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Keywords: El Lissitzky, Theo Van Doesburg, De Stijl, Relativity, relationships between art and science

Research

Some Adaptations of Relativity in the 1920s and the Birth of Abstract Architecture

Abstract. John Hatch examines the friendship between Theo Van Doesburg and El Lissitzky, which was fuelled by a shared interest in scientific theories. Both moved from painting to architecture in seeking out a form best suited to conveying the spatiotemporal experiences phrased by Relativity, resulting in some remarkably innovative architectural designs and theories.

El Lissitzky set out to become an artist, but after failing the admittance test at the Saint Petersburg Academy of Arts, he turned his attention to architectural engineering, graduating from the Technical Institute of Darmstadt in Germany. Upon his return to Russia in 1914 Lissitzky followed up on his interest in art, designing and illustrating children's books, most notably of Jewish folktales. Lissitzky's talents in engineering and art resulted in his being hired in 1919 as head of the Workshops of Graphic and Printing Arts, and Architecture at the Artistic-Technical Institute in Vitebsk (Belarus), an art school established by Marc Chagall. It is there that Lissitzky met the Ukrainian painter Kazimir Malevich whose Suprematist works would have a profound impact on Lissitzky's career as an artist.

A notable aspect of Malevich's art, for Lissiztky, was its incorporation of scientific theory. Malevich drew on thermodynamics, describing the coloured forms of Suprematism as representing nodes or concentrations of energy, and its whole narrative as one paralleling the universe's evolution toward thermal death, as postulated by the second law of thermodymanics. The White on White series of 1917-1918, represents the penultimate moment of the end of the material world for Malevich, in favour of a higher spiritual reality inspired by his interest in theosophy [Hatch 1995: 120-168]. Lissitzky did not share Malevich's spiritualist beliefs and where Malevich saw Suprematism as a terminal point for human history, Lissitzky saw it as the starting point for a complete transformation of our material existence. Lissitzky wanted to use Suprematism, or his variant of it, the "Proun" (acronym of "project for the affirmation of the new"), as a blueprint for social reconstruction – a hope fuelled by the October revolution of 1917.

In devising his own variant of Suprematism, Lissitzky wanted to update the science it drew upon. One of the earliest and most obvious examples of the incorporation of new scientific theories in Lissitzky's work is found in *Proun G7* (fig. 1). This work is based largely on a diagram found in Hermann Minkowski's seminal essay "Space and Time," published in 1908 (fig. 2).[1] This is even more clearly illustrated in the studies for *Proun G7*, where the copying of Minkowski's space/time continuum diagram is quite literal. The most telling aspect is that *Proun G7* not only incorporates the hyperbolas found in Minkowski's diagram, it transcribes the oblique presentation of the *x*- and *y*-axes as well.

DOI 10.1007/s00004-010-0024-6; *published online* 9 February 2010

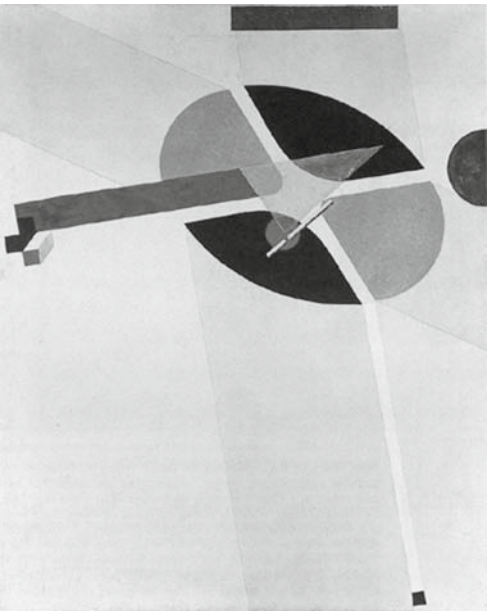

Fig. 1. El Lissitzky, *Proun G7*, 1923, tempera, varnish and graphite on canvas, 77 x 62 cm, Kunstsammlung Nordhein-Westfalen, Düsseldorf

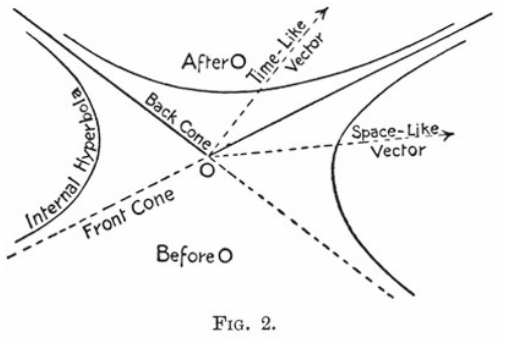

FIG. 2.

Fig. 2. Hermann Minkowski's space/time continuum diagram, Fig. 2 from the essay "Space and Time" [Minkowski 1908: 84]

Minkowski was a Russian-born German mathematician who was a teacher of Einstein's in Switzerland. He was one of the earliest scientists to appreciate the full potential of Einstein's theory, and his text supplied the first rigorous mathematical/geometric treatment of Relativity. Minkowski endorsed Einstein's concept that our perception of reality is invariably associated with the four dimensions of space and time, remarking that "Nobody has ever noticed a place except at a time, or a time except at a place" [Minkowski 1908: 76]. His particular formulation of this idea involved the use of non-Euclidean geometry and imaginary numbers. Minkowski's analysis concluded by calling on science to finally abandon the classical notion of absolute space in favour of relative spaces, or as Minkowski himself put it: "We should … have in the world no longer space, but an infinite number of spaces" [Minkowski 1908: 79].

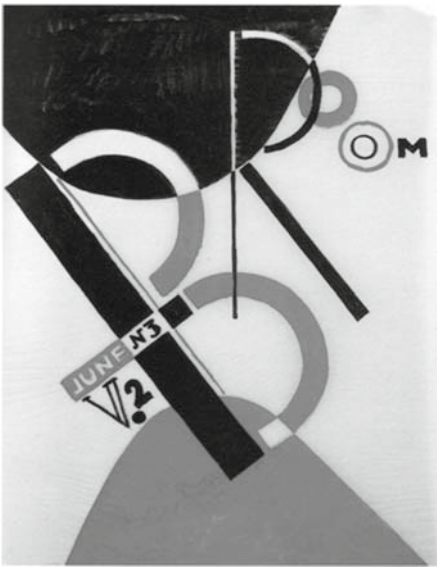

Fig. 3. El Lissitzky, Cover of the art magazine *Broom*, vol. 2, no. 3, June, 1922

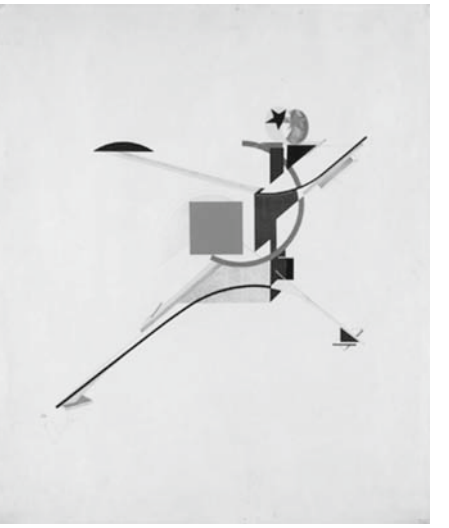

Fig. 4. El Lissitzky, *First Kestner Portfolio, Proun*: print no. 3, 1923, lithograph, 64.0 x 49.0 cm

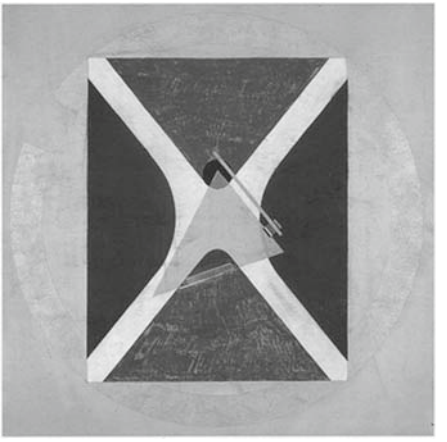

Fig. 5 (above). El Lissitzky, *Proun 43*, c. 1922, watercolour, gouache, india ink, aluminium paint, collage, on board, 66.8 x 49.0 cm, State Tretiakov Gallery, Moscow

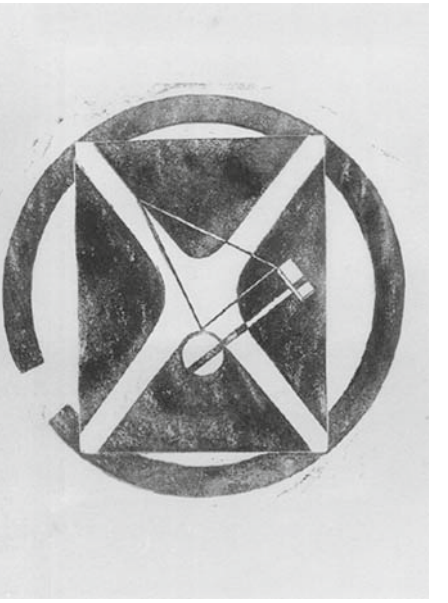

Fig. 6 (right). El Lissitzky, *MA: Cover Proof*, 1922, linocut on transparent paper, 27 x 19.8 cm, Municipal Van Abbemuseum, Eindhoven

This is a passage which must have endeared Minkowski to Lissitzky, since the latter's Prouns represent an attempt at working with a number of different spaces. Surprisingly, despite extensive scholarly mentions of the importance of Einstein's Theory of Relativity for Lissitzky, no one has ever suggested the derivation of *Proun G7*, and subsequent works, from Minkowski's diagram.

The overall importance of Minkowski's diagram is reflected in the number of times it reappears, under various guises, in Lissitzky's work. For example, it is paraphrased on the cover of the art magazine *Broom* from June of 1922 (vol. 2, no. 3) (fig. 3), and adapted for the image of "the new," found in the *Figurine portfolio, Victory Over the Sun* (1920-21). In both cases, we find Lissitzky using hyperbolas which are slightly offset, echoing Minkowski's oblique presentation. In the *First Kestner portfolio, Proun* (1923), the image found on sheet number three incorporates both the hyperbolas and the *x*- and *y*-axes found in Minkowski's diagram (fig. 4). In *Proun 43* (ca. 1922) Lissitzky simply transposes the image found in *Proun G7* (fig. 5). It also appears on the August 1922 cover of the Hungarian magazine *MA* (vol. 7, no. 8) (fig. 6).

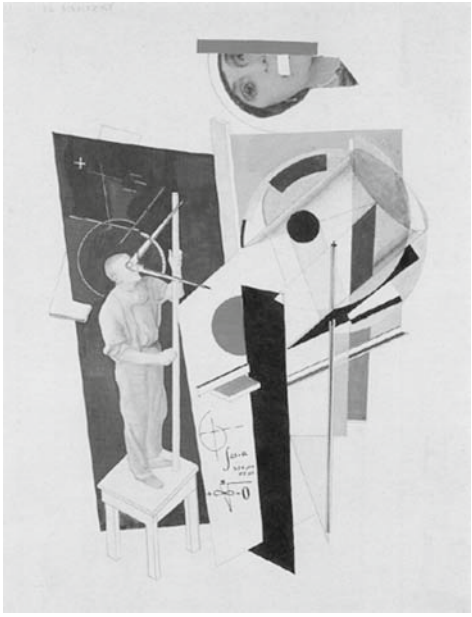

Fig. 7. El Lissitzky, *Tatlin, Working on the Monument*, 1921-22, collage, (29.2 x 22.9 cm), Grosvenor Gallery, London

Significantly, in all of these, Lissitzky anthropomorphizes the diagram devised by Minkowski, transforming it into a symbolic representation of the "new man." In both *Proun G7* and *Proun 43* there are a number of elements near the focal point of each image which are referred to by the art historian Alan Birnholz as "architect's equipment" [Birnholz 1973: 150-152]. These likely refer to Lissitzky's own architectural training. In turn, they also point to the fact that Lissitzky's "new man" was the architect or constructor of a new reality, one founded on the new mathematics and the Theory of Relativity. This point is more clearly made in Lissitzky's collage *Vladimir Tatlin, Working on the Monument* (1921-22) (fig. 7), in which Lissitzky includes a mathematical formula composed of an imaginary number (the cubic root of -0) and a symbolic expression of positive/negative infinity.

It is most likely a symbolic reference to Minkowski, who not only used imaginary numbers in his equations dealing with the space/time continuum, but also defined the continuum as extending from negative infinity to positive infinity. Thus, the inclusion of this mathematical formula in his collage suggests that Lissitzky saw the Russian sculptor Tatlin as an embodiment of the "new man," although there is little evidence of Tatlin's interest in Relativity.

While working on the Tatlin collage at the end of 1921, Lissitzky was in Germany where he met the Dutch artist Theo Van Doesburg, who at the time was trying to obtain a teaching position at the Bauhaus in Weimar. Van Doesburg was the driving force of De

Stijl, the Dutch modern art movement that was founded in 1917 by Van Doesburg, Bart van der Leck, and Piet Mondrian. Curiously enough, Lissitzky and Van Doesburg shared a common interest in science, and where Lissitzky's art was influenced by Malevich, Van Doesburg's mature work was fuelled by his passionate interest in Mondrian's painting. The similarities continue in an eerie fashion. Mondrian was also deeply involved in spiritualist beliefs and shared Malevich's interest in theosophy. Like Malevich, Mondrian incorporates a number of elements from nineteenth-century science, in part due to theosophy's adaptation of nineteenth-century scientific theories, although not as thoroughly as Malevich. Mondrian makes only the occasional but nevertheless significant references to energy and matter, and specifically the concept of the ether. Like Lissitzky, Van Doesburg did not share as passionate an interest in the spiritualism of his mentor, and wanted to update the scientific references.

Van Doesburg's interest in the physical sciences emerges around 1918 and is related to one issue on which he and Mondrian could not see eye-to-eye, namely the representation of time or movement in painting. Again, like Malevich, Mondrian's work was a signpost to a higher spiritual dimension, one which was immutable and absolute, and to include time in the realm of the timeless was obviously not an option for Mondrian. Like Lissitzky, Van Doesburg was more interested in how to translate Mondrian's visual idiom into practical, material terms, and consequently, time/movement was integral.

Van Doesburg wholeheartedly embraced the premise that all is relative, all is in continual movement and, consequently, that there are no absolutes in the universe. He had discussed these ideas with Mondrian just before the latter left for Paris in 1919. In a letter to the De Stijl architect J.J.P. Oud, Van Doesburg related that he had met with Mondrian in June of 1919 and discussed at length his belief that all is in '*mouvement perpetuel*.' He added that Mondrian rebutted his interpretations in a rather dogmatic manner. Shortly thereafter, no mention is found in Van Doesburg's writings for *De Stijl* of these concepts, except under the guises of I.K. Bonset and Aldo Camini. These two authors were pseudonyms for Van Doesburg and represented, in part, an outlet for his ideas on time and space. This appears to have been done specifically to avoid offending Mondrian, as Carel Blotkamp suggests [1986: 30]. Not surprisingly, Mondrian warned Van Doesburg about the inclusion of these contributors in *De Stijl* [Blotkamp 1986: 30].

Bonset claimed to be a Dada poet and, as such, his inclusion in De Stijl seemed rather odd. Yet reading his work, we discover that he explicitly voiced Van Doesburg's views on space and time. In his "X-Images" (published in *De Stijl* issues of May and July 1920) a debt to scientific thought is immediately apparent in the title of these poems, where *x* suggests not only a link to x-ray imagery, but also to an unknown quantity in mathematical equations: an interpretation which makes sense in terms of the emphasis Van Doesburg would place on mathematics and geometry in his painted works. Furthermore, space and time are also themes, as expressed in the following passage:

> did you experience it ph y S I C A L L Y
> On
> -space and
> -time
> pastpresentfuture
> the behindhereandyonder
> the mix-up of the nought and the phenomenon.[2]

But why Dada? What attracted Van Doesburg to Dada was, firstly, its destructive character as an eradicator of past tradition. This was a goal Mondrian endorsed as well and is why in letters between the two, around 1920, they would sign themselves as "Dada-Does" and "Dada-Piet" [Holtzman & James 1986: 124]. But for Van Doesburg, Dada was more than simply a needed cultural bulldozer, it also represented a new image of reality which he himself adopted; it was an image founded on relativistic principles. As Bonset related in "What is dada???????", published in *De Stijl* in 1923, "Dada is the great phenomenon which is parallel to the relativistic philosophies of the present period … .Dada cannot be fixed by laws" [Bonset 1923: 131]. Consequently, Bonset claimed Einstein as a dadaist.

This position that reality cannot be fixed by laws later became a fundamental principle of Van Doesburg's "Elementarism", the term he used to describe his new art, which incorporated the oblique in opposition to Mondrian's orthogonal. As Van Doesburg related in 1927, "Elementarism advocates the complete destruction of traditional absolutism"; he added that it "acknowledges a form of plastic expression in four dimensions, the realm of space-time" [Van Doesburg 1927: 163, 165].

What is interesting about these excursions by Van Doesburg into the realm of relativistic philosophy is that they belie their varying sources. It would be a mistake to claim that Van Doesburg knew much of Einstein's Theory of Relativity before 1921. In fact, the first explicit reference made to Einstein only occurs in 1923 in the article "What is dada???????". Einstein was not the only individual to formulate a relativistic theory at this time. Too often we jump to the conclusion that if time and space are mentioned together, a reference is being made to Einstein's theory. This is certainly not the case with Van Doesburg. The references Van Doesburg made to space and time in his writings between 1913-1918 are taken from Theosophic texts. For example, Van Doesburg was particularly enthusiastic about M.H.J. Schoenmaekers's works, a number of which he had read by 1918. In his book *The New Image of the World* (1915), Schoenmaeker sets forth a space/time theory based on an interpretation of fourth-dimensional theories current at that time [Blotkamp 1986: 30]. It is only as of 1918 that Van Doesburg began to examine scientific texts dealing with relativity.

Van Doesburg may have turned to scientific interpretations of relativity in 1918, but nothing suggests that he specifically studied Einstein's Theory of Relativity. In a letter dated Sept. 22, 1918 to the poet Antony Kok, Van Doesburg wrote that he had read Henri Poincaré's *New Mechanics* and E. Cohn's *The Physics of Time and Space* and, furthermore, recommended that Kok read "the Relativity theory of Professor Lorentz." The latter is a rather curious statement which has never been questioned before. It has probably been assumed that Van Doesburg meant Lorentz's texts dealing with Einstein's Relativity theory. But he may have simply been referring to Lorentz's own Relativity principle. It is not commonly known outside the discipline of the history of science that Lorentz had, with the assistance of Poincaré, formulated a principle of relativity. In general terms, the differences between the Lorentz/Poincaré principle and Einstein's theory are not obvious, but in specific terms Einstein's theory was more extensive in its bringing together mechanical and electromagnetic phenomena, whereas Lorentz and Poincaré's formulation stressed the mechanical to the exclusion of the electromagnetic. Also, Einstein found no use for the ether, replacing it with space, while Lorentz and Poincaré retained the concept of an ether.

The reason why Van Doesburg's first encounter with relativity would have been with the Lorentz/Poincaré principle rather than Einstein's theory could simply be because Lorentz was Dutch. Also, Bart van der Leck, the co-founder of De Stijl, is known to have attended lectures given by Lorentz and he may have related some of Lorentz's ideas to Van Doesburg [James 1957: 60]. Another factor may have been Henri Poincaré's popularity with artists at this time. He's mentioned by the Italian Futurists, New York Dada, and the Cubists; Van Doesburg published Poincaré's article "Pourquoi l'espace à trois dimensions" in *De Stijl* magazine and lists Poincaré's *New Mechanics* in the library of *De Stijl* [Blotkamp 1986: 29-30]. This is not to say that Van Doesburg was not aware of Einstein's theory, but it is possible that Van Doesburg thought that the Einstein and Lorentz/Poincaré theories were essentially the same; a mistake made by a number of contemporary physicists as well, most notably Max Planck [Hirosige 1976: 70].

Van Doesburg's interest in coupling time and space would manifest itself in earnest in 1921 and, significantly, in architecture. And in a series of lectures given in Weimar in 1921, he announced his new vision for architecture:

> In contrast to the painterly approach inherent in an architecture of two-dimensional facades, the task of the architect is to annul three-dimensional volume by correctly expressing the relationships involved in the arrangement of space …
> … For modern architecture the proper use of colour in space is the most important and difficult issue of our time … .A balance between the elements of space and time can be achieved only in terms of coloured plasticism, which is to say, in terms of painted three-dimensional space-compositions [Van Doesburg 1922: 124-125].

It is in his architectural designs that Van Doesburg would fully flush out his ideas on space and time in art, which would eventually find their way into his paintings.

Lissiztky did not turn to architecture as readily as Van Doesburg did in giving form to ideas related to relativity. However, he did abandon Minkowski's diagram as a Proun image by 1923. One suspects that Lissitzky may have been initially attracted to Minkowski's diagram because it was one of the only "images" of Relativity available. Unfortunately, as Lissitzky must have realized, it is a symbolic rather than actual depiction of the unity of time and space. If the Proun works were to be an architectural blueprint for a new reality, they had to propose how that reality could be realized as material form. This could obviously not be achieved with Minkowski's diagram of the space/time continuum. Consequently, Lissitzky continued to focus his attention on the manipulation of space, which had always been a central component of the Proun works, but with the added element of time. But this introduced a huge problem, namely of how to translate time or motion in a static medium like painting.

Motion is one of the elements involved in Lissitzky's *Proun 93: Free-Floating Spiral* (c. 1923) (fig. 8). The spiral is in fact a series of concentric circles placed one inside the other, with the center point of each moving progressively closer to the bottom left portion of the largest circle. Visually, there are two effects generated by this design. Firstly, the close proximity of the lines gives the illusion that the spiral is in movement: almost like the vibration of a metal spring. Secondly, the spiral creates the impression of a cone, but one which is ambiguous as to whether we are looking at the outside of the cone or looking into it. These effects were certainly directed toward creating an optical sensation of the unity of time and space, i.e., movement in space.

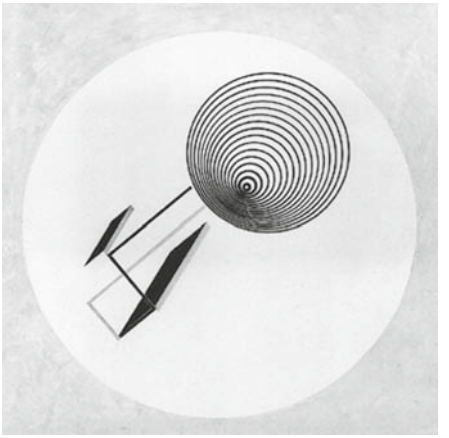

Fig. 8 (above). El Lissitzky, *Proun 93: Free-Floating Spiral,* c. 1923, graphite and colour pencil, india ink, pen and gouache, 49.9 x 49.7 cm, Staatliche Galerie Moritzburg Halle

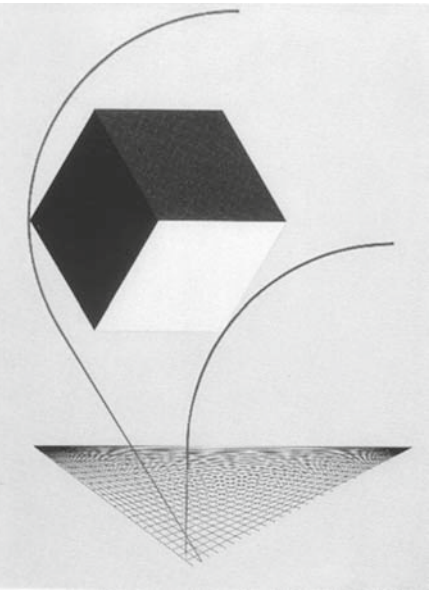

Fig. 9 (right). El Lissitzky, *Proun*, 1924-1925, pen and ink, watercolor, collage 64.6 x 49.7 cm, Museum of Art, Rhode Island School of Design

The optical effect produced in *Proun 93* is recreated in *Proun* (1924-1925) (fig. 9) and *Proun 99* of 1925. The latter painting was Lissitzky's last and may have been conceived as such since it is the simplest and most succinct summary of the Proun theme. In *Proun 99*, Lissitzky creates a multi-dimensional experience involving one-dimensional lines, a two-dimensional strip, a three-dimensional cube and what is most likely a non-Euclidean grid. The latter is suggested by the slight curvature of the grid which, given Lissitzky's familiarity with Carl Friedrich Gauss, is most likely a reference to Gauss's co-ordinate system, which was designed to solve irregular grids such as those describing a curved surface. Although each of the dimensional components found in *Proun 99* appear to generate a coherent image, a closer examination shows otherwise. The one-dimensional lines appear to support the three-dimensional cube, yet by definition this is impossible. In terms of the two-dimensional strip, the viewer reads it at the top as being a certain distance from him/herself, but as the eye moves down this strip, its spatial position vis-à-vis the viewer changes when examined in relation to the cube, and changes yet again in relation to the grid. The spatial position of the cube is also ambiguous: the two lines appear to situate the cube at the edge of the grid, yet the size of the cube and the position of the grid itself suggest otherwise. This play on dimensions is typical of all Lissitzky's Prouns, and was directed at making us aware of the nature of space.[3]

Proun 99 illustrates what Lissitzky would call imaginary space, namely the unity of space/time through the three-dimensional cube which Lissitzky manipulates in a similar manner as the spiral found in *Proun 93*. The application of silver gray paint on one side of the cube creates a shimmering surface, paralleling the vibration of the spiral in *Proun 93*. The cube, like the spiral, is also handled in such a way as to allow a dual reading: either we are looking into the cube or the outside of it (an effect which is accomplished, in part, by the slight irregularity of the cube). Lissitzky hoped that this dual reading would create the impression of an inward/outward-shifting cube, and thus generate the

illusion of spatial movement in painting. With this illusion and the dialogue between the different dimensions presented in *Proun 99*, Lissitzky recapitulated a key objective of *Proun* which he outlined in 1921, when he wrote:

> Proun advances towards the creation of a new space, and by dividing it into the elements of its first, second and third dimensions passing through time, it constructs a polyhedral but uniform image of nature [Lissitzky 1976: 70].

Proun 99 was a successful work, but one suspects it was not a satisfactory one for Lissitzky. The shifting cube was essentially an optical trick, an illusion, which represented a reversion to the trompe l'oeil devices of the Renaissance. It simulated movement rather than generating real movement. Lissitzky himself noted in his article "A. and Pangeometry" [1968] (a tribute to Nikolai Lobachevski's famous essay of 1855) that Futurism and Suprematism presented only static symbols of movement and that the new art had to finally cross the threshold of incorporating real motion, real time. This is the most likely reason why Lissitzky finally abandoned painting. As an inherently static medium, it was clear that painting was unsuited for the task Lissitzky ultimately had in mind. But his abandonment of painting was certainly not a tragic decision for Lissitzky, since he did present Proun as the "interchange station between painting and architecture." Van Doesburg may have had a hand in this move.

Van Doesburg's knowledge and use of physical theories grew immensely after his first encounter with Lissitzky at the end of 1921. Obviously, Van Doesburg could not have found a more fitting fellow enthusiast of modern science: someone well-versed in the finer points of physics and mathematics, and particularly Einstein's Theory of Relativity. Lissitzky appears to have convinced Van Doesburg that Einstein's Theory was worth considering more fully. Whether through extensive discussions with Lissitzky or a more serious examination of the literature, Einstein's Theory begins to play a more considerable role in Van Doesburg's work by 1922. This is revealed in the Dada passages quoted earlier, as well as the new approach to architecture Van Doesburg outlined while teaching in Weimar.

In 1922-23, Van Doesburg collaborated with a young Dutch architect, Cornelius van Eesteren, whom he met in Wiemar in 1922. Van Eesteren was an architecture student whose final student project was the design of a university for Amsterdam. He had sketched out the design in the Netherlands, but it underwent a radical transformation after he met Van Doesburg. The actual extent of Van Doesburg's contribution to the design of the structure is unknown and problematic. He did claim a substantial role, as he noted in a letter to Van Eesteren: "I could point out to you … your University before and after that first stay in Weimar". Although the final appearance of the structure is well-known, Van Eesteren's original conception is not. But given the traditional, classical design of Van Eesteren's earlier projects, the final design of the central building of Amsterdam University appears to have been influenced substantially by Van Doesburg. I am dwelling on this point since one of the striking aspects of the plan is its X shape (fig. 10), a feature which reappears in another collaborative effort, "La Cite de Circulation" (1924-29). This recalls Lissitzky's "New Man" and its derivation from Minkowski's diagram. It seems reasonable to suggest that it inspired the Amsterdam University plan, especially when one compares Lissitzky's image of the "New Man" published in *MA* and Van Doesburg's *Composition for the Floors* (1923) (fig. 11) and *Colour Designs for the Ceilings* (1923) (fig. 12).

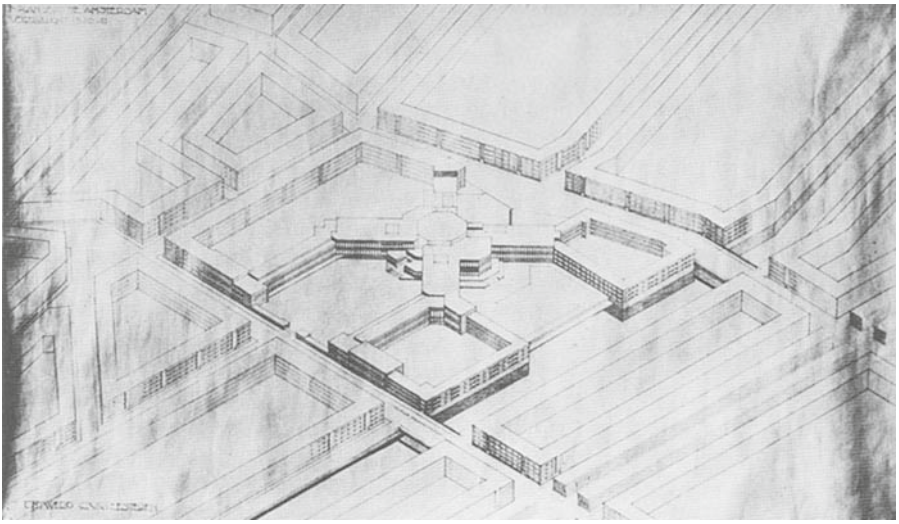

Fig. 10. Cornelis van Eesteren with Theo van Doesburg, *Design for a University in Amsterdam*, 1922, Van Eesteren-Fluck & Van Lohuizen Stichting Foundation, The Hague

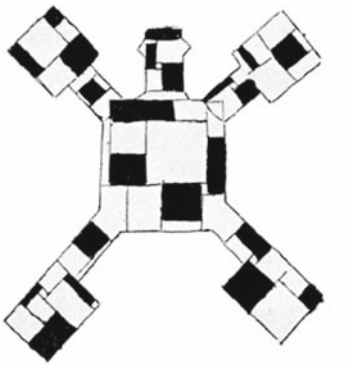

Fig. 11 (above). Theo van Doesburg, *Composition for the Floors*, 1923, fig. 12 in *L'Architecture Vivante*, no. 9, autumn 1925

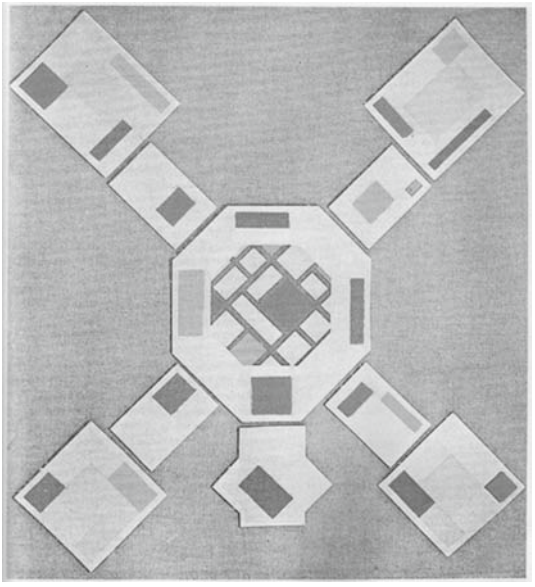

Fig. 12 (right). Theo van Doesburg, *Colour Design for the Ceilings*, 1923, fig. 12 in *L'Architecture Vivante*, no. 9, autumn 1925

This may have been one way Van Doesburg translated Relativity into architecture. Significantly, it is Van Doesburg's designs for the ceiling of the University Hall that inspired his counter-compositions involving the use of the oblique as opposed to Mondrian's orthogonal relationship.

Lissitzky may also have related to Van Doesburg the interpretation of the past, present and future derived from the Theory of Relativity, a concrete example of which found its way into the work of Russian sculptor Naum Gabo. This interpretation of events in a Relativistic universe is outlined in Minkowski's essay "Space and Time" and

explained at length by Hermann Weyl,[4] whose "Light Cones" Gabo copied almost literally [Hatch 1995: 358-364]. It is quite likely that Lissitzky had read Weyl and was familiar with Weyl's "light cones", which distinguish between the active future and passive past. This interpretation found its way into Van Doesburg's 1924 article, "Surrealism. Realistic Dialogue" published in *De Stijl* (1924), in which, in his discussion of Cubism, he dissects himself as narrator into "my past I" and "my future I". It is also in this text that Van Doesburg noted his dissatisfaction with the intuitive approach to art, wishing to replace it with a scientific (mathematical) determination [Baljeu 1974: 68-70]. It may be far-fetched to suggest a parallel between this text and Relativity's interpretation of time, but given the close relationship between Lissitzky and Van Doesburg the suggestion seems justified.

In 1923, Van Doesburg was given the opportunity to express his architectural principles fully and concretely; previous to this, all of Van Doesburg's architectural experiments were applied to already constructed buildings. The art dealer Léonce Rosenberg, who sold Mondrian's works and was a supporter of De Stijl, commissioned the group to construct a villa for him. The buildings, three in all, were never constructed, since Rosenburg did not have the funds to build them. But the plans and models provided an important experimental ground that allowed Van Doesburg, with the help of Van Eesteren, to refine and further develop his new ideas on architecture.

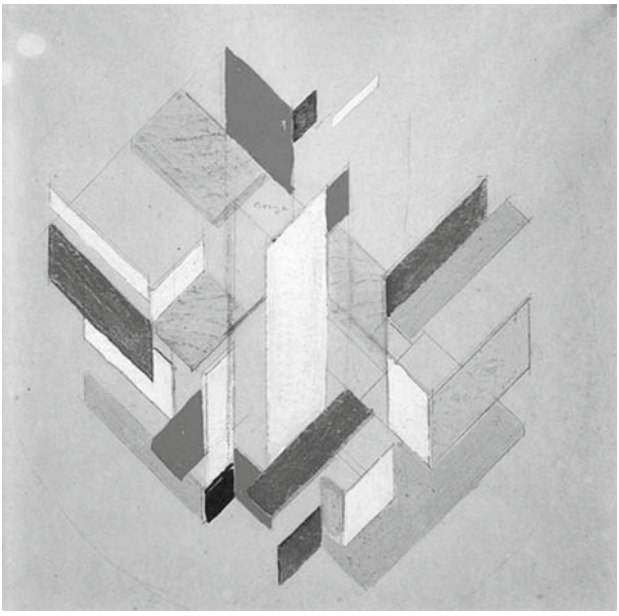

Fig. 13. Theo van Doesburg, *Countercomposition in Primary Colours for an Artist's House*, 1923, 36.8 x 38.1 cm, Dienst Verspreide Rijkskollekties, The Hague

In the Rosenberg commission, Van Doesburg draws upon Mondrian's concept of planar construction (fig. 13). Mondrian had defined Neo-Plastic architecture as based on "a *multiplicity of planes*" [Mondrian 1922: 171]. This is not how Van Doesburg had conceived his earlier architectural models. One of the first major manifestoes dealing with the Rosenberg commission, published in *De Stijl* in 1924, related that the structures were formless, based on the definition of space by way of rectangular planes. These planes

defined a system of spatial relationships, where no one element of the construction could be viewed as a closed, inactive space. This definition meant the rejection of the groundplan in architectural design, as Van Doesburg remarked:

> The … planes, which separate the different functional spaces, can be *mobile*, which means that the separating planes … can be replaced by movable screens or slabs … .In the following phase of this development in architecture, the groundplan must disappear completely. The principle of two-dimensionally projected space-composition, as *fixed* by a groundplan, will be replaced by exact *calculation of the construction*, a calculation which must transfer the carrying capacity to the simplest but sturdiest points of support. Euclidean mathematics will no longer serve this purpose; yet by using Non-Euclidean calculations in four dimensions, this calculation can be accomplished quite easily [Van Doesburg 1924: 144].

The need for non-Euclidean geometry in architectural design points to the fact that space and time are involved. Van Doesburg himself made this clear:

> The new architecture calculates not only with space but also with time as an architectural value. The unity of space and time will give architectural form a new and completely plastic aspect, that is, a four-dimensional, plastic space-time aspect [Van Doesburg 1924: 144].

Van Doesburg unfortunately supplied vague descriptions on how these principles could be translated into concrete terms. Despite noting how simply one can conceive an architectural model using Non-Euclidean geometry, there exist no examples of this technique in Van Doesburg's own sketches or descriptions in his writings. We do know though, that the use of colour was important in creating the four-dimensional aspect of Van Doesburg's new conception of architecture: "The new architecture employs colour organically as a direct means of expression of relationships in space and time" [Van Doesburg 1924: 145]. But again, as was the case with the groundplan, little is said as to how colour functions in this regard.

However, a unique feature of Van Doesburg's design is that there is never one fixed point from which one can define the whole of the structure. Every vantage point provides a unique view that is never repeated. In other words, there is no defining moment, no fixed or absolute point, and thus Van Doesburg achieves an inventive type of completely relativistic, Dadaist type of architecture. It embodies a notion we will encounter with Lissitzky, that every point in space is related to a unique moment in time.

The exterior appearance is complemented by the interior, for which Van Doesburg proposed the use of moving walls/partitions that would allow for a variety of interior configurations. This is an idea that would be employed in what is arguably the only De Stijl structure, the Schröder House, designed by Gerrit Rietveld with the help of Truus Schröder in 1942-25. Rietveld was a furniture designer who joined De Stijl in 1919. He helped Van Doesburg and Van Eesteren with the Rosenberg commission, designing the models, and his work with them contributed to his creation of some unique pieces of furniture, the Schröder Table and Berlin Chair (1923), which followed the principles being outlined by Van Doesburg. Obviously, Rietveld embraced Van Doesburg's redefining of architecture, since the Schröder House would follow a number of the suggestions laid out by Van Doesburg.

Van Doesburg's architectural theories and designs must have inspired Lissitzky. In "A. and Pangeometry," Lissitzky set out the possible means for creating imaginary space in art, beyond the confines of painting:

> … we know that a material point can form a line; for example: a glowing coal while moving leaves the impression of a luminous line. The movement of a material line produces the impression of an area of a body. There you have but an intimation of how one can build a material object by means of elementary bodies, in such a way that while it is motionless it forms a unity in our three-dimensional space, and when set in motion it generates an entirely new object, that is to say, a new expression of space, which is there for as long as the movement lasts and is therefore imaginary. … Motion is incorporated … as an ingredient in the total complex of the elements which are to build the new bodies [Lissitzky 1968: 352-353].

This entailed the use of objects which function on the basis of rapid rotation or vibration. Lissitzky illustrated an example of it in his text "A. and Pangeometry" and also mentioned a work by Naum Gabo which, in Lissitzky's words, "stylized the pendulum-movement of a metrodome".[5] For Lissitzky, the space generated by the rapid movement of an object is imaginary for the simple reason that it only exists "as long as the movement lasts." Once the movement ceases, the object returns to its original state as part of our three-dimensional reality. But such works were nothing more than illustrations of imaginary space, which explains why Lissitzky did not experiment with kinetic sculpture. He wanted to move one step further by creating a work in which one could physically experience the unity of time/movement and space.

Lissitzky had constructed an actual physical space based on his Proun imagery before 1925, the *Proun Room* (1923) (fig. 14), in part encouraged by Van Doesburg's own work in architecture. Upon its walls were affixed three-dimensional recreations of Proun paintings. The objective was to generate a living space that encouraged one to walk within it. Thus, movement was a component of the work. That the theme was to somehow build an environment in which one could experience the unity of time and space is suggested by the fact that Lissitzky had planned to adapt the composition of *Proun G7* for the ceiling of the *Proun Room*. This theme was radically reformulated in the Dresden and Hanover Exhibition Rooms of 1926 and 1928 respectively.

In the Dresden *Room for Constructivist Art* (fig. 15), Lissitzky placed thin vertical strips perpendicular to the wall, strips which were seven centimeters wide and placed at seven centimeter intervals. The wall itself was painted gray and the strips were painted white on one side, black on the other and the ends gray. The result was that as one moved within the room, its color shifted gradually from white to gray to black. Added to this was the hanging of the pictures in the room on moving panels, which allowed the viewer to physically participate in the transformation of the room. The Hanover room, *The Abstract Cabinet*, (fig. 16) repeated these devices with some modifications and additions. The movable paintings were complemented by rotating showcases for the sculpture. Instead of vertical strips, Lissitzky used thinner triangular ones (three centimeters wide at their base), spaced at smaller intervals (two centimeters apart); the sides of the strips were once again painted white on one side, black on the other and gray at the tip. The modification of the strips made the transformation in wall color more gradual, intensifying the effect presented in Dresden.

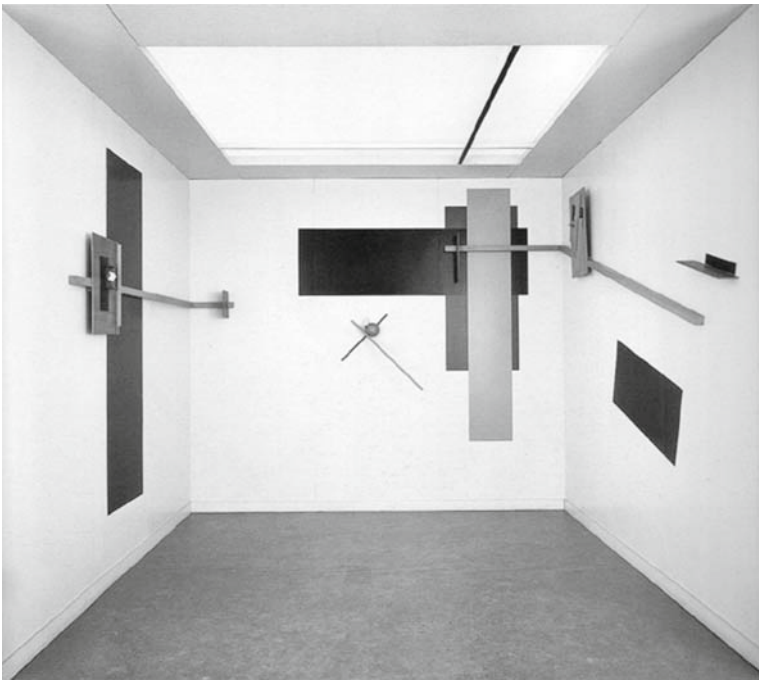

Fig. 14. El Lissitzky, *Proun Room*, 1923, reconstruction, 300.0 x 300.0 x 260.0 cm

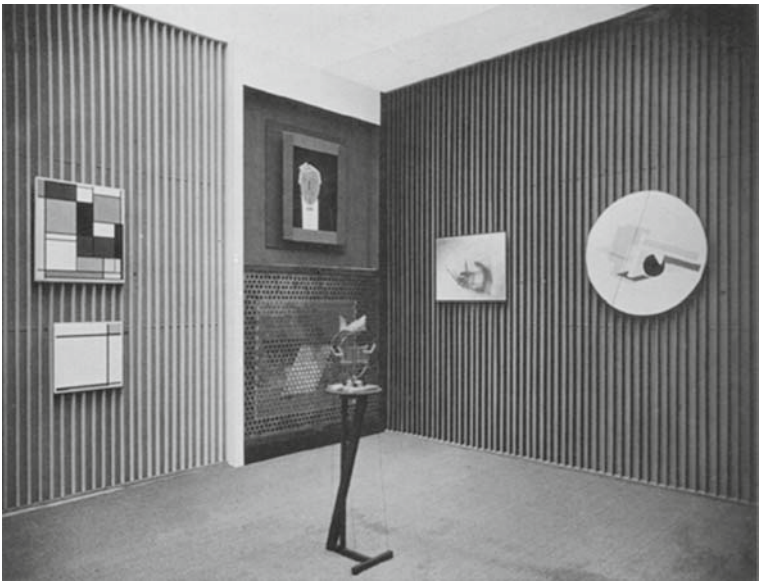

Fig. 15. El Lissitzky, *Room for Constructivist Art*, Dresden, 1926, 6 x 6 m

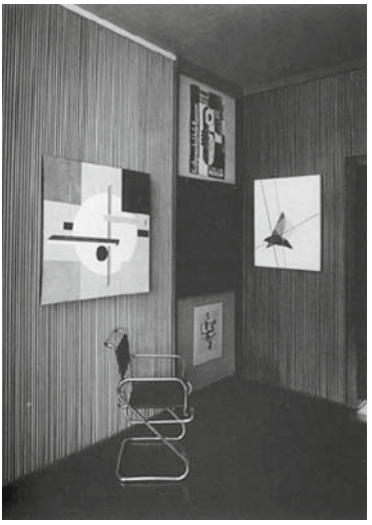

Fig. 16. El Lissitzky, *The Abstract Cabinet*, Hanover, 1928, 300.0 x 427.0 x 549.0 cm

As spectators at a 1991 retrospective in Paris of Lissitzky's work were able to witness in a reconstruction of the Hanover room, the effect created by this exhibition space on the viewer was remarkable. It was best experienced by visualizing the appearance of the room just before entering, and then proceeding into it with one's head down; once inside, the immediate impression upon raising one's head was a sense of disorientation, caused by the feeling that the space you are in is not the same space you saw just before entering. As one moved within the room, its appearance changed continuously in a mesmerizing way. This accomplished Lissitzky's goal of uniting time and space, where for each point in time, defined as movement, there was a unique spatial configuration, i.e., visual appearance of the room or "room-space," as Lissitzky called it. The Hanover room represented Lissitzky's most ingenious and successful aesthetic embodiment of Minkowski's statement that "Nobody has ever noticed a place except at a time, or a time except at a place." This clearly echoes what happens with the Rosenberg commission designs.

The failure of the Rosenberg commission to materialize resulted in Van Doesburg's return to painting. But Van Doesburg's experiments with architecture were not abandoned; they would find their way into his paintings, resulting in some rather significant and controversial changes, most notably Mondrian's departure from De Stijl. Mondrian could live with Van Doesburg's interest in time in art when it concerned itself with architecture, since this was by definition a materialistic art form. But once Van Doesburg began to boldly incorporate these ideas into painting, Mondrian could no longer endure the corruption of his own Neo-Plastic ideals.

Van Doesburg claimed by 1926 that his paintings were a "plastic intuition, controlled by a scientific idea, which is needed by the new man" [Van Doesburg 1926a: 155]. This debt to the Theory of Relativity was further spelled out in "Painting and Plastic art", when in defining "Elementarism", the name Van Doesburg gave to his new art, he wrote:

> *Elementarism* is the equivalent of relativity, of the latest discoveries about matter and of phenomenological definitions concerning the unlimited, yet latent, omnipotence of human intelligence. In contrast to religious dogmatists [an obvious slur against Mondrian], the Elementarist considers life only as 'a perpetual transformation' … [Van Doesburg 1926b: 160].

He added that

> Elementarism is preparing for the realization of elementary counter-plastic form, and we must first destroy the use of the static axis in contempt for

> the Euclidean view of life (which relates to the static point) [Van Doesburg 1926b: 160].

Elementarism thus summed up all of Van Doesburg's experiments in art dating back to around 1918 and which had essentially remained in the background until 1926. Strangely enough, Van Doesburg reconciled with Mondrian shortly before his death in 1931, and re-embraced his mentor's positions on art.

Lissitzky's interest in science and its role in his art continued but in a somewhat more muted form necessitated by the rise of Stalinism. For Lissitzky the Theory of Relativity supplied the most fundamental reformulation of reality occurring in his time and, more importantly, was part of a broader cultural change, where:

> … the confines of expertise have been blown to bits. Methods which were once employed in a particular branch of art, knowledge, science, philosophy, are now being transferred into other areas. This is happening, for example, to the four coordinates of Minkowski's world … [Lissitzky 1976: 60].

Lissitzky's art was extensively nourished by "Minkowski's world" and, for Lissitzky, the future rested with a better understanding of science. It is certainly for this reason that Lissitzky began planning and designing a mathematics book for children in 1928.

Acknowledgments

I must thank Dawn Ades, Linda Dalrymple Henderson, Kim Williams, Gerard Curtis, and Danika Irvine for their help at various stages of the research and writing; my usual nod to Karen, Robbie and Patrick, who patiently put up with my obsessions; and, for their invaluable financial support, many thanks to the Social Sciences and Humanities Research Council of Canada. However, as appreciative as I am for all this help, this article is dedicated to my parents who passed away a few years ago and whose absence has created an immeasurable void in my life and those who knew them; they always reminded me that my first crib was a gift from the Physics Department at Queen's University

Notes

1. [Minkowski 1908: 84, fig. 2]. This collection of essays was originally published in Germany in 1920 and was already in its third edition by 1923.
2. [Bonset 1920: 114-15]. Blotkamp translates the last line as "the pell mell of nothingness and being"; cf. [Blotkamp 1986: 30].
3. Most of the effects described pertaining to *Proun 99* are found in the Proun illustrated in fig. 9, with the exception of the two-dimensional strip.
4. [Weyl 1922: 169-177]. English readers of texts on Relativity will probably be more familiar with A.S. Eddington's "Absolute Future, Absolute Past and Here-Now hourglass model". This model is essentially the same as that published by Weyl nine years earlier. The similarity of these models is due to the fact they are both based on Hermann Minkowski's seminal work on Relativity; see [Eddington 1928: 41-50].
5. [Lissitzky 1968: 352]. The Gabo work in question is the *Kinetic Construction* (1919-20: The Tate Gallery, London).

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