Egyptian Architecture, Posadas' Metaphor for Composition

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Abstract

Over the years, but especially along the twentieth century, many composers have focused their gaze towards Architecture. Alberto Posadas' music often resorts to the use of exogenous models, mainly scientific and artistic ones, as a starting point to compose. This paper analyzes – summoning archeology, epistemology, mathematics and esthetics – the way he has used the magnificent Sneferu's Bent Pyramid at the royal necropolis of Dahshur (Egypt) as an inspiring object. This architectonic model has been useful for him to raise a dense network of metaphors that links spatial aspects of the building with temporal aspects and hierarchic parameters in his quintet *Nebmaat*.

Brief Historical Review

It is hard to understand Music as a self-referential discipline. From Ancient Greece and even in non-Western previous civilizations [4], musical thought has been closely linked to numbers. Greek musical legacy shows the discussion between Pythagorean conception of Harmony as arithmetical ratios and Aristoxenus' advocacy of hearing as the primary basis for a musical theory. Tardive readings in the Middle Age of Boethius' texts reintroduced in the Christian World these Greek questions (via *quadrivium* and supported by Archytas' conception of Maths). Throughout the centuries, many theoretical discussions have inherited these approaches, but in quite different contexts and formulations; hence, as Michel Serres says, "la musique n'a jamais cessé de rester grecque" ("music has never ceased to remain Greek") [16].

Considering thereupon Music as a discipline close to numbers, it is not hard to imagine that several interdisciplinary bridges have been summoned by composers to intertwine their work with other artistic domains, guided by a more or less conscious help of Mathematics. Among them, Architecture has been accurately suitable in that sense because of the inherent structural calculations it demands. One of the best known – and mystified – historical case is Guillaume Dufay's *Nuper Rosarum Flores* (1436), composed for the consecration of Filippo Brunelleschi's Basilica de Santa Maria del Fiore. This motet has an isorhythmic proportional structure (6:4:2:3) that has been analyzed by authors like Charles Warren [20] as a reflection of the Dome framework. Craig Wright [23] disproves this hypothesis and attaches those proportions to the biblical description of the King Solomon's Temple (Kings 6:1-20). Whether tangible or exegetical, it seems certain that there is an underlying architectural model for that composition.

The twentieth century has led to a closer interaction between architectural and musical events. As Susana Moreno says quoting Le Corbusier [10], architectural experience can be thought in contemporary terms as a non-synchronic phenomenon but sequential in time, and the opposite could be true about musical experience referred to space. Many examples can be convoked. Continuing with the Le Corbusier's contribution, his joint project with Iannis Xenakis for the Pavilion Philips in the 1958 Word Exposition, Brussels, is the first great multimedia experiment mixing architecture with music and film.

Edgard Varèse composed his tape *Poème éléctronique* (1958) for this event. It seems that Varèse perfectly fit in this project due to his art-science conception of Music [19] and Architecture [3], a kinship he found since his childhood [15]. Xenakis found a more robust vicinity of these two domains, even from his early *Metastasis* (1954), a score that shares with Pavilion Philips projective sketches. He considered Architecture one of his three 'paraboles' to compose [24]. The *Polytopes* were huge projects entirely designed by him, concealing musical, light and architectural aspects in a polysemic space that proof this fertile path [12]. Not even Varèse or Xenakis are lonely examples, other composers like Luigi Nono in *Prometeo* (1984) with Renzo Piano at San Lorenzo in Venice, Daniel Ott in *klangöperklang* (2000) with Peter Zumthor at the Hannover Expo 2000 or Beat Furrer in *FAMA* (2005) with LIMIT architects at Donaueschinger Musiktage have successfully developed ephemeral multidisciplinary spectacles.

Alberto Posadas' Models

Alberto Posadas (Valladolid, 1967) is one of the most prominent Spanish composers of his generation. His music has been widely premiered and played in Europe and Canada, in outstanding festivals such as Agora (IRCAM), Festival d'Automne de Paris, Ultraschall Berlin, Operadhoy Madrid, Encontros Glubenkian Lisbon, Ars Musica Brussels and Festival MUSICA Strasbourg.

Posadas inherited from his master Francisco Guerrero a balanced position between musical thought and scientific influence. His theoretical and aesthetical foundations are widely supported by three modeling branches [22]. First, scientific models have often stimulated his imagination to try to transpose in music some regulatory mechanisms of Nature or several algorithmic methods to construct mathematical objects. It may be mentioned among them the musical use of Brownian Motions (where Xenakis was a pioneer [17]) in *Ondulado tiempo sonoro…* (2003) and *Modulaciones* (2006), the Mandelbrot Set in *Órbitas* (2007) [2], the botanic L-systems developed by Aristid Lindemayer [11] in *Arborescencias* (2007) and *Glossopoeia* (2009) or the lung fractal model proposed by Edward R. Weibel [21] in *Bifurcaciones* (2007). The second modeling path is introduced by Visual Arts in order to transpose spatial elements into music parameters. In this regard and so far, Painting and Ancient Architecture have been the two most attractive disciplines to him. Anamorphic technics leaded him to compose *Anamorfosis* (2006) and an intuitive reading of Francisco de Goya's paintings emboldened his *Cuatro escenas negras* (2009). Interactions with architecture will be discussed in the next section. Finally, the last family of models is supported by the organological and acoustical study of musical instruments. This positioning is akin with French spectralism – a musical movement born in the 70s – where the spectral models of sound [1] were the starting points for several composers like Tristan Murail or Gérard Grisey. *Eridsein* (1995), *Sínolon* (2000) and *Anábasis* (2001) are the most representative Posadas' solo pieces in that sense.

The Bent Pyramid at Dahshur vs Posadas' *Nebmaat*

Nebmaat (2003) is a mixed quintet – clarinet, saxophone and string trio – composed by Posadas for the Ars Musica Brussels. The Musique Nouvelle Ensemble premiered it, conducted by Jean Thorel, in 2004. First page contains the dedication "A Egipto" (to Egypt), which denotes the overwhelming fascination this region causes him. In fact, it is not the only piece in his catalogue with an Egyptian reference: *Pri em hru* (1994), *Seth* (1999), *Snefru* (2002), and *Resplandor (poema lírico dedicado a Atón)* (2008) show this evident influence. In particular, *Snefru* and *Nebmaat* have been inspired by Sneferu's funeral pyramids.

The architectural model. Sneferu was one of the greatest pharaohs of Egypt. He founded the IV dynasty and governed around the 2600 BC, and his inheritor to the throne was Khufu (Cheops). His Horus Name and his Nebty Name was Neb-Maat, which means 'Lord of the Harmony' in terms of justice and balance.

Many great funeral complexes were built during Sneferu's reign, two pyramids at Dahshur, the Bent Pyramid and the Red Pyramid, and a third one at Meidum. In fact, these architectural projects reflect the transition from the old step pyramids – composed by series of decreasing mastabas – to the majestic ones, with his son's Great Pyramid of Giza as an archetypal completion. The most amazing pyramid built during Sneferu's government in terms of visual shape was the Bent Pyramid. Its faces present a double slope (54º27' lower and 43º22' upper), so in geometric terms it looks like a solid composed by a lower truncated pyramid and an upper smaller pyramid. One of the most assumed hypotheses to explain this bizarre form is the eventual modification of calculations during its construction [9]. Its internal corridors are also exceptional because two different entrances lead to two funeral chambers from different cardinal points. The Pyramid of Chefren has also two entrances, but both located in the Northern façade. From the perspective of architectural model recovery, the very first Egyptologist who tried to reconstruct the design of the Bent Pyramid was John S. Perring after his exploration in 1839. Several great adventurous campaigns followed his steps: Karl R. Lepsius (1843), Jacques de Morgan (1894), Alessandro Barasanti (1901) and Gustave Jéquier (1924) among them. After the Second World War, Abdessalam M. Hussein began the first deep architectonic research, a frustrated project but retrieved by Ahmed Fakhry and the engineer Hassan Mustapha in the 50s. They published the first scientific and proper description of the pyramid shape and content, with a very accurate estimation of its external and internal measurements [5].

An analogical model. We have seen in the first section several historical interactions between Architecture and Music. The most contemporary ones show how composers have worked in multidisciplinary projects to provide physical environment a musical sense: visual and acoustical spaces share a common flux to engender a joint experience. Even Dufay's *Nuper rosarum flores* is hardly linked to the Basilica di Santa Maria del Fiore – if we finally accept Warren's doubtful theory – because it was conceived to be played during it's consecration. Conversely, Xenakis' *Metastasis* and the Pavilion Philips are different projects, at least sharing the same author. But the nearly four and a half thousand years gap between Sneferu and Posadas places the relationship in quite a different level. Here, the composer acts as a 'virtual archeologist' who tries to reinterpret the architectural model with a musical meaning.

How should an exogenous model like this be placed in a musicological analysis? Mikhaïl Malt (IRCAM) proposes the existence of a modeling space – conscious or unconscious – between the concept space and the writing space to explain the composition processes [7], [8]. Inspired by André Giré's thesis [6], he classes the possible feeder models engaged in a compositional act in four vast categories: logic models, analogic models, metaphoric models and phoric models. Analogic ones are those whose ontological entities are far from the 'musical matter', and so provide significance via analogy (in its philosophical sense). Based on this nomenclature, the Bent Pyramid has operated as an analogical object in Posadas' modeling space during the composition of *Nebmaat*.

The mathematical passage. Nevertheless, the pyramid can only supply for this purpose an ensemble of size and angular information, just measurable and order relationship data. It is essential therefore to furnish an operative subspace immerged in the modeling space to set the relationships between spatial data and chronometrical materials in order to compose. Next paragraphs will show Posadas' strategies to operate this transfer. They will summarize his technical algorithms from a critical perspective, and several mathematical proposals will try to model some intuitive choices.

First of all, Posadas has chosen some geometric elements from the pyramid external shape and the measuring corridors data from its internal structure to construct several reservoirs. From its shape, he has used the base diagonal and edge, the height from the base to de apex and the upper smaller pyramid edge and apothem, all them in terms of proportional relationships. These five geometric elements are also a priori linked with five gestural typologies in the strings of the quintet, with their equivalents in the woodwinds. On the other hand, the two internal passages of the pyramid give three new blocks of proportions, because Posadas has employed two different calculations from the Northern corridors: old

data from Perring and contemporary ones. The offset between them is here an amazing point (they also differ in number of corridors, due to Perring's manipulations to get access into a funeral chamber), probably one of the most incentive aspects of the model. This exceptional circumstance has been the original idea for Posadas to develop heterophonic layers in the woodwinds. He has operated all these givens as proportional sequences. They have been summarized in the tables below.

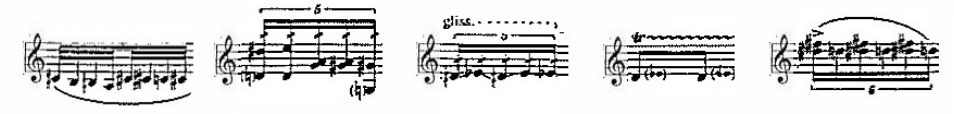
Element	Diagonal	Base edge	Height	Lateral edge	Apothem
Proportion	38.65	27.33	15.22	10.07	8.73
Linked musical gesture					

Table 1: *External proportions and corresponding musical gestures (percentages).*

Passage	Corridor								
	$l_{\cdot,1}$	$l_{\cdot,2}$	$l_{\cdot,3}$	$l_{\cdot,4}$	$l_{\cdot,5}$	$l_{\cdot,6}$	$l_{\cdot,7}$	$l_{\cdot,8}$	$l_{\cdot,9}$
North (Perring) $l_{1,\cdot}$	9.58	51.25	3.47	4.17	3.19	7.92	11.25	5.14	4.03
North (actual) $l_{2,\cdot}$	9.86	52.78	9.03	2.36	4.86	11.53	5.28	4.31	∅
West (actual) $l_{3,\cdot}$	31.25	49.03	8.75	6.11	4.86	∅	∅	∅	∅

Table 2: *Internal corridors proportions (percentages).*

These data have been employed by the composer to control the chronometric structure of the score. Let's consider T the total timing of the work (excepting the final coda, designed intuitively). Posadas has used a very simple method to segment the piece with these proportions, just inspired by the all-scale detail property of fractals. The idea is to segment T in several scales. For example, the string trio chronometric mapping considers a first partition in formal sections following Perring's Northern proportions. Each one of these segments is then divided into shorter periods with the canon of actual Northern proportions, and Western ones cut up again following the same procedure, always taking intermediate rounding. Therefore, this algorithm can be summarized with the formula below, where the chronometrical order in the score keeps up the lexicographical order of $d_{i,j,k}$ elements.

$$d_{i,j,k} = round\left(l_{3,k} round\left(l_{2,j} round\left(l_{1,i} T\right)\right)\right)$$

The same process has been established for the woodwinds timelines, just 'rotating' – via (1 2 3) cycle – the order of the passages in the foregoing algorithm. Posadas has rounded data in each step (checking his computer sketches), but if not and as a trivial consequence of commutativity, all these timeline durations would be interlinked with an only different index precedence in lexicographical order. Thus, the information could have been considered a $9 \times 8 \times 5$ hyper-matrix oriented for each instrumental group via the action of A_3 alternating group, equivalent to transposing ordinary matrices, a more compressed management of data. Moreover, an incoming mechanism has operated new mergers and portions of timeline partitions, but this time in a more subjective and arbitrary way. Sometimes, a correlative sequence of short durations which are regrouped in a larger temporary structure; conversely and more frequently, long durations are subdivided into shorter ones using external shape proportions. There is here a really amazing and original point: Posadas has inverted spatial and temporal relationship scales. Thereby, internal proportions control the temporary macrostructure whilst external data penetrate the detail.

Nevertheless, the use of external ratios has had a higher prevalence than just a timely or anecdotal presence. Let's consider a local sequence of those correlative durations, as for example the violin discourse in the first section of *Nebmaat* (partially shown in figure 1). Here we can find a tense melodic contour that juxtaposes the aprioristic five musical gestures. Posadas has nested a weighted distribution of these gestures from the external proportions with nonadjacent locations, where the accumulated duration for each gesture during this section is almost adjusted to its attached external ratio (see table 1). Also notice the decreasing durations in the exposition of these five gestures at the very first measures. They try to fit again with those external proportions at the last timeline level which evidences again a 'fractal spirit', this time in a hierarchic dimension adhered over the chronometric one.

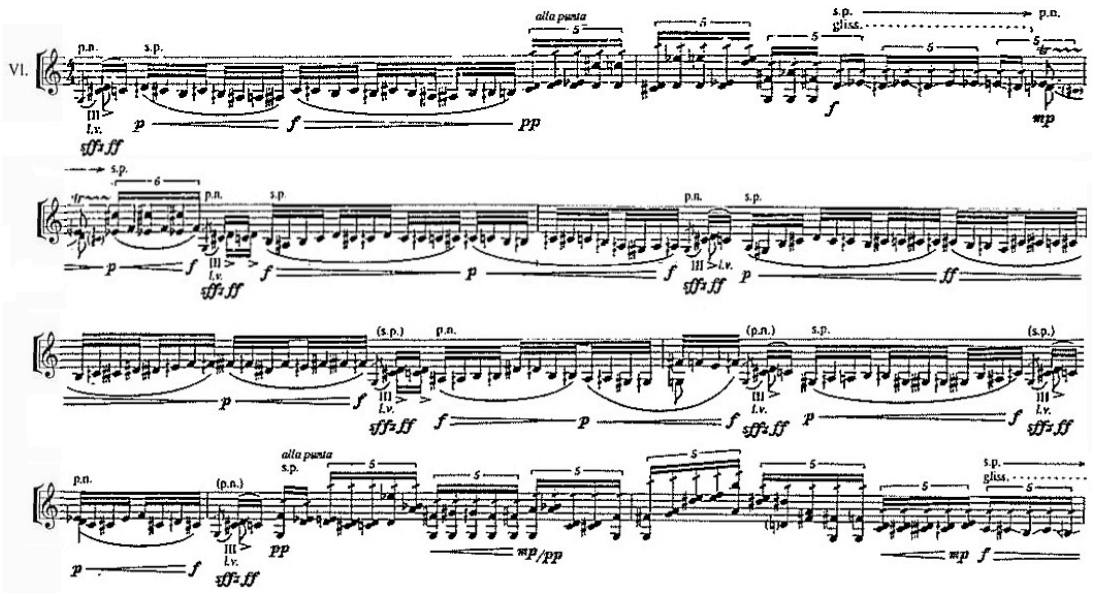


Figure 1: Nebmaat *violin excerpt (measures 1-8), with the kind permission of the author.*

Posadas has adjusted its distributions in an intuitive way, probably not the optimal ones in terms of mathematical fit, but it is not difficult to model this problem invoking Graph Coloring Theory to optimize these distributions. Let's consider a correlative partition of durations t_i ($i = 1, \ldots, n$) from a total timing T as the i-th edges of a chain (from the foregoing algorithms), and all the edge coloring (function ξ) possibilities imposed by the use of exactly five colors. Let's call p_j the pyramidal proportion associated to the j-th color. We define the ε error function of a coloration C as below. The problem to solve is to minimize function ε from all possible colorations.

$$\varepsilon(C) = \sum_{j=1}^{5} \left| p_j T - \sum_{i \in \xi^{-1}(j)} t_i \right|$$

A metaphorical model. The analogical modeling is not the only influence the ancient pyramid exerts on *Nebmaat*. Recalling Malt's classification of models, the Bent Pyramid also behaves as a metaphorical object in Posadas' modeling space. From this point of view, the model adopts a rhetorical purposefulness: the composer has attempted also to translate physical sensations inside Sneferu's pyramid into musical time perception. This is the case of the second section in the quintet: here we are immersed in a suspended listening, a frozen time that concerns a referential loss of orientation. It tries to reflect the way a visitor gets lost in a pyramid, wandering along the narrow and gloomy corridors with an implicit direction but a loss of compass.

Further mathematical considerations about *Nebmaat*. The previous sections have shown up the way Posadas has operated an inventive musical transfer from an architectural model. Although the choice of the Egyptian funerary complex circumscribes the chronometrical decisions and a weighted hierarchy of gestures, it is not the only model involved in the computable structure of *Nebmaat*. In fact, a mathematical object has been borrowed to resolve a local problem within the pale of the modeling space. The violin's melodic line in Figure 1 has been entirely constructed through the use of a Brownian Motion (in terms of pitch sequencing, the rhythmic patterns have been already discussed). This mechanism can quickly generate a 'wrinkled' melodic contour, controlled by certain initial conditions in order to obtain a particular and effective music result. Posadas has finely exploited Miguel Ángel Guillén's tools – Guerrero's informatics assistant – to operate the musical conversion. Here, he has only needed to draw on a single Brownian Motion for a soloist line, but he often develops several simultaneous motions to build polyphonic complex layers and interactions in other pieces of his catalogue. From a theoretical point of view, Carlos Satué [14] has succinctly discussed the way these composers have successfully implemented those stochastic processes in their music.

Conclusions

This paper has highlighted the way a pristine architectural source can be bountiful from the viewpoint of a shrewd composer. However, although his use of this model could be criticized as a forced analogy that does not really 'represent' the building, it is completely rooted in Posadas' compositional and aesthetical thought. When Posadas works with instrumental models, he often describes his research as both 'archaeological' and 'scientific', combining the discovery and exploitation of unconventional *modes de jeu* – hidden techniques in the depths of the instrument – with the acoustic analysis of its sound production. This double metaphor can be extrapolated to the way he has composed *Nebmaat.* Thus, he has revisited the ancestral tomb from an unconventional regard that allows him to weave an original network of analogies and metaphors with his music, just to encourage a factual study of the architectural model, providing enough information to construct a robust musical discourse. On the other hand, other modeling processes in Nebmaat – borrowed from different areas of knowledge – have helped him to unify his musical catalogue. Nevertheless, we should not forget that algorithmic procedures do not ensure a compositional success that mainly comes from artistic insight, one of Posadas' gifts.

Last but not least, it is important to emphasize the symbolic aspect of a fully endowed of auratic meaning object as a pyramid is. Although the sound evoked in the second section of the score may be identified as a 'musical ecstasy' due to the metaphorical influence of the arcane grave, Posadas' approach to Music looks for a technical objectification and artistic expression devoid of superstition or mysticism [13]. Anyway, Music has been often regarded as a gateway to transcendence, not only through the prism of Romanticism, and perhaps this point gives full right to this music and funeral monument alloy. As one of the most renowned Spanish contemporary philosopher and esthete says [18]:

> "El límite está siempre entre la naturaleza y el mundo y entre el mundo y el misterio. En este linde se aloja siempre la música: civilizando el sustrato salvaje y fiero que nos emparenta al mundo físico, animal, e introduciendo una gnosis sensual en relación con los misterios de ultratumba que nos conmueven."
>
> ("The limit is always between nature and world, and between world and mystery. At that borderline music always dwells: civilizing the wild and fierce substrate that intermarries us to the physical and animal world, and inserting a sensual gnosis in relation to the soulful mysteries beyond the grave.")
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> Eugenio Trías

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