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Research

Counterpoint in the Visual Arts. A Perspective Based on my Graphical and Sculptural Work

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Abstract. Counterpoint is a concept which has its roots in music, where it refers, loosely speaking, to the simultaneous presence of musical lines which complement one another, at times converging and at other moments evolving into a relationship of contrast. In this paper I use the notion of counterpoint in a visual context. I conjecture that such an extended use is meaningful, and explain this for graphical work as well as for sculptures. I take the freedom to illustrate this with some of my own artwork.

Introduction

Counterpoint is a concept that originated in music. The transfer of this concept to the context of visual art broadens its meaning. If the meaning of 'counterpoint' is stretched too far, one risks to make the concept almost trivial. But there are forms of visual art for which a meaning of sufficient specificity can be maintained, and for which the analogy with the musical context is reasonably clear. I will illustrate this for graphical art as well as for sculptures, and will take the freedom to take my own artwork as a basis for my explanation.

The graphical works which I create have a relation with string theory. This relation is stronger than a weak metaphor, since different works correspond to different higher dimensional vibrations of a picture. When the same picture is used as a starting point, the works belong together and the visual representations have relations of both similarity and contrast, and may express complementary meanings of a deeper underlying theme. Further, my sculptures are often created in pairs or groups, and a play of convergence and divergence between individual works can enter the process of creation. The relation between interior and exterior in my sculptural work creates additional aspects of counterpoint.

Graphical work and counterpoint

In this section I will explain how I perceive counterpoint movements in my graphical art. I will do this in three steps. First, I will explain why different levels of meaning are present in a single work. I will refer to higher dimensions and will sketch the philosophical and historical context of my method. In the second subsection I will be somewhat more specific on the technique that I have elaborated. These considerations will allow me to come to the subject of counterpoint in the third subsection, which is the section with the illustrations.

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Levels of meaning in a single work

My graphical work takes images of the environment as a starting point. I transform these images by defining additional dimensions, which means that I (a) de-contextualize the images and (b) at the same time add new context.

(a) My transformations take a building or person out of the familiar context. This separation from context occurs because the transformations are based on particular physical and mathematical methods. Recent physics teaches us that higher dimensions and non-Euclidean geometry are indispensible for describing both the smallest and the largest scales of reality. These concepts play a central role in the computer simulations that I use to transform objects that we perceive on our scale. Our cognitive capacities have evolved in three dimensions. I have often observed that transformations that pass through higher dimensions result in a visual language suitable for expressing poetry, but such that our daily concepts are not apt to nail down the specific nature of this poetry. This disconnection makes my technique suited to working around particular deep themes connected with the human condition (I comment on this below).

(b) While these transformations take objects out of their familiar frameworks, the transformation also adds visual elements and new context to an image. More specifically, in each work, my goal is to achieve one of the following three aims:

1. The image of an object of high particularity, such as a building, can be transformed into an image that displays a universal symbolism. There are many views on what good art is. I often find myself attracted by artwork that for some reason tends to have a universal appeal. In some of my works, I express a shift toward universality by constructing transformations that yield motifs referencing universal core themes of myths or religions. These themes allude to conceptions of reality as a whole. As noted above, my transformations involve concepts that are central to physical descriptions of, among other things, the largest scale of reality. In my artwork, these recently developed concepts resonate with old concepts that are associated with this largest scale.

2. The visual elements involved in a transformation may give a building additional connotations, which are linked with the place where it is found, or with the meaning the place has for the artist.

3. In several works, I specify the transformation in such a way that the result expresses a theme or property of the worldview associated with the transformation. These transformations are about additional dimensions and non-Euclidean geometry. The context of such concepts is recent physics and they are associated with a non-classical worldview. These include, for instance, perspectives on time, which I express in the visual language enabled by the transformations.

The processes of de-contextualization and re-contextualization imply that an artwork has different layers of meaning. There is the starting picture with its 'ordinary' meaning, for instance a picture of a clock. This is transformed into a visual composition that has a direct visual interpretation, for instance an anthropomorphic interpretation if the deformation is such that a face or a person can be recognized. There is also an interpretation at a deeper level, when the face or person formed by the clock has an expression corresponding to a deep property of time, or, more generally, when the composition is reflecting such a property.

Subjecting the same picture to different higher-dimensional vibrations leads to different artworks. If these works are put together, counterpoint appears on the level of visual composition as well as on the level of deeper meaning: time has several connotations, both from the perspective of daily life and from the perspective of recent physics, which allows for counterpoint relations on a deeper level. An example will clarify what I mean. Bur before turning to it, I will elaborate on the method which I use and on its philosophical context.

Higher dimensions and basics of the method

Let me describe in general terms how I transform a flat photograph into a higher-dimensional surface. To begin, I define an origin in the plane of the photograph. Suppose that, in each point of the plane, a piece of rope is stretched that connects this point with the origin. On the plane I place a sphere that touches the plane at the origin. Now suppose that we wrap around the sphere the rope connecting a point with the origin, keeping fixed the endpoint of the rope that is located at the origin. The other endpoint of the rope then defines a point in three dimensions. Mathematically, we can also put a four-dimensional hypersphere on the plane of the photograph. By wrapping the rope around the hypersphere, we map each point in the plane of the photograph onto a four-dimensional point. This procedure can be defined for hyperspheres, but also for more complicated geometrical forms of arbitrary dimensionality.

By the process that I described graphically in terms of wrapping a rope, I map each point P of the plane of the photograph onto a higher-dimensional point, so that the plane is transformed into a higher-dimensional surface. Then, I project this point back onto the plane of the photograph, which leads to the identification of a point Q in that plane.[1] I transfer the colour values of the latter point Q to the former point P. Given that with an appropriate choice of geometry, the higher-dimensional surface is folded several times above the plane of the photograph, this procedure results in an image that contains several reduced copies of the original picture.

Colors in my artwork have usually shifted relative to the original photograph. I use two techniques to accomplish this transformation. First, I translate the curvature of the geometry into a color shift. The most straightforward way is the application of a redshift, in agreement with the concept in general relativity that curvature implies this phenomenon. There is also another technique that I use to determine the colors in my works. By placing point-sources in space from which solarization waves originate, I emphasize particular places in the image, or I determine their role in the composition (I am using the concept 'solarization' according to its meaning in photography, where it refers to the phenomenon in which a color moves over into its complementary color). I obtain still more freedom for working with color by using colored lightsources and by combining different layers into the final image. In practice, both the determination of an appropriate geometry and the determination of appropriate colorization are the most time-intensive aspects of my technique.

There is a reason why I mention some more technical concepts in this section. The concepts that are combined into my method originate in fundamental mathematical and physical models. Thus, there may be a connotation of 'heaviness' in two respects: it is heavy in the sense of being technically difficult, but it is also heavy in the sense that reflecting on deeper reality carries an existential load; an attitude of brooding comes close sometimes. Precisely in order to balance this 'heavy' aspect, in several works I use a visual language that is deliberately fairy-like: deeper reflection then resonates in a light visual language with a touch of humor. The artworks illustrate that deeper reality, or thinking about it, must not necessarily lead to some kind of somberness. Instead, from it sprouts a poetic language of forms confirming a pleasant spirit. It is the ambition of my art to appeal aesthetically to people who are not familiar with the method with which the art is created. But those who are more or less familiar with it will recognize an additional layeredness, even in works that were created in an intentionally fairy-like style.

Higher dimensions in art

Around the end of the nineteenth century, the idea of higher dimensions began to affect art and culture, ranging from literature to theology. In 1884, Edwin Abbott published his satirical novel *Flatland: A Romance of Many Dimensions*, which is still being reprinted.[2] His main character is a square who lives in a two-dimensional world. In this world, the social status of a person is determined by his number of sides. Triangles are considered less intelligent, and priests are polygons with several sides. Women in Flatland are lines and have a single side. One day, the main character is lifted out of the plane by a three-dimensional sphere. He acquires the notion that there are more than two dimensions. When he talks about this idea in Flatland, his notions are considered subversive, and he is put in prison.

Abbott not only aimed at social satire, but also criticized the educational system, which suppressed creativity instead of encouraging it (being a schoolmaster himself, he was in a good position to make this diagnosis). In the art world, which took a position independent of formal schooling at many decisive moments, the idea of higher dimensions soon firmly took root.[3] For instance, in his Paris time, Picasso became familiar with a book on higher-dimensional geometry by the mathematician Esprit Jouffret [1903]. The book has several schemas visualizing projections of hypercubes, which can be recognized in Picasso's 1910 paintings in which he initiated cubism (see [Robbin 2006]). Also several of his fellow cubists created paintings visualizing how the world would look from a four-dimensional perspective. Higher dimensions also influenced futurism and expressionism. Whereas cubism considered an additional spatial dimension, futurism tried to represent the idea of a four-dimensional space-time, which implies that different temporal perspectives are integrated into a single painting. Expressionists often worked with a more symbolic representation of higher dimensions. One example is Dali's *Crucifixion (Corpus Hypercubus)*, in which Christ hangs on a three-dimensional unfolding of a four-dimensional hypercube.

At the current moment, about a century after the cubist movement originated, physical theories have become more sophisticated, but higher dimensions have remained a core theme in physics. String theory (and its successor, M-theory) evolved into an eleven-dimensional theory, covering ten spatial dimensions and one time dimension. In addition to the three spatial dimensions of our ordinary perception, there are six spatial dimensions that are strongly curved in all versions of the theory. The tenth spatial dimension has different properties in different variations of the theory.[4] In one of these, it is extended infinitely and offers room for an infinity of parallel universes.

With respect to the application of higher dimensions in art, the current moment differs in several ways from the first half of the twentieth century. Because recent theories deal with domains in which much higher energies are considered, the curvatures that are presently contemplated are stronger and more complicated. Correspondingly, I use geometries that sometimes result in fractal images. But higher dimensions also emerged in another domains, such as crystallography. As was found in the 1980s, quasicrystals can be considered as projections of parts of high-dimensional grids of hypercubes. There are artists who based graphical works or paintings on this science [Robbin 2006]. As I explain below, I apply these concepts in my sculptures. Another change with art from the first half of the twentieth century follows from the fact that, at this moment, we have computers. We can simulate higher-dimensional models and in this way reflect on the implications of higher dimensions with exactitude, whereas the artists of the cubist movements largely depended on intuition only.

Philosophical comments

Our physical reality includes sixty powers of ten. What does that mean? Take the smallest size that appears in physics, which is the size of a string in string theory. Multiply this length by ten. This length is again multiplied by ten, and so on, until sixty multiplications have been performed. At that point, we have reached the scale of the largest cosmic structures that we have observed. As humans, we find ourselves at the middle point of these orders of magnitude.[5] At our order of magnitude, and for energies that confront us in daily circumstances, we can describe reality with models that work with a three-dimensional Euclidean space and an independent time dimension.

This is not the case for smaller or larger scales, or for energies that are significantly larger than those we encounter in our typical daily environment. The first physical theory to be formulated in four dimensions was the theory of restricted relativity, in which space and time became a four-dimensional whole. Non-Euclidean dimensions were incorporated into the development of general relativity. In the course of the past century, many trials have targeted the addition of more dimensions, with the aim of obtaining a unified theory for the forces of nature [Van Loocke 2008: ch. 6; Halpern 2004]. Only string theory has come close to achieving this ambition in a mathematically coherent manner.

String theory is also being applied in cosmology, as so-called string cosmology. Among cosmologists, however, the inflation model of the cosmos is most popular at that scale. In the course of the 1980s this model led to a reformulation of classical big-bang cosmology. Because this reformulation is a profound one in different respects, several authors have written in terms of a 'revolution' in cosmology [Van Loocke 2008: ch. 7; Guth 1997]. The inflation model integrates general relativity with some central concepts of particle physics (a central concept being the so-called inflation field, formulated by analogy with the Higgs field in particle physics). This model implies that our universe is immensely larger than our visible universe. In addition, our universe is one among many 'islands universes' in the inflation vacuum. For an observer who stands inside an island universe, such a universe is infinitely large and has a unique moment of origination, the moment of the big bang. For an observer standing outside the island universe, the big bang lasts infinitely long and takes place at the boundary of an island universe of finite size. Such facts are consequences of the way in which inflation cosmology integrates general relativity.

At the very beginning of our island universe, the largest and the smallest scales coincided, simply because the largest level was as small as the smallest level. A fraction of a second after the beginning, however, the inflationary phase began. During this phase, quantum fluctuations were magnified up to macroscopic orders of magnitude. This resulted in inhomogeneities in the distribution of matter and energy, leading to the structures we presently see in the universe, like galaxies and galaxy clusters. Because of the role of quantum fluctuations in the origination of cosmic structures, a common refrain is the proposition that the same uncertainty principle that describes the behavior of the electron was responsible for the formation of the galaxies. Without galaxies or stars, there would, of course, be no people. Recent cosmology thus emphasizes the very early stage of the universe and the quantum fluctuations present at that stage as significant for everything that would follow. This very early stage can only be described with higher-dimensional, non-Euclidean geometry. Our existence became possible because cosmic inflation magnified the properties of this stage.

Above, I used the term 'de-contextualization'. The transformations which I construct take an object out of its familiar, three-dimensional Euclidean context – the context that is typical and familiar for our order of magnitude. On the basis of the above observations, this de-contextualization is open to a broader interpretation: it refers not to the order of magnitude, but also to the moment in cosmic history. Higher dimensions are a reference to the earliest stage of everything that exists.

Scientific experiments or technological realizations aside, the question is whether or not we, at this moment of cosmic history, are locked into our present scale. For me, this is an open question. I refer to something that everyone experiences, namely consciousness. Consciousness at present is not explained. I am aware that for some people, this statement is emotionally loaded but evolutionary theory cannot explain consciousness either.[6] Since the mid-1980s, it has become common to draw a distinction between 'hard' and 'easy' problems of consciousness. The 'easy' problems concern the question of which neural structures correlate with consciousness as well as questions concerning their function. The 'hard' problem concerns the question why this correlation even exists. As far as consciousness is concerned, current science can identify correlations, but that is profoundly different from establishing underlying causation.

Some scientists propose that reference to the smallest level of reality is necessary before progress can be made on the hard problem of consciousness.[7] Such an achievement would yield a captivating picture. If that were the case, then matter, at moments at which consciousness is correlating with it, would be described using models encompassing concepts that are also central to the theories describing the origins of our universe. Many religions and old myths propose such a relationship between human consciousness and the origination of the universe. It is impossible to predict whether or not this scientific integration I describe here will actually transpire: perhaps yes, perhaps, no.

But it is normal practice for artists to find inspiration in deep, open questions. As I noted above, I like to work with the shifts from particularity to universality. The core themes of myths are a gratifying beginning to the realization of this movement. Identifying the themes I incorporate into a particular work is not always an easy task. One reason is simply the fact that knowledge of these themes is not widespread or that a theme is communicated from a single perspective only. Take, for instance, the theme of the Fall. At first sight, this choice seems to be only an archaic theme from the Old Testament, hardly an inspiration for contemporary art. Only if we can look beyond the Judeo-Christean-Islamic complex can we grasp the universality behind this theme. In the Old Testament, God exiles people from Paradise. In African myths, we often hear the opposite: The people repel the gods by breaking the harmony of the world [Van Loocke 2008: ch. 2; Sprout 1991]. The deeper common theme is that a particular type of serenity, acceptance, or humility is valued more highly than an egocentric orientation or conceit that people use to try to escape their human condition. This underlying theme is more abstract than the concrete, visual language of the myths. In different works, I have at times intertwined such themes, both abstract and more concrete.

Space-time, evanescence of being, and non-verbal poetry

The higher-dimensional geometry I apply is non-Euclidean and therefore curved. As a result, an object (or parts thereof) can appear several times. For clarification, I refer to a gravitational lens. Consider a star located behind a galaxy. The gravitation of the galaxy is equivalent to a curvature of space-time, which has a lens effect on the light sent out by the star. Therefore, it is possible that we see different images of a single star. By analogy, one can observe that the original image often reappears several times in my works.

With an appropriate choice of geometry, it is possible to create an image that consists of several part-images, or that seems to scatter into fragments, in each of which the whole can be recognized. In this way, I work with a complexity that, although aesthetic, has a certain degree of capriciousness. But even an image that seems to be fragmenting retains its poetry. Because of the relationship between fragmentation and evanescence, I regularly use this technique of fragmentation to express the poetry of evanescence.

The transitoriness of being is usually associated with agony. Life has moments that make it almost impossible to see the poetry of evanescence. In different works, I try to reflect a visual glimpse of that poetry. But I have another reason I work with this theme in my art. Einstein proposed that the agony associated with the fragility of being was relative from a four-dimensional perspective anyway. The real arena of physical processes is four-dimensional space-time as a whole.[8] A moment of consciousness correlates with a small area in space-time. This restriction of consciousness burdens us with the illusion of evanescence. To Einstein, this insight was relevant to his sense of life, and he tried to comfort survivors of deceased friends with this insight.

Whether Einstein was on the right track with this attitude is a matter of discussion.[9] There are many other ways to cope with the fragility of being. For instance, recent insights on personal identity are relevant.[10] People are discontinuous processes to a significantly higher extent than introspection suggests. If we do not have a truly essentialistic self, there is no such self that can disappear or evanesce. Still, I share with Einstein the view that insights on the fundamental structure of the universe do have implications for our sense of life.

I return to another point that I made in the first section. I use the higher-dimensional perspective to add meaning. Nevertheless, the visual poetry of the resulting artwork may be explicable only in part with verbal concepts. Our aesthetic, emotional, and cognitive intuition have evolved in three dimensions. In my works, one recognizes the presence of a visual poetry. But because our usual concepts are fitted for a three-dimensional universe, verbal descriptions of appreciation of works that refer to higher dimensions are subject to restriction. The clear presence of poetry, without words available to articulate it, is one of the facts we mean when we use the word ‘sublime’ in an artistic context. Higher dimensions therefore offer a suitable context for working with the sublime.

Graphical work and counterpoint

After these remarks we are ready to consider an illustration. Consider the photograph in fig. 1. It shows the clock on the cathedral of Ypres (Ypres is a city in Belgium famous for its commemoration of the first world war). We let the image vibrate, and do not confine ourselves to the third dimension but we let the deformation extend to higher dimensions. We proceed with the projection to the plane of the photograph in accordance with the explanation given higher. This we do three times. After appropriate colorization, the works shown in figs. 2a-c result.

Fig. 1. Picture of the clock on the cathedral of Ypres

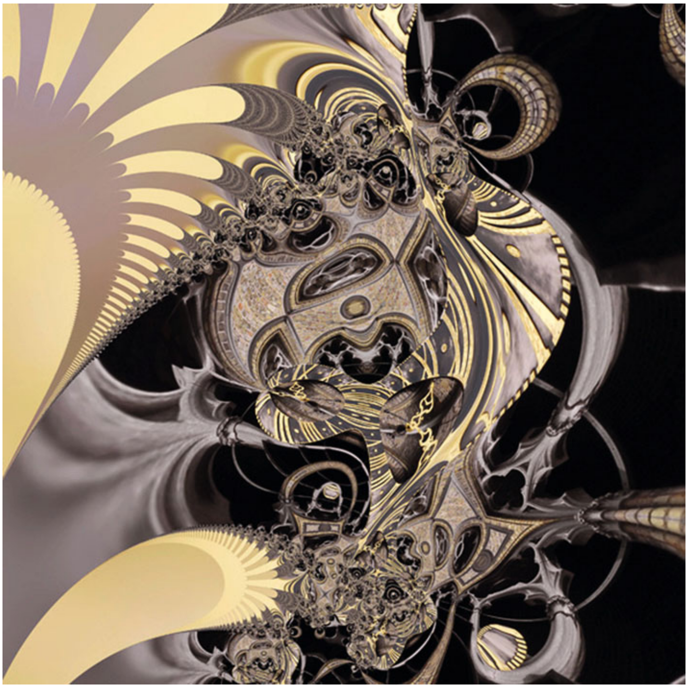

Fig. 2a. Clock cathedral of Ypres, 2010 #5

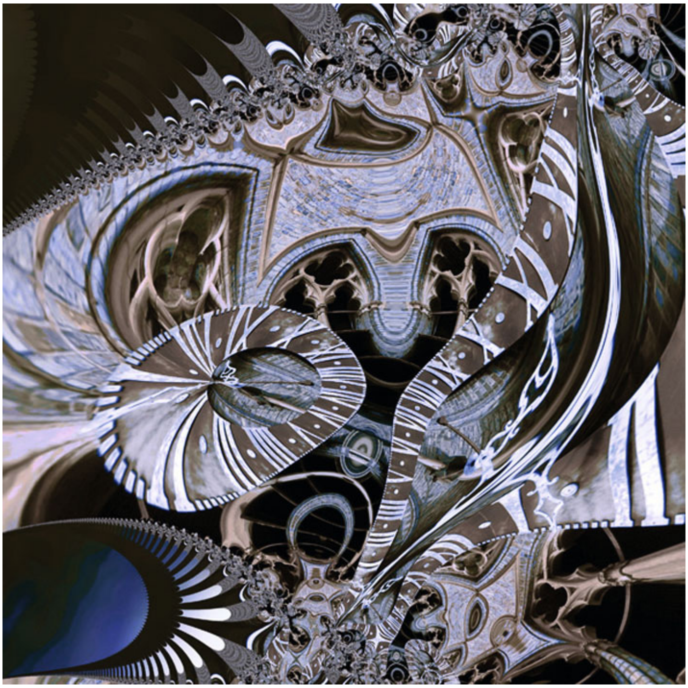

Fig. 2b. Clock cathedral of Ypres, 2010 #6

Fig. 2c. Clock cathedral of Ypres 2010 #3

As is exemplified in these illustrations, in most of my works one recognizes motifs with an easy interpretation, such as eyes and mouth, heads and bodies, mythical birds, and so on. This is achieved by proper construction of the higher dimensional geometric model. I choose it in a way so that the motifs combine into a composition that accords with my inspiration. Different compositions express different connotations of time. Along with easily interpretable motifs, one recognizes themes surrounding the deep problems of time, which strengthen counterpoint relations between different works, since different deeper themes may be articulated in different works.

Sculptures and counterpoint

Kepler and the golden section

Higher dimensions play a central role in my sculptural work as well. There are two historical lines of mathematical work which can be seen as precursors to the method I am using. The first one is Kepler's geometry. Kepler was one of the brightest mathematicians of his time. One of his points of interest was the mathematics of the golden section, or as he called it, 'division into extreme and mean ratio'. In the field of algebra he discovered how the number Φ=1.618 appears in the Fibonacci sequence. He also discovered polyhedra in which is a defining number, such as the triacontahedron. It has thirty identical faces, each of which is the golden rhombus (in a golden rhombus the ratio of the long diagonal to the short one is equal to Φ). It is a structure which reappears in recent mathematics from a new viewpoint: the triacontahedron can be obtained as a combination of the basic cells of quasicrystals. The latter are described at this moment with help of projections from higher dimensional structures onto three-dimensional space. Partial triacontahedra can be seen in several of my sculptures.

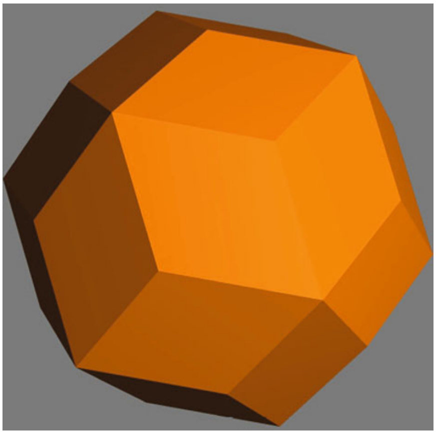

Fig. 3. Kepler's triacontahedron

Because the golden section played such a remarkable role in his mathematical reflections, Kepler stated: 'Geometry has two great treasures. One is the theorem of Pythagoras; the other the division of a line into extreme and mean ratio. The first we may compare to a measure of gold, the second we may name a precious jewel'. From our perspective this reads like an exaggerated statement. But Kepler's worldview was religious-Platonic, complemented with thoughts we would associate with magic or overly literalistically conceived mythology.

Kepler was not only a mathematician and an astronomer, he also was an astrologist, devising his own astrological technique on the basis of planet configurations. During the Renaissance, several philosophers valued astrology more highly than astronomy. Kepler shifted this order. Since the late Middle Ages the idea that God's thoughts are rational had gained support. Inspired by this, Kepler was convinced that these thoughts could be reconstructed with geometry and numbers. Astronomy was a better context for such an endeavor than astrology. But in spite of this shift, part of his thought remained rooted in older traditions. For instance, it can be conjectured that he came to the concept of elliptical planetary motion by taking inspiration from the egg form, which in Orphic mythology defines the initial form of the universe. The historical context of sculptures in which the golden rhombus plays a central role is therefore an appropriate context to link recent scientific and older mythical themes.

As I mentioned, Kepler was one of the brightest mathematicians of his days. But there is a domain in which he had been surpassed by Arab mathematicians and architects of the Middle Ages. It is a domain in which the golden section also plays a role, and that is properly understood only since the 1980s. In his work *Harmonices mundi*, Kepler considers tilings of the plane, that is, he considers various sets of polygons which can pieced together to cover the plane without gaps or overlaps. In Arab mosque art, this type of problem was considered earlier, since Islamic art excluded images of humans or the Prophet, and the Arabs often made recourse to geometrical motifs. Compositions of motifs were used to cover large walls or portals. The question therefore arose of how to tile the plane in a way that is of sufficient beauty and sophistication to do justice to the dignity of a religious building, while at the same time remaining practically feasible. It was recently discovered that in certain Arab patterns, tilings can be identified which were constructed by Roger Penrose in the 1970s (see [Lu and Steinhardt 2007], or, for more illustrations, [Prange 2009]). The Arabs appear to have found tilings with a special property: they are non-periodic. In the next section I explain why this is remarkable, and how this is related with my sculptural work.

The golden section, tilings and projections from higher dimensions

In the 1970s, Roger Penrose was searching for non-periodic tilings of the plane. In such a tiling, the whole pattern cannot be obtained by translation of subpatterns. The reason for his search had to do with a fundamental problem in mathematics: if such a tiling exists, then a particular type of mathematical problem could be proven to be unsolvable in principle. Mathematics has problems for which a solution would mean that all of mathematics would be inconsistent. This would entail, for instance, that 1 equals 2. Therefore, it is posited that such problems are unsolvable in principle. Around 1973 Penrose had indeed found different non-periodic tilings, one of which is shown in figs. 4a-b.

Consider the two rhombi in fig. 4a. The acute angles of the rhombi measure 36° and 72°, respectively; these are the angles which appear in the golden triangle. These rhombi tile the plane non-periodically as shown in fig. 4b. It can be observed that there are different points at which one can recognize motifs with partial pentagonal symmetry. Because of the prominence of the golden section in the regular pentagon, this adds to the prominence of the golden section in the planar quasicrystal tiling of fig. 4b. There is another fact that emphasizes the relation of this structure with the golden section, which is related to a remarkable insight achieved by the Dutch mathematician Nicolaas De Bruyn in 1981.

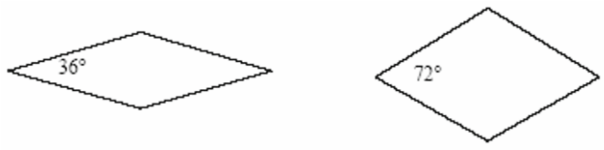

Fig. 4a. The two rhombi which are combined in fig. 4b

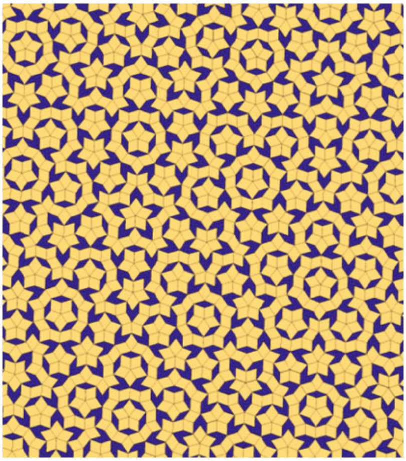

Fig. 4b. Non-periodic tiling of the plane

An ordinary crystal has translation symmetry: its molecular structure has sub-patterns which, after translation, reappear in the entire structure. A quasicrystal is also composed of a limited number of types of cells, but their combination is non-periodic. Because of applications in material science and in design of electronic components, quasicrystals are widely studied. Quasicrystals have been fabricated in the laboratory, and it has recently been discovered that they occur in nature as well. De Bruyn's insight was that two-dimensional quasicrystals (tilings of the plane like in fig. 4b) are projections of part of a five-dimensional grid of hypercubes. Three-dimensional quasicrystals, which play an important role in my sculptural work, result as projections of part of a grid of six-dimensional hypercubes onto three-dimensional space.

At first sight this may seem surprising, since a grid of cubes, whatever their dimensionality, is perfectly periodic. Therefore it is remarkable that a projection of such a grid results in non-periodic structures. The point which explains this fact is that only part of the grid is projected. This is easy to explain when we consider the projection of a two-dimensional lattice on a line (which is a one-dimensional structure). Fig. 5 shows a grid of squares, a yellow and a green line. The yellow line is the line onto which part of the grid is projected. The projection is confined to points on the grid located between the green line and the yellow line (these points are marked by red circles in fig. 5).

The angle between the horizontal lines of the grid and the green and yellow line is defined such that its tangent equals $1/\Phi$. The projection of the points marked with red circles leads to a division of the yellow line into line segments of two lengths, denoted L and S, respectively (L standing for long, S for short). The ratio of the lengths of these segments is equal to Φ. The pattern LSLLSL… that results is non-periodic, and can be recoded in such a way that the numbers of the Fibonacci series appear. By a similar procedure, two-dimensional and three-dimensional quasicrystals are obtained as projections of grids of five-dimensional and six-dimensional hypercubes, respectively.[11]

$$\tan(\theta) = 1/\Phi \quad \frac{|L|}{|K|} = \varphi$$

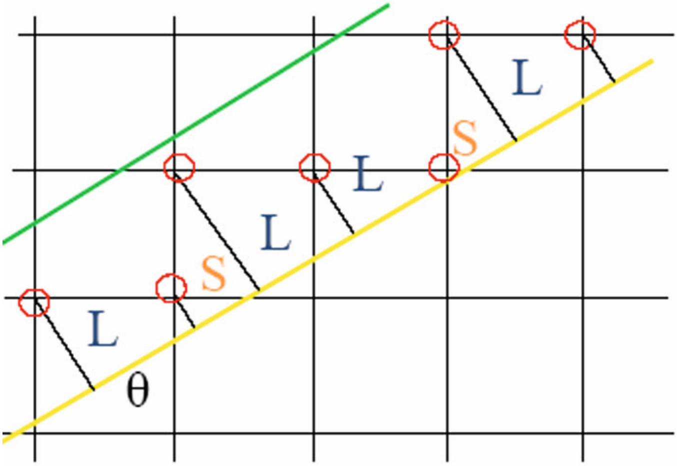

Fig. 5. Projection of part of a two-dimensional grid leads to a non-periodic one-dimensional structure on the yellow line

In two dimensions, quasicrystals can be build by assembling the two rhombi in fig. 4a. In three dimensions, we obtain quasicrystals by combining the two golden rhombohedra (fig. 6). The golden rhombohedra have six faces, each of which is the golden rhombus. With these golden rhombohedra, different familiar polyhedra can be composed. Twenty rhombohedra (ten of each type), for instance, if correctly assembled, result in Kepler's triacontahedron.

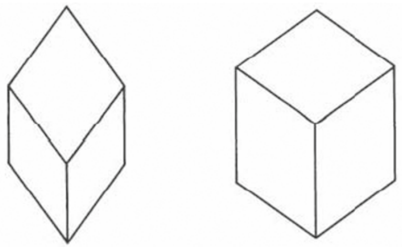

Fig. 6. The golden rhombohedra

Initially, I explored this world of forms with help of software I had written for this purpose (there are many open questions on the combinatorics of the golden rhombohedra; mathematics constrains the combinatorics of the basic cells less stringently than in the two-dimensional case). Fig. 7 shows a simple example in which two partial triacontahedra can be recognized at the top. This software-based approach is not always practical, since a full sculpture (meaning a sculpture with an interior that is completely filled with golden rhombohedra) easily contains many more rhombohedra than there are, for instance, in a triacontahedron. For me, the best way is to work on the basis of intuition. I make a large set of golden rhombi and combine them into a sculpture that fits my inspiration. Because by far not all combinations of rhombi result in an extended surface without holes, this takes much practice and experience-based spatial insight; that is a precondition for this kind of art. In some instances working on the basis of intuition leads me beyond the original context of quasicrystals. For some of my sculptures I verified that it is impossible to fill them with quasicrystals, even though all angles between the golden rectangles involved are familiar from quasicrystals. Other works can be filled completely with the golden rhombohedra.

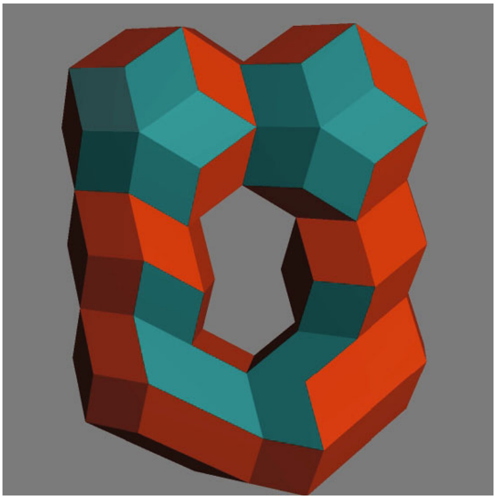

Fig. 7. Form resulting from combination of the golden rhombohedra

Sculptures tiled with mirrors

I make my sculptures open; therefore they have an exterior and an interior. I tile the interior completely with mirrors of a golden rhombus shape. Sculptures with mirrors have different antecedents in contemporary art. For instance, Robert Smithson created sculptures in which he combined different mirrors, and in which a limited number of mirror-reflection iterations are visible.[12] In comparison to such installations and constructions, my work has a more intricate complexity of light reflection. In this sense it is related with video-feedback art, in which loops are created by a videocamera which is directed at a screen. The image registrated by the camera is transmitted to the screen, captured by the camera, sent to the screen, and so on. As a result, the screen displays fractal patterns. A variation of this type of loop appears in the interior of my sculptures, but without the intervention of a camera and electronics. An incoming ray of light is reflected several times on different mirrors before reaching the eye of an observer. Since different rays reflect on different series of mirrors, an image with fractal depth results.

Because the mirrors have the shape of the golden rhombus, they create images which at times have a cubistic feel. The image changes every time the observer changes position. The environment, as well as the observer, are drawn into the reflection process and become part of the artwork. Below I include three examples of sculptures (figs. 8a-c).

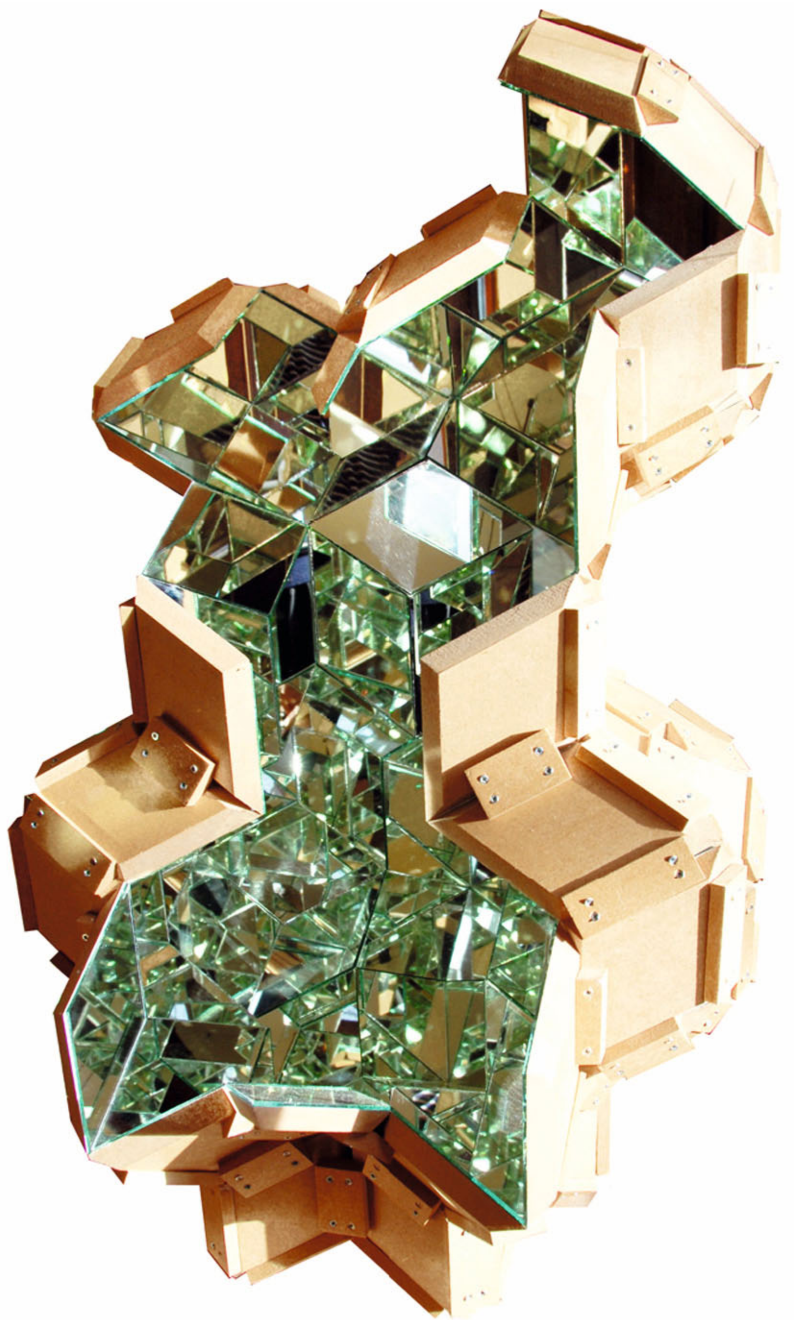

Fig. 8a. First example of a sculpture (Ph. Van Loocke 2010, Sculpture #1)

Fig. 8b. Second example of a sculpture (Ph. Van Loocke 2010, Large sculpture #1)

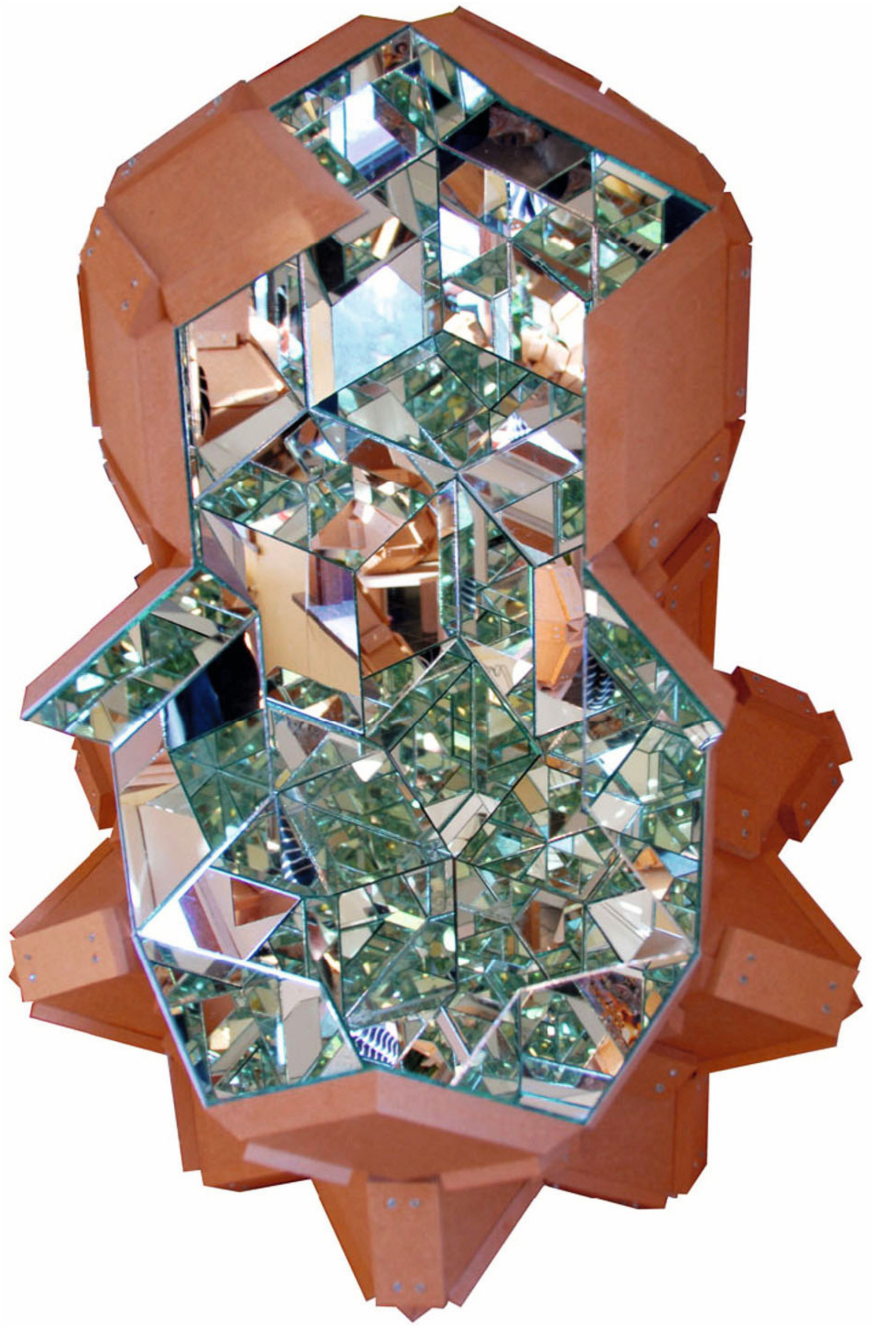

Fig. 8c. Third example of a sculpture (Ph. Van Loocke 2010, Sculpture #2)

Mirror based photography

When I zoom in with a photo camera on the interior of my sculptures, images result in which light weaves a pattern of fragments that belong together, but which nevertheless seem disparate. Figs. 9a-b show two examples. In course of the reflection process some fragments receive more light than others, and the sharpness with which they are present in the image is inevitably subject to variation (focussing on large fragments implies that smaller fragments become more vague and vice versa: although the physical distance between the mirrors and the camera is not subject to strong variation, the lengths of trajectories of light rays differ strongly as a function of the number of reflections to which they are subject).

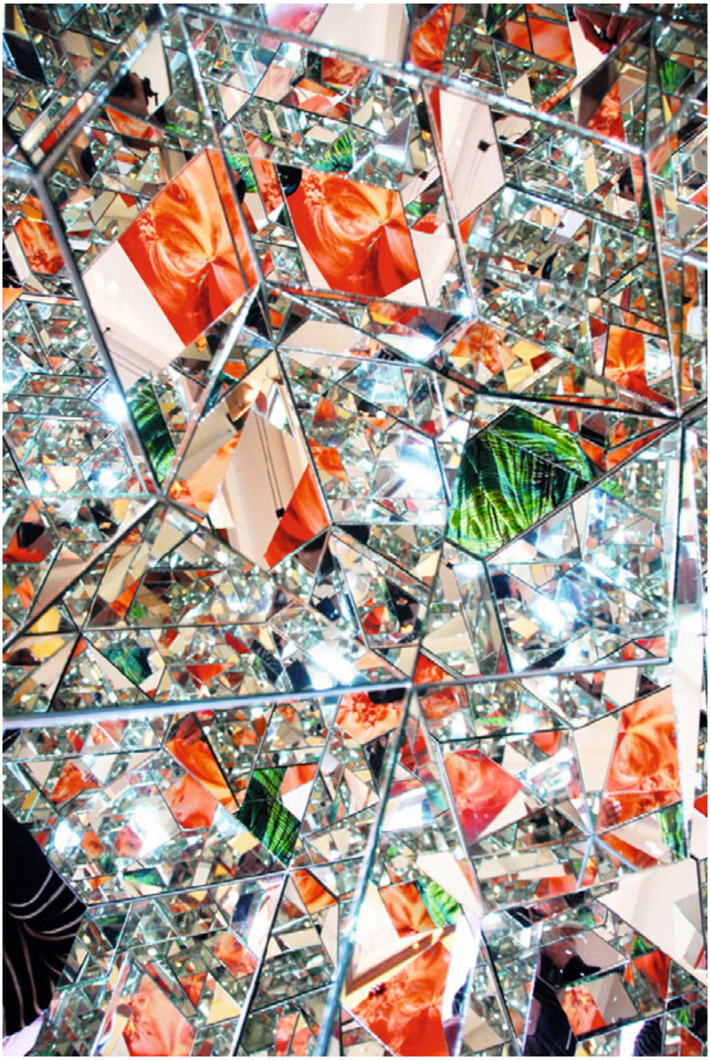

Fig. 9a. Ph. Van Loocke 2010, mirror based photography #1

Fig. 9b. Ph. Van Loocke 2010, mirror based photography #6

I want to make two additional metaphysical comments in relation to this art, which helps to understand the point that I am about to make concerning counterpoint. First I make a remark on the mirrors, which reflect one another in such a way that in a sculpture with a limited number of faces, a much vaster complexity appears. The theme of mirrors which mirror one another is an old theme in Eastern philosophy. Think, for instance, of the mirrors or 'pearls' of Indra, which mirror one another in an infinite regression, so that in each pearl a pattern of infinite detail is created. This theme entered Western philosophy thanks to Leibniz. Leibniz's view strongly differs from Descartes's atomism, according to which reality is composed of infinitely small atoms. In interplanetary space these revolve around the sun and like minuscule stones they drag the planets around the sun in their vortexes. In Leibniz's view, reality is composed of monads, which are infinitely small mirrors that reflect one another. For instance, the mirror in our brain which is mirroring best acquires dominance, and it determines the content of our consciousness. Leibniz was influenced by Eastern philosophy.[13] For several centuries, he had few followers in Western philosophy. But I like finding affinity between my art and the great stories, especially when the latter extend over different cultures. It gives inspiration and it may relate art of the present with world views of the future.

The second example of a metaphysical relation that I give at this place concerns 'intellectual' kabbala. I use the adjective 'intellectual' in order to make it clear that I am not referring to new-age kabbala but to the kabbala of Isaac Luria, who in the sixteenth century proposed a cosmogenesis with different stages. At the beginning there was only the infinity of God. In this infinity there is no place for a world like ours, since God fills everything. At a certain instant, God selects a special point in this infinity. He retracts from this point and allows it to expand.[14] Thus comes into existence the place where our world can originate. But since God had to retract from this place in order to enable our world, his qualities are no longer permeating it. Therefore, evil can exist. But if we take an open, relaxed attitude, then we still perceive traces of the goodness of God. Fragments of the world contain traces of the initial divine light, and it is up to people to connect these fragments and to increase their relative weight. The theme of fragments, and the play of the light connecting them, is visible in the photographic work that I make on basis of my sculptures. Acceptance of Luria's cosmogenesis is not a necessary condition for appreciating this art form, but familiarity with this metaphysical context can add another layer of meaning, which may increase the subjective value of an artwork.

Counterpoint and sculptural work

As in case of my graphical work, different semantic levels are present in a single work. In case of sculptures, this holds for the interior as well as for the exterior. In the exterior and at a figurative level, certain motifs, such as biomorphic themes, abstract people, and so forth, can be recognized. The higher-dimensional projections which describe the shape of the exterior have a physical and metaphysical context that I have outlined when I discussed my graphical work. In addition, the golden section, which is prevalent, has its own long tradition with ramifications in Platonism and beyond. The interior of a sculpture, and the mirror based photography to which it leads, can be related to Eastern metaphysics, with Leibniz or with kabbala.

This often creates a counterpoint in an individual sculpture. The finiteness of the exterior communicates with the sheer infinity of the interior, and the metaphysical themes associated with the exterior complements the mirror-and-light metaphysics associated with the interior.

In the case of my graphical work, a single photograph leads to different works if different higher-dimensional deformations or 'vibrations' are applied to it. In the case of my sculptural work, the same grid of six-dimensional hypercubes leads to different sculptures if different parts of the grid are projected (although some sculptures fall outside the range of quasicrystals, as I explained before). In some instances I create my sculptures in small groups, and I orient the interiors of the sculptures toward one another, so that the reflecting mirror systems in different sculptures increase the complexity of the reflection pattern in each of them. In this case, the counterpoint is not only involved through the complementary relations between interior and exterior in individual sculptures, but is also observed in the relation between different sculptures.

Conclusion

The round table session at Nexus 2010 entitled "Generative Architectural Codesness" included two interventions in which counterpoint is discussed and explained from a broad perspective. Moderator Celestino Soddu explained how counterpoint is a major theme in his architectural work. The dynamics of convergence and divergence of several forms is evident in the method that he designed, in which algorithmic variation is combined with an artist-based selection process. I took the freedom to discuss the concept of counterpoint in relation with my own artwork. Both in my graphical and in my sculptural work it has a natural place.

Notes

1. The point Q is located in the plane of the photograph, but may fall outside the area covered by the latter. In order to associate colour values with Q in such a case, I tile the plane caleidoscopically with the photograph. This means that each tile has a copy of the photograph, with orientation in such a way that neighbouring tiles contain images which are mirrored along the shared side.
2. Note that this was before the restricted theory of relativity had been formulated. The concept of higher dimensions was studied in mathematics and from there found its way into art.
3. A large number of famous artists from the first half the twentieth century were inspired by the concept of higher dimensions. The classical reference work on this subject is [Henderson 1983].
4. For an overview, see [Van Loocke 2008].
5. For the scales in our universe and for the cosmological concepts to which I am referring below, see [Primack and Abrams 2006].
6. For a keen discussion, see [Blackmore 2003]. For my position on consciousness, see [Van Loocke 2008: ch. 8].
7. See, for instance, [Penrose 1997]. In a statistical analysis of the opinions of scientists, the stance that Penrose defends would appear to have the support of a minority. The history of science and the observation of the sociological mechanisms at play suggest that one cannot draw very firm conclusions from this fact.
8. 'Arena' is a strong word: from Einstein's perspective, all change is illusion and only static structures in four-dimensional space-time exist – otherwise, for instance, our past could change.
9. Einstein's opinion implies that the future is fixed, which is too deterministic in view of quantum mechanics. The discussion referenced is whether small or large variations of Einstein's view are tenable.
10. These recent scientific insights come close to old Buddhist propositions: see [Van Loocke 2008: ch. 9] and [Blackmore 2003].
11. For a more extended description, see [Dunlap 1997].
12. See for instance the work 'Four Sided Vortex' at the beginning of the official site for Robert Smithson's work on www.robertsmithson.com
13. Through Anastasius Kircher (who had contact with Jesuits who had traveled to the East) Leibniz had become familar with Eastern concepts. Leibniz's cosmology, like the Eastern cosmologies he knew, is a correlative cosmology instead of a causal cosmology. Monads do not interact causally (like in classical physics one process influences another one by exerting a force on it or by bouncing onto it), but are rather synchronized beforehand by the creator of the universe, which explains the coherence of our world. The hierarchical relation between monads also agrees with Eastern philosophy [Van Loocke 2008].
14. One may wonder how far the analogy goes between Luria's cosmology and present scientific cosmology, since both approaches share the theme of an expanding universe. A more detailed comparison shows that there are indeed various similarities; see [Primack and Abrams 2006].

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