰, since the 20th century and continuing today, cosmovation tends to become such an increasingly individualized phenomenon. Although composers do share common musical practices, have studied according to mostly the same musical methods, know and enjoy more or less the same repertoire, they also have their own blend of musical vocabularies, tastes, interests, points of reference and of preference, and may act from disparate points of departure, so much that they will tend to conceive music quite differently from each other, and produce highly individualized styles of music. Individualization makes the cultural context more complex and fragmented, and, in an attempt to make sense of this, or out of a "necessity" to label them in some expedite mode of promotion or diffusion, there is a tendency to group composers together in a certain "ism" or genre. Most often than not, the result is a grouping that does not do justice to what composers are actually proposing. As an example of this is the term "contemporary music": one needs to be more explicit about what this term entitles rather than simply using it indiscriminately, so that there will be no misunderstanding about what it stands for.

¹⁰ It seems safe to say that the universe of "20th-century and contemporary composition" is still a "Western world", a "Western music", notwithstanding the international and global scenario in which composers from the entire world (Brazil, Bolivia, Mexico, South Africa, Australia, New Zealand, China, Japan, Korea, to name but a few) join the practice of musical composition, a practice that cannot ignore the European/North American past and present tradition. Western music became something like Tibetan Buddhism: it has spread worldwide, and can no longer be identified with its geographic place of origin.

The task seems to be to embrace individualization as part of our “learning to live together with chaos”¹¹. Since there is no longer a necessarily common canon to be followed, composers have found themselves seized by the opportunity to create their own individual canon according to what they *see fit* (world vision). This should not be understood as indulgence and caprice; it has to do with one’s own artistic inclinations, instinct, intuition, and consciousness that identify what one wants to become. From this desire to become something comes a consequent choice of education: while education is received in childhood not by one’s own choice but from someone else’s choice, in a later or more mature age, a person may choose consciously their own continued education and acquire the skills and knowledge that the first education failed to provide. It is like recognizing one’s own destiny and place in the world, like the favorable *habitat* not only for surviving but for thriving. I have called this situation of the 20th- and 21st- centuries composers a “cosmological state of things” ([27, p. 243]), a situation that favors composers to come up with individualized ways of organizing sound and music for their creative practices. “Individualized” does not mean always unique and certainly never completely independent from other practices, since *creatio ex nihilo* does not apply to human practices. It means the freedom to choose one’s artistic and theoretical references and to dialogue with that chosen segment of history.

The repertory of New Music created since 1945 is a large reservoir of examples of the “cosmological state of things” in which their creators are living. The work of Karlheinz Stockhausen is probably the most consistent example of a poetics in which there is an entirely new creative endeavor for each composition: each piece is born from a specific new way of structuring and organizing sounds. Milton Babbitt (1926-2002), speaking about what he calls “for now, serious music”, introduces the term “contextuality”, a helpful notion in the recognition of the cosmological *status* of New Music, since it refers to the new and autonomous context created at each new work of a composer. It starts with serial music, where a tone row, being created for each composition, defines the context of each piece always in a different way, turning the piece into a self-referential, autonomous entity.

“musical compositions of the kind under discussion possess a high degree of contextuality and autonomy. That is, the structural characteristics of a given work are less representative of a general class of characteristics than they are unique to the individual work itself. Particularly, principles of relatedness, upon which depends immediate coherence of continuity, are more likely to evolve in the course of the work than to be derived from generalized assumptions. Here again greater and new demands are made upon the perceptual and conceptual abilities of the listener.” ([3, p. 2])

Serial contextuality also means freedom; this was Anton Webern’s (1883-1945) feeling about composing: “but now I can invent more freely; everything has a deeper unity. Only now is it possible to compose in free fantasy, adhering to nothing except the row” ([44, p. 59]). Contextuality becomes acute in indeterminate and aleatory music, where each composition is created by a completely new set of rules the result of which is always somewhat different. Somewhat or entirely, as in the case of Earle Brown (1926-2002) and his composition *December 1952*, which is a one-page graphic score with lines and dots to be freely realized by an indeterminate number of musicians, and read in any position (upside or upside down, vertically or horizontally) with no established starting or ending point. As an extreme case of indeterminacy and contextuality, *December 1952* seems to have lost its own contextuality, or this contextuality becomes entirely dependent on the performer’s interpretation of the score.

¹¹The phrase is one of the many aphorisms by my composition teacher in Brazil, German composer Hans-Joachim Koellreutter (1915-2005): “we must learn to live together with chaos” (“precisamos aprender a conviver com o caos”).

Luigi Pareyson's theory of formativity is also helpful in the recognition of the cosmological *status* of the poietic activity of an artist. Applying to music what he says about art, composing music is an act of forming or shaping a form, a doing that, while doing, invents how to do. The creative process is the process of realization of the whole or idea (*forma formante*), which provides the direction of the creative activity since its beginning, guiding the artist "like an omen of the work it desires to actualize" ([38, p. 75])(my translation). It is clear that, in this conception, the *forma formante* not only creates contextuality at each work, but also is what creates the final form (*forma formata*).

The analogy between composition and cosmology may be applied to a musical style as well, or a music period in history, but, because of the individualization process, I mean it mainly in regards to a single composer's production, and more exactly to my own, since it would not be correct to generalize and say that all (or the majority of) composers agree that composition is a cosmology. In fact, I have not found other composers that conceive music as cosmology. Karlheinz Stockhausen comes closest in conception, as exemplified by several statements such as the following: "*Mantra*, as it stands, is a miniature of the way a galaxy is composed (...) As it was being constructed through me, I somehow felt that it must be a very true picture of the way the cosmos is constructed" ([13, p. 242]). Japanese composer Jōji Yuasa (b. 1929), mentions that a "composer's music reflects his individual cosmology, and that this cosmology encompasses both his cultural identity and the collective consciousness of the society which shares his language (...) music is a metaphor or metonymy of a composer's cosmology" ([46, p. 197]). However, his article does not go any further on this idea, except for attributing an important role to language in shaping cultural identity, and stating that a person's sensibility, way of thinking and perceptions are ruled by language. Yuasa's idea corresponds to what I have been saying about cosmovision; in my words, Yuasa's statement is that music reflects a composer's cosmovision. His statement does not proceed to conceiving compositional formative and organizational principles as a musical cosmology. Hans-Joachim Koellreutter speaks of the different aesthetic phases in the history of western music as determined by different levels of human consciousness. This idea certainly has to do with cosmovision but, again, not with musical cosmology as I am proposing here.

As mentioned above, a composition is a microcosm, a universe (*kosmos*) of sounds. But in addition to the sounds themselves, music is also the order of sounds, the whole of formative and ordering principles which put sounds together, creating the mutual relationships and ways of interaction of sounds, in the same way as, in the Greek concept of *kosmos*, natural phenomena are in relationship and interaction creating a tight unit. Sounds must be organized to acquire the *status* of music. Sounds, textures, chords, melodies, sound masses, rhythms, gestures, motifs, phrases, whatever morphological units in a given composition are like natural phenomena in the acoustic universe called "composition". The relationship between them is determined by formative principles or codes. These musical principles and relationships give shape to a universe of sounds; they *are* the laws of nature of this sound world. A principle, in the sense of classical Greek and Latin philosophy, "is a fundamental rule or cause (principle, *arché* - ἀρχή – the beginning, which rules and governs everything)" ([39, p. 28]). A formative principle gives shape and form to music. Therefore, there are principles (or causes) that give form/existence to the consequent phenomena observed (or heard) in music, integrating them in a unified whole. Music composition is a cosmology, seen as the *rationale* of its creation.

The analogy between compositional formative principles and laws of nature must be investigated a little closer, since there is a fundamental difference between the two. The term "laws of nature" is generally used in reference to moral, politic, and legal doctrines, but the meaning that

relates to music composition, viewed as a *physis* (nature)¹², a microcosm, comes from its use in the natural sciences, as the attempt to describe, understand and even predict natural phenomena based on the observation of empirical evidence. Newton's Law of Gravity, or Darwin's Law of Natural Selection are good examples of laws of nature in the natural sciences. In this analogy between musical cosmology and the natural sciences, where the composition is identified with an acoustic cosmos, it is possible to speak of a *scientific cosmology of composition* to identify the principles that shape this musical natural world. In this case, the term "laws of nature" are better understood as "physical or scientific law". However, while "physical law" is a scientific generalization based upon repeated experimental observations that describe aspects of the universe, the "laws of nature" of a composition are the principles governing the *generation* of musical forms; they are not obtained or inferred from observation and empirical evidence; laws resulting from these activities would be the findings of musical analysis, and not of musical creation. For this is what musical analysis does when it analyses a composition: it observes the *forma formata* with the goal of describing aspects of that universe of sounds by general ideas inferred by means of that empirical observation. Compositional formative principles are not descriptive, but rather prescriptive; they are invented by the composer, who acts according to them, even when breaking them¹³, in order to generate the desired musical result. In this sense, there are moments in the compositional process when techniques, methods, rules and formative principles are tested and evaluated as achieving or not the desired results by means of observation and analysis of the "empirical evidence", i.e., the results obtained by them; some of them might not be what had been "requested and ordered by the whole as *forma formante* along the forming process" ([38, p. 101]) (my translation), in which case they are discarded by the composer, until the right ones are found. The moment of adopting the formative principle that "works", the right technique, is immediately recognized by the composer because it transforms the *forma formante* in the right *forma formata*. In any case, and to conclude, formative principles are not like scientific laws because the latter are descriptive and the former are prescriptive; the term "laws of nature" may only be used with this distinction in mind and, preferably, referring to the results of a musical analysis.

At this point, it would be important to provide concrete examples of formative principles, "laws of nature" at work in a composition. One simple example is the principle of imitation, by which a melody written on a part is written on another part starting after one or two beats from the beginning of the first part, and transposed according to a given interval (for example, an octave above or a fifth below). This technical procedure is, in the poietic level, a group of actions: repeating a melody in another part, transposing, making adjustments, etc, while, from the point of view of the neutral level, that is, the composition itself, it is an immanent principle of organization.

With the purpose of providing more examples of formative principles in my own music, I should refer the reader to the article "Expanded Modal Rhythm" which describes in detail and with examples, part of the temporal/rhythmic organization principles I have been using since 1989.

The above considerations establish composition as cosmology based on two causes: 1) the high contextuality and autonomy of composers' works since 1945, and 2) the simple analogy between music as organized sound and the world as organized matter (a cosmos). In the first cause, as already argued, the composer, in a "cosmological state of things", may create music according to a very particular prospective (cosmovision, world view) and produce a music that is consequently,

¹² There is no word that translates all the meanings of the Greek word *physis* (*φύσις*), but "nature" is a generally accepted one.

¹³ My composition teacher in Italy, Franco Donatoni (1927-2000) used to say that, to avoid becoming a bureaucrat, the composer created the codes ("*i codici*") or laws *in order to break them*. Furthermore, and however, I believe that formative principles may be general enough as to provide a great flexibility in their application, without the composer needing to go against them.

highly individualized and, nonetheless, authentic, valid and contemporary, in the sense that it could not have been produced in another time. It is the research for and creation of one's own techniques and formative principles, and not the simple adoption of the already existing ones, that allows the composer to create a new musical thought, a new musical cosmology. As for the second cause, the analogy musical order/world order consists in the recognition that, because the musical composition is conceived according to the ancient Greek concept of *kosmos*, it reflects the Greek conception that the universe is an ordered, organized whole of phenomena. Therefore, it is possible to affirm that (my) compositions are microcosms that *imitate* nature, the macrocosm (the universe). However, this is not all that is meant by the analogy: there is also the musical imitation of actually existent *conceptions* of the macrocosm that interest me the most.

Before considering this, it is important to understand correctly the idea of art as an "imitation of nature". Even today, in this respect, Aristotle's concept of poetic mimesis (*μίμησις*) as "a kind of recreation of reality according to the laws of possibility and likelihood" ([39, p. 168, v. IX]) seems to be the appropriate theoretical reference. It is not the case that the artist copies nature: the painter is not imitating nature for drawing a tree, for example; what is "copied", better say, what is imitated, is the *activity* of nature, in the sense that the artist "imitates nature in the process of creating a world or a whole" ([42]). Or, quoting Anton Webern, who quotes Goethe, "art is a product of nature in general, in the particular form of human nature" ([44, p. 19]), or still, "everything must be just as in Nature, since here (in art), too, Nature expresses herself in the particular form 'man'. That's what Goethe says." ([44, p. 44]).

The whole created by the artist is a microcosm (*μικρὸς κόσμος*), a "miniature thing" that encloses the characteristics of something much larger. Theories of the microcosm/macrocosm appear first in history comparing the human being (*minor mundus*) with the universe (*maior mundus*), as they share, in these theories, the same aspects or elements in structure or nature (and vice-versa) ([1, p. 321]). The idea developed since ancient Greece through the Renaissance, and lost momentum due to the advent of modern science¹⁴, in the philosophy and sciences of the 18th century. It is not an exclusivity of the western world either, as it appears, for example, in Indian religions such as Buddhism and in the Vedic idea of Puruṣa, Cosmic Person (Ṛg Veda X, 90 hymn)¹⁵. In the realm of the arts, the idea turns the art work into a microcosm.

"The idea of the microcosm, the notion that the structure of the universe can be reflected on a smaller scale in some particular phenomenon, has always been a favorite in the history of aesthetics. (...) Even the famous doctrine of art as the imitation of nature lies in germ in these early cosmologies, if we take imitation in its liberal and true meaning, not as the duplication of isolated things, but as the active attempt to participate in a superior perfection". ([18, p. 6])

Therefore, a musical composition is a microcosm when it reflects the structure of the universe on its own small scale.

Some ethnomusicological studies corroborate this statement, as they identify a relationship between the way music is structured in a music culture and the cosmological conception of that culture, that is, "a way a specific people understand and relate to the phenomenal world": musical form as cosmology. Although ethnomusicologists do not speak of microcosm, it is, in fact, the case of a macrocosm/microcosm equivalence. For example, in their studies of Javanese gamelan music, ethnomusicologists Judith and Alton Becker use the term "iconic" to refer to this relationship. I will adopt this meaning of the word "iconic" hereinafter in relationship to my own music. The

¹⁴ Throughout this article, the expressions "modern science", "modern world", and "Modernity" refer to the historical Modern Era, which starts roughly around the year 1500 and arguably finishes (?) in 1989.

¹⁵For the relationship of this idea with composition, see the article "Música e Sacrifício", [24].

idea is that a music's power (truth or beauty) is associated with the iconicity (or "naturalness", non-arbitrariness) of the coherence system behind that music. "Iconicity can be defined using Burke's categories¹⁶ as finding the image of something in another realm" ([4, p. 205]). Therefore, finding the image of the cosmos (cosmology) in music makes music iconic with cosmology. This is exactly what Becker describes Javanese gamelan's music structure to be: it is iconic with the Javanese system of calendrical cycles. "In Java, a day is reckoned by describing its position within a number of simultaneous cyclic systems all moving at a different rate or all of different lengths." ([4, p. 209]). In a similar way, gamelan music is ruled by multiple cycles with pitches "coinciding at predictable points in the music system" ([4, p. 208]). The coherence system in case here is that of *coincidence*, for, "as pitches coincide at important structural points in gamelan music, so certain days coincide to mark important moments in one's personal life. One might say that gamelan music is an idea made audible(...)" ([4, p. 210]).

Another example is given by ethnomusicologist Paul Humphreys in his study of ceremonial songs of the Pueblo Indians. In the coherence system that informs the music of these ceremonial songs, the Tewa cosmos is ordered in six levels of spiritual and corporeal existence, with both spatial extremes (the center and the periphery) considered as sacred. *Katcina* dance songs'

"musical organization has iconic significance in relation to cosmological orientation. (...) 'centripetal organization' and the activity of composing songs stand in iconic relationship as well. Song makers must work 'inwards' from large-scale formal requirements through a somewhat more flexible web of prescribed vocable formulas to the melodic content of initial and final sections, only last composing the portion of the song identified as 'song's middle' and which song makers from a number of pueblos acknowledge as 'the hardest part' to compose" ([22, p. 74]).

The ethnomusicological examples above are sufficient to make the point that the traditional music of a given culture is a microcosm; it expresses its own underlying cosmology; it imitates, in its structure and formative principles, the image of the cosmos prevailing in that culture. It does not seem to matter whether or not the iconicity described is a conscious element of its culture's people, their musicians and listeners, as the cosmological foundation of human behaviors is often buried in the unconscious. What matters is that the cosmology does find its reflection in musical form: *form as cosmology*. This "symbolic reflection of cultural meaning", to use the words of ethnomusicologist Alan P. Merriam, shows one of the ways music is symbolic, and helps "to understand music not simply as a constellation of sounds, but rather as human behavior" ([34, p. 258]). Yet, at the same time I bring this citation to provide the academic context (the study of music as culture) in which ethnomusicologists see the relationship between music and cosmology, I feel the "but rather" part of Merriam's statement needs a "correction". Since "but rather" implies "instead" and indicates that the understanding of music as human behavior is a *better* understanding of music than the structural understanding, I prefer to simply state that it is important to understand music in both ways at the same time, as a constellation of sounds *and* as human behavior. Musical structure (music as a "constellation of sounds"), as proven by Becker or Humphreys, has much to say about creative processes and human actions, and to abandon or diminish its study is to waste a good opportunity for advancing the study of music as culture. Therefore, in order to avoid defending the point that cosmovision is defined by society or culture, it is important to stress that, on the contrary, it is culture, as a complex of learned human behavior patterns that *expresses* its cosmovision and cosmology. It is not possible to dwell on this subject any longer because the goal of this article is another. However, as in all situations in which there

¹⁶ Kenneth Burke's *The Rhetoric of Religion: Studies in Logology* (1961) describes four realms of referentiality, i.e., realms which words can refer to: the natural, the socio-political, logology (the realm of words about words), and the supernatural.

are two aspects in a possible relationship of cause and effect, it is more likely that the two elements in question (in this case, society/culture and cosmology) influence each other in a feedback relationship. While agreeing to say that a cosmology is a cultural construct, I am only recognizing that cosmology is *partially* a cultural construct; culture is the realm of manifestation, the temporal and spatial limiting factor or context in which human beings bring to manifestation ideas and objects of art (among other things). Therefore, ideas and objects of art will always be formed in relationship to whatever is already manifest in the culture, but in the creative process—which includes both the formation of (even cosmological) ideas and or artistic objects—it is not the *forma formata* (the finished cultural idea or object of art) that determines what is being created next, but rather, the *forma formante*, the archetype. If it were not so, cultures would be static and unchanging, ideas would never change, and their music would be stuck with the repetition of a limited repertory of pieces.

In addition, following modern science's line of questioning, which limits truth or knowledge exclusively to that which can be proved empirically, one might argue that, for example, the Tewa cosmos of the Pueblo Indians mentioned above in Humphreys' study is a mistaken idea of what the universe "is in reality". For this has been the main concern of modern science, to explain the universe objectively and quantitatively, once and for all. This line of questioning seems out of place.

Firstly, for the purpose of the iconic relationship between music and cosmology to take place, it does not matter whether the cosmological view is scientifically "true" or not: the lack of scientific truth in a given conception does not invalidate its influence on the music, nor the music itself, with which it is iconic. In this context of iconicity, it is irrelevant whether the earth is flat or not, or that it is at the center of the universe or not. Cosmology is an *image* of the cosmos, a set of ideas. The imitation of nature in art is always the imitation of what human beings think nature is. Cosmology is a conception about the universe and not the universe itself, and this conception is, in fact, the order human beings see in the world; *the conception is the cosmos*. Without a cosmic conception, the world is an unintelligible mystery, just like sound without order is not music.

Secondly, because cosmology, as a science of the world, exists since Antiquity, it should not be limited to the conceptions of modern science. The common use of the term "cosmology" currently in the media, popular knowledge and outside of academic circles of the Humanities (Philosophy, Comparative Religion, Anthropology, Mythology) has reduced its meaning to a purely physical description of the cosmos, leading straight to the notions of "space, the last frontier" and the Big Bang theory. Because of this overwhelming propaganda in mass culture, it is easy for the layperson to forget, or even to ignore, that traditional cosmologies did exist before modern science, were not limited to a simple cosmography and should not be dismissed as nonsense.

Once studying the non-scientific cosmologies of Antiquity, European Middle Ages, and non-western cultures from the Middle to the Far East, one not only discovers the existence of several culturally diverse conceptions, but also, that they frequently express a fundamental unity transcending their differences. It is an awesome phenomenon that disparate cosmologies such as those found in Vedanta, Platonism, Pythagoreanism, Sāṃkhya, Sufism and Buddhism, among others do have important points of connection, similarities and even identities. Philosopher Titus Burckhardt (1908-1984), whose main concern is metaphysics, explains, from that prospective, the reason why there is such a variety of cosmological conceptions:

"Cosmology is thus the science of the world inasmuch as this reflects its unique cause, Being. This reflection of the uncreated in the created necessarily presents itself under diverse aspects, and even under an indefinite variety of aspects, each of which has about it something whole and total, so that there are a multiplicity of visions of the

cosmos, all equally possible and legitimate and springing from the same universal and immutable principles.” ([8, p. 17]).

Although the main object of a traditional cosmology is the world as it exists, it is also concerned with metaphysics, differently from modern science, which is satisfied with the mechanistic explanation of the world.

“Cosmology as such does not refer to the Absolute or pure Being, but rather to existence, the totality of created and manifested worlds. However, as the cosmos would not exist without its divine origin, and, from the point of view of its essence, it cannot be but a limited image of the divine, cosmology is interested indirectly in the metaphysical truths, those from which it receives its ultimate certainties” ([7, p. 19]) (my translation).

This statement clearly shows the transcendental background of a traditional cosmology, its connection to religious and theological traditions, and its concern with the relationship between the human being and the world, and between them and a “metaphysical truth” or, in other words, the Sacred. In the majority of the cases (in fact, I cannot think of any exception), traditional cosmologies are in accordance with their related religion. Religion may be defined here as a cultural or a people’s ensemble of ideas, beliefs and practices that follow their conception (theology) of the Sacred. By its turn, I understand by *sacred* that which religious scholar Rudolf Otto (1869-1937), by derivation of the Latin term *numen* (divine, or non-personified divine presence), defined as the “numinous” in his 1917 book *Das Heilige*: while “((...)) ‘the holy’ is a category of interpretation and valuation peculiar to the sphere of religion ((...)) it completely eludes apprehension in terms of concepts ((...))” ([36, p. 5]), the numinous is “((...)) ‘the holy’ *minus* its moral factor ((...)) minus its ‘rational’ aspect altogether” ([36, p. 6]).

Therefore, traditional cosmologies confer to music other meanings beyond that which, up to now, I have identified as the “scientific cosmology of music”, and which generates a rational knowledge (*episteme* - ἐπιστήμη) about the physical aspect of the musical microcosm: its structure, formative principles and compositional techniques. I mean *episteme* very much in the ancient Greek sense of a rational science. In the analogy with a traditional cosmology, I should speak of a *contemplative cosmology of music*, as this assigns a specular or symbolic quality and scope that generate a gnostic knowledge (*gnosis* - γνῶσις) about the musical microcosmos, i.e., the physics of the musical microcosm, its structure, formative principles and compositional techniques. I do not mean *gnosis* specifically as in the mystical knowledge of certain late Antiquity religious-philosophical groups, which is the immediate reference of the term, but rather in a wider sense, as an intellectual intuition of the numinous.

In order to describe this relationship of the music with the numinous, as opposed to a relationship with the immediate empirical reality, I prefer the term “contemplative” instead of “traditional” or “cultural” cosmology. Until recently, I have used the term “cultural cosmology of music”. However, this turns out to be a reductive approach, as “cultural” emphasizes only the relativity of cultural diversities, it only refers to the fact that traditional cosmologies vary according to culture. Also, “cultural”, in terms of knowledge, is not in the same level as “scientific”. The term “contemplative”, or even “gnostic”, is a better complement to “scientific” than “cultural” or “traditional”, the latter often being used in opposition to “modern”.

Contemplation, from the Latin *contemplatio*, means consideration, observation and study, and “is the prolonged insistence of the gaze or thought over a source of wonder or admiration” ([14, p. 568]) (my translation). The Latin root *templum* (a sacred place) indicates that this insistent gaze aims at a mystical *henosis* (ἕνωσις, oneness or unity) with the numinous. German theologian Friedrich Heiler (1892-1967) writes, in 1933, about the definition of contemplation:

“The clearest definition of contemplation was perhaps presented by St. Thomas Aquinas (...) ‘contemplation is the simple intuition of divine truth, proceeding from a supernatural principle’. Contemplation is spiritual vision, a total vision, directed toward the divine reality in its transcendental totality, a vision that is not voluntarily induced by human activity but that arises without our volition, that—speaking in religious terms—is inspired, infused, bestowed as a divine charisma” ([20]).

Therefore, a contemplative cosmology reflects the mystical or spiritual vision over which it is founded. The idea of a contemplative cosmology of music returns to contemporary musicians an element of poetics, aesthetics and the philosophy of art that has been present in the art of practically all times and of probably every people, and that had been rejected and forgotten, perhaps, only by Modernity: the sacredness of the creative act and the function of art as a vehicle for spiritual truth. It seems fair to say that in the late modern (post-modern?) world, generally speaking, materialistic and utilitarian values have emptied music (and art in general) from any spiritual meaning and reduced it to the *status* of a disposable item, while, in tribal societies, for example and also generally speaking, the sacred is seen in everything, and consequently, even the most banal utensil is crafted as an art piece, because, in fact, they are all sacred objects.

In the same way, the words of the Parisian architect Jean Mignot (fl. 14th and 15th- centuries) in 1398, at the time of the construction of the Milan cathedral, “*Ars sine scientia nihil*” (art without science is nothing), summarize the nature of sacred art and the close relationship between art and science in the Middle Ages, a conception that was beginning to be challenged already at that time¹⁷. In medieval understanding, the term *ars* means *techné*, the ability to make things, and *scientia* does not mean science as we understand it, but the reason (*ratio*), the theme, the content, or dominant motif of the work, which is spiritual truth ([10, p. 229]). Therefore, in the Middle Ages, art without spiritual content is nothing. The tendency to separate art from science eventually led to the modern scientific view that traditional cosmology’s attempts to explain natural phenomena are naïve or plainly wrong—who could possibly defend the idea that the earth is flat, after science’s discovery that it is round? Traditional cosmologies, as they are not scientific in the modern sense of the word, express themselves by means of allusions, parables, myths, and symbols in a way that is comparable to art.

It is in the spirit of this engagement with existing traditional cosmologies that the analogy between composition and cosmology is finally complete: by means of the musical imitation of actually existent contemplative or mystical *conceptions* of the macrocosm. While the medieval *musicus* was more a cosmologist than a practical musician, concerned with what Boethius called *musica mundana* and the concept of *harmonia tou kosmos*, harmony of the cosmos or universal harmony, the contemporary composer becomes invested by the cosmologist role, similar to that of the *musicus*, by means of associating musical composition with a contemplative cosmology. This, in its turn, does not have to be limited to Pythagorean philosophy, but may be expanded by contemplative cosmologies of other traditions. The *scientific cosmology of composition* and the *contemplative cosmology of composition* stand to each other not in a relationship of contradiction or opposition but in that of complementarity and interdependence.

I should briefly mention that, although it has been my choice to engage exclusively with contemplative cosmologies, there still is the possibility for composers to work at an iconic relationship of their music with contemporary scientific cosmological thought. A good example of this is found in the late works of Hans-Joachim Koellreutter, those he called “essays” instead of “compositions”. Works like *Dharma* (1990) or *Wu-li* (1992) are iconic with certain principles

¹⁷ Coomaraswamy narrates that Mignot’s phrase was the answer he gave to the nascent opinion that “science is one thing and art another”.

of Quantum Physics, which explain the composer's choice for open form and his "relativistic aesthetic of the imprecise and paradoxal". These two works in particular refer, at least in their titles, to concepts which come, respectively, from Indian and Chinese contemplative cosmologies. Koellreutter's permanence in India and Japan from 1964 to 1974 ([28]) seems to have been a decisive period for the development of this tendency to connecting several works to concepts from Buddhism (*Sunyata*, 1968), monistic Vedanta (*Advaita*, 1968), and Zen Buddhism (*Yügen*, 1970). In fact, aligned with ideas from Fritjof Capra's book *The Tao of Physics*, Koellreutter also saw a connection between Quantum cosmology and Hindu, Buddhist and Taoist philosophies. Curiously, while none of his works' titles indicate a relationship of the music with Quantum Physics, several indicate Buddhist or Hindu mysticism. Conversely, in his discourse about his musical work, Koellreutter was much more eloquent about establishing a connection with Quantum Physics instead of mysticism, as if Quantum Physics provided a safer rhetoric which corroborated, in a scientific way, that which was already present in these mystical traditions (this is, in fact, one of the points defended in Capra's book). Certainly, these musical compositions of Koellreutter display a strong attraction towards the transcendent, numinous Being, and this fact places them in direct relationship with contemplative cosmologies.

Several of my musical works have included one or as many elements as possible, to convey, musically, the symbolic coherence that constitutes or is found in an existing contemplative cosmology. A particularly expressive work in this regard is my *Sacrifício* (1998), for mixed choir *a cappella*, which is composed according to the Vedic idea of sacrifice (*yajña*) as cosmic law, by means of "sacrificial structures", interdependence, complementarity and inversion as formative principles in the music¹⁸. The role of number in this composition will be described further ahead.

I have a great interest in the philosophical and cosmological thought of pre-Socratic philosophers, especially Pythagoras of Samos (c.570-c.495) and sixth century Heraclitus of Ephesus, (c.535-c.475 B.C.E.), which has helped me engender a number of musical works. In *Madrigal de Fogo* (1996, for mezzo-soprano, strings—vn., vla., vc., db.—and two percussionists), the voice sings, in Greek, selected cosmological fragments by Heraclitus about fire, cosmic fire, and the elements. This piece is a "madrigal" in the sense that it "imitates" the content of the text. The composition as a microcosm establishes an analogy with Heraclitus' conception of cosmos, by which all phenomena are generated by fire, all are transmutations of the primordial element, fire. In the music's universe of sounds, the element that corresponds to fire is rhythm, understood as becoming (*devenir*), since both fire and time live by self-consumption, in the same way as music. The syllabic and quantitative nature of Greek language allows the rhythm of the text to become rhythm in the other instrumental parts¹⁹. There is no thematicism, but simply a constant transmutation of the words into instrumental sounds, following the Heraclitean cosmological principle sung in the first fragment of the text: "*panton hen kai ex enos panta*", "from All, one; from One, all".

In another work, "*...a natureza ama esconder-se...*" (1989), for oboe, Bb trumpet and cello, the title itself is a fragment by Heraclitus which states that "nature loves to hide", meaning that the real constitution of things, i.e., the formative principle that shapes them, "loves to hide" from plain view. This idea prompts me to conceive a music which sounds according to a certain organization or order principle which is not easily perceived neither clearly apparent. This notion surely has to do with Franco Donatoni's emphasis on *procedimenti nascosti*, hidden compositional techniques or codes that he used in his own works.

¹⁸ As this article is concerned with the role of number or mathematical models applied to composition, I should refer the reader again to the article "Música e Sacrifício" ([24]), which describes the relationship between music form and the Vedic sacrificial cosmology.

¹⁹ See expanded modal rhythmic principles in [23]

At this point, it is necessary to conclude the description of the poetic context in which number and proportion find an application in my music by briefly approaching the ideas of composition as cosmogony and spiral musical time.

II. COMPOSITION AS COSMOGONY

A cosmology always implies a cosmogony, to the extent that it may be very difficult to separate one from the other, the description of the cosmos (cosmology) from the account of its origin (cosmogony or cosmogenesis). As a discipline in the Humanities, cosmogony “has to do with myths, stories, or theories regarding the birth or creation of the universe as an order or the description of the original order of the universe” ([32, p. 94]). Regarding the musical composition as a microcosmos, this corresponds to looking at the creative, compositional process as analogous to a cosmogony. Each composition has its own compositional process, and a detailed description of it would take into consideration the composer’s method (from the Greek *methodos*, the path to reach a goal). This means that we would be back to the issue of the ensemble of techniques which, used in a certain sequence of steps (the path) obtains a certain result, even if this path had not been foreseen by the composer. In fact, it may not be clearly foreseen, but, according to the idea of *forma formante*, which guides the creative process, it might be envisioned intuitively. Therefore, this leads back again to cosmology, the formative principles of the neutral level, seen as techniques, in the light of the artist’s poetic level.

Such is the conundrum between cosmology and cosmogony. Therefore, the discussion about compositional process as cosmogony must not be about methodology or technique (which belongs to the scientific cosmology of composition), but about its meaning from a contemplative and artistic point of view, which is how the compositional process and the resulting composition “reflect the uncreated in the created”, reflect their “unique cause, Being”. One could say that what follows is a metaphysic of musical creation.

In “the active attempt to participate in a superior perfection”, the contemplative point of view sees the compositional process as a repetition of the creation of the universe, the sacred act *par excellence*. It is a repetition in the human scale, a re-enactment of an act attributed to (a) god, or to a reality that transcends the human being. This idea comes directly from Romanian philosopher and comparative religion scholar Mircea Eliade’s (1907-1989) thesis that the cosmogonical myth is a model for every significant human activity including rituals and artistic creation: “every construction or fabrication has the cosmogony as paradigmatic model. The creation of the world becomes the archetype of every creative human gesture, whatever its plane of reference may be” ([15, p. 45]). When I first read, in 1988, in Eliade’s 1949 book *The Myth of Eternal Return*, about the re-enactment of Creation that takes place in the process of a city’s foundation, for example, the idea was for me perfectly natural and applicable to the work of creating music, even if Eliade was referring to “archaic societies”:

“If the act of the Creation realizes the passage from the nonmanifest to the manifest, or to speak cosmologically, from chaos to cosmos (...) all this beautifully illuminates for us the symbolism of sacred sites (centers of the world), the geomantic theories that govern the foundation of towns, the conceptions that justify the rites accompanying their building. We studied these construction rites and the theories which they imply (...) every creation repeats the pre-eminent cosmogonic act, the Creation of the world” ([16, p. 18]).

As strange as it seems, the notion that the creation myth of an “archaic” society could be a model for the compositional work of myself, a contemporary Brazilian composer, at the time (1988)

living in Italy, sounded to me as unquestionable and true. I still wonder to this day how this can be... A couple of years later, another reading that was for me “as lightning in a calm sky” was the Puruṣa Sukta, Ṛg Veda X, 90 hymn, which narrates a Vedic cosmogonic myth by which the universe is created from the sacrifice and dismemberment of Puruṣa, the Cosmic Person: it was, to me, like a clear description of the process of musical composition. . . , and eventually led to the 1998 choral piece *Sacrificio*.

I am probably not the only composer who could talk about their personal experience of this cosmic creation re-enactment through composing music. But I do it while being aware of the sacredness inherent in the process, or aware that I am attributing to it this sacred quality, which ultimately amounts to the same thing. When I am about to start working on a new piece, I feel it as a latent, unmanifest sonic energy or sound that I can visualize or imagine as a sphere, unless it already comes as a musical idea. Most often, the hearing comes later in the process, but initially, I sense this kind of entity that I am willing to bring to the outside world through the intuition of a title, or of a formative principle and technique, or through a musical structure. There is no formula to approaching this sphere. Most of the times, because of a structural *rationale* that seems to dominate my way of thinking, I start planning the macroform, the macrocosm of the piece (the macrocosm of the microcosm...), its proportions, its larger sections. Then, these ideas become material for the microform, i.e., the local structures that the listener experiences directly when listening to the finished work. This is clearly a desire to establish, in music, traditional cosmologies’ principle of identity or similarity between the macrocosm (universe) and the microcosm (human being) within the piece itself, i.e., by creating identity or similarity between musical macroform and microform.

My conscience of what the piece is grows gradually. Along the working process, I feel like the explorer of a *terra incognita* that I am creating at the same time that I am exploring it. I think this applies to every composer whose work is born from research of something new. It is through the work of composing, by trial and error, that I become conscious of the sound universe of the composition, therefore, giving to it a meaning and a final form. Probably, as in Pareyson’s theory of formativity, the composition is bound to have that final form from the very beginning, the time in which it was still unmanifest, as *forma formante*, which becomes *forma formata* along the process. The composer should just be able to get in the right syntony with *forma formante*’s vibrations. The piece, before it is composed, lives only in potentiality, outside of existence. Unmanifest, it remains part of the undifferentiated absolute until the composer becomes gradually conscious of it by bringing it to light through the compositional process (cosmogony), which consists in the creation and application of the necessary, appropriate and rightful formative principles and structural relationships (scientific cosmology).

This process of creation I have just narrated above is, to a contemplatively inclined mind, sacred in itself simply because it is a poetic act, i.e., an act that brings forth into nature-existence-something that did not exist before. Therefore, this human creative act of composing music shares the same nature of the act of Creation of the world. It turns undifferentiated sound (chaos) into music (cosmos); the composer witnesses in first hand, experiences directly, and actively helps the conduction of the transformation path travelled by *forma formante* from potential to actual, from archetypal to typical. And this is probably what Karlheinz Stockhausen meant by “as it (the piece) was being constructed through me” in a previously presented quotation.

To compose music with this awareness of artistic creation’s sacredness and with the intention of conveying an existing contemplative image of the cosmos (cosmology) at the structural level of the music’s organizing and formative principles is to *cosmicize sound*. I have borrowed the idea of “cosmicization” from Mircea Eliade:

“The cosmicization of unknown territories is always a consecration; to organize a space

is to repeat the paradigmatic work of the gods. . . . Establishment in a particular place, organizing, inhabiting it, are acts that presuppose an existential choice—the choice of the universe that one is prepared to assume by ‘creating’ it. Now, this universe is always a replica of the paradigmatic universe created and inhabited by the gods, hence it shares in the sanctity of the god’s work” ([15, p. 32-34]).

As the composer creates and explores the *terra incognita* of a new musical language through work, research, listening, and, last but not least, inspiration, this “land” takes shape and becomes music, home and style: becomes a cosmos. The awareness of this musical process “from nonmanifest to manifest” as being sacred cosmicizes sound, or, in other words, consecrates it (con-secrate = to associate with the sacred): cosmicization “is always a consecration”. This is the first part of cosmicization: the consecration of the musical creation act (or the awareness that it is sacred) because it repeats the Creation of the world by transforming, like world into cosmos, sound into music. But to a non-contemplatively inclined mind, this idea will be questioned in this way: *since concert music is not liturgical, how can it be sacred music; where does this power to consecrate come from? With what authority can a composer declare their secular work to be sacred?*

No one would question that Olivier Messiaen’s (1908-1992) *La Nativité du Seigneur* (1935) or *Quatour pour la Fin du Temps* (1941) are pieces of sacred music, since the Catholic themes are evident in their titles, although these pieces are concert, non-liturgical music. However, the same can be said of anyone of Messiaen’s bird pieces from his *Catalogue des Oisexaus* (1956-8) i. e., that these are sacred music as well, since birds are sacred for Messiaen. And even *Modes des Valeurs et d’Intensités* (1949), an “abstract” piece and almost a technical experiment, can also be seen as sacred, as, in Messiaen, the same musical cosmology (as a group of techniques) generates all of his pieces, whether or not he associated them with religion. The recognition that Messiaen’s music is sacred comes from the authority of his religion’s faith, which is Catholicism. Therefore, Messiaen’s power to consecrate his music comes from a culturally established world religion. However, when Karleinz Stockhausen attributes sacredness to works such as *Stimmung* (1968) or *Inori* (1974) (*inori* is a Japanese word for prayer or adoration), the recognition of this attribution is not—and has not been, historically—so straightforward. The frequent negative criticism of these works exemplifies the rejection, within the concert music world, of “foreign mysticism” and other notions that express the disagreement with a composer’s authority to attribute sacredness to their music when they are not members of their own society’s predominant religion or when their music does not reflect it. A non-contemplatively inclined mind—one that does not perceive the sacred—will never find a satisfying rational argument that can support the idea that the individual’s awareness of the artistic creative act’s sacredness is enough in itself to empower the individual to state that their art is sacred.

What to say about the case in which the composer does not value or is unaware of their own creative act as being a sacred act? Can one speak of cosmicization in this case? One uses the adjective “sacred” to emphasize a *perceived* quality (“sacred”) of the substantive “act”. Is this quality still there, in the substantive, when one is unaware of it or cannot perceive it? I will leave these questions open... However, the individual does not live in isolation from culture and society. Ideas about the sacred will necessarily be confronted with cultural ideas about the sacred, found in world’s religions, in other people’s experiences of the sacred. The ideas of an individual will never come “out of the blue, and, for this reason, for the composer that considers their creative act as sacred, their authority comes exactly from this perception”.

Music is certainly capable of “sharing the sanctity of the god’s work of cosmic creation” with renewed force when its formative principles are intimately connected to an existing, traditional contemplative image of the cosmos. We have seen it in the examples of Pueblo Indians and Javanese gamelan above. This image becomes manifest in music, thus re-enacting cosmic creation

by repetition or mimesis of that cultural sacred image of the cosmos. In other words, music is capable of conveying cosmological contents when it is iconic with that cosmology, or when a composer organizes music by formative principles similar, analogous or same as the cosmological formative principles (believed to be) in operation within a given cosmology.

Therefore, it is by conveying a traditional contemplative cosmology that composers are finally or ultimately invested with the authority to consecrate their music as sacred, an authority that, in the view of those who do not perceive the sacredness of artistic creation, was lacking. Thus, composers (and artists in general) may no longer be accused of simply inventing a personal cosmology or a personal symbolism. In fact, in Eliade's archaic societies, the foundation and building of a city always follows the traditional cosmology of the people, thus enabling them to consecrate or cosmicize territories as a "replica of the god's work"; the god's work remains the model and primordial reference.

As shown before, the traditional music of a society tends to be iconic with its cosmology. Iconicity had been defined as "naturalness" and "non-arbitrariness" in Judith Becker's article on Javanese gamelan because "music systems are instances of the way a specific people understand and relate to the phenomenal world" ([4, p. 215]). Again, playing the role of the devil's advocate, a question could be rightfully raised about this relationship between a contemporary composer and a traditional cosmology: *what is natural and non-arbitrary about the music of a contemporary composer who obviously does not live in the traditional cosmology his music is supposed to be iconic with?*

The only answer to this question is that such composer should make all effort to establish that traditional cosmology as their own, to fully engage with it in all possible aspects of life and work, so that it won't be just an intellectual abstraction or an arbitrary choice, but a lived one. In fact, it is a choice because one sees in it truth and sense. It is "the existential choice of the universe that one is prepared to assume by 'creating' it", to repeat Eliade's words on cosmicization. Contemplative cosmologies contrast sharply with the contemporary regular, most commonly stereotyped, urban, modern, consumerist, individualist way of life. To go against that could turn into a daunting or even impossible task: it would involve taking personal choices in a very opposed direction to the "natural" tendencies of contemporary society. However, if one seeks coherence and integration between life, knowledge and art, it is not because of the seeming difficulty of the path that one should refrain from travelling it. Study in depth of the different contemplative traditions is one of the paths to attaining a full understanding and assimilation of their contents; to the willing researcher, these traditional contents are easily accessible nowadays, the idea that they are remote, difficult to find and *passé* being an entirely equivocated prejudice. From study comes the possibility of these contents being applied to one's life, not as a nostalgic return to the past, or a superficial reproduction of behaviors, but rather as part of their assimilation into a new, albeit individual, cosmovision. Evidently, an "individual cosmovision" is not conceivable without it sharing its content with cultural, collective cosmovision(s), for the simple reason that, as mentioned before, the individual does not live in a bubble, isolated from any contact whatsoever with cultural practices. A traditional cosmology can become, today, an integral part of a contemporary cosmovision and, in this sense, the music composed accordingly will be iconic with it.

III. SPIRAL MUSICAL TIME

The spiral is a complex symbol that human beings have drawn or carved for centuries since the Paleolithic; it appears in the Vedic, Yogic, Tantric, Hermetic, Celtic, Christian, Taoist, Maori, and Cabbalistic traditions, to name but a few, each emphasizing perhaps different aspects of the spiral, but always revealing it as an archetypal symbol of the creative processes' great strength

and emanation. The spiral is also seen in natural phenomena as growth processes such as waves, hurricanes, shells, animals, plants, the moon phases, the seasons becoming, and the sun's ecliptic path. "Growth" must be understood as intensification in either of the two complementary directions of the spiral—coiling and uncoiling—by which the expanding, outward, movement represents cosmogony, creation and multiplication of phenomena, towards manifestation or birth, while the contracting, inward movement, represents eschatology, destruction, retraction from multiplicity of manifestation, decline or death ([11, p. 156]).

When the musical composition as *forma formata*, sense form, the microcosmos, takes the spiral as a constructive principle of its whole macroform, it coincides with the spiral and leads back to the archetype (*forma formante*, not sense form). The spiral becomes *present*, not only as the formative principle but also as the musical time experienced by the listener, when it establishes, in organized sounds, its cyclic and intensifying trajectory. The music becomes a symbol of the spiral and, consequently, also of the archetype.

Apparently, the spiral seems to be a spatial symbol, as it has been traditionally represented visually in petroglyphs, sculptures, architecture, paintings, drawings, etc, and, therefore, is most often *seen* than heard. However, it is naturally not only spatial, but temporal as well, since its line denotes a progressive process of transformation in time. The spiral is a space-time continuum. Furthermore, depending on its own momentum, this identity macroform/spiral results in a more or less gradual musical becomingness. The speed of the spiral can be as intense as a vertiginous vortex or as gradual and slow as not to be immediately noticeable. In this respect, two ideas are important guidelines for my conception of *spiral form composition or composition in spiral time*: one from American composer Steve Reich (b. 1933) and another from Hungarian composer György Ligeti (1923-2006).

The idea of music as a gradual process originates in Reich's short 1968 essay, *Music as a Gradual Process*, in which he talks about a music that is, literally, the process. For him, this process must be perceivable, this being the reason why Reich's music of that time is repetitive. This idea is also important, in a similar way, in my spiral forms as it is desired and intended that the spiral as a formative process/principle be aurally recognizable and perceivable. However, there is neither minimalism nor repetitive music in my spiral form compositions, since they aim to the accumulative effect of the spiral's *different return*. Reich's idea that "once the process is set up and loaded it runs by itself" ([40, p. 33]) is, to a certain extent, present in these spiral works, but only insofar the general principle needs to be preserved and needs to function as Ligeti's idea of "notional compositional structure". Ligeti suggested that the composition needs to provide the listener with a notion of its structure and of the formative principles through sound, by ear, without the recourse to complex analysis and intellectual effort over the musical score. His exact words are: "in working out a notional compositional structure the decisive factor is the extent to which it can make its effect directly on the sensory level of musical perception" ([30, p. 31]). His point of view is diametrically opposed to Franco Donatoni's poetics of hidden procedures.

Musical time, understood as musical form *as it enfolds in time*—and, therefore, as experienced by the listener—acquires a direction, a teleological sense, when it is organized as a spiral. In this case, musical time is linear and cyclical at the same time. Cyclical time²⁰, which is a special case of temporal circularity in music, turns over itself and, as it does so, it does not progress any further and remains ultimately static. Spiral time, which is another special case of temporal circularity, has the cyclical auto-referentiality combined with a linear aspect, which consists in the production of difference by the accumulative effect of its outward or inward tendency. The spiral turns around itself but, when it arrives at the "same" point, this is no longer the same point: it

²⁰ For a reflection on cyclical musical time, see my article "Tempo musical cíclico no *Miserere mei, Deus* de Gregorio Allegri ([25])

is the same in another level of realization. The spiral's *telos* (τέλος, end or purpose) lies in the infinite, either when expanding or contracting, and it consists in its own ordering tendency: *the process is the purpose*; this will become clear with the following musical examples. However, as a composition cannot last forever, the spiral form ends by simple interruption of the process, either because, if expanding, it would not make aesthetic sense for it to continue indefinitely, or because, if contracting, the process had arrived at its center, which is always a point of origin and of no manifestation, which requires the music to stop.

The spiral as a dynamic structure, constructive principle or musical process appeared for the first time in my 1984 violin and piano duo *De Natura* but, at that time, I was not aware of it as a spiral. In fact, it is composed of two alternating or entangled spirals, one contracting, the other expanding, characterized by two kinds of contrasting textures: the contracting spiral is multilayered or polyphonic, and the expanding is monodic, a growing unison in both instruments. Both spirals use Fibonacci numbers to control their expansion or contraction: the contracting spiral starts with a section of 144 eighth notes, then 89, 55, 34, 21, 13, 8, while the expanding spiral grows from 8 eighth notes to 13, 21, ... until 144. Therefore, the macroform is sectioned by the numbers 144 – 8 – 89 – 13 – 55 – 21 etc.

The spiral has been a conscious object of my compositional research since 1988, beginning with the piano solo work *Pralāya*. Since then, several other compositions have created different spiral temporalities: musical time organized by the cyclic, continuous and intensified winding /unwinding transformation process, which is characteristic of the spiral. In the same way that diverse spiral lines may be defined by different geometries and mathematics, innumerable are the ways by which musical time may appear to be expanding or contracting as a spiral.

A characteristic of spiral musical time is that it most often applies to the whole macroform of a work, and only a few works have explored spiral time only in certain parts or sections. Although it is a continuous movement, spiral musical time can be articulated by *phrase cycles*. The expression "phrase cycle" tries to relate musical "phrases" with the context of spiral time, but it should not be understood as "phrases" in western classical/romantic morphology, which belongs to a linear and dialectic time context. The expression is abbreviated to "cycle", and is meant to simply indicate a structure of musical course (or duration) which has, like the "phrase", a complete sense, within the context of spiral temporality. This complete sense, therefore, is reached by the completion of a spiral turn or cycle. After this completion, the spiral starts over, but at another level of manifestation. The moment between completion and re-start may or may not include a break (interruption, *caesura*, *fermata*) in the movement.

Two aspects of spiral time are naturally mathematical: duration and gnomonic growth. Duration can be ruled by pre-established ratios either in a linear time composition or in a spiral time composition. In the latter case, the macroform is the total duration of the spiral, and the sections are the durations of its expanding or contracting cycles. The rate of growth or decrease of the length (duration) of each spiral cycle defines such proportion, as will be seen in the musical examples ahead. Gnomonic growth, on its turn, is more specific of spiral time, as it is a form of "growth by accretion or accumulative increase, in which the old form is contained within the new (...) all figures which grow by gnomonic expansion create intersections upon which spirals can be drawn" ([29, p. 65-66]). Lawlor provides an ancient definition of a gnomon according to mathematician Hero of Alexandria (ca. 10 C.E. – ca. 70 C.E.): "a gnomon is any figure which, when added to an original figure, leaves the resultant figure similar to the original", therefore, just like the modern fractals.

Gnomonic growth appears in the construction of Hindu temples, in the horns of rams and antelopes, mollusk shells, in the Pythagorean *tetraktys* and other triangular numbers, in rectangular numbers, and in several geometrical processes of recursive self-similarity such as the infinite

accumulation of alternating pentagrams and pentagons (in figure 1), or the equally infinite process of marking a square inside golden rectangles (figure 2). Gnomonic growth is certainly not the only form of growth or increment that I have applied to my compositions, but it does provide a sense of beauty as in mathematics as in art, especially in relation to the principle of macroform/microform identification. The role of proportion in gnomonic structures is decisive for the rhythmic quality of the perceived process.

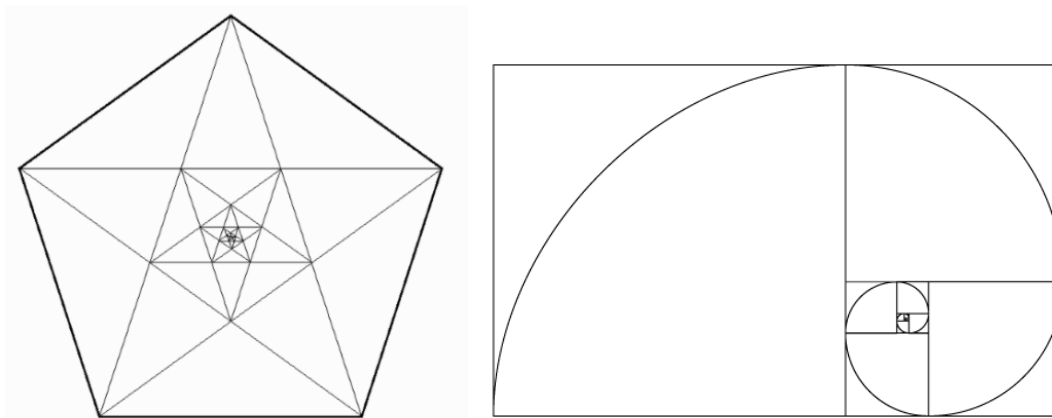


Figure 1: Left: The diagonals of a pentagon form a pentagram. The intersections of the pentagram form a smaller pentagon. Draw again the diagonals of the smaller pentagon, *ad infinitum*. Right: Draw a square inside a golden rectangle. Inside the smaller rectangle, draw another square, *ad infinitum*. A logarithmic spiral is formed by linking the opposed corners of the squares by a continuous curved line).

By presenting the ideas of spiral time and composition as cosmogony before tackling the subject of number and proportion in composition, I expect to have made easier to discuss the musical examples, because in their majority, these proportions define the durations of spiral cycles and of the whole macroformal spiral. I also thought that presenting first the poetic context in which number and proportion find their musical application in my own music would result in a better understanding of why these proportions are brought into the music.

IV. NUMBER AND MUSIC

Number and proportion appear in my music at all levels of temporal organization, from the microform to the macroform. Since 1989, I have made extensive use of a set of formative rhythmic principles designed to generating ametric textures, complex polyrhythm, cross-rhythms and certain specific qualities of rhythmic flow defined by syllabic rhythms ruled by numerical ratios. I call this set of principles *expanded modal rhythm* because they greatly expand the kind of organization found in the rhythmic modes of 12th- century polyphony of the Notre Dame School. A full description of the general principles of expanded modal rhythm is available in a previous article ([?]), in which my main concern was to explain what modal rhythm is and what is “expanded” about it. These principles do organize local rhythms (microform) as well as the work as a whole (macroformal design).

Expanded modal rhythm ([24]) is based on the idea that durations are either long (—) or short (∪), and that they can be quantified by a temporarily fixed — : ∪ (long : short) ratio involving any whole number of time units (*chronos protos*). Notre-Dame rhythmic modes not only fit in this description, since they were mostly constructed at the 2:1 ratio, but also indicated that their

formative principles could be expanded. The appearance of long and short durations in Notre Dame polyphony was related to Greek feet such as *iambos*, *dactylos* etc. In my music, I work with rhythmic patterns called “syllabic meters”, which are combinations (or permutations) of any given number of durations, called syllables. Therefore, the Greek feet are only a small part of this collection of patterns, obtainable from combinatoriality. As an example, the six-syllable meter — U — — U U can be assigned a 2:1 ratio with the quarter note as *chronos protos* resulting in the rhythm of Example 1. The same pattern, with a 4:3 ratio and the eighth note as time unit is shown in Example 2. It is the combination of ratio syllabic structures alternating long and short syllables that forms a rhythmic mode, and a mode should be understood as exactly what it is: a mode, a manner, therefore, a quality, a rhythmic quality, a quality of movement.



Figure 2: a) Syllabic meter — U — — U U (2:1) ↓ ; b) Syllabic meter — U — — U U (4:2) ↓.

At the same time that the application of numbers to music implies quantification, it also brings quality to music. This quality is the qualitative aspect of the number: two-ness, three-ness, etc. The proportion, as it puts two (or more) quantities in relationship, creates relativity between these quantities to each other. Proportion, “or Reason (ratio) is the comparison, correspondence or relation that exists between a number and another” ([33, p. 6]). As in the Quadrivium, Music is Number in Time. While this quality of rhythmic movement is immediately perceived aurally at the microformal level, as shown in the examples above, it is still perceived in the macroformal level, albeit less directly, or in a different manner, since the length and content of durations is much bigger. I should now concentrate on the role of proportion in the macroform, i.e., compositional design, as much more about the relationship between number and microformal rhythms has already been shown in the article on expanded modal rhythm.

When I start working on a new piece, one of my first compositional actions is to attribute a ratio to the largest (and also the smaller) sections of the work’s macroform: to determine (or pre-determine) how many parts will constitute the piece, and what is the balance or proportion between their durations is a decision that pertains to an abstract and numerical level, since the music has not yet been composed, but only its “size” and the size of its parts is being decided. What the macroformal ratio *suggests* in terms of its numerical relationship should be explored by the *content* of these pre-determined durations of sections.

The simplest macroformal ratio is 1:1, and it is found in the piece *Sacrificio*, for choir, which is iconic with the cosmogonic Vedic myth of Puruṣa and the philosophy of the *Brāhmanas* and *Upaniṣads*. The macroform is symmetrical and is governed by a 1:1 ratio, since the first and second parts have exactly the same duration. A dotted quarter note rest on measure 186 at the exact center of the music separates the first half of the piece from the second. This rest is the arrival of the first section’s spiral contraction towards the point of non-manifestation, silence, *bindu*. The second part is a spiral expansion towards multiplicity of phenomena. In this way, the macroform shares the same cosmological symbolism of god Shiva’s drum, the *damaru*, which has the shape of an hourglass²¹. Because the piece is sung in Sanskrit, the microformal rhythm of vocal parts respects the long and short syllables of the Sanskrit language even when, in the music, syllables assume values different from 2:1, which is Sanskrit’s original long-to-short ratio.

²¹ The article “Música e Sacrificio” ([24]) describes this subject at length.

There is a static quality about the 1:1 ratio. This is easily perceived in the microformal level, as equal values result rhythmically in a series of regular pulses. Depending on how long this pulsating rhythm goes on, it will, eventually, reveal itself not only as regular but as static, unless it changes. The richer are the combination of different values in a line, the more varied and, therefore, kinetic is the line's *rhythm*. Seen from another angle, the pulsation, in all measured music, is the simplest, most primordial level of rhythmic organization, one that remains "behind" or "underneath" varying rhythms. As pulses are grouped in meters (2-beat, 3-beat, 4-beat meters), a second level of regularity is generated: meter, which is, in itself, a higher level beat. If meter remains unchanged for the duration of the macroform, meter is no longer just regular, but becomes non-moving, a static element. In this case, because it never changes, meter moves from the *en-tempo* to the *hors-tempo* category²². In the other hand, if meter changes frequently, it tends to disappear, because there will be no regularity at its level. This is when longer morphological units will take over the reference role for measuring this higher (metric) level flow or rhythm.

As a ratio governing the macroform of two equal sections, the 1:1 ratio is static for a number of reasons. First, because there are only two occurrences of the "1" duration (as in *Sacrificio*), this results in the simplest case of a binary relationship: that of equality, a sense of perfect balance, like two equal weights on a scale. This, however, is what the ratio means as a numerical relationship; this is what the ratio *suggests* to what will happen in the musical time. As it concerns the macroform, each part is really a section of music, during which *something* happens, this "something" being the *content* of their duration. At least in theory, it is possible to imagine that, even in a macroform divided in a 1:1 ratio, the sections could be out of balance because of the effect produced by the music filling that duration.

In the spiral contraction that makes the first section of *Sacrificio*, the music gradually loses momentum, while the opposite happens with the second section, which gains momentum with its spiral expansion and multiplication of rhythmic and polyphonic activities. Other elements in the pitch organization and morphology concur to create a sense of balance suggested by the 1:1 ratio, even with the opposite momentum qualities of each section. In fact, the whole conception of sacrifice as a creative principle consists in the interdependent or complementary balance of the two aspects of a same coin, just exactly in the same way that breathing alternates inspiration and expiration or objective time alternates days and nights.

A more familiar example of 1:1 macroformal ratio is found in Johan Sebastian Bach's *Goldberg Variations*. The Aria and practically all of the thirty Variations are made of two sections of exactly the same duration, each with sixteen measures²³. Bach respects the 1:1 ratio and symmetry by creating music in the first part that is balanced by the music of the second part, by several means such as morphological *quadratura*, motivic consistency and tonal route (the route from one tonal region to another).

An elementary aspect of music composition is that whatever the composer intended to be sections of a piece should actually *result* in sections: this is produced by creating *contrast* between the content of the sections, using characteristic materials and processes for each one. A certain level of ambiguity may be desirable and there is no need to be didactic, as the listener is capable of perceiving such contrasts, just as long as the sections are *notional compositional structures*, as mentioned before.

²² *En-tempo* and *hors-tempo* are terms created by Iannis Xenakis to differentiate music as a phenomenon in time from music as a set of formative principles ([45, p. 68]).

²³ Variations 3, 9, 21 and 30 have two eight-measure sections, a different 1:1 ratio. Variation 16, an Overture, contrasts with all other Variations with its 2:1 ratio: the first section, in 2/2 has 16 measures, while the second section, in 3/8 has 32 measures. Because the eighth note is performed as a triplet and not as a regular eighth note, each 3/8 measure of the second section corresponds to one quarter note in the 2/2 of the first. It follows that four 3/8 measures (one hypermeasure) are equivalent to one 2/2 measure, resulting, therefore, in eight hypermeasures or in a 2:1 macroformal ratio for Variation 16.

The macroform of the first piece composed using expanded modal rhythm, “. . . a *natureza ama esconder-se. . .*” (1989), was defined, as I was mainly concerned with Greek feet, as *kretykos* (– ∪ –) at the ratio 2:1. Therefore, the piece has three sections, starting with a large one, followed by a short and ending again with a long. Long sections are twice as long as the short section. The rhythmic lines are constructed using a sequence of Greek feet, which, because they are used reiteratively, is called a *time cycle*. In the second piece with expanded modal rhythm, *Mojave* (1989), for piano and two percussionists, I started to use the time cycle as a time unit for measuring the macroform. Used in this manner, the time cycle was called a “theoretical cycle” because it is not audible as a rhythm in the music, but serves the main purpose of measuring the macroform (it is not the case to dwell on the other purposes at this moment). *Mojave* is clearly articulated in two sections, the first kinetic, the second static, and the “theoretical cycle” corresponds to the duration of 21 eighth notes²⁴. The ratio is 33:15, meaning that there are 33 cycles in the first, longer section, and 15 in the second (corresponding to a ratio of 2,2:1). However, because of the tempo change between sections (the first is at quarter note MM = 72 and the second at MM = 54), the actual proportion between sections is 1,65:1, which would correspond to 24,75:15 in terms of “theoretical cycles”. One of the basic principles is to only use cycles in their entire length, so this shows that the cycle as a time unit is subordinate to tempo. Later on, I decided to call “theoretical cycles” by the Sanskrit name *tāla*, which comes from classical Indian music; the Indian *tāla* has similarities with the *tāla* in my music. For the purpose of this article, it is enough to understand the *tāla* as a time unit measuring the macroform and the ratios of its sections.

In the following section of this article I will describe in greater detail the ratios at work in a few key compositions: *Pythagoras* (2001), *Metagon* (2008), *Phoînix* (2010), *Triskelion* (2015), and *Santuário de Baleias (Whale Sanctuary)* (2016).

Pythagoras

Pythagoras, for tenor recorder solo, is iconic with Pythagorean cosmology, for it applies to music composition the original Pythagorean idea of cosmos, in the specific meaning by which “the world is order when it is harmony and number, which keeps the Whole unified and such as it is” ([39, p. 62, v. IX]) (my translation). I have mentioned before that number is such a fundamental element in Pythagorean cosmology. In fact, in Pythagoreanism, number was the principle of all things; “All is number”, would have said Pythagoras. Number “is the principle, the source, and the root of all things”, writes Theon of Smyrna ([17, p. 21]).

“. . . the so-called Pythagoreans, the first to be absorbed in mathematics, not only advanced this particular science, but, having been brought up on it, they believed that its principles are the principles of all things. Now, of these principles, numbers are naturally the first. As a result, they seemed to see in numbers, rather than in fire, earth and water, many similarities to things as they are and as they come to be: for one sort of modification of numbers, so to speak, is justice; another, soul and mind; still another, opportunity; and so forth. Musical modes and relations, too, they saw in terms of numbers. And all other matters appeared to be ultimately of the nature of numbers; and numbers were for them the primary natures. In view of all this, they took the elements of numbers to be the elements of all things, and the whole heaven to be harmony and number. They were adept at finding numbers and harmonies, both in patterns of change and in the structure of parts. And they organized and unified

²⁴ This is actually one of the possible forms of the rhythmic cycle used for the construction of rhythmic lines, and results from the 4:2 ratio combined with the sixteenth note as *chronos protos*.

the whole arrangement of the heavens to exhibit its harmony. And if they discovered defects anywhere, they invented the necessary additions in order to make their whole system hang together perfectly.” ([2, p. 15, Book A, 5, 985b])

This rather long citation from Aristotle’s *Metaphysics* was included here because it is not only a description of Pythagorean ideas about number, but also a criticism of them. Aristotle’s rationalism is in great contrast with Pythagorean’s thought: it is with Aristotle that number starts acquiring the sense it has for us now, i.e., that of mere quantification, an operation of the mind, an abstraction. However, for the Pythagoreans, number is “a real thing, actually, the most real of all things, which, as such, can be the constitutive principle of all other things” ([39, p. 80, v. 1]) (my translation). It is important to read, instead of Aristotle’s, the surviving texts from actual Pythagorean philosophers such as Archytas (first half of 4th century B.C.E.), Iamblichus (c. 250 – c. 325 C.E.), or other anonymous ones preserved in the writings of other authors such as Photius (c. 820-891 C.E.), so that one may grasp the Pythagorean point of view and the right frame of mind to understand them. In fact, Aristotle’s way of looking at the “so-called” Pythagoreans leads, in the best cases, to appreciating them as having been “probably the first to recognize the abstract concept that the basic *forces* in the universe may be expressed through the language of mathematics” ([31, p. 31]) and nothing more.

The macroform of *Pythagoras* represents the Pythagorean *tetraktys* (the sequence of the first whole numbers, adding to the perfect number 10, the decad) and is divided in four spiral movements: *Monas*, *Katharsis*, *Theoria* and *Theosis*. The connection established between each movement and the *tetraktys* is that these movements are in the ratio 1:2:3:4. The sum total of these durations is $1 + 2 + 3 + 4 = 10$, as in the “*tetraktys* of the decad”. According to the Pythagorean oath, the *tetraktys* expresses

“the Pythagorean conception of the process by which the One goes out into the manifold world. The *tetraktys* is not only a symbol of static relations linking the various parts of the cosmos: it contains also the cosmogonical movement of life, evolving out of primal unity the harmonized structure of the whole. It is a fountain of ever-flowing life” ([12, p. 207]).

English classical scholar Francis M. Cornford (1874-1943) also explains that “Pythagoras regarded (the *tetraktys*) as ‘the nature of number, because all men, whether Hellenes or not, count up to ten, and, when they reach it, revert again to unity’.” This reversion symbolizes the life cycle, by which mortals are born, grow, reach maturity, grow old and pass away and are re-born: “Nature causes them to come to their goal in her region of darkness, and then back again out of the darkness they come round in mortal form, by alternation of birth and repayment of death” ([12, p. 208]).

Another important concept is that of the Monad, *monas*, which is both the cosmos as a whole and the principle that generates everything in the cosmos. In fact, the Monad, or Unity, the One, is not a number, but the principle behind Number: “numbers—especially the first ten—may be seen as manifestations of diversity in a unified continuum” ([17, p. 21]). As an example of such continuum, the One as the source of all numbers, Fideler suggests a circle in which to inscribe various polygons, or the vibrating monochord string as unity, which sounds, when plucked, the complete harmonic series.

The Monad is represented by the 10-note melody that starts the first movement (*Monas*) and is called “nucleus”: the nucleus is the source of everything else in the piece. The creative power of the number One is reflected in the outward spiral motion of the first movement, which, although subtle, increases melodic manifestation. The other three movements, *Katharsis* (purification),

theoria (contemplation of the first principles, i.e., numbers), and *theosis* (union with God) relate to the three paths of spiritual development in ancient Pythagoreanism and, since these are the individual's attempts of reconnection with the creative principle, are represented, in the music by spiral structures with inward direction. While *Monas* and *Theosis* use the same melodic nucleus, *Katharsis* and *Theoria* each use "their own" nucleus form, but these are derived forms from the original nucleus in *Monas*, as shown in the Fig. 3.

Calmo ♩ = 84

a) *no rubato, with rhythmic precision but expressive*

Agitato, molto marcato e ritmico ♩ = 84

b) *p molto calmo* *poco rallentando* *attaca*

Largo, molto calmo e semplice ♩ = 84

c)

Figure 3: Melodic nucleus in each movement of *Pythagoras* (2001): a) *Monas*; b) *Katharsis*; c) *Theoria*.

Because the first movement is the Monad, it represents the number One. The second movement, *Katharsis*, as the number Two, is twice as long as *Monas*. It is ruled by the dualism of long and short notes, loud and soft intensities, and the sense of struggle or strife. The nucleus melody is placed at the end of each phrase cycle. As the cycles approach the end of the spiral, the nucleus appears gradually less ornamented, until, at the end, it is stated twice, reaching its pure, completely unornamented form at the very last time. The third movement, *Theoria*, is three times as long as *Monas*. As representing the number Three, it overcomes the struggling tone of dualism of the previous movement by means of its tranquil fluidity. Synthesis over long/short rhythmic dualism is achieved by the creation of a new level of temporal organization, namely, the three-beat meter which, in the a-metric context of the piece, is a new feature. A sense of temporality, of past, present and future is established by the melodic nucleus placement in the middle of each phrase cycle (and no longer in the end, as in *Katharsis*). Therefore, each cycle is formed by an antecedent, followed by the nucleus, and by a consequent. Antecedent and consequent are structurally related by complementary formative principles. As their durations shrink, all that remains, at the end of *Theoria*, is the nucleus, stated three times, and reaching its pure form at the very last time. The fourth movement, *Theosis*, is four times as long as *Monas*. The number Four, as well as the concept of *theosis*, represents completion and union with God. For this reason, it is the movement that most resembles *Monas*. Each phrase cycle is a rhythmically augmented and heavily ornamented version of the *Monas* nucleus. As the spiral contracts, each cycle becomes shorter and less ornamented, until at the end, the nucleus is stated four times, reaching, at the very last time,

the final identification with the pure, original melodic nucleus, as a drop of water dissolves in the ocean.

In *Pythagoras*, the tāla works basically as a measure unit to control the ratios involved between movements and phrase cycles. One tāla has the length of the nucleus, i.e., ten quarter-notes. The first movement, *Monas*, is a microcosm of the four-movement macroform, as it has four phrase cycles growing in the same ratio 1:2:3:4 as the macroform's movements 1:2:3:4 ratio, and this is easily seen by the duration of notes in the melody: the nucleus is stated in *Monas'* phrase cycle A as 10 quarter notes. Cycle B is formed by ten half notes, with a slight ornamentation; cycle C further increases ornamentation and time values become dotted half notes; finally, cycle D, is formed by ten whole notes. In terms of tāla-s²⁵, this leads to the Table 1:

Table 1: Duration of phrase cycles in *Monas*

<i>Monas</i>	phase cycle A	phase cycle B	phase cycle C	phase cycle D
number of tāla-s and durations in ♩	1 = 10 ♩	2 = 20 ♩	3 = 30 ♩	4 = 40 ♩

Consequently, the entire duration of the *Monas* spiral is equal to 100 quarter notes on the metronome mark of MM = 96. Here, the phrase cycles are not in accordance with Fibonacci numbers, but only with the *tetraktys*.

The length of each phrase cycle in the other movements is ruled by the golden ratio phi, ϕ , as expressed by Fibonacci numbers. The Fibonacci sequence, which is fixed in the numbers 1, 2, 3, 5, 8, 13, 21, 34, 55, etc, and the 1:2:3:4 ratio between movements are not commensurate elements. There is a different solution for each movement to the problem of fitting together the Fibonacci sequence and the 1:2:3:4 ratio between movements.

The duration of the *Katharsis* spiral is equal to 200 quarter notes (twice as long as *Monas*). It is easier to see the relation with Fibonacci numbers by looking at the total as equal to 400 eighth notes. *Katharsis* contracts in five phrase cycles according to the first five Fibonacci numbers in retrograde order, because the cycles are decreasing in length: 8, 5, 3, 2 and 1. Multiplication of these numbers by 20 leads to the number of eighth notes in ϕ ratio: 160, 100, 60, 40 and 20. Table 2 shows the actual durations of the phrase cycles in the *Katharsis* spiral to be very close to these numbers in ϕ ratio:

What Table 2 does not show is that there are two consecutive statements of the 20 eighth-note-long nucleus, the first as the last 20 eighth-notes of phrase cycle D and the second (and final) as phrase cycle E. In *Katharsis*, each phrase cycle is formed by a melodic line followed by the nucleus ending the cycle. The melodic line is progressively shortened, but the nucleus remains intact in length, decreasing only in ornamentation. When cycle E arrives, there is nothing left of the melodic line, and this results in the two consecutive statements of the nucleus. In fact, the sum total of all phrase cycles (A+B+C+D+E, i.e., 170 + 104 + 64 + 42 + 20) is equal to 400 eighth notes, as it should be, and the two consecutive statements of the nucleus conclude the movement as reminding the listener that *Katharsis* is about the number Two.

Table 3 shows the actual durations of the phrase cycles in the *Theoria* spiral. Initially, in order to determine the duration of each phrase cycle, the Fibonacci numbers were multiplied by 30

²⁵ I use the plural form tāla-s by adding a hifen and an "s" because the correct plural of this Sanskrit word is not "tālas".

Table 2: Duration of phrase cycles in Katharsis

<i>Katharsis</i>	phase cycle A	phase cycle B	phase cycle C	phase cycle D	phase cycle E
Actual durations in ♪	170 ♪	104 ♪	64 ♪	42 ♪	20 ♪
Fibonacci numbers $\times 20$	160	100	60	40	20
Actual number of <i>tāla</i> -s	8.5	5.2	3.2	2.1	1
Fibonacci numbers	8	5	3	2	1

(resulting in $8 \times 30 = 240$, $5 \times 30 = 150$, $3 \times 30 = 90$, $2 \times 30 = 60$ and $1 \times 30 = 30$). However, this series of numbers is, again, incommensurable with the prescribed total duration of 300 quarter notes (thrice *Monas*), or 600 eighth notes for *Theoria's* macroform. The actual durations were arrived at so as to result in a sum total of 540 eighth notes, since phrase cycle F would, by necessity, include three consecutive statements of the 20 eighth note-long nucleus, which is equal to $20 \times 3 = 60$ eighth notes. These three consecutive statements reassure to the listener, the number Three. $540 + 60 = 600$ eighth notes. Therefore, the value of 226 eighth notes of phrase cycle multiplied by $\phi = 0.618$ results in 139.668, which is rounded up to 140, the duration of phrase cycle B. By the same procedure, multiplying 140 by 0.618 result in 86.52 (rounded up to 87 for phrase cycle C), and so on until 33 is obtained for cycle E. Notice that the value of 20 eighth notes of the nucleus could never be reached by this treatment of the Fibonacci numbers.

Table 3: Duration of phrase cycles in Theoria








<i>Theoria</i>	phase cycle A	phase cycle B	phase cycle C	phase cycle D	phase cycle E	phase cycle F
Actual durations in ♪	226 ♪	140 ♪	87 ♪	54 ♪	33 ♪	20 ♪
Actual number of <i>tāla</i> -s	11.3	7	4.35	2.7	1.1	–

Therefore, the actual durations of *Theoria's* phrase cycles are not Fibonacci numbers, but they stand in a ratio closer to the ϕ ratio than Fibonacci numbers do. The actual number of *tāla*-s also reflects the ϕ ratio: $11.3 \times 0.618 = 6.9834$, which rounds up to 7.0, and so on and so forth for the other *tāla* values.

The *Theosis* spiral was composed according to a particular idea: the ten-note *Monas* nucleus is the material for each phrase cycle. Heavily augmented and ornamented at the first cycle, it is gradually shortened until it reaches its original form in the last cycle, when it is, then, stated

four times consecutively, to provide the final sense of conclusion of the work. Table 4 shows the resulting durations for each phrase cycle obtained from the augmentation principle by which, in each cycle, each note of the nucleus is augmented from one quarter note to a Fibonacci number, starting with 13 for cycle A, 8 for cycle B, 5 for cycle C etc.

Table 4: Duration of phrase cycles in Theosis

<i>Theosis</i>	phase cycle A	phase cycle B	phase cycle C	phase cycle D	phase cycle E	phase cycle F
Actual durations in 	130 	80 	50 	30 	20 	10 
Actual number of <i>tāla-s</i>	13	8	5	3	2	1

By this principle, the sum total of phrase cycles A, B, C, D and E is equal to 310 quarter notes. The four consecutive statements of the nucleus in cycle F is equal to 40 quarter notes. The *Theosis* spiral, therefore, has a total of 350 quarter notes, and not 400, as the 1:2:3:4 ratio would require. However, the ratio is still at work by a change in tempo: the first three movements were all at metronome mark MM = 96. The *Theosis* spiral, with its 350 quarter notes at MM = 84, has the same duration as 400 quarter notes in MM = 96, i.e., 250 seconds (4'10"), four times the 62.5 seconds (1'2.5") of *Monas*.

Metagon

Written for the Zen Buddhist bamboo flute, the *shakuhachi*, *Metagon* (2008) is a solo composition of approximately fifteen minutes of duration²⁶. A metagon (Fig. 1) is a spiral line formed by open polygons. It starts with a triangle, which is circumscribed by a square, then a pentagon, an hexagon, and so forth, possibly indefinitely. Each polygon is "open" in the sense that its last side does not close the figure, making it possible for the outer figures to circumscribe the inner ones with no lines touching each other.

Metagon's macroform determines a single finite segment of a possibly infinite melodic, rhythmic and textural tendency which is the formative principle represented by the metagon, the "metagon principle", the process by which each polygon has one side added in relationship to the one immediately circumscribed by itself. *Metagon's* macroform entirely respects this principle as applied to temporal organization: the piece is a monody line segmented in phrase cycles (each is a turn in the spiral line) which gradually expand in duration: they become longer in the same ratio as the principle suggested by the metagon's figure: initially, a polygon with three sides, then with four, then five, etc. This relationship occurs here with the number of "measures" which, deprived of any metrical meaning, simply serve as a unit for the measurement of the phrase cycles: the first cycle lasts two measures, the second three, then four, five, until the last, with twenty seven. *Metagon's* macroformal spiral has a total of twenty six phrase cycles.

The spiral tendency suggested by the metagon is also applied to pitch content, i.e., space. The monody starts with a single pitch, and gradually includes the greatest multiplicity of pitches available in the instrument. Tonal centricity (the center is C, third space in treble clef) does not

²⁶ More about Metagon (including the full score) is found in "Tempo Espiral em Metagon" (IRLANDINI, 2013).

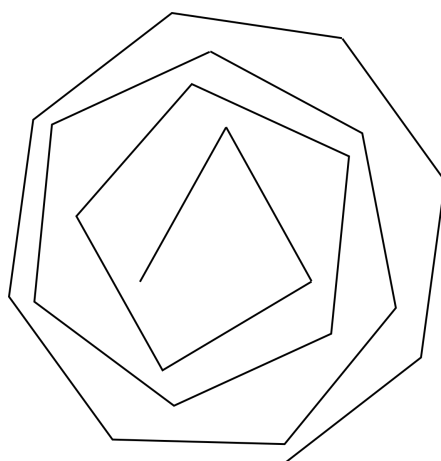


Figure 4: *Metagon*.

imply tonalism, but simply a central point in a gradually expanding textural pitch space. Pitches are included accumulatively one by one in each phrase cycle, by adding a new pitch a half-step above or below the last new note. Explained differently, in relationship to the central C, pitches are added first by the upper semitone (C \sharp), then the lower semitone (B natural), next by the upper interval 2 (the whole tone, D), then the lower (B \flat), next by upper interval 3, and so on and so forth, gradually expanding the melodic *tessitura* and the textural space.

Phoînix

I wrote the three pieces of the series *Bestiarium, v. I* between the years 2008 and 2013. *Phoînix* was the second piece to be completed, although it is number one in the series. Each of the compositions in the *Bestiarium* explores musical analogies with mythological and symbolic aspects of animals. The following discussion will concentrate on the role of the ϕ ratio in the macroformal plan of the composition, which is not in spiral form.

Figure 2 shows that *Phoînix* is divided in three large sections preceded by an eight measure-long Introduction which is not part of the ϕ calculations. Section I, with 183 quarter notes of duration, is in a ϕ ratio with sections II + III, both summing up a duration of 297 quarter notes. $183:297 = 0.61616162$, which is very close to $\phi = 0,618$. The ratio between sections III and II is $114:183 = 0.62295082$, also approximately close ϕ .

Furthermore, the inner subdivisions of sections are also in an approximate ϕ ratio: in section I, $(I1 + I2):I3 = 113:70 = 1.61428571$, and $I1:I2 = 70:43 = 1.62790698$. The same occurs with the inner subdivisions of sections II and III.

The values involved here (297, 183, 114 or 113, 70 and 43 or 44) are approximately in the ϕ ratio in the same way as the Fibonacci numbers express the ϕ ratio approximately. In fact, the point of departure was the creation of a number sequence similar to Fibonacci's. The sequence is based in the same principle of adding the two previous numbers to form the next, starting arbitrarily with the values 1 and 3:

$$[1 - 3 - 4 - 7 - 9 - 16 - 27] - \mathbf{43} - \mathbf{70} - \mathbf{113} - \mathbf{183} - \mathbf{296} - \mathbf{479}$$

Only the terms in bold font are used in the composition because those are the ones that express the ϕ ratio more closely. In fact, the ratio between 3 and 4 is 0.75, between 4 and 7 is 0.5714

Table 5: Phoínix *macroform*

Introduction (34 ♩)	I (183 ♩)			II (183 ♩)			III (13 ♩)	
	I ₁	I ₂	I ₃	II ₁	II ₂	II ₃	III ₁	III ₂
	70	43	70	70	43	70	70	43
c. 1-8	c. 9-42	c. 43-62	c. 63-99	c. 100-134	c. 135-154	c. 155-190	c. 191-212	c. 213-227
A	B	D	E	G	I	K	N	P
Pesante	Tranquilo		Tranquilissimo	Energico e preciso			Pesante e ossessivo	
			ϕ_1			ϕ_2		ϕ_3
	183			296				

(...), and between 43 and 27 is 0.62790698. Only from terms 43 and 70 is that the ratio starts to be acceptably approximate to the ϕ ratio ($43:70 = 0.61428571$), and, from then on, they become progressively closer to $\phi = 0.618$. The same occurs with the Fibonacci sequence, where only with terms 8 and 13 does the ratio become very close to $\phi = 0.618$ ($8:13 = 0.61538462$).

Notice that the last measure in the music, a 4/4 measure with two sounds in the percussion (lion's roar followed by the tam-tam), does not count for the purpose of ratios between sections. The two sounds are meant to be as a final period mark. If computed, that measure would add four extra quarter notes to the 43 that make section III₂.

Triskelion

The archetypical sense of wholeness brought about by tri-partition is shown by the fact that so much music in three parts or for three musicians has been composed throughout the centuries. "The Triad is the form of the completion of all things" (Nichomachus of Gerasa, c. 100 a.D.), and this is confirmed by the three-movement sonata form, the Hindu *trimurti*, or the unity of the circle, which depends on its center, radius and circumference. The *triskelion* (τρισκέλιον) is one more tri-unity (trinity), each of its parts being a spiral.

Triskelion, for piano, viola and percussion (bass marimba, large tam-tam and *djembé*) explores relationships between three elements: three movements, three musicians, three simultaneous musical layers, three percussion instruments. More specifically related to the *triskelion* shape is the fact that each movement evolves as a spiral, first expanding from silence, then, reversing direction, contracting into silence. Each spiral/movement has three expanding and three contracting cycles, at the fixed ratio of 1:2:3 for the expansion and 3:2:1 for the contraction, thus preserving the rotational symmetry of the drawn triple spiral line in the formal relationship of the three musical movements. As a consequence, all movements have the same duration, forming the proportion 1:1:1. Furthermore, each instrument predominates in the texture of each movement: the piano in

the first, the viola in the second, and the *djembé* in the third.



Figure 5: Triple spiral on the entrance stone of the Neolithic mound at Newgrange, Ireland (photo: Luigi Irlandini).

There is no fixed symbolic association of each movement or musician to any one of the three meanings that have been associated to the *triskelion*, or to any specific interpretation of it. I was directly inspired by the pre-Celtic triple spirals carved on the entrance stone and inside the inner chamber of the Neolithic mound at Brú na Bóinne (Newgrange, Ireland) (see the three spirals at the tip of the stone in the left corner of figure 4, above). The original meaning of these triple spirals is unknown but, to me, from their placement on a tomb monument constructed according to the movements of the sun, it is cosmic and relates to the human being's journey into and out of existence. It is suggestive of life in three stages (youth, maturity and old age), a tripartite cosmology (Earth, Sea and Sky), or even as the tri-unity of Man, Earth and Sky represented by the Shintoist *triskelion*-shaped *mitsudomoe* often painted on *taiko* drum from Japan. Therefore, the 1:1:1 ratio in the music was suggested by the fact that the three spirals in the Newgrange monument are approximately of the same size, and each has three cycles or layers of curves.

Santuário de Baleias (Whale Sanctuary)

Composed for soprano saxophone and strings orchestra during the months of September and October 2016, *Whale Sanctuary* (*Santuário de Baleias*) originates from imagining and wishing that all oceans would be kept in their pristine condition, free from industrial hunting and waste; an arguably naïve, but legitimate wish. If the oceans were kept in this way, they would become a sanctuary, a protected environment, therefore a sacred space, for the existence of not only whales but the entire maritime fauna and flora... The idea of composing a "sanctuary" implied, again, a visualization of music as space, and a treatment of formal proportions and symmetries such as those found in temple construction and the architecture of sacred spaces.

In order to establish a concrete analogy between the oceans and the musical space-time continuum, I determined the durations of the five musical sections to be proportional to the real surface areas of the five oceans. After finding such information ²⁷, I attributed the value

²⁷ I used Google and found the following oceanic surfaces: Pacific: 165,250,000 km²; Atlantic: 106,400,000 km²; Indic: 73,560,000 km²; Antarctic: 20,330,000 km²; Arctic: 14,060,000 km². These numbers may vary depending on the source. Although I could not find again my initial source, the oceanic surfaces indicated at <http://www.whatarethe7continents.com/the-worlds-five-great-oceans/> are very similar to those above: Pacific: 165,200,000 km²; Atlantic: 106,400,000 km²; Indic: 73,556,000 km²; Antarctic: 20,327,000 km²; Arctic: 13,986,000 km².

1 to the smallest ocean (the Arctic) and, after calculating the other values proportionally for the other oceans, arrived at the values 1.0; 1.4; 5.2; 7.6 and 11.7. Out of the need to simplify them, I rounded them up or down to more manageable numbers, first obtaining the values 1.0; 1.5; 5.0; 8.0 and 12.0. The compositional process involved many changes in the use of these values because several aspects of the composition had to be served by these numbers. In the first place, the macroform divided in five sections according to the syllabic meter $\cup - - - \cup$ has each syllable representing the oceans in the increasing order of their surfaces: Arctic, Indic, Atlantic, Pacific and Antarctic, therefore, 1; 5; 8; 12; 15. This needed also to be coherent with the macroformal time unit, the *tāla*, for which I finally found the value of 10 quarter-notes. In addition to this, each of the five sections is divided in the same macroformal syllabic meter, which becomes a middle-form structure, i.e., the subdivision of each macroformal syllable. Each middle-form syllable contains a spiral expansion of its musical materials, and the growth rate is the same as that of the oceanic surfaces. At some point, it was also inevitable to notice the similarity of the numbers 1; 1.5; 5; 8; 12 with Fibonacci numbers, 1; 2 (or 3), 5, 8 and 13. For reasons that have to do with satisfying all formal needs into a one coherent system, I rounded the numbers to meet the Fibonacci series, therefore arriving finally to the macroformal durations 1; 5; 8; 13; 3 (not 2, which would have been the closest approximation to 1.5, if this had been the only matter in question). The growth rate of each middle-form syllable along the five sections, expressed in terms of how many quarter-notes they contain is 30, 150, 240, 390 and 90. This, in terms of the number of *tāla*-s that constitute each section is 3, 5, 8, 13 and 3.

V. CONCLUSION

The importance of number and proportion for music composition in the 21st century is probably a matter of personal choice. Different composers in different periods have not only rejected or embraced the idea (and practice) of allowing number to determine some aspect of their music but also have conceived differently *how* number determines music; and the reasons for this are of a poetic nature.: poetic, because it is directly related to the composer's "program of art". Musical works may be, even if only partially, at specific aspects of its construction, determined by numerical relationships. In fact, hadn't aspects of a work been conceived firstly as number relations, the resulting music would have changed considerably: music would indeed sound differently. While putting "number ahead of sound" may feel to some composers as something unmusical, something alien to the nature of musical creation and inspiration, for others, music and number have always had an intimate relationship which can still be explored and practiced today. In my case, the use of number does not harm my compositional freedom, and there remain plenty of opportunities for spontaneity within the given musical materials.

The presence of number by itself does not guarantee the resulting work to be good music. In fact, depending on how it is used, there is a good chance number can cause a certain stiffness in the resulting music, as well as a rigidity in the compositional process and, consequently, in the compositional mind. Composers who assign a creative role to number in their music are, in the best cases, fully aware of this danger. After all, music is not number; number and music are different things, and a proof of this is that Music in the Quadrivium was not concerned with musical composition. However, were there no good reasons at all for assigning a defining, creative and active role to number in composition, this practice would not have been so present throughout western music's history, not to speak of the role of number in music theory, which has been important since Antiquity. Again, that there may be actually "good" reasons for number to come before music in its process of creation is an appraisal for which there is no consensus; it is a matter of personal choice; it depends on one's poetics, the way one composes, and it depends on the

numerical relationships themselves, since not all of them are “musical”.

For this reason, I have not brought to this article a historical review of musical works in which number takes a defining role in music. The discussion was mainly concerned with my own poetics, and with the exposition of the particular motivations for such a relationship between music and number.

Concerning the cosmicization of sound, there still remains one observation. Until now I have only spoken about the composer in the process of artistic/musical creation, and it would not be appropriate to exclude the performer, the musician who actually brings the composition to physically vibrate in the air. Performance corresponds to the final stage of cosmic creation re-enactment; it gives music a physical reality. The French word used for the moment in which the musician plays the music composed by someone else, *réalisation*, means production, actualization, and expresses the idea that a composition becomes real only when it is played, performed, i.e., when it is created in a physical, sounding way. The results of those formative principles acquire a brief, however concrete existence; it is only when it is performed that the music becomes an acoustic reality, a concrete universe of sounds. Until this moment, the composition has remained *in potentia*, locked inside the musical score, a text, a musical reality in fossilized form, or an encrypted message a-waiting to be deciphered. This work of deciphering is done by the performer, during the stage of their work called *interpretation*.

According to the traditional conception in western music culture, in this model²⁸ of musical creation, composer and performer stand in different hierarchical levels within the creation process, the composer being on a higher level than the performer. This seems to be a logical consequence of the actions taken by each artist: the composer writes the text, the performer reads it. It is possible to make an analogy between the roles of composer and performer with the role of divine creators in creation myths from the world. Ethnomusicologist Marius Schneider (1903-1982) made an extensive comparative study of several sonic cosmologies, creation myths according to which the world is created from sound, and their relationship with music, and was able to

“(…) distinguish an Omnipotent God from another god who is assigned to create the world. The Omnipotent God never gets involved in the action: he only has the idea of creation and limits himself to “utter” with an almost imperceptible voice, the name of a lesser god, whom he assigns the execution of his own idea. (...) in America, the god of thunder, the “big screamer”, executes the work of creation commanded by the great Manitu. However, this lesser god, who is more properly the creator, still is too high to occupy himself with the creation of a material world. In order to finish his work he delegates a demiurge (*coyote* or *transformer* according to the English and American ethnologists) and assigns him the partial materialization of the acoustic world. This assistant, who sometimes is some sort of lunatic, not always is a faithful server.” ([41, p. 23-24]) (Translated by the author).

In this context, which finds corporeity and materiality as the lowest level of creation, even when manifestation should be seen as the crowning of Creation, the composer would be the lesser god, being gifted with the power of imagination and craftsmanship to create sounding microcosmos (in the plural), and the performer would be the demiurge or *trickster*, who deals directly with matter and creates music by playing an instrument or singing. This analogy does not intend to deify the composer neither the performer, neither makes an apology of their egos. In fact, painters, composers, architects, doctors usually suffer of the God complex without the need of any theoretical support. Neither does this analogy intend to offend the performer by calling them “a

²⁸ There are other models, such as the composer/performer, or the improviser.

lunatic". I bring this analogy only because it lives in western music culture, in the way artists are frequently compared to gods or geniuses, and because it finds an echo in the divine figures of worldwide creation myths. If the humanly created universe "shares in the sanctity of the god's work", according to Mircea Eliade, every creative act is sacred, divine, and it seems logical to connect the facts in this way: that a composer receives what is uttered by the Omnipotent God, and that the performer brings to realization what the composer was capable to hear from what had been uttered.

From all this, what is really meaningful and important is to recognize that artistic creation happens through the artist, composer or performer, who is a channel capable of shaping that energy that wants to be formed, the *forma formante*, nature. For Jean Cocteau (1889-1963), "a poet is in a way the work-hand whose act engages a self more profound than himself which he doesn't know too well, mysterious forces which inhabit him and which he knows poorly" ([9]). The artist is just a physical agent helping the process to take place, or, to use Anton Webern's words (themselves quoting Goethe) from a 1933 lecture, "man is only the vessel into which is poured what 'nature in general' wants to express" ([44, p. 15]).

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