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"To make music with visionary power": On the Relationship of Music and Mathematics In Vilém Flusser's Work[1]

> "[...] music is the greatest and holiest mystery of all. It is not necessary for it to conceal itself; it is dark in its magnificent, extremely complex simplicity, in mathematical simplicity. Like death and life."
>
> Vilém Flusser, *The Gesture of Listening to Music*

In this essay, I would like to explore an aspect of Flusser's work, which despite its significance has received little attention so far: the relationship between music and mathematics and the complex mediatic dialectics of sound, number, image and word that goes with it. I would like to focus on two related texts, which although written 22 years apart show some remarkable parallels with regard to this issue: *The History of the Devil* (1963) and *Into the Universe of Technical Images* (1985).

Other important aspects that would have to be taken into consideration, are the relationship between hearing and seeing, sound and image, which Flusser assigns in his lectures on communicology in the 1970s (Flusser 1996b) to the two fundamental forms of dialogue in the West: the Jewish and the Greek. A further thematic link could be drawn to the word-field *Stimme,* voice, *Stimmung,* atmosphere*,* and *Stimmigkeit*, coherence, consistency, *es stimmt,* it is right, with reference to Heidegger, and the associated idea of harmonic resonances, which lies at the center of Flusser's *The Gesture of Listening to Music*. Furthermore, a reference could also be made to the philosophical fiction *Hörigkeit* – bondage, enslavement – in the book *Angenommen*, Suppose that (1989), which discusses the relationship of hearing and seeing in relation to their political meaning.[2] Finally, it would remain to be seen how Flusser's vision relates to Friedrich Kittler's (2006 and 2009) unfinished tetralogy of the relationship between music and mathematics. I want to come back to these issues in some future essay.

[1] This text is based on an earlier German version (Guldin 2013a). I would like to thank Annie Goh for having helped me with its translation.

[2] See the contribution of Annie Goh in this issue.

Chamber music

In the chapter ‚Chamber Music' from *Into the Universe of Technical Images* Flusser uses the small group of musical performers and its dialogic mode of operation as a metaphor for a possible future telematic society.[3] Contrary to the big orchestra, chamber music is an intimate spectacle: a small group of chosen players, meeting in a narrow space, each one playing a different instrument. A venture among friends. The decisive perspective, according to Flusser – who is also formulating one of the main tenets of his theory of art here –, is not so much that of an assisting audience but that of the single actively participating musician. As with carnival, the fundamental difference between public and actor has been abolished. „This brings us to a closer examination of chamber music – not the sort one hears in concert halls but the sort experienced by those who meet to make music. I imagine these musicians meeting not to read scores but to improvise from available scores, as was common in the Renaissance. A recording of the music will become the basis for further improvisation by future musicians. This is to suggest chamber music as a model for dialogic communication in general, and for telematic communication in particular." (Flusser 2011: 162)

Flusser's interpretation is based on a theoretical distinction he developed in the 1970s, that between dialogue and discourse (Flusser 1996b). The musical score, which is the result of previous dialogical combinations acts in the musical context as a discourse inspiring new dialogical reconsiderations. These, in turn, are recorded, but thanks to recent technological changes not on paper anymore. This passage from the textual score to the magnetic tape of the recorder is more than a simple technological actualization of a hitherto unchanged process. It suggests a radical rupture on the level of the code that has to be seen as a part of the passage from texts to technical images. In this context, the intervention and mediation of the analogy between mathematics and numbers on the one side, and music and notes, on the other, plays a central role, which I am going to deal with in the second part of my paper. But let me get back to chamber music.

The musicians operate within an authorless, collective universe that is not referring to any privileged original score but to an endless row of possible future dialogs, each one nested in all the others. This opens up a second relevant aspect with regard to a certain view of classical music and a more traditional view of the symphonic orchestra. By playing the music from a composer of the past, one must aim for the highest degree of similarity with the original intention and form. As with the traditional view of translation where original and translation have to be equivalent to each other, this vision aims for a subordination of the single players and the orchestra as a whole

[3] See also the contribution of Paulo Chagas in this issue.

to the will of the composer. Ironically, enough, music, which is a not representational medium, becomes through this an imitation of an earlier work. Instead of innovation and transformation, this more traditional view, aims for fidelity and reproduction. Within the universe of chamber music, however, these conceptions are without importance: „The basis for such making is an original score, a program, a set of rules. But using recordings of recordings of recordings, this core will soon disappear behind the horizon of the musicians who are improvising with continually reprogrammed memories. In chamber music, there is no director, no government. The one who sets the tempo is only temporarily directing things." (Flusser 2011: 162)

Chamber music is a well-ordered, self-regulating cybernetic game. When the director of a symphonic orchestra fails, the musicians generally lay down their instruments or venture into a cacophony of sound, each section and each player wandering off in another direction. Within the smaller universe of chamber music instead of chaos setting in a new structure emerges, a playful combination of chaos and order. „And yet chamber music demands an exceptionally close adherence to rules. It is cybernetic. Chamber music is pure play, by and for the players, for whom listeners are superfluous and intrusive. […] Precisely to play as though it were playing solo, each instrument plays as though it were an accompaniment. To play for himself, each player plays for all the others. Each improvises together with all the others, which is to say, each adheres to precise rules (consensus) to jointly change them in the course of the playing." (Flusser 2011: 162) The creation of temporary consensus is also a feature of dialogue and telematic society. The single musicians constitute a small circle, within which they act both as senders and as receivers of information at the same time. Their collaborative joint playing aims at the elaboration and synthetization of a new information, creating a temporary and thus revocable consensus enabling the single participants to emerge from the musical context. The true meaning of this game is to be found in the process itself and not in the information created therewith. This information, furthermore, has „no tangible substrate, except, of course, for the recording device. But this recording device is nothing like the chamber music (the result of the work) […] it serves as its memory, which is durable and can be randomly replayed." (Flusser 2011: 162-3) The non-representational art of music is the best-adapted medium to articulate the specific vision of an immaterial ephemeral form of art, which Flusser formulated in his works of the 1980s.

Flusser draws a connection between the world of music and the world of technical images. Chamber music precedes the apparatus and telematic society, but as with Jazz, much about it reminds one of post-industrial forms of communication, "above all the camera obscura aspect." (Flusser 2011: 163) Flusser plays with the double meaning of the word camera, the photographic camera on the one hand and the chamber on the other. The camera is a dark cell that is linked to

the chamber in which the musicians meet and play. Both are 'black boxes'. From these dark chambers emerges new information, created according to cybernetic criteria.

As the previous considerations have shown, Flusser's critical vision of chamber music can be interpreted as a dialogical model that is linked in many ways with the world of mathematics, suggesting a subterranean complicity between numbers and sounds. I would now like to deal with this aspect.

Mathematics and music

In *Língua e realidade* Flusser describes music as the eastern border of his *mapa das línguas*. The middle vertical axis, dividing the globe into a western and an eastern half can be seen as a first rough separation between auditive and visual symbols. The eastern part of the graphic as a whole tends towards the world of music, its eastern border, by passing through the territory of spoken language. This transition can be found in all linguistic layers. The alphabet of inflected languages corresponds to a musical notation system. The single letters represent sounds. Contrary to the isolating languages of the east, inflected languages have omitted in the course of their history the development of an independent written language. When the visual elements disappeared from the inflected languages and a phonetic system started to prevail, these languages were unable to create a pictorial system of their own, „um sistema pictórico que fosse diretamente uma língua. […] Não tendo desenvolvido uma língua escrita independente, pende o gráfico, se for aplicado às línguas flexionais, pesadamente para o lado direito." (Flusser 2004: 169) This pronounced closeness of inflected languages to the spoken word can also be detected in the poetic layer whose task is to propose aesthetic innovation and new forms of experience. Flusser suggests a direct correspondence between western culture and inflected languages. This entails that the whole of western art moves towards music. „A poesia das línguas flexionais tende para a música. *A música é o lado estético, a vivência das línguas flexionais*." (Flusser 2004: 169)

In this first conception, the West and the East are opposed to each other: the phoneme is opposed to the written character, and the auditive world of sounds and the musicality of inflected languages to the visual pictorial world of isolating languages. The border between music and mathematics is overcome, but not thanks to mathematics, as in Flusser's later vision of calculating computation from *Into the Universe of Technical Images,* but thanks to the notion of nothingness. Between the nothingness of authentic silence in the north of the language globe and poetry, we can find the layer of *oração,* prayer. The more the musical language approaches the layer of *oração* in an attempt to overcome itself by depleting and emptying out itself and by evoking nothingness, the more poignantly its inner structure becomes visible: the logic and symbolic structure of the

inflected languages. It is as if in close vicinity to nothingness the woven linguistic veil would burn up and vaporize next to a clarifying sun, revealing the sustaining skeleton beneath. „Mas curiosamente, sua qualidade estética se intensifica na mesma medida. Quanto mais lógica a música, quanto mais rigorosa […] tanto mais bela. E agora, vista a partir da música, aparece de repente a qualidade estética da matemática. […] Nestas camadas rarefeitas, onde a língua se dissolve no indizível, desaparecem as distinções: matemática, reza e música confundem-se num único todo […]." In this rarified layers mathematics, prayer and music merge and become one. In the early version of the relationship of mathematics and music metaphors of fluidity and liquidity, of dissolving and merging still prevail. In the version of the 1980s, the idea of a world of wind-swept sand dunes and cloudy clusters made of droplets, dots, grains, particles, bits and pixels takes over. Flusser speaks of the „qualidade musical da matemática" and the „qualidade matemática da música" (Flusser 2004: 171), the musical quality of mathematics and the mathematical quality of music, calling this moment the most important contribution of inflected languages:

In the sixth chapter of *The History of the Devil*, Flusser defines music as the hum of language, a volatile and fleeting fabric without any meaning, a „net made only from threads that crisscross each other […]."[Translation RG] (Flusser 1996a: 147) He introduces, thus, a new important aspect in his definition of music: the absence of any kind of representation. Music finally only refers to itself. As I have already shown, this relationship is another important link between the three codes of images, numbers and sounds in *Into the Universe of Technical Images*. The technical sounding images that have become possible thanks to calculation do not refer anymore to any world out there, but project alternative worlds that can be used as models for new behavior patterns. "This meaningless language […] does not talk, but hums, music is pure reality […]." [Translation RG] (Flusser 1996a: 148) In music, language condenses to the point where single words lose their individuality fraught with meaning and start merging and blending with each other. What we are left with are „pure meaningless sounds." [Translation RG] (Flusser 1996a: 148) In this sense, music can be considered the highest and densest form of poetry. A fabric that does not represent anything anymore but is pure presence.

In *Língua e realidade* Flusser introduces a synchronic and spatial model to describe the relationship of mathematics and music, in the *History of the Devil* he adds a diachronic explanation. He makes use of a model that will also be of central importance in *Into the Universe of Technical Images*: Music and mathematics are considered as two connatural dimensions that drifted apart in the course of western history but have finally come together again in the present merging into each other. A hidden structural analogy can be made out between the seventh and last of the deadly sins, sloth and the sadness of heart, with the stage of technical images.

In a letter to Felix Philipp Ingold written on the 8th February 1983 Flusser re-interprets the seven sins from the perspective of *Towards a Philosophy of Photography* and the history of media-evolution and code revolution described there. Another important element is the notion of negentropy that he developed in his communicology of the late 1970s (Flusser 1996b: 9-15). God is nothingness – and stands indirectly also for the general entropic tendency of the universe –, the devil, on the other hand, represents a negetropic tendency that is superimposed on God. In the terminology of the late 1970s it is an epicycle sitting on top of a cycle (*auf-sitzen*, *auf-gesetzt*), with the two circles moving in opposite directions. In the last stage, the devil finds back to God. "Energy and matter disintegrate into fields, spirit disintegrates into bits." [Translation RG] (Flusser 1982) The initial and final stages of nothingness correspond to each other. Nothingness corresponds to the stage of zero-dimensionality of calculated and computed technical images. Flusser interprets this development in view of a possible convergence of East and West. „In an afterword, I ask the question if the West is not after all the only historical culture […] and if the Far East has not anticipated the contemporary relapse into 'God'." [Translation RG] (Flusser 1982)

"Music, knowledge and mathematics", writes Flusser in the seventh chapter of *The History of the Devil*, are three interconnected aspects of language. Mathematics has always been „pregnant with music […] mathematical insight [Einsicht] […] related to musical inspiration [Eingebung], and the composing of musical notes to the juggling with figures." [Translation RG] (Flusser 1996a: 178) However, we cannot conceive any longer „the word syncretistically […] as music and mathematics. For us the musical symbol, the note, and the mathematical symbol, the number have moved too far away from the living word. […] Mathematics is, therefore, for us moderns generally the opposite of music, it is a loosening up [Auflockerung], refinement [Verfeinerung], thinning [Verdünnung], an objectivation of language." [Translation RG] (Flusser 1996a: 178) Mathematics is an attempt to single out the symbolic side of the word. Thanks to this, the phenomenal side disappears in favor of abstract clarity. „Music moves in the opposite direction." [Translation RG] (Flusser 1996a: 178) It condenses the word and transforms the symbol into a new phenomenon of a higher reality. Because of this music has generally been experienced up to the present as the opposite of mathematics. „In recent times, music and mathematics seem to converge again, logicians and composers of dodecaphonic music seem to join hands." [Translation RG] (Flusser 1996a: 174) Despite these tentative advances, the reunification of mathematics and music is far from being completed. A true fusion of the two areas can only be achieved by the calculatory digital technology of the computer and its ability to compute sounding technical images.

On music

In „Na música", a text that was written in the 1965 belonging to the lecture course *Influencia do Pensamento Existencial Sobre a Atualidade*[4]*,* Flusser deals in great detail with the issues discussed in this paper. He starts out by referring to the close connection between mathematics and music in classical Greek culture, defining music as the art form par excellence, „uma espécie de modelo de todas as artes. […] a música era tida, como a matemática, como o método de alcançar a sabedoria." (Flusser 1965: 2) Music was considered a model for all the arts and a way to achieve wisdom. This tradition was lost in the course of western history, but resurfaced in the philosophy of Arthur Schopenhauer. I will come back to this essential connection at the end of my paper.

As in *Língua e realidade,* Flusser envisages the relationship between music and mathematics as the most important contribution of the inflected languages to world culture. In modernity, which for Flusser begins with the Renaissance, pure music was invented and developed. „O seu impacto sobre a nossa situação tem sido, até agora, menor que o impacto da ciencia, mas para o futuro a música pura me parece ser a mais importante das duas. Consideramos portanto por um instante o que significa *a música pura, a toccata*, para falarmos em termos do Renascimento. É ela um fénomeno ausente nas demais culturas, ausente na nossa história, e, com efeito, a música pura é a maior contribuição do Ocidente moderno ao tesouro da humanidade. Muito maior, creio eu, que a ciencia e tecnologia." [Emphasis mine RG] (Flusser 1965: 2) Even if its impact has so far been less important than that of science and technology, music is in the long run the more important of the two. This pure, mathematically inspired form of music, is also linked to a final fusion of science and art, for Flusser one of the pivotal aspects of the creation of a future telematic society.

The term *toccata* – from the early Baroque – indicates an instrumental piece of music for keyboard or plucked string instruments with a loose musical structure and a strongly improvisational character featuring fast-moving virtuoso passages. *Toccata* comes from the Italian *toccare*, to touch, and refers to a central aspect of Flusser's later media philosophy of the 1980s: the idea that our creative relationship to the world has moved to the fingertips. We interact with the world, analyze and reshape it by pushing buttons and keys on the keyboard of our computers. The associative link is even clearer in German where to touch means not only *berühren* but also *be-tasten*. Our fingertips touch the keys, *die Tasten*, of our keyboard, *die Tastatur*, the same way the musician plays his piano or plucks his string instruments creating a metaphorical correspondence between sound, number, key and fingertip.

[4] This text has been included in the present issue of *Flusser Studies*.

Other essential aspects that were already dealt with in *The History of the Devil* are the non-representative structure of music and its meaning for the inflected languages. Music is the hum of language, a meaningless abstract netlike fabric, which in turn is the expression of the phonetic nature of inflected languages. Contrary to *The History of the Devil*, in *Na música* the non-representational, pure music is not linked to any specific historical moment. However, the Renaissance is at the same time the very moment, in which for Flusser the diasporic migration of the numbers from the alphanumeric code begins. In this way, he conceives two parallel evolutionary lines that will finally converge and merge in *Into the Universe of Technical Images*.

Science, writes Flusser, is an attempt to adjust the *res cogitans*, the intellect, to the *res extensa*, that is, to the doubtful reality that surrounds us. „Essa adequação tende para a matemática, porque a estrutura da coisa pensante é equivalente à aritmética, isto é: a estrutura gramatical da língua. A música pura é a propria articulação dessa estrutura. Na música a coisa pensante não se adegua a algo duvidoso. A música é a expressão de si mesma." (Flusser 1965: 2-3) This adjustment is fundamentally a mathematical enterprise, because the structure of the intellect is equivalent to mathematics, which in turn corresponds to the grammar of the inflected languages. Pure music is the final articulation of these superposed interconnected layers. As such, it is no longer an adaptation to the reality out there but an expression of itself.

Concrete and Abstract

In *Na música*, furthermore, Flusser introduces the notions of concrete and abstract, to which I will come again at the end of this paper, especially with regard to their significance for telematic society. Music abstracts from the reality it originates from: „música pura é, neste sentido, uma arte abstrata. Mas como articulação da coisa pensante é ela a articulação do indubitável […] daquilo que há de mais concreto. A música pura é, neste sentido, uma arte concreta. Os termos 'concreto' e 'abstrato' dependem do ponto de vista […] daquilo do qual *estou abstraindo*, e daquilo *junto com* o qual estou *crescendo*. A música, por ser articulação da própria estrutura da coisa pensante, é a vivencia mais concreta que temos. Nela a nossa própria vóz nos vem da fora. Nela nos reconhecemos. Mas é ao mesmo tempo a vivencia mais abstrata que temos. Nela somos libertados da ilusão da representação, de todo figurativismo. A música simplesmente é, e nada representa." [Emphasis mine RG] (Flusser 1965: 3) In the purity of its abstraction, music is the most concrete thing we have. In fact, it emerges from the grammatical structure of inflected languages and its mathematical expression, that is, the very basis of our perception of reality. Music frees us from the illusions of representation, by giving us back a world that is pure surface, does no longer represent anything and is no longer the effect of anything else, but simply is. The con-

ceptual pair concrete/abstract similarly to the pair dialogue/discourse presupposes a circular dialectical relationship. Abstraction starts out from concreteness but at a certain point becomes concrete again. The first and the second concreteness are related but fundamentally different.

Flusser uses the words 'abstract' and 'concrete' in their etymological sense. Abstraction comes from the Latin *ab-strahere*, to take something away, to strip off, to separate, but also to detach, to free oneself from something. Things become abstract when they are removed from their context. Human beings attained abstraction by moving back from the four-dimensional time-space continuum into which they were plunged, and with which they were organically linked. This was a loss, but also set human beings free. The ladder of abstraction with five different rungs that Flusser developed in *Into the Universe of Technical Images* (Flusser 2011: 6-7) carries the human race further and further away from the earliest stage. Each stage is reached by moving further back, by abstracting one level after the other like single cards taken off a card-deck one after the other.[5]

The etymology of the word 'concrete' also articulates essential moments of Flusser's evolutionary media history. The word comes from the Latin *concretus* and is the past participle pf the verb *concrescere*, which means to *grow together* or *to con-dense* – in German *ver-dichten*. This is actually the word that Flusser uses in his Portuguese text: "Os termos 'concreto' e 'abstrato' dependem do ponto de vista […] daquilo *junto com* o qual estou *crescendo*." Literally: 'The terms 'concrete' and 'abstract' depend on the point of view […] of that with which I am growing'. The new calculated and computed reality of technical images emerging from computer screens is possible thanks to a process of concentration and densification. The German words are *raffen*, to reap, to gather and *ballen*, to clot, to agglomerate, and to form a bale. The single pixels are gathered and clotted together, to create a condensation. The two meanings of the Latin *concretus* could be used to differentiate the two forms of concreteness, the first, before man started moving up the ladder of abstraction and the last, which was reached with the invention of sounding technical images. The first meaning of the word – to grow together – articulates something organical and collective, a process we passively submit to in order to be incorporated into a bigger reality that will determine our being. The second meaning, on the other hand – to con-*dense* –, implies an active moment of projection, through which we create our own reality (see also Guldin 2013c).

Further traces of the conceptual pair concrete/abstract together with an early view of the historical progress in three separate stages towards a new form of concreteness that reappears in a new expanded form in *Into the Universe of Technical Images* can be found in the early essay *Concreto-Abstrato* (Flusser 2002: 151). In Flusser's view, the concrete poets around Augusto and Haroldo

[5] A further version of this process can be found in Flusser's narration of *Human History as Television Drama* that has been included in this issue of *Flusser Studies*.

de Campos were on the brink of abandoning a purely representational form of literature in order to develop a form of writing that would not imitate but create reality. In this context, it is the concrete reality of the proper name (Flusser 2002: 149), a musical form of literature. This connection can also be found in the Portuguese version of *The History of the Devil* where one whole subsection (7.1.2) is dedicated to the relationship of music and concrete poetry (Flusser 2005: 163-165). "Música", writes Flusser there, "è beleza pura. Música è articulação da realidade. […] Ouvindo música, estamos sendo confrontados com a estrutura da realidade. […] A música vence a ilusão, porque representa diretamente a realidade, que é nossa vontade criadora." (Flusser 2005: 164)

In another passage, Flusser evokes Schopenhauer's notion of the immediacy of the will. "A música è a manifestação mais imediata da vontade. Todos os demais discursos são vontade deturpada, vontade *abstraída*, são ilusão [...]. Se fosse possível purificar todos os demais discursos [...] *concretizar* todos os demais discursos, teria sido superada a ilusão, e restabelecida a realidade. Trata-se, com efeito da tentativa de traduzir todos os discursos, todas as linguagens, para a linguagem musical, para *concretizá-los*." [Emphasis mine RG] (Flusser 2005: 165) In this vision, all languages and all forms of discourse are translated into the concreteness of music revealing at last their pure artificiality. One of the examples Flusser discusses is concrete poetry. Concrete poetry is a weapon of the will against the illusion, "procura evitar a *abstração* e manter a *concreticidade*." [Emphasis mine RG] (Flusser 2005: 165) But let me come back to the relationship of music and mathematics.

The convergence of music and mathematics

We are ready to accept the non-representational nature of music, writes Flusser in *Na música*, but we are not ready to admit that all our thinking, and everything that is created by it, does not represent anything but our own models. We are not ready to accept the musicality of our own thinking. Another important aspect of the relationship between music and mathematics, that we have already come across, is its specific meaning for the history of the west. Flusser emphasizes once more the beauty of mathematics and the rigor of music adding, this time, a few examples, probably because the text is a lecture addressed to students. "Nos grandes sistemas matemáticos resplandece a beleza do pensamento, e estes grandes sistemas, como o *maxwelliano* ou o *riemaniano* são aceitos por sua beleza. E nas grandes composições musicais resplandece o rigor do pensamento, e estas grandes composições como a *bachiana* nos arrebatam pela sua estrutura impecável. No fundo, não é possível distinguir-se entre matemática e música, e sentimos,

emocionados, que a confluencia desses dois métodos de análise linguística é a meta da nossa cultura. Em outras palavras: a meta da nossa cultura é a matematição e musicalização da língua." [Emphasis mine RG] (Flusser 1965: 3) The aim of Western culture is, therefore, the mathematization and musicalization of language. Maxwell. Riemann. Bach.

The history of music in the west is characterized by its separation from the other arts and its dissociation from science and technology. The arts tended more and more towards figurativism, guided by notions of realism and representation. The sciences, on the other hand, aimed at complete mastery of nature, but this also resulted in figurativism.[6] "Do ponto de vista da música não passa a tecnología de uma arte figurativa." (Flusser 1965: 3) With regard to Flusser's late oeuvre the notion of figurativism holds another important meaning. Art and science have turned to the material world of objects and thus committed themselves to a false form of concreteness solely linked to the object and to objectivity. In Flusser's sense, however, neither the subject nor the object, but only their two-way relationship are concrete. Dialogical human relationships and the temporary consensus they create are also concrete. Concrete are, finally, the new technical imagination –which Flusser calls *Einbildungskraft*, visionary power, in his German texts of the 1980s and early 1990s to distinguish it from the more traditional term *Imagination* – and the alternative worlds that it projects.

Flusser does not define any precise period for the separation of music from the other arts and its separation from science and technology, but we may assume that he meant the Renaissance and the positivistic worldview of the 19th century. This allows him to locate the epochal moment of transition in the present. Only quite recently, writes Flusser, music has begun to wash around and submerge other cultural activities. In this way, its promises and potentialities can manifest themselves and be carried into effect. "As artes plásticas e a literatura começam, conscientemente, a musicalizar-se […] obras como a de Joyce, podem ser consideradas perfeitamente como composições musicais com outros meios. […] sistemas como o einsteiniano pode[m] ser concebido[s] como composição musical […]. A ciencia começa a despertar para o fato ser ela disciplina puramente linguística, isto é arte abstrata, e por isto mesmo eminentemente concreta." (Flusser 1965: 4) A new sense of life emerges from this situation, a new sense of reality and its radical artificiality but also new possibilities and forms of creativity. This, however, will only be possible when the border that has been created in modernity between art and science will finally be removed. In this historical process, the Renaissance plays an ambivalent role: it stands, on the one hand, for the moment, in which pure music was invented and numbers started liberating themselves from the tyranny of words, but on the other it is the starting point for the problematic separation of art and science Flusser laments in different occasions. "O desevolvimento,

[6] See also the contribution of Marta Castello Branco in this issue.

do qual participamos, e que aponta uma fusão entre matemática e música, e que terá por resultado a superação da ciência pela sua transformação em arte abstrata, iniciou-se, históricamente, pelo Renascimento no qual surgiu a música não representativa." (Flusser 1965: 6) This theoretical position developed by Flusser in the 1960s still lacks an essential element that will be added in the course of the 1980s: its technical implementation, that is, the calculatory technology of the computer and its capacity to compute new alternative worlds.

In a text published in 1986, Flusser recapitulates the historical stages sketched in *Na música* from the point of view of technical images. „Ever since the fifteenth century occidental civilization has suffered from the divorce into two cultures: science and its techniques – the 'true' and the 'good for something' – on the one hand; the arts – beauty – on the other. This is a pernicious distinction. Every scientific proposition and every technical gadget has an aesthetic quality, just as every work of art has an epistemological and political quality. More significantly, there is no basic distinction between scientific and artistic research: both are fictions in the quest of truth (scientific hypotheses being fictions). Electromagnetized images do away with this divorce because they are the result of science and are at the service of the imagination. They are what Leonardo da Vinci used to call 'fantasia essata.' A synthetic image of a fractal equation is both a work of art and a model for knowledge. Thus the new photo not only does away with the traditional classification of the various arts (it is painting, music, literature, dance and theatre all rolled into one), but it also does away with the distinction between the 'two cultures' (it is both art and science). It renders possible a total art Wagner never dreamt of." (Flusser 1986: 331)

As the texts discussed so far have shown, this final synthesis consist of a series of parallel converging processes. Mathematics and music merge, abolishing a separation that has lasted for centuries. East and West reach out to each other. The areas of art and science separated during the Renaissance and the domains of politics, art and science divided in the course of the 19th century join each other again. The different codes and media permeate and impregnate each other. All borders are removed, also those between artist and audience, art and life. Another fusion takes place on the sensory level. In the 1970s, Flusser had already pointed to the double western heritage of hearing and seeing and linked it to the Judeo-Christian and Greek world. This lamentable separation goes hand in hand with the western hierarchization of the senses and the privileging of the visual over the auditive. It is reminiscent of the historical development of the inflected languages, but in reverse manner.

Visible sound and sounding images

The divorce of sound and image can also be found in Schopenhauer's work. In his philosophical system, the musical world of the will is diametrically opposed to the pictorial world of representation – in German *Vorstellung* also a central term in Flusser's philosophy of photography. The world of music possesses absolute immediacy, it does not emerge from the imagination and does not "depend on the receiver's ability to decode it […]." (Flusser 2011: 164) Images, on the other hand, are derivative, can be traced back to imagination and need to be decoded. They form a veil that positions itself in front of the musical universe disguising it (*ver-stellen*). In Schopenhauer's work music stands for concrete unmediated existence and the world of images for abstract illusionary deceit.

Flusser's point of view – even if his terminology is in part inspired by the work of Schopenhauer – is radically different. To overcome the opposition of image and sound he equates composing and computing. „We don't need to wait for electronic music to recognize this quality about music: the universe of music is as calculated and computed as that of technical images." (Flusser 2011: 164) The universe of technical images is a two-dimensional universe of surfaces, but contrary to that of traditional pre-technical images and similarly to the musical universe, it is no longer representational, but „free of any semantic dimension. The technical images are pure art in the same sense that music alone once was. […] Since the beginning of computing, technical images have rushed spontaneously to sound, and from sound spontaneously to images, binding them." (Flusser 2011: 164-5) This tendency towards a merging of the two codes has already dominated pre-technical images and pre-technical music.

The synthesis of image and music does not imply that the visual and the auditive simply coexist next to each other. Flusser envisages a complete reciprocal interpenetration of the two codes, something that is neither image nor sound, and much more than sound and image. Thanks to computer software codes can be broken down into bits, which then can be reassembled in a new way: „the technical image [is] the first instance of music becoming an image and an image becoming music." (Flusser 2011: 165)

An example that aptly sums up Flusser's position, but only for the visual dimension, is the work of the American artist Nancy Burson to whom Flusser dedicated a short essay published in 1987. Flusser starts out with one of his favorite quotations, two verses from the *Rubaijat* of the Persian poet Omar-i-Chajjam: "We shatter it to bits, and then remold it nearer to the heart's desire." (Flusser 1998: 146) "Expressed in less poetic terms", continues Flusser, "we calculate the world in order to compute it." (Flusser 1998: 146) [Translation RG] Flusser uses the English word 'bits' in a double sense: in the general sense of bits and pieces and in the more restricted

sense of binary digit, the basic units of information theory. We shatter the world to bits in order to recreate it according to our own wishes. We project new composite realities. Nancy Burson does the same. She creates chimeras through photography. Her chimeras, however, are not like the traditional ones from Greek mythology: a lion with the head of a goat arising from its back and a tail ending in a snake's head. Her pictures are not assembled like a collage, through simple juxtaposition. The mythical chimera was composed from different heterogeneous elements. If Bellerophon instead of fighting it, so again Flusser, had kicked it up its backside the lion's head would have tumbled on the right and the snake tail on the left. This would not be possible with Burson's chimeras. Her portraits of politicians – combining Hitler, Stalin and Mussolini into a single face –, and her ironical composite female beauties – a cocktail mixed out of Audrey Hepburn, Bette Davis, Grace Kelly, Sophia Loren and Marilyn Monroe – are based on computer programs that work according to a specific algorithm. "These new 'authentic' chimeras", writes Flusser, "are self-contained independent phenomena." (Flusser 1998: 146) [Translation RG] As Flusser points out, this trend can be detected in all synthetic images "even those that present themselves as scientific or political documents rather than art." (Flusser 2011: 166)

Neither the concept of the audio-visual nor the existence of electronic intermixers that translate images into sounds and sounds into images, correspond to the new level of integration that has become possible with the invention of calculated technical images. Even if the rather broad notion of the technical image that has evolved in the course of the years (Guldin 2009) comprises also analog photography and film, Flusser means digital technical images that surface on computer screens. „On the basis not only of its structure, but also of its technology, so-called computer art is moving toward sounding images and visible sound." (Flusser 2011: 166) This translation of images into sound and sound into image is reminiscent of earlier attempts at transforming mathematics into music and music into mathematics. Images, finally, manage to get rid of their representational character and to become pure art the way music always was. Flusser mentions two examples that anticipate this general trend: abstract painting and the scores of contemporary music. „[…] only synthesized images are really conceived musically and made musical with visualizing power […] because everyone will be a composer, will make images. The universe of technical images can be seen as a universe of musical vision. […] Once they have both become electronic, visual and acoustic technologies will no longer be separable." (Flusser 2011: 165)

In Flusser's vision, *synthesis*, *to synthesize* and *synthetic* belong to the same conception linking his early modernist notion of synthesis[7] through translation to his late post-modern concept of a synthetic remodeling of reality. From this late point of view, the successful integration of image

[7] Flusser's very first book, *Das zwanzigste. Jahrhundert*, The 20th Century, written around 1957-8, bears the programmatic subtitle: ~~*Ein*~~ *Versuch einer subjektiven Synthese* – attempting a subjective synthesis.

and sound in the synthetic sounding technical image is a reparation of the early schism within inflected languages and the repression of images in favor of phonemes. This is achieved through the very synthesis of mathematics and music that Flusser was already envisaging in *Língua e realidade* und *The History of the Devil*, the most important contribution of inflected languages to world culture. The result of this general synthesis is a non-representational, immaterial, ephemeral but concrete world made possible through interpersonal dialogue and technical implementation: A world that is continuously and playfully reinvented situating itself beyond Schopenhauer's division.

Flusser concludes his description with a reference to the dream-topos from early German Romanticism, however, with a rational twist. „It is a dream world, then, that does not lie below waking consciousness but above it, conscious and consciously constructed, a hyperconscious dream world. It will therefore be pointless to try to interpret dreams: they will mean nothing beyond themselves, and they will be tangible – a world of pure art, of play for its own sake. *Ludus imagines* (play of the image) as *ludus tonalis* (play of sound) and the merging consciousness of the power to imagine as that of *homo ludens* (man the playful)."(Flusser 2011: 166)

Conclusion

The reconstruction of the relationship of mathematics and music attempted in this essay reveals once more the astounding subterranean coherence of Vilém Flusser's thought and work, and the way early thematic issues are taken up again and again to be systematically enriched through constant addition of new perspectives. Flusser defined his writing practice based on subsequent multiple translations and retranslation as the creation of plurilingual palimpsests in which all previous linguistic layers were present in the final text, if only between the lines. This model can also be used to explain the functioning of his oeuvre. Nothing gets lost. Some time or other the smallest detail is sucked back into the creative maelstrom and hurled towards the center of the work. In the context of mathematics and music it is particularly interesting that the fundamental weakness of inflected languages, the absence of the visual element, is overcome through the emancipation of numbers form the alphanumeric code and its collaboration with music.

Last year I was invited, together with Dirk Michael Hennrich, to hold a speech on Vilém Flusser and *Flusser Studies* at the first international meeting of *Xcoax* (http://2013.xcoax.org/), a conference dedicated to computation, communication, aesthetics and X, which was held in Bergamo (Italy) from the 27th to the 28th June. My final Flusser quote, which also appears in this essay, was referring to the idea of *Gesamtkunstwerk* and the work of Richard Wagner. In the discussion that followed my speech, one participant drew my attention to the problematic political di-

mension of Wagner's project of a total artistic synthesis and some of its more frightening totalitarian implications. As Tzvetan Todorov (2009) pointed out in an essay published in the journal *Lettre International* parts of the European artistic and intellectual avant-garde always had connections to doubtful political projects of their time. Flusser kept emphasizing the deep ambivalence of media and their utopian but also dystopian possibilities. His unilaterally utopian reading of the endless technical possibilities of the computer that can be found in some of his very last texts, however, lacks in my view the critical verve that characterized his writings of the 1970s and early 1980s (see Guldin 2014). In these enthusiastic musings, the profound ambivalence of all media seems to evaporate and disappear behind the brave new world of numbers emerging at the horizon. This is probably the theoretical prize to be paid for a conception that focuses on a general convergence of all levels in a final synthesis.

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