Silvia Fômina

THE PROMISED SPACE / Der versprochene Raum

The What and the How of a transdisciplinary interactive Opera

The Why of the What and the How, had been suspended on the road by its own weight; later it was collected by Oblivion and disseminated in the air; today the What and the How continue their route alone and at a dancing pace.

s.f.

There is a region in which the *What* coexists with the *How*, the real with the imaginary, art with science. I do not understand it as an antagonistic region of two opposing divinities - intelligence and emotion - but as a common trough, a free zone, a territory of conceptual exchanges of mutual fertilization. The great musical and literary works project deep glances about reality and the great scientific advances redefine the limits of the imagination. And in this creative game they complement and meet each other.

The focus of interest covered by the *Space. Polyphonies. Memory* symposium, and that the select group of artists and scientists who integrated it continue to develop at present, visit that territory of coexistence: they contain or inspire solutions to scientific problems or create instances in which the scientific criterion intervenes in an intuition of similarity, where the metaphor it no longer presents itself as a product of the dissimilar, but it becomes an argument about the nature of the real. Moments in which the artist becomes a scientist, and the latter in *Inventor of fanciful metaphors* - as the *Universe as a book* by Galileo Galilei was described, of divine origin, but written in mathematical language, with circles, triangles and geometric figures.

Just as there is science in fiction, there is fiction in science: in the four works of 1905, *The miraculous year*, Albert Einstein proceeded largely as an artist, taking ideas - which were considered mathematical fictions by the prominent scientists of the time - and accepting them as part of the real world.

Music and metaphor are present in physics, biology, engineering, neuroscience, literature and philosophy, just to name the fields with which we have started our journey. Besides the Galileo's *Universe as a Book*, I would like to remember here *The Arrow of Time* proposed by the physicist Arthur Eddington. This *arrow of time* is conceived to discover the curious asymmetry of a macroscopic world that clearly differentiates the past from the future, but in its microscopic entrails, this past and future coexist in harmonic symmetry: the *four-dimensional map*, the very nature of the transience of the musical matter. Space and time are to some extent interchangeable, but if one drew that map on a block of solid paper, time would progress in a preferential sense, and just like music, it expresses this directional property of time, something that does not have its counterpart in space.

Another concept of poetic content and common source to these two universes, science and art, is the one outlined by Werner Heisenberg - one of the inventors of *Quantum Theory* - is

that light and matter are both individual entities, and the apparent duality emerges of the *limitations of our language*. Music exists because words *grid* or *format* a continuous and infinite reality. To go beyond that *grid* - *format*, it is necessary to resort to permutations that extend the reach of intelligence. From these permutations emerge the *micro-revelations* and *resonances* of the aesthetic experience and - perhaps they are the same - the unexpected keys to understanding the universe. Therefore, what more than once began as an artifice of the sounding and poetic imagination, as a protoplasm where thinking and feeling converge, then germinated in a scientific synthesis of reality. Perhaps because refracted by different crystals, the great mysteries converge in the same focus; or because, in short, all language is metaphorical.

Scientific fantasy and artistic fantasy: About the libretto and spatial staging of *The promised Space*

I am pleased to outline here the path that has led me to select the stories that originated the basis of the script, and currently inspire the construction of the interactive and transdisciplinary opera *The Promised Space / Der verprochene Raum*:

*

First of all, it seems important to me to name the most striking case of artistic anticipation, in this case, literary, of a scientific idea: it is the story *The Garden of Forking Paths*, published in 1942, where J.L. Borges anticipates a theory of physics in an amazingly literal way.

According to the *Theory of Quantum Mechanics* - along with *Relativity*, one of the most revolutionary theories of the twentieth century - microscopic particles suffer from a striking schizophrenia: they can be *simultaneously in several places*, and only happen to be *in a single defined place when they are observed* with a detector. That is, it admits the possibility that they are in a *superposition of states before being observed*, and in *a defined state, after being observed*.

After the measurement process not only changes the memory of X (or of the observing public), but changes the state of the observed. It makes no sense here to say that the observed is in one state or another, because the observed is *simultaneously* in the two states. This peculiar characteristic that has no place in our experience in everyday reality, confronts us with another of the conceptual revolutions of quantum mechanics and encourages our intuition to immerse ourselves in other paths of space-time perception: *the loss of existence of an objective reality in favor of several realities that exist simultaneously*.

The theory (widely confirmed by the experiment) anticipates the *probability* of finding the particle somewhere. Now: if both X (or the public), as well as the particle are subject to the quantum laws: by what mechanism the particle *chooses* the place where it will be detected, or the atom *opts* for a state (spin up) and not for another (spin down) after being observed? This question summarizes the so-called *problem of measurement*, unresolved until today. The solution to this paradox probably goes beyond quantum theory and is closer to art, especially to the musical universe.

The only coherent way out - albeit extravagant and "*loaded with too much metaphysical baggage*" for many physicists - is the resisted *Theory of parallel worlds*, which the physicist

Hugh Everett-III published (under another name) in 1957. According to this theory, at the very moment of measurement, *the universe is divided and multiplied into several copies*, one for each possible result.

But the first to conceive parallel universes that multiply was not Everett-III, but the writer J.L. Borges. In *The Garden of Forking Paths*, he proposes a *Time labyrinth* in which, each time that one is faced with several alternatives, instead of opting for one and eliminating others, *one chooses - simultaneously - for all.*

The remarkable similarity between the Borges' story and Everett's work reaches the botanical, since Borges speaks of a garden of paths and Everett, of a branched tree:

The trajectory of the memory configurations of an observer who makes a series of measurements is not a linear sequence of memory configurations, but a tree branching out with all possible outcomes that exist simultaneously (H. Everett-III).

In all the fictions, every time a man is faced with different alternatives, he opts for one and eliminates the others; in the one of the inextricable Ts'ui Pên (central figure of its story), he opts - simultaneously - for all. He creates, in this way, different paths, different times, which also proliferate and bifurcate. (J.L. Borges)

In our everyday world we are faced with situations in which *chance* plays a crucial role and whose description also requires a *probabilistic language*. That is to say, the *many simultaneous worlds* are incorporated into my work, with my attention focused on the *loss of the idea of a linear trajectory*, in favor of a *description in terms of the probabilities of the trajectories*. The world then appears as a temporary labyrinth, in which a growing and vertiginous network of divergent, convergent and parallel times coexists. That weft of times that approach, bifurcate, intersect or that secularly ignore each other, covers all possibilities: "we do not exist in most of those times; in some there is you and not me; in others, me, not you; in another, both" (Borges).

Submerging in the *Theory of the many worlds*, at the moment when X or the public becomes aware that the observed is in a defined state, *Eureka*!: The universe is divided into two or more almost identical copies. In each quantum measurement or observation by X / or by public, the universe branches, with one component for each possible result of the experiment. The sequence of memory configurations of X – or *the trajectory of memories - is different in each of the universes*.

Now, where are all these parallel universes? According to the Theory, these universes *do not interact*, so that they could occupy a single space, here, in our universe.

Another answer is that the universes are *stacked* in an additional dimension of which we know nothing about.

Another possibility, which bring together the two previous ones, proposed by the one who writes here, is that the parallel universes are *without interaction, stacked, fragmented and distributed* in as many trajectories of memories as the number of X-participants of the public, waiting for a space-time labyrinth that summons and gathers them - perhaps by means of an outburst of sudden magic, inspiration, or passion of the chance - to finally find their defined

state - heterogeneous, cruel, blind and beautiful at the same time. Only for the propitious and fleeting moment that *The Promised Space* lasts.

This possibility of representation of individual and simultaneous worlds of the soloist/s or the public will be worked through interactive and virtual reality techniques, applied here to the opera.

In our transdisciplinary journey we have also entered into the exciting, intricate and infinite world of neuroscience. We have focused on the subject of *decision making* - which constitutes one of the most relevant current focal points of the discipline - and on the other hand, that of *subjective perception of time* - especially and with great interest on my part, that that expresses the idea of *dilatation and temporary detention*.

The individual steps of the figures on the scene, which define the game of chess miniatures through the public-soloist-X interaction, as well as the tactile-light spatial-temporal labyrinth created in real time by the soloist, are used in *The Promised Space / Der versprochene Raum* as a structural and scenic basis of:

a) Real and immersive virtual interactive scenes in society, and

b) Virtual isolated monologues, in which the factor of individual temporal perception constitutes the engine that generates the visualization of the environment, and not vice versa.

This music-science correlation centered on the temporal factor was inspired by the *Theory of Relativity of Time* by A. Einstein and the story of J.L. Borges *The secret miracle*, used in the final part of my libretto: Einstein imagines the space strewn with clocks and shows that they are delaying one with respect to the other, located at different distances from each other. In its temporal landscapes we could find, for example, three clocks A, B and C: if the C-clock were moving at the speed of light, from the system of A and B it would be seen that in the C-clock *the time It has stopped*!

In *The Secret Miracle*, Borges describes the scene of the instant before the execution of the writer Hladík in Prague: *The physical universe <u>stopped</u>*. *The men who were going to kill Hladík were <u>motionless</u>. The sergeant's hand <u>perpetuated an unfinished gesture</u>. In the yard, a bee projected <u>a fixed shadow</u>. The wind <u>had stopped as in a painting</u>. Hladík <u>tried</u> a scream, a syllable, the twisting of a hand. He understood that he <u>was paralyzed</u>. <u>Not even the faintest rumor</u> of <u>the impeded world</u> reached him. He thought "I'm in <u>hell</u>, I'm <u>dead</u>". He thought "I'm <u>crazy</u>". He thought "<u>time has stopped</u>".*

Hladík has a different time from the rest of the universe, this *dilation of the time* that reaches even the *detention*, it is his own time, the *time of his conscience* - his heart keeps beating and his eyes blinking.

The technical difference with Einstein's watches is that they are in motion. But that extravagance of *non-synchronous time lines* is possible even when the clocks do not move one with respect to each other. The idea of times that elapse in different ways for different individuals has a long previous trajectory in literature, in universal folklore and in music. In the epigraph of *The Secret Miracle*, Borges quotes the Koran (II, 261): *And God made him die 100*

years and then encouraged him and said, how long have you been here? - one day or part of a day - he replied. Also in *The Search for Averroes*, the protagonists spend 309 years in a cave and then wake up. Likewise Cervantes, when his *Don Quixote* enters the cave of Montesinos, counts 3 days in there, and when he went outside only one hour has elapsed.

With Einstein, time then enters in the choreography of space: *If time is no longer absolute* and depends on the speed of the person measuring it, then *space is also relative*. He sees the distance between his clocks compressed, in the same factor as his time expanded.

Returning to the texts that inspired the libretto of *Promised Space / Der versprochene Raum* also the story *Tlön, Uqbar, Orbis Tertius* by Borges describes that: *The geometry of space comprises two somewhat different disciplines: the visual and the tactile. The latter corresponds to ours and subordinates to the first ... The basis of visual geometry is the surface, not the point. This geometry ignores the parallels* (here refers to the *curved space*) *and declares that the man who moves modifies the shapes that surround it* (alludes to the *gravity* that modifies the curvature of space).

As for the *Theory of Relativity and Gravitation*, *space also changes with gravity*: the length of a measurement rule varies according to gravitational attraction, i.e.: *gravity curves space*. Just as gravity changes the clock times, it also modifies the space.

The curvature of space is a notion difficult to digest, since we have only the visual experience of curved *surfaces* - like the earth - *embedded* in a three-dimensional space, an empty space of structure to be filled by objects.

If, on the other hand, the radius of a circle that goes from the center of the Earth to any height is measured with a ruler, and then the diameter of that circle is measured, it does not match with "*the perimeter is equal to 2\pi by the radius*" In this case the perimeter of the circle is somewhat less than 2π by the radius, which evidences the curvature of space. It is not the very curvature of the earth that affects the length of the rules, but the gravity, and what is curved is the space itself. The mathematician Carl Gauss, creator of the *Egregious Theorem*, was the first to demonstrate that it is possible to know if we are on a curved surface *without looking outside* that surface.

But the first literary and scenic-spatial artistic anticipation that has inspired my vision of *habitable hyperdimensional curved worlds*, it is possible that it was *The Divine Comedy*, by Dante Alighieri. Dante's cosmology is complex and seems to anticipate what we now call *a curved space that closes on itself*.

In *Paradise*, Dante implicitly approaches a question that we all used to ask ourselves: Does the Universe have *borders*? Dante describes his ascent, sphere by sphere, to Primum Mobile, beyond the Empyrean, residence of God and the angels. Each semi-universe, on both sides of the Primum Mobile is composed of 9 concentric spheres that first increase the diameter and then decrease it. Dante is confused by this, and Beatriz explains it in song 28.

Imagine that we are walking from the North Pole to the South Pole, a trip during which we cross concentric circles (the parallels), which increase in size until we reach the Equator line

and then begin to decrease from there. Dante's world is, however, three-dimensional, and *instead of crossing circles it crosses spheres*.

It is easy to conceive a two-dimensional curved surface as the surface of the earth, which surrounds and covers a three-dimensional world. Now: a surface in three-dimensional space is similar by extension: while the parallels are the intersection of the sphere with horizontal planes (of constant coordinate around the earth), the spherical surfaces that Dante crosses are the *intersections of a hypersphere of 4 dimensions* with constant coordinate *planes around an axis*. The result: *concentric spherical surfaces that increase and decrease in diameter*.

Beatriz explains to Dante that the spheres have a classification, a *greatness* that does not correspond to their size, but is indicated by their speed. While the diameters increase and then decrease, the rotation speed of the spheres increases as the Primum Mobile crosses. The speed, which continues to increase even when the diameters of the spheres increase and then decrease, indicates a measure of distance to the North Pole, or to the center of the spheres. Dante always moves away from the center, but the diameters, as well as the parallels on the surface of the earth, increase and decrease in size.

The topology of Dante's *Divine Comedy* corresponds, therefore, to a curved space, an idea that had to wait for the arrival of Einstein to enter through the big door in the world of science. And the interesting thing is that, if the space is curved, it *can be closed on itself*; it *can expand without a center, all the points are the center and none is,* in the manner of Pascal's sphere, whose *center is everywhere* and *its circumference in none*.

About Intuition

It is essentially the thought about the human constellations, their movements, beliefs, tendencies and their relation with the micro- and macrocosm, which leads me to focus my attention and sharpen the intuition through the musical matter. I consider that I use music as a vehicle and guide to initiate inquiries and remain in long meditations on this metaphysical relationship.

It would be interesting to reflect on the *intuition* unjustly relegated - in the generalized and popular conception - to the territory of the irrational *"chemically pure"*, or, to put it better, to the field of the non-rational. The verb *intuir* (from the Latin *intueri*: to look, and this from *intui-tionis*: image, look) is rescued by the scholastics as the immediate movement of an object, the penetrating, rapid and total understanding of an idea, the instantaneous apprehension of the true.

Intuition could be defined as *sensitive or emotional*, linked, perhaps, to the capture of revealed truths - hence its use by scholasticism; or *empirical-volitional-intellectual* intuition, which can be related to scientific methods to become one of them. Not only for the German phenomenology, in the case of sensitive or emotional intuition - or Bergson in the empirical one - but mathematicians in general, recognize and consecrate it as a powerful methodological tool.

Now, in the case of musical creation this tool plays a major role in accompanying the composer and author in his obsession to unravel existential intrigues, in what refers to the Universe, to the origins and mysteries of circumstances such as *time, infinity, uncertainty or indeterminacy* and *chance*.

About the Chance

The presence of *chance* in the universal scenario, this new and transcendental protagonist, irremediably defines the *death of determinism*. An approximate simile - and undoubtedly coarse, though explanatory, is the irrationality (or the emotional) as an unavoidable part of human behavior, as well as the idea of followers of *Quantum theory*, extended to one of the topics increasingly investigated by psychology, both in the individual as in the social.

Chance, then, is one of the frontiers. Not so much of the Universe, but of our possibility of knowing it in totality, until its last corner. On this side, both in the scientific microcosm and in the artistic creation, there is then *a refuge, an impregnable edge*. His research in the scientific world and that of compositional creation, means a great effort and a fascinating engine of inspiration, which has provided *permeable space-time structures*, with enormous possibilities of deterministic-probabilistic interaction. They are processes of simultaneous type - in the case applied to my works – of materials and textures conceived and controlled by their degree of *induced probability of permeability*.

Macro- and microuniverses

Let us return to this source offered by intuition: What happens to us with *the other extreme*, *the macro-universe*? From the Aristotelian *sphere of stars*, the evolution of human thought and intuition - not without setbacks, dramas, censorship and deadly self-censorship, both in science and in art - had also permanently crossed edges or barriers.

The scientific path that goes from the heliocentric scheme to the persuasion generated by the inexorable protagonism of the *Island-Universes* and the extra-galactic space, finds its curious metaphorical parallel in the evolution of our systems, theories of western musical notation and spatialisation, from the Greek modes, scales and *diabulus* sounds, through fragmentation and tonal dissolution, up to electroacoustic synthesis, control and spatial location of sound.

Five years before Heisenberg gave birth to the *Uncertainty Principle*, in 1924, Edwin Hubble, in the United States, was concerned with measuring the distances to which remote stars of galaxies outside the Milky Way are, by means of a spectrograph. He found that they *fled* from us at higher speeds when they were farther away: their *escape* increased with the distance (like the spots painted on a balloon when it is inflated at an accelerating rate).

All the sites of the Universe move away from each other, not being able to find the center of this movement. There is nothing *before* or *outside* the Universe - just as there is nothing before or outside of sound matter. Better said, the *before* and the *out* there, do not exist; it is useless to refer to them. One could say in an equivalent way, that the composer, the scientist or a god is *the before* and *the outside*, but that would fall within the scope of creation or of the vision of faith and not in that of cosmology or that of the very essence of space-time musical matter.

On the other hand, the *constant flow* with which Newton's physics identified time had also perished: the Universe, continuing its expansion, *continues to create time and space*.

Interestingly, here, too, are two possible parallels between this macro-universe and the spatio-temporal micro-cosmos of the sound material. Regarding the first, it is worth remembering that looking at the sky in a starry night we are observing both space and time - without knowing, if the star that emitted the light that reaches our eyes still exists. Just as when entering an empty space, which we intuit that has been witness and container of multiple superimposed layers of times and trajectories of memories of life, the quality of the sound there (or quality of the silence, for others) will be discernible by sharpening our ear, intuition and memory - without knowing, neither in this case - whether the source of origin of this spectrum, apparently empty, has a real and living external existence, or are a result of the momentary symbiosis of our inner ear with sound *microrevelations*, in that space and at that precise moment.

Another possible parallelism between these macro- and microuniverses, from this *constant creation of space-time in continuous expansion*, is that which depends on the contained mass - the one that is being measured with the space telescope that is named after the discoverer of the *Universe in expansion* - E. Hubble. Fundamentally it is about determining the amount of *dark matter*, whether the expansion will continue indefinitely or whether, in some tens of thousands of years, it will revert into a *big-crunch* (the *great crunch*) and the Universe will fall back on itself to a point *without any dimension* and infinite temperature and pressure: a last and gigantic *black hole*. On the contrary, the *big bang* - the *big explosion* - would it have been a *white hole*? Do we come from some other universe where physical laws dispense with the categories of time and space, without which our biological way of life is impossible?

Inspired and concentrated in this factor of expansion and continuous creation of space-time that depends on the contained mass, the last scene of *The promised Space* brings to the scene this expansive process - and at the same time that of a gradual accumulation of *mass* - through a movement of polyrhythmic choral masses, with a number of members in continuous growth, which trace paths of divergent direction that branch and fragment gradually, as they design their evolution in the scenic space.

When reaching its highest point of sound density, speed and atomization of the momentary internal paths, this sound-kinetic human polyhedron then begins its retrograde process: reversing, becoming rare, centrifuging and losing acceleration, this time dragging and neutralizing all kinds of heterogeneity - polyrhythmic, timbral and spatial - until reaching a state of maximum compression, concentrated and enclosed in a single point that escapes invisible in space, on a silent scene. At this point, the outside and inside converge, and every form of hierarchy between choral masses and soloists, between them and the audience, between a before and an after, between human reality and scenic-spatial fiction disappears. *** (see régie and spatialisation material with sequential aerial space-time views of the paths).**

Here the *uncertainty principle* governs the spaces to be traveled and their times, to take us perhaps, to that other universe that contains us, of which we know nothing, but which we already hear or intuit and which only needs to be searched.

The frontiers of before and after

As our universe is entropic and rigorously complies with the 2nd law of thermodynamics - it goes from order to disorder and that allows it to exist, its existence is that *transit* as it is ours between the perfect biological order of birth and the absolute disorder of the death - it is so that the *thermal death* will happen billions *before* the *big-crunch*.

On the other hand, we cannot, never, contemplate our origin. It could be assumed that *seeing* in space and time, it would be possible, with devices more powerful and perfected than the Hubble space - telescope, to examine the *big-bang*. Something like making a photograph of our primordial embryo, or, moreover, of the precise moment of conception: Absolutely impossible. There is a border called the *observable Universe*, it is *the horizon* - also of our possibilities: *behind* it, darkness, eternal and unappealable. It is the *limit* of the macrocosm. However, with the successor of Hubble, the *J. Webb telescope* located very far from our earth with special shields that will block the sunlight, the earth and the moon in an area called L2, our senses will be greatly *augmented and prolonged in what is not visible* for the observation of the extreme ends of the universe. Everything indicates that confirmation and discoveries - very important for the macro- and microcosm - are coming in the near future.

Here too we are inspired by these two frontiers of an *still inaccessible before* and *after*, like an open door to the possibilities and mysteries of the open forms, tensions and beauties of the porous structures: the audible and the *apparently non-audible*, the imaginable and the limited by our sensorial human borders - suspiciously evident continuities but not encompassable in its macro-dimension by our reasoning, or conversely, supposedly homogeneous material or sound surfaces and volumes, whose micro-components remain invisible and silent to our capacity for discernment.

The cultivation and development of the incorporation into our vital space of *a form without fixed pre-established form* or of variable forms that depend to a certain extent on its environment (that is, not necessarily framed by the *edges* or *limits* of *beginning and end*, or development more or less adapted to - or forced by - the conventional laws of the work in terms of its *representation*), is a long-term sensitive adventure, which requires a deep attention and consubstantiation with the real and imaginable environment. It requires the abandonment of personal structures that could hinder the fluidity of this continuous incorporation and the movement of the new elements demanded by the dynamics and the current needs of the work in question.

However, the faithful maintenance of the primordial focus of interest, which was guided by the *induced probabilistic intuition*, requires control, so to speak, permanently updated through the healthy exercise of self-criticism. These tools offer in my opinion, a viable methodology of steps to take on the immense board of creation possibilities, between the borders that are *time*, *chance*, *fiction* and *supposed realities*.

That Hellenic expression updated by the current political empiricism, which affirms that *the* only truth is the reality, converted to the marvelous world of musical composition - and by extension to every form of human creation and inquiry - would establish that in reality *The Truth in singular, it does not exist; and in truth, The Reality, either.* Something that the

followers of the *quantum* and the composers of the *no-things* would subscribe to without hesitation.