THE GRAPHIC TRANSLATION

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An essay containing theoretical content of great value, Jole de Sanna's *Metaphysical Mathematics* required a valid graphic support in order for the mathematical theorems to be understood by all, even those not predisposed with specific mathematical knowledge. In order to facilitate comprehension, a direct illustration of the spatial aspects and the mathematical theory taken into consideration in the individual paintings, was considered necessary. To illustrate the text, Professor de Sanna involved a group of postgraduate scenography students at the Brera Academy of Fine Arts of Milan who were participating in a specialist degree program through a reform of the university system: Manuela Carosio, Isabella Fumagalli, Beatrice Laurora, Julian Sambuco, Serena Zen and Paolo Zuzzi. Their specific training as scenographers aided them in the comprehension of spatial aspects such as: perspective, illumination, proportion, organization of the "spatial box", factors, which were revealed by Jole de Sanna's studies as fundamental for a heightened understanding of de Chirico's work. It was necessary to devise a system of indications with a precise logic of exhibition in parallel to the text, capable of providing visual indications that could reveal the underlying geometric structures of the composition in support of the applied theory. The coordination of this research was entrusted to Katherine Robinson who, having translated the text into English, had acquired a thorough comprehension of the subject matter.

In order to illustrate the mathematical and geometrical rules brought to light by Jole de Sanna's research, the students adopted a criteria for the graphics that was the least invasive possible, as not to disturb or load the painting with lines or marks inherent in the original work. The process, initiated as a straightforward illustration of a text, gradually began to reveal the inner structure of the paintings in an astounding manner: not only was the theory readily applicable to the illustration of the individual paintings, it soon proved befitting of a true geometric demonstration, the rules and measurements of which coincided with millimetric precision to the forms.

Further geometric demonstrations were developed by the students pertaining to this research. A few key points of interest or ideas for research were individuated during the work sessions with Professor de Sanna or found in the study material she proposed, such as Lobačevskij's *New Principles of Geometry*. Other discoveries were the fruit of the group's research and verification methods as well as their commitment to this project. A selection of these discoveries and their explanation can be found in the following text.

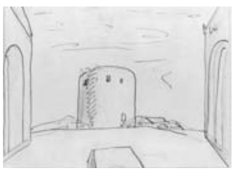
Involving the minds of these young scenographers in this research brought about some important discoveries. Amongst others, these include the anatomic study of the muscular system revealed by Paolo Zuzzi in *Le duo*, and graphic elaborations such as the captivating little heads of Cavour drawn by Isabella Fumagalli in order to illustrate the study of the head's movement in *Le voyage émouvant*. Julian Sambuco's versatility and commitment in creating the computer graphic images provided a substantial contribution to the realization of this project.

It is exciting to be able to retrace the logical structure of de Chirico's composition from point A, to point B, to point C, thus encountering its beauty and coherence, which give a greater, more universal access to the metaphysical content.

The Metaphysical Piazza

A fundamental element of the metaphysical piazza is the fact that the piazza is a cube and the portico is a tetrahedron. In *Timaeus*, Plato associates the cube with the earth and the tetrahedron with fire. The cube is identified with the earth for its quality of stability and the tetrahedron with fire for the acuteness of its shape. With these two polyhedra, de Chirico enacts astronomical translations around the piazza, the spatial construction of which is modified with regard to time, by means of the light and the casting of shadow, as well as with regard to the regular polyhedron, which is deformed in relation to a pseudosphere. In the following text, the cube's fundamental role in the piazza's construction will be examined and geometric explanations will be offered concerning the movement of the tetrahedron.

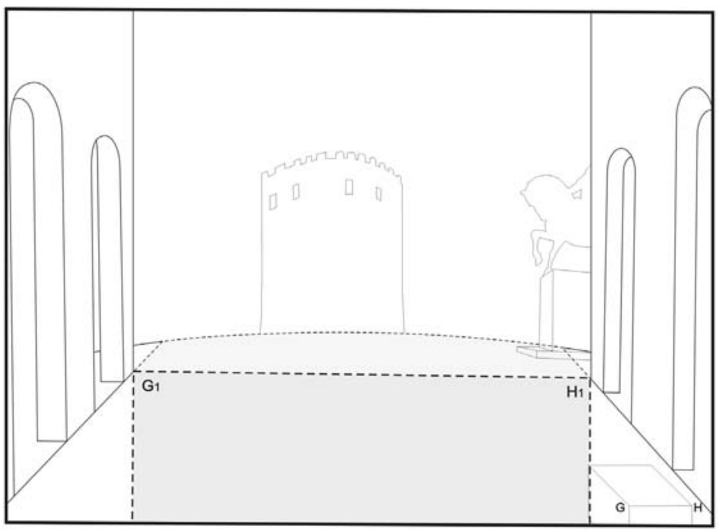
"The significance is now clear: the cube that stands for the earth moves with respect to the solid that stands for fire, (the sun), the tetrahedron. By means of Platonic geometry, celestial space inhabits the piazza." [1]



Study for 'La tour rouge'

La tour rouge, 1913[2]

In this painting the sketched cube at the lower right provides indications concerning the construction of the piazza. The line that separates light from shadow is actually the edge of a large cube that occupies the piazza in its entirety. In fact, in the preparatory study, de Chirico assigns the cube a central role in the composition's construction.



Demonstration:

By prolonging the sides of the two porticos to the painting's lower margin, the shadowed face of the cube takes form. By lengthening the perspective lines of the porticos, the top side of the cube is determined on the sun-drenched plane (with an optical adaptation). The edge of this new cube G1-H1 corresponds to the line of shadow that divides the piazza and

1 The sentences in italics are extracts from the article *Metaphysical Mathematics* by Jole de Sanna, which have been chosen in order to correlate these demonstrations to the principles she has discovered. This sentence is a excerpt from *L'énigme de l'arrivée et de l'après-midi,* 1912.

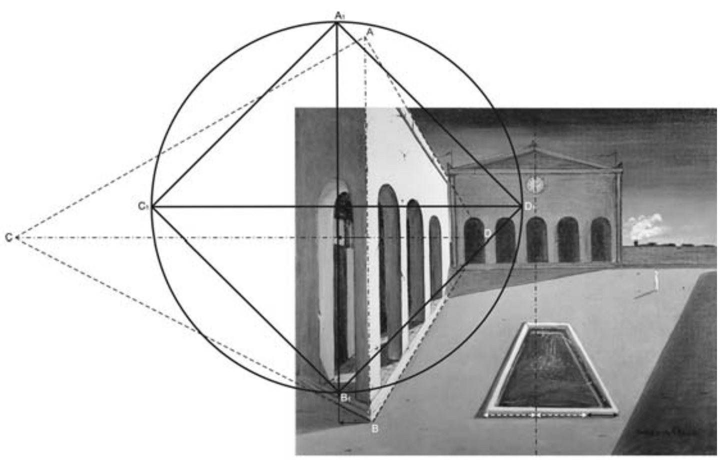
2 A re-reading in *Metaphysical Mathematics* of the painting's analysis is recommended for a fuller understanding of the explanations that follow.

is exactly six times greater than the edge GH of the small cube. Once the cube has been identified in the painting, it is hard to ignore it. The strong stability of this cube brings about an even greater sense of movement of the piazza's curved surface.

"A sensation of ongoing motion is created by the tower, which slides with respect to the axis of the painting. The result is achieved by means of optical stimuli through retinal reaction (Gestalt)."

Les plaisirs du poète, 1913

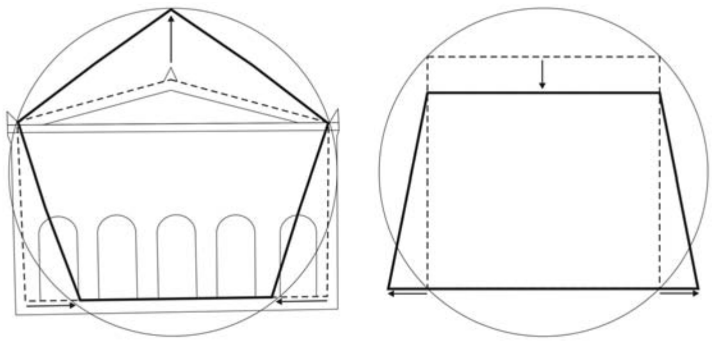
"Les plaisirs du poète is the first Platonic solid that actually deforms time. The perspective of the portico on the left is the centre of action: in central conic projection it is, in fact a tetrahedron. The foreshortened portico is a Platonic tetrahedron inserted into a Platonic sphere. The painting has no geometric centre; its measurements are elastic, they slide both forward and to the right. The quantity of time is measurable on the fountain, which can not be divided into symmetrical parts, the lower corner stretches out to the right. The measurement we have gathered on the plane is only a clue. The significant measurement lies within the Platonic Sphere. It is therefore necessary to dismantle the painting by looking at its construction as a spatial box."



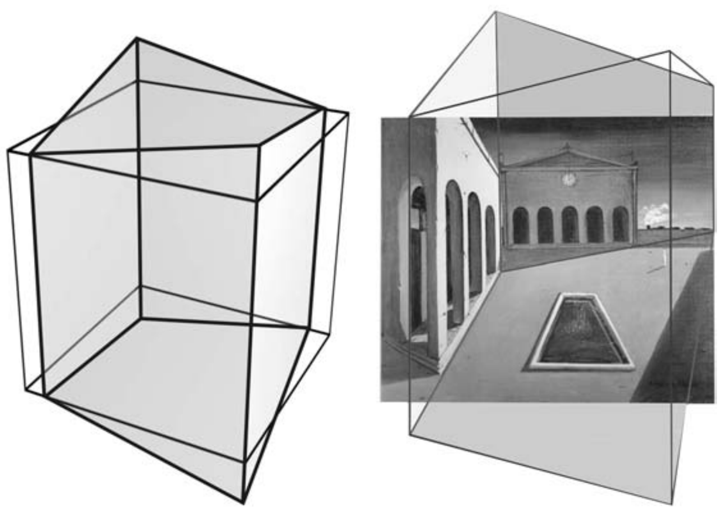
Demonstration:
The corner of the portico's base (the tetrahedron's vertex) returns to its original or regular position (inscribable in a sphere) when moved up and to the left in the unit of measurement taken on the fountain. The other

vertex of the tetrahedron (the vanishing point of the perspective lines at the far end of the portico) is moved up and to the right. The portico then becomes a regular tetrahedron that can be inscribed into a sphere.

Analogous to the tetrahedron of the portico, the *propylaeum*'s pentagonal façade can also be inserted into a sphere. By squeezing the bottom corners of the façade of the *propylaeum* inwardly in the unit of measurement taken on the fountain and by raising the peek of the roof the same



distance, the five-sided facade returns to the shape of a regular pentagon. The reconstruction of this pentagonal face, which can now be inscribed in a sphere, provides us with the movements necessary to identify the



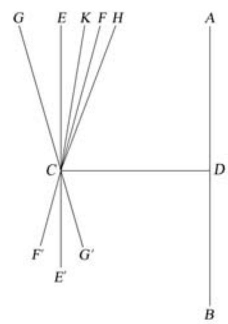
compression executed by the artist on the spatial box of the painting. Using the same unit of measure, a square is then squeezed in the opposite directions of those that we have just exerted on the front of the *propilaeum* to obtain the face of a deformed cube. It is inside this deformed

cube that the painting is constructed.
The surface of the piazza has a negative curvature, or "saddle surface", according to Gauss's theorem. The geometric construction of the piazza and the portico is based on hyperbolic geometry.

La lassitude de l'infini, 1913 (1912)

"The piazza is suspended on two celestial orbits, which is the true subject of the painting."

The surface of the piazza is a pentagon: *the face of the dodecahedron displays only its bottom half with its vertex pointing down. Its shape is completed below, outside the painting.*
As the pentagon is in perspective, its angles have widened and no longer correspond to the 108° angles of a regular pentagon. Angles of this same degree are found elsewhere in the painting and will serve as a reference.
The two porticos, the "banks" of the piazza, enact Lobačevskij's new notion of parallelism in a double game.

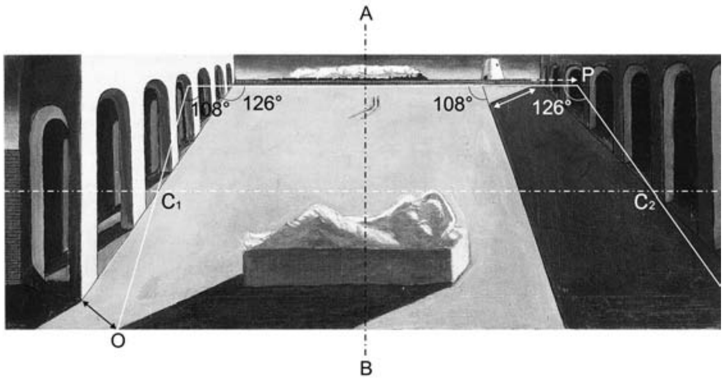


Lobačevskij introduces the way (or direction) of parallelism. If AB is a line and point C a point on a plane on which all lines coming from point C must intersect AB, as does the perpendicular CD to AB; or not intersect AB, as for example the perpendicular CE to CD. Commencing from the position of CD, a ray can describe a section of lines in two directions, counter clockwise and clockwise; the first corresponded to the course DA on line BA and the second to the opposite course, DB.

Pivoting on the point where their bases intersect the painting's horizontal median line at points C1 and C2 respectively, the porticos have rotated: one, in one direction, the other, in the opposite. The portico on the left (in the light) has rotated in a clockwise direction, while the portico on the right (in darkness) has done so in a counter clockwise direction. Ariadne's body, crossed through the middle by the vertical median line of the painting seems to mirror the same notion: a point on her stomach acts as a pivot upon which the top half of her body is turned in the opposite direction from the lower half.

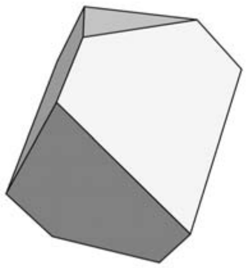
"The upper margin of the shadow created by the portico on the right-hand side forms a scalene triangle with the base of the wall and acts as Ariadne's true thread in the portrayal of the infinite in the piazza."

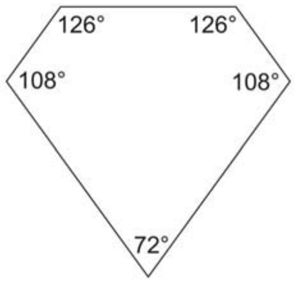
Demonstration:
The length of this triangle's edge is the same as the distance between the corner of the tetrahedron at the bottom left and the point where Ariadne's shadow touches the painting's margin at point O. From this point a line is drawn that passes through C1 until it meets the prolongation of the base of the wall under the train. The line created indicates the position of the portico prior to the clockwise rotation. The resulting angle measures 108°,



the angle of a regular pentagon. The rotation, which has occurred in a clockwise direction, has carried the portico to its present position. The angle is symmetrical to the angle on the right where the prolongation of the portico's shadow meets the same wall. With respect to axis AB, this clockwise rotation is reflected by the portico on the right in a counter clockwise direction. And thus, two harmonic movements that reveal celestial motion are established in the painting.
The original position of the portico on the right can also be re-established. Its rotation proves to have taken place in a counter clockwise direction. From the tip of the small scalene triangle previously identified, point P is set at a distance of the same length of the unit of measurement previously used, along the line of the wall's base. From this point a line is traced that passes through C2. The resulting angle measures 126°, a value that is validated by the fact that it is identical to the angle between the wall and the portico on the left.
The double clockwise-counter clockwise movement compensates itself, adding on the left what has been taken away on the right, therefore modelling, through perpetual transformation, the space of the piazza in a temporal compression (the relativity of solids). As occurs in an algebraic equation, the double movements cancel each other, leaving a single portico in stillness, which is illuminated on one side and in shadow on the

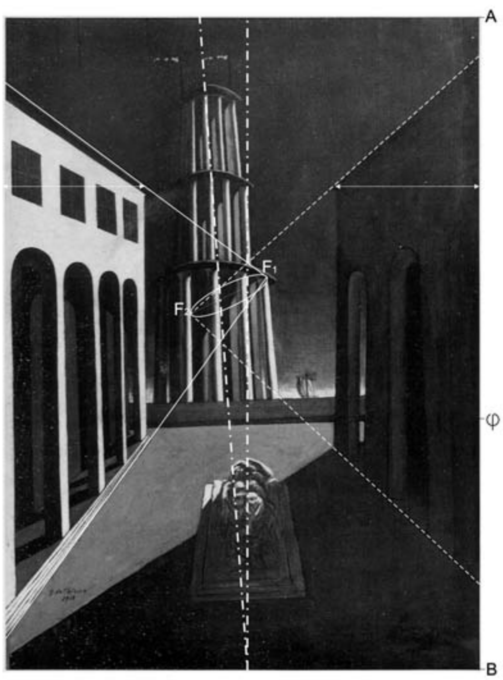
other. Points O and P are in fact the same point. We, the spectator, find ourselves to the right of the portico in light and to the left of the portico





in darkness. But if it is the same portico, where are we?
Furthermore, the pentagonal face of the piazza's surface contains two angles at the back that measure 126°: one on the left-hand side in the light, and the other, which results from the modelling of the piazza's surface, on the right-hand side. These measurements recreate one of the faces of the polyhedron in Albrecht Dürer's engraving *Melancholy*.[3]

L'après-midi d'automne, 1913
"The structure of the painting designates it as a mathematical document. Advancing at the base and distancing itself towards the top, the tower's



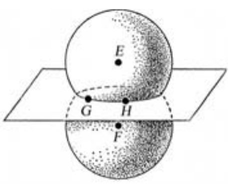
[3] Schreiber proposes that it comes from a rhombohedron with 72° face angles, which has been truncated so it can be inscribed in a sphere. P. Schreiber, "A New Hypothesis on Durer's Enigmatic Polyhedron in His Copper Engraving 'Melancholy I'", *Historia Mathematica,* 26, 1999, p. 369-377.

prominent entrance maintains a game of balance, giving the painting the complex convexity that originates in the paintings of 1913."

Description:

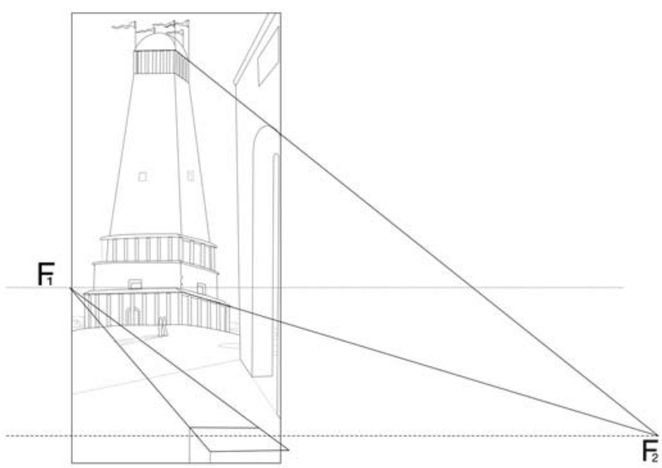
The painting is divided in the Golden Ratio height-wise with the upper margin of the piazza. The median axis of the painting cuts Ariadne in half. The two porticos are equal in width and the corners of their roofs converge upon the same horizontal line, while the perspectives of their bases converge upon the axis of the tower, which is leaning. The vanishing points of the two porticos' perspectives are different, F1 and F2 (due to the difference in the perspective of their bases). A line traced from F1 to F2 creates an axis for the construction of an ellipse, on which the tower turns.

La nostalgie de l'infini, 1913-1914



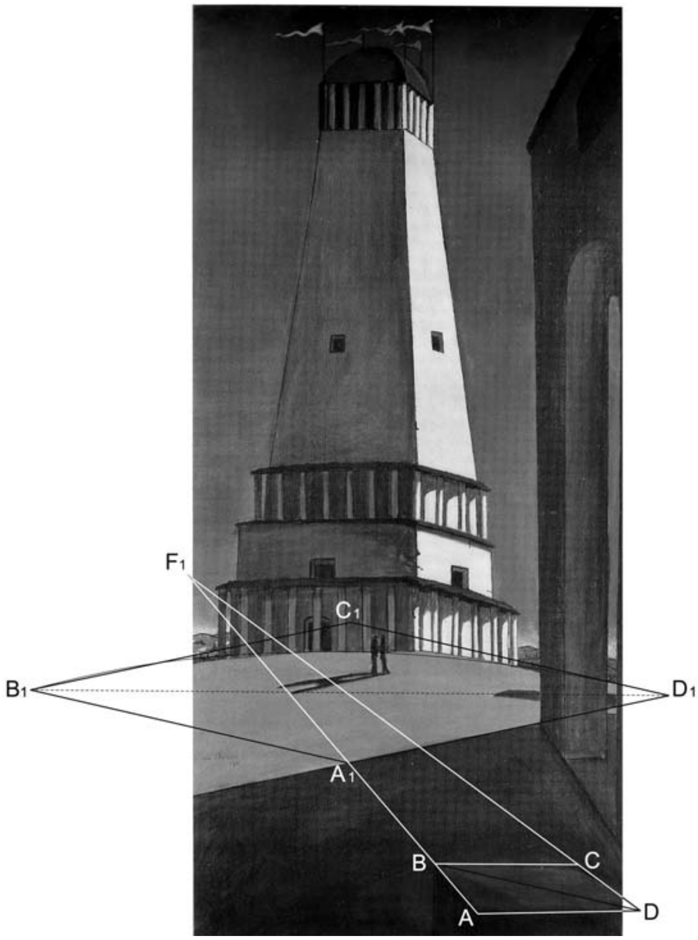
Lobačevskij

"The painting deals with the axioms of movement. The cube (the earth) is in axonometric projection on the right. Lobačevskij's problem of the rotation of a plane around two poles is dealt with here: when the centres E, F exchange places, the spheres that surround them pass from one side to the other of the plane, each covering one another's position. As a result, the plane's surface in this new position coincides with that of its former position. Turning on an axis, the planes flip over in space."



Demonstration:

The construction of the painting is set on two different horizons. The horizon of the cube and the portico F1, is higher than the horizon of the tower

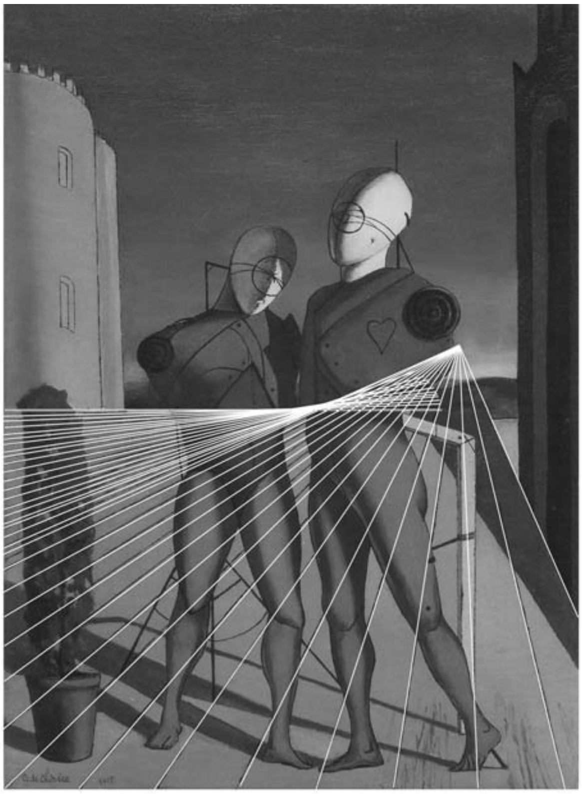


F2, which is in line with the cube at the bottom right-hand corner.
Once again, the cube at the bottom right is the key to the entire composition. By following the perspective line AB of the cube, point A1 is established where this line crosses the shadow of the portico. The prolongation of the curved line of the piazza's horizon sets point D1 where it meets the continuation of the portico's shadow line on the right. This is the first side of the new cube and its length is exactly twice that of the corresponding side AD of the little cube. Point B1 is found by lengthening the diagonal DB of the small cube and constructing a line parallel to it that passes through A1. B1 - D1 is the axis on which the plane turns. With respect to the axis, point A1 = C1. The new plane corresponds exactly to the piazza's surface, with an optical adaptation (the curvature). On the right, a shadow cast from something outside the scene helps to sustain the horizontal direction of this axis. Continuing towards the left, the axis touches

the shadow of the couple on the head of one of the two figures. This point is also crossed by the perspective line of the small cube A - F1 on its path to its vanishing point, touching the head of the other figure as well. The other perspective line D - F1 passes between the two figures where their shadows meet in an "X". The centre of this "X" provides the vertical axis of the leaning tower.
Furthermore, as demonstrated by Lobačevskij: centre E corresponds to centre F, while each point G can be carried to another point H on the generating circle. This happens to the tower that accomplishes a rotation towards the right which involves the plane as well.

Le duo, 1915

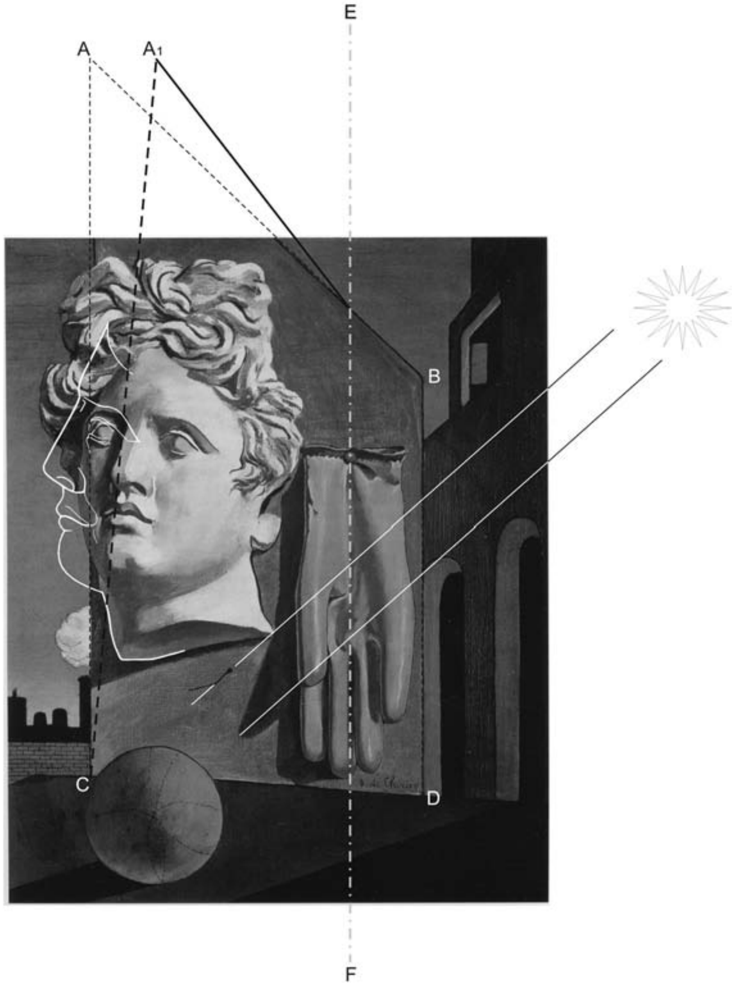
"The open window on the heart "beyond the chest" in the painting 'J'irai... Le chien de verre', 1914, focuses on man's physiological foundation, following the investigation of the venous circulation in the painting 'L'arc des échelles noires'. Even 'Les contrariétés du penseur' takes up the investigation of the heart. What's inside?"



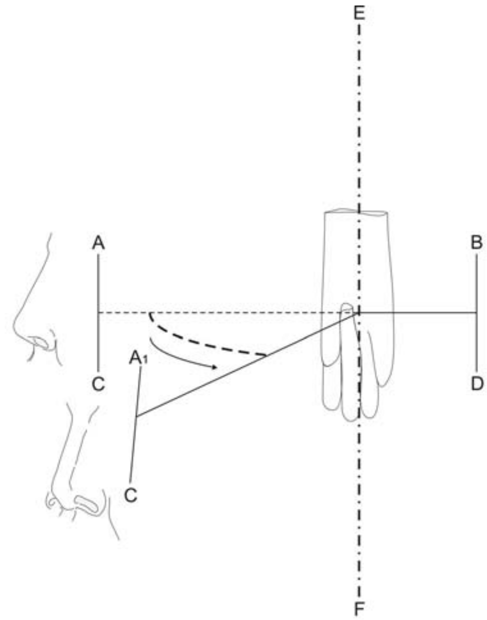
The lengthening of the perspective lines of the flooring reveals an anatomic study on the muscular system. The lines do not meet at a common vanishing point. Instead, the left side is subject to a twisting movement, as if the flooring was stretched like a muscle. Line becomes an inner perspective, made tense through human movement.

Le chant d'amour, 1914

"The face of an icosahedron during translation is positioned in relation to the head according to a topological diagram: head and polygon are oriented in a double reciprocal movement in respect to the glove which is the transformational axis."



Demonstration:
Consider ABCD the face of the polyhedron in its original position prior to the torsion. Pivoting on axis EF (the glove), the left side, AC, is carried forward determining the present position of Apollo's head on axis A1-C. Basically, we see Apollo's head in the position it occupies after the torsion has taken place, while the glove and the right side of the wall BD, continue to maintain their original position, prior to the move.
A true gnomon, the little nail casts its shadow on the surface of the icosahedron in the new position, while the shadow of the glove indicates the icosahedron's original position.



What happens is this: in the time it takes our eyes to move up from the base of the wall to the top, the position of Apollo's head has carried forward the left-hand side of the wall upon which it rests, while the right-hand side remains immobile. Although the wall is painted on a two-dimensional surface, through the mind's perception (Gestalt) and the force with which Apollo captivates our attention, it becomes three-dimensional. In order to fold a two-dimensional surface forward de Chirico activates the spectator's perceptive ability in real time, making Apollo, from the depths of history, a voyager on a hyperbolic surface.

Translated by Katherine Robinson