

CONSTRUCTING VISION:

László Moholy-Nagy's *Partiturskizze zu einer
mechanischen Exzentrik*, Experiments in Higher
Spatial Dimensions

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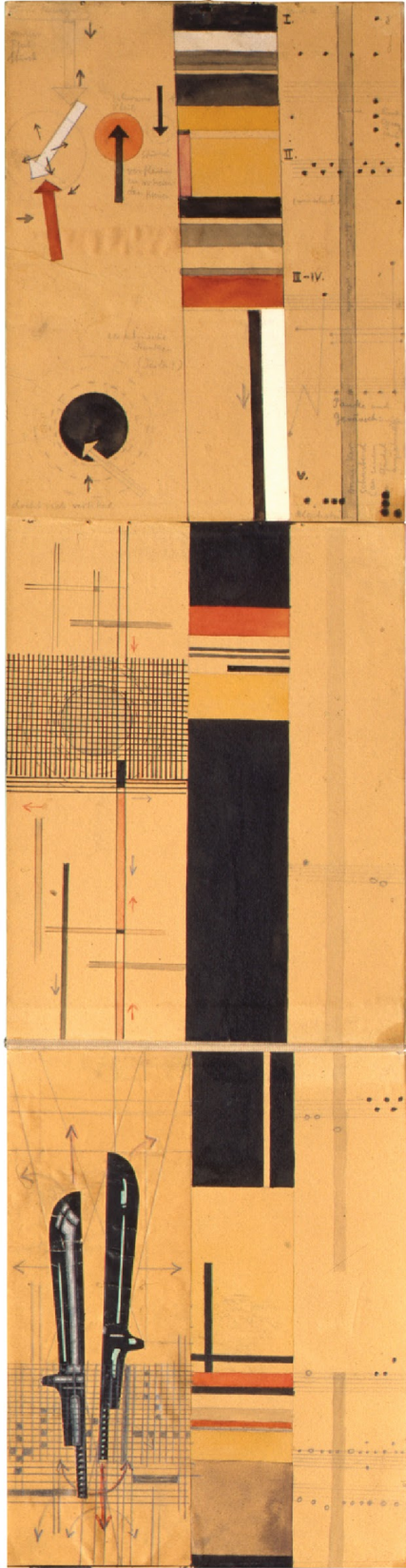
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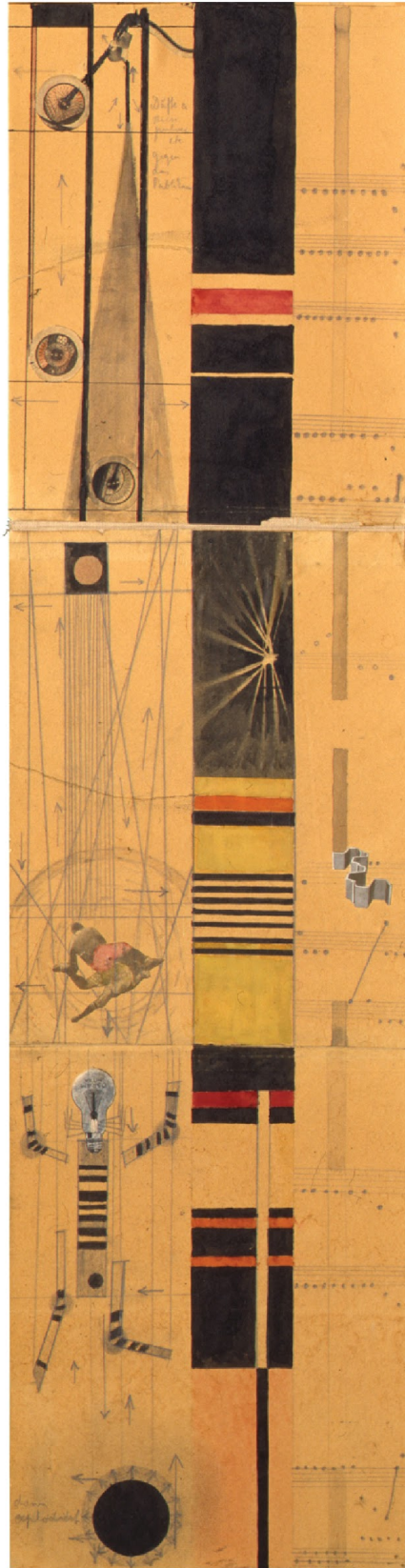
theater

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match edge

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ABSTRACT

In 1936, while an expatriate in London, László Moholy-Nagy signed the *Manifeste dimensioniste*, crafted by Hungarian poet Charles Sirató, declaring his allegiance to the pursuit of creating artistic works in higher dimensions. In his artworks and writings, Moholy-Nagy was deeply invested in emerging technologies of the early twentieth century in the service of seeing the world differently, augmenting and training the sensory organs to visualize higher dimensions of space, essentially to see what does not appear, what is apparently invisible. Through his work with light and movement, which took many forms, painting, photography, film, kinetic sculpture, and theater, he worked through traditional and avant garde notions of space and time as related to psychophysical experience. Moholy-Nagy held that higher dimensions could be experienced through a re-education of human senses and began to lay out his claim for the education of the senses in order to see the world differently as early as 1922 in "Produktion-Reproduktion" (*De Stijl*). In *Malerei, Fotografie, Film* (Painting, Photography, Film, 1925), Moholy-Nagy asserted that through the visual objectivity produced photographs, especially in oblique photographs, "**[w]e may say that we see the world with entirely different eyes.**"

In this dissertation, I examine the influence of contemporary psychophysical, space-time theories on a stage/ performance design created by Moholy-Nagy, in particular, the two versions of his design for a synaesthetic theatrical performance entitled, *Partiturskizze zu einer mechanischen*

Exzentrik (Score-Sketch for a Mechanical Eccentric): one a hybrid, mixed media drawing (c. 1923) and the other a revised version printed in *Die Bühne im Bauhaus* (The Stage of the Bauhaus, 1925). Following the structure of the hybrid drawing, each chapter is an interpretation of a single panel of the drawing, corresponding to the prelude and the five acts of the performance. This interpretation was made through a close reading of the drawing itself, examining the references made in the images and notations, comparing the two versions, and uncovering similar themes in his lectures, writings, and artistic works, and, in turn, pursuing references to physics, psychology, mathematics, and literature, whose profound influence was acknowledged by Moholy-Nagy in those texts. These influences include the writings of Albert Einstein, Hermann Minkowski, János Bolyai, Hermann von Helmholtz, Rudolf Carnap, Sigmund Freud, Wilhelm Wundt, E. T. A. Hoffmann, James Joyce, and many others. Through this analysis, I reveal the ambitious intention at the heart of the *Exzentrik*, to immerse the audience in a synaesthetic experience that expands their psychophysical consciousness using electromagnetic vibrations in the form of visible and invisible light and sound, as well as shocking and comedic forms and movements, and that, thereby, opens the audience to the construction of a new vision that endows them with the capacity to envision higher dimensions of space.

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László Moholy-Nagy *Partiturskizze zu einer mechanischen Exzentrik*,

Experiments in Higher Spatial Dimensions

Jodi Lynn La Coe

GENERAL AUDIENCE ABSTRACT

In 1936, while living in London, László Moholy-Nagy signed the *Dimensionist Manifesto*, written by Hungarian poet Charles Sirató, declaring his allegiance to the pursuit of creating artistic works in higher dimensions, such as three-dimensional paintings or four-dimensional space-time constructions. In his artworks and writings, Moholy-Nagy was deeply invested in the emerging and advancing technologies of the early twentieth century in the service of seeing the world differently, augmenting and training the sensory organs to visualize higher dimensions of space, essentially to see what does not appear to the naked eye, for instance x-ray images reveal what is apparently invisible. Through his work with light and movement, which took many forms, painting, photography, film, moving sculptures, and theater, he explored how a person experiences space and time both physically and intellectually and Moholy-Nagy began to lay out his claim for the education of the senses in order to see the world differently. In *Malerei, Fotografie, Film* (Painting, Photography, Film, 1925), Moholy-Nagy asserted that through the visual objectivity produced photographs, especially in oblique photographs, **“[w]e may say that we see the world with entirely different eyes.”**

In this dissertation, I have examined the influence of contemporary space-time theories on two versions of Moholy-Nagy's design for a theatrical performance called the *Score-Sketch for a Mechanical Eccentric*, one a hand-drawn and painted collage (c. 1923) and the other a revised version printed in *The Stage of the Bauhaus* (1925). Following the structure of the former,

each chapter is an interpretation of a single panel of the drawing/collage, corresponding to the prelude and the five acts of the performance. This interpretation was made through a close reading of the drawing itself, examining the references made in the images and notations, comparing the two versions, and uncovering similar themes in his lectures, writings, and artistic works, and, in turn, pursuing references to physics, psychology, mathematics, and literature, whose profound influence was acknowledged by Moholy-Nagy in those texts. These influences include the writings of Albert Einstein, Hermann Minkowski, János Bolyai, Hermann von Helmholtz, Rudolf Carnap, Sigmund Freud, Wilhelm Wundt, E. T. A. Hoffmann, James Joyce, and many others. Through this analysis, I will reveal the ambitious intention at the heart of the performance, to immerse the audience in a multi-sensory experience that will expand their consciousness, thereby, to expand their sensory perception, using shocking and comedic displays to psychologically open the audience to the possibility of perceiving higher dimensions of space.

for Evan

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While being geographically remote, Hilary Bryon and Oliver Botar have also been indispensable guides. While I have told her this in person, it is worth immortalizing in an acknowledgements. In a very tough but uplifting way, Hilary encouraged me not to rush things, but rather to invest in reading and writing as much as possible, while I had this 'luxury' of time. Hilary's insights into architectural representation and interpreting objects, dimensionally, have been particularly

provocative. Without knowing me or ever having met me, she and Oliver Botar were willing to entertain my initial excited and nervous ramblings about Moholy-Nagy and “seeing the world with different eyes,” willing to share their time and insights, willing to commit to working with me. I can only imagine their willingness as a leap of faith, since my ideas were wholly unsupported at the time. However, having their ears from the very beginning of my studies was so very helpful. Although he is THE expert on Moholy-Nagy living today, Oliver was sensitive to the fact that I was embarking on a new journey. During our first video conference, Oliver gave me one spoonful of encouragement and one spoonful of doubt, the former about noticing that Moholy-Nagy was interested in seeing the world differently with oblique points of view and the latter about whether or how Moholy-Nagy would have known about perspective constructions. I am grateful to Oliver for his generosity with his knowledge, connections at archives, and introductions. It was also a pleasure to have Oliver be a keynote speaker at the Frascari Symposium III, embracing an architectural topic like ceilings and dreams in relation to Moholy-Nagy's work on the derangement of the senses was magical.

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PRELUDE

Perception and Apperception in the
Construction of Vision: Deciphering
László Moholy-Nagy's *Partiturskizze zu
einer mechanischen Exzentrik*

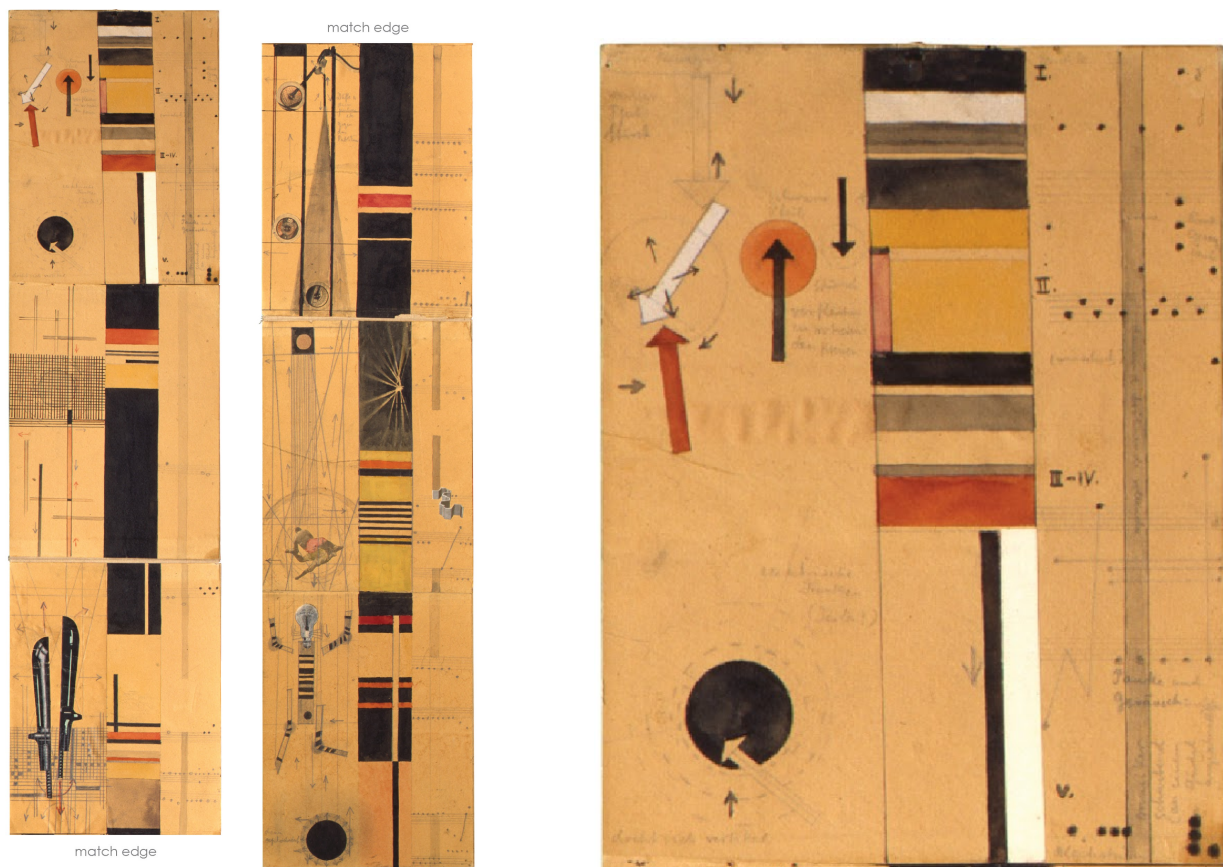


Figure 0.1: László Moholy-Nagy, Untitled, c. 1924, graphite and color pencils, ink and watercolor, and collaged pieces on paper: 140 x 17.8 cm (55.125" x 7.0156"), Theaterwissenschaftliche Sammlung Schloss Wahn, Universität zu Köln + Prelude Detail.

Artists and scientists at the beginning of the twentieth century were attempting to overcome the limitations of sensory perception through theoretical and physical training exercises, often linked to technological advancements promising both objectivity and acuity in visualizing, heretofore, invisible higher dimensions of space. These limitations are both physiological, involving the anatomy of sensory organs, and psychological, involving the interpretation of sensory stimuli. László Moholy-Nagy was one of these artists who practiced art as a process of scientific investigation. In his *Partiturskizze zu einer mechanischen Exzentrik* (Score-Sketch for a Mechanical Eccentric, c. 1924),¹ Hungarian artist László Moholy-Nagy created a collaged drawing describing an immersive, synaesthetic, theatrical performance intended to shock the senses of the audience, in order to awaken dormant perceptual capabilities (**Figure 0.1**). In this state of openness, Moholy-Nagy would penetrate the consciousness of the audience with abstract and enigmatic displays containing hidden meanings linked to an invisible dimension. Using the penetrative power of optophonetic vibrations, he would challenge how people think, engaging the mind and body to perceive additional dimensions of space. An examination of the contents of the *Exzentrik*, in light of his writings and scientific references, will provide insight into the framework within which Moholy-Nagy used point-of-view to construct psychophysical projections of fourth dimensional space.

The *Partiturskizze zu einer mechanischen Exzentrik* exists in two versions: one being a hybrid work of art combining collaged elements from newspapers and magazines with drawing, painting, and handwritten text, referred to hereafter as the hybrid *Exzentrik*, or hybrid drawing; the other

¹ László Moholy-Nagy, *Partiturskizze zu einer mechanischen Exzentrik*, (c. 1924) located in the Theaterwissenschaftliche Sammlung in Schloss Wahn of the Universität zu Köln. A shorter, printed version appeared the following year in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *Die Bühne im Bauhaus*, Walter Gropius and László Moholy-Nagy, eds., (Munich: Albert Langen Verlag, 1925), 44 and foldout. The printed version of the *Exzentrik* appeared in the hardcover English translation, but not in paperback printings: Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *The Theater of the Bauhaus*, Arthur S. Wensinger, trans., (Middletown, CT: Wesleyan University Press, 1961), 48 and foldout.

being a similar version prepared for print in the fourth volume of the *Bauhausbücher* series, *Die Bühne im Bauhaus*, referred to as the printed version of the *Exzentrik*. Completed in 1924, the hybrid *Exzentrik* was arranged into three columns running across six sheets of paper mounted onto three rigid cardboard panels, the reverse side of which was covered by a continuous piece of ivory linen, effectively creating three folding panels with a vertical orientation (**Figure 0.2**). The overall dimensions of the hybrid drawing for the *Exzentrik* are 140 X 17.8 cm (55.125" X 7.0156"). In comparing the changes made between the original hybrid drawing to the later printed version of the *Exzentrik*, the major structural differences include (a) the removal of most of the content of the final act, the fifth act, featuring a large marionette, and (b) the addition of a second column of "Form + Bewegung" (Form + Movement), essentially distributing elements from the single column in the hybrid drawing into two columns in the printed version (**Figure 0.2**).² Both of these changes reduced the length of the *Exzentrik*, perhaps due to printing limitations.

Several additions to the printed version of the *Exzentrik* aid in deciphering the hybrid drawing. For instance, Moholy-Nagy included an oblique diagram of a stage design, a descriptive paragraph with a provocative list of words and phrases, of which some were also found among the handwritten notes on the hybrid drawing, and his essay, "Theater, Zirkus, Varieté" (Theater, Circus, Variety), in which he situated his design within a schematic of historical developments in the form and intention of the theater and three collages relating to the content of the *Exzentrik*. In this essay, Moholy-Nagy proposed a radical shift away from the historical theater as vehicle for the dissemination of propaganda to a transformative, synaesthetically activated theater, capable of expanding into the subconscious on a visceral level in order to perceive the world afresh.³

² While both of the "Form + Bewegung" columns and the "Licht (Farbe)" (Light [Color]) column simply omit the fifth act, the "Ton" (Sound) column cuts most of the third scene aligning the fourth and fifth scenes of the music with the third and fourth scenes.

³ Moholy-Nagy, "Theater, Zirkus, Varieté," in *Die Bühne im Bauhaus*, 1925, 45 + 54–55: "Es muß endlich eine

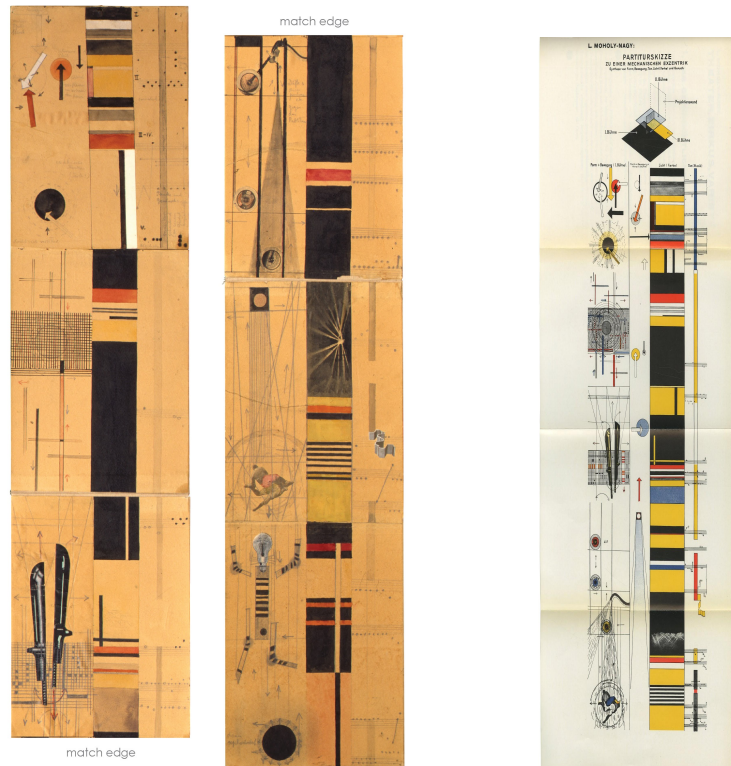


Figure 0.2: László Moholy-Nagy, (left) Untitled, c. 1924, for complete caption see note to Figure 0.1 + (right) *Partiturskizze zu einer mechanischen Exzentrik* (Score-Sketch for a mechanical Eccentric), in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar. *Die Bühne im Bauhaus*, Munich, Albert Langen Verlag, 1925, Tricolor print on glossy paper: 56.4 x 22 cm (22.375" x 8.625").

Moholy-Nagy approached his art and design work with the nature of an experimental scientist, repeatedly re-examining traditional ideas, producing new insights, and introducing new

Aktivität entstehen, welche die Masse nicht stumm zuschauen läßt, sie nicht nur im Innerenregt, sondern sie zu greifen, mittun und auf der höchsten Stufe einer erlösenden Ekstase mit der Aktion der Bühne zusammenfließen läßt." (It must finally emerge [as] an activation, in which the mass[es are] not left to watch in silence; they, not only excited on the inside, but rather, they grab, act with and, from the highest level of a redeeming ecstasy with the action of the stage, are allowed to flow together.) Translation by author.

technologies whenever possible. Moholy-Nagy arrived in Berlin in March 1920,⁴ shortly after Arthur Eddington's 1919 photographic confirmation of Einstein's "Zur Elektrodynamik bewegter Körper" (On the Electrodynamics of Moving Bodies, 1905), known later as his *Special Theory of Relativity*, and his "Die Grundlage der allgemeinen Relativitätstheorie" (The Foundation of the General Theory of Relativity, 1916).⁵ While began experimenting with notions of perception and apperception in his photographs, *Photograms*, and *Photoplastiks*, serving as a basis for his explorations into higher dimensions of space. In his writings toward the end of his tenure at the Staatliches Bauhaus (State Bauhaus) in Dessau (1925–1928), Moholy-Nagy had fully developed this form of inquiry into space and time, experimenting with the psychophysical interplay of light, shadow, and movement.⁶

⁴ Oliver A. I. Botar, *Technical Detours: The Early Work of Moholy-Nagy Reconsidered* (New York: The Art Gallery of The Graduate Center, The City University of New York and The Salgo Trust for Education, 2006), 86. Botar previously published a detailed account of Moholy-Nagy's artistic growth embedded in his journey from Hungary through Austria and to Berlin in his essay, "An Activist-Expressionist in Exile: László Moholy-Nagy, 1919–1920," in Belena S. Chapp et al., eds., *László Moholy-Nagy: From Budapest to Berlin 1914–1923* (Newark, DE: University Gallery, University of Delaware, 1995), 74 in which he compared Sibyl Moholy-Nagy's recollections with a letter that Moholy-Nagy wrote to his friend Iván Hevesy mentioning the Kapp-Lutwitz Putsch (March 13–17, 1920). See also Sibyl Moholy-Nagy, *Experiment in Totality*, 2nd ed. (Cambridge, MA: MIT Press, 1969), 17.

⁵ Albert Einstein, "Zur Elektrodynamik bewegter Körper" (On the Electrodynamics of Moving Bodies), *Annalen der Physik* (1905) and "Die Grundlage der allgemeinen Relativitätstheorie" (The Foundation of the General Theory of Relativity), *Annalen der Physik* 49 (Berlin, 1916): 769–822.

⁶ Drawing from concepts related to the German *Pädagogische Reformbewegung* (Pedagogical Reform Movement), Moholy-Nagy called for the full education of the senses in his early writings; see Oliver A. I. Botar, "Sensory Training," in *Sensing the Future: Moholy-Nagy, Media and the Arts*, (Zürich: Lars Müller Publishers, 2014), 17–39.

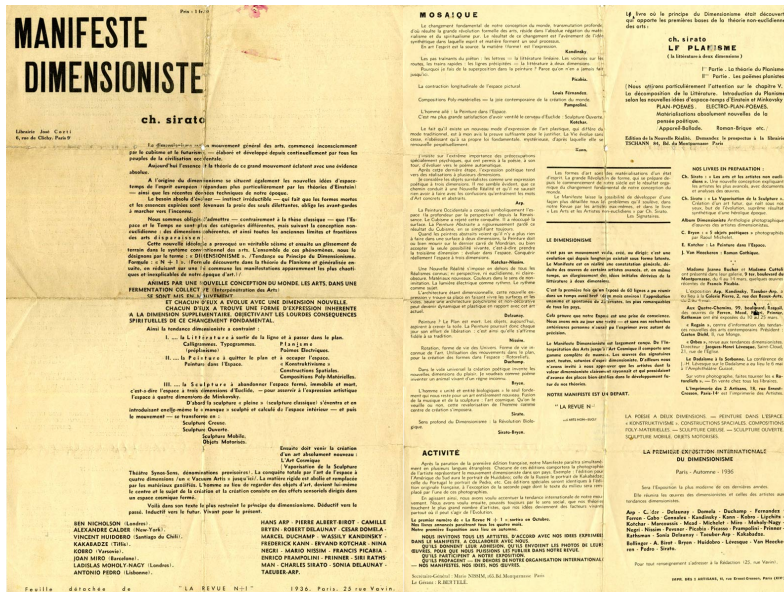


Figure 0.3: Charles Sirató, *Manifeste dimensionniste*, recto and verso, originally published as a folded insert for *La Revue N + 1*, Paris, 1936.

From London in 1936, Moholy-Nagy declared his allegiance to dimensional explorations and signed the *Manifeste dimensionniste* (Dimensionalist Manifesto), written by Hungarian poet Charles Sirató calling for artists raise their works to the next higher dimension using the geometric analogy of point to line, line to plane, plane to cube, and cube to “vaporization” (**Figure 0.3**).⁷ Many other leading avant-garde artists who had been working in the area of higher dimensions signed the manifesto including Marcel Duchamp, Wassily Kandinsky, Francis Picabia, and Hans Arp.⁸ In

⁷ Although an anachronistic reference, Moholy-Nagy's manifestoes, such as the here-referenced *Manifeste dimensionniste*, lectures, writings, and artworks created after the *Partiturskizze zu einer mechanischen Exzentrik* are used to illustrate Moholy-Nagy's life-long interest in the visualization of space-time. These later texts provide insight into the sources of Moholy-Nagy's early interests, ranging from historical and contemporary art to literature to science, psychology, and politics. As a person who immersed himself in current trends and intellectual circles, it is also more than likely that Moholy-Nagy read widely from avant-garde and scientific journals as they appeared, which he would later reference repeatedly in his own writings, providing justification for anachronistic references in this interpretation.

⁸ Oliver A. I. Botar, “Charles Sirató and the Dimensionist Manifesto” in *Dimensionism: Modern Art in the Age*

the same year, in a speech made at an informal general meeting of the Royal British Institute of Architects (RIBA) on 9 December 1936, Moholy-Nagy implored his audience to consider the implications of different spatial concepts in architecture, including levels of dimensional space and non-Euclidean space,⁹ which he had previously compiled in his *Bauhausbuch, Von Material zu Architektur* (From Material to Architecture, 1929, in English translation known as *A New Vision*):

man spricht heute von dem: mathematischen, physischen, geometrischen, euklidischen, nichteuklidischen, architektonischen, tänzerischen, malerischen, szenischen, filmischen, sfärischen, kristallinen, kubischen, hyperbolischen, parabolischen, elliptischen, körper-, flächen-, linearen, drei-, zwei-, ein-, } stufigen, projektiven, metrischen, isotropen, topologischen, homogenen, absoluten, relativen, fiktiven, abstrakten, realen, imaginären, endlichen, unendlichen, grenzenlosen, universalen, äter-, innen-, außen-, bewegungs-, hohl-, luftleeren, formalen usw. raum.¹⁰ (We speak to-day of: mathematical, physical, geometric,

of Einstein, Vanja V. Malloy, ed. (Cambridge, MA and London: MIT Press, 2018), 19–47. This manifesto was first prepared for the unrealized publication *La Revue N + 1* (Paris: Librairie José Corti, 1936) as a loose insert but was later published in a supplement to *Plastique*, no. 2 (Paris, summer 1937). The manifesto was translated into Hungarian by Sirtó and may be found in Tamkó Sirtó Károly, "Dimenzionista Manifesztum," *A Vízöntő-kor hajnalán* (Aquarius at Dawn), Budapest, Szépirodalmi Könyvkiadó, 1969, 209–211. First appearing in English translation in Mary Ann Caws, ed. and trans., *Manifesto: A Century of Isms* (Lincoln, NE: University of Nebraska Press, 2001), 536–538. The full list of signatories in order of printing: Ben Nicholson, Alexander Calder, Vincent Huidobro, Kakabadze, Kobro, Joan Miro, Ladislav Moholy-Nagy, Antonio Pedro, Hans Arp, Pierre Albert-Birot, Camille Bryen, Robert Delaunay, Cesar Domela, Marcel Duchamp, Wassily Kandinsky, Frederick Kann, Ervand Kotchar, Nina Negri, Mario Nissim, Francis Picabia, Enrico Prampolini, Prinner, Siri Rathsmann, Charles Sirato, Sonia Delaunay, [Sophie] Taeuber-Arp.

⁹ The lecture was published in *Journal of the Royal Institute of British Architects*, London, Third Series, v. 44, n. 5, January 1937). The majority of this speech was taken directly from *Von Material zu Architektur* in which Moholy-Nagy called for a new conception of space (social, biological) constructed using profound material innovations, first published in English translation in 1932 in London.

¹⁰ László Moholy-Nagy, *Von Material zu Architektur*, ed. Walter Gropius and László Moholy-Nagy, *Bauhausbücher* 14 (Munich: Albert Langen Verlag, 1929), 194.

Euclidean, non-Euclidean, architectural, dance, pictorial, scenic, spherical, crystalline, cubic, hyperbolic, parabolic, elliptical, bodily, surface, lineal, one-dimensional, two-dimensional, three-dimensional, n-dimensional, projective, metric, isotropic, topographic, homogenous, absolute, relative, fictive, abstract, actual, imaginary, finite, infinite, limitless, universal, etheric, inner, outer, movement, hollow, vacuum, formal, etc., etc. } SPACE.)¹¹

In the footnote accompanying this list, Moholy-Nagy cited two early works by German physicist-philosopher Rudolf Carnap, *Der Raum: Ein Beitrag zur Wissenschaftslehre* (Space: A Contribution to the History of Science, 1922) and *Der logische Aufbau der Welt* (The Logical Structure of the World, 1928) (**Figure 0.6**).¹² Citing Carnap's *Der Raum* and *Der logische Aufbau der Welt* at the outset of his fourth chapter with the same title as the earlier of the two reference texts, "der raum (architektur)" (space [architecture]), is important not only for understanding Moholy-Nagy's notion of space, or more accurately, of spaces, but it is also crucial to understand his conviction that anyone, an artist like himself or even his students, could operate as a scientific investigator. As an advocate of Logical Positivism, in *Der Raum*, Carnap had compiled a similar, although abbreviated, list of spaces and asserted that our conception of space had been based upon our perception of its suitability at a particular place and in a particular moment in time. As pragmatically useful fictions, each of the types of space listed, therefore, do not necessarily

¹¹ László Moholy-Nagy, *The New Vision: Fundamentals of Bauhaus Design, Painting, Sculpture, and Architecture with Abstract of an Artist*, rev. and enlarged edition, trans. Daphne M. Hoffmann, (Mineola, NY: Dover Publications, 2005), 162, originally published as *Von Material zu Architektur* (Munich: Albert Langen Verlag, 1929), 194. Between the two lists, the original German and the later English version, supervised by Moholy-Nagy c. 1938, he substituted "n-dimensional" for "filmisch" (filmic).

¹² Rudolf Carnap, *Der Raum: Ein Beitrag zur Wissenschaftslehre* (Space: A Contribution to a History of Science) originally published in *Kant-studien* (Berlin: Reuther & Reichard Verlag, 1922) and *Der logische Aufbau der Welt* (Hamburg: Felix Meiner, 1961). The latter was translated into English by Rolf George, *The Logical Structure of the World: Pseudoproblems in Philosophy* (Berkeley: University of California Press, 1967).

cancel out the validity of the other types of space that would be more useful in other circumstances.¹³ Carnap, who straddled the fields of mathematics, physics, psychology, and philosophy, believed that scientific knowledge and experiment should not be limited to a chosen few, who were trained scientists. Rather, scientific investigation should be, fundamentally, an open endeavor to understand the nature of the world.¹⁴

Building upon these basic principles, Moholy-Nagy conducted his own practice of art and design as a scientific investigator and, in kind, endeavored to teach his students to fearlessly conduct their own research.¹⁵ To that purpose, in his last work published posthumously, *Vision in Motion* (1947), he wrote:

Space or space-time experience is not merely the privilege of exceptionally talented persons. It is a biological function, as important and as common as the experience of color, shape and tone. Its connotations are numerous. There is, for example, the hope that it will help in grasping future problems and vistas, enabling us to see everything in relationship, that it will furnish us with the right concept of cooperation and defense against aggression, where again space and time are inseparably intertwined.¹⁶

Moholy-Nagy documented a similar sentiment in his early writings, such as in *Malerie, Fotografie, Film* (Painting, Photography, Film, 2nd ed., 1927) when he wrote:

¹³ Carnap, *Der Raum: Ein Beitrag zur Wissenschaftslehre*, 1922, 15.

¹⁴ Abraham D. Stone, "On the Sources and Implications of Carnap's *Der Raum*," *Studies on History and Philosophy of Science*, v. 41, n. 1, (2010), 73.

¹⁵ Moholy-Nagy taught at the Staatliches Bauhaus in Weimar (1923–1925) and Dessau (1925–1928) and at three iterations of the New Bauhaus, School of Design, and Institute of Design in Chicago (1937–1946).

¹⁶ Moholy-Nagy, *Vision in Motion*, 266.

raumerlebnis ist kein privileg begabter menschen, sondern biologische funktion die biologischen grundlagen des raumerlebnisses sind einem jeden gegeben, so wie das erlebnis der färben oder der töne, durch Übung und geeignete beispiele kann ein jeder diese fähigkeit aus sich herauschälen, wohl werden zahlreiche unterschiede in der erlebnisfähigkeit Vorkommen, genau wie das bei andern erlebnisgebieten der fall sein mag — grundsätzlich aber ist das raumerlebnis einem jeden zugänglich, selbst in seiner reichen, komplizierten form.¹⁷ (**Space experience is not a privilege of the gifted, but is a biological function**[.] The biological bases of space experience are everyone's endowment, just like the experience of colors or of tones. By practice and suitable exercises this capacity can be developed. To be sure, there will be many degrees of difference in the maximum capacity, but basically space experience is accessible to everyone, even in its rich, complicated forms.)¹⁸

Not only did Moholy-Nagy develop an interest in Carnap's theses at the beginning of his career, he retained this sentiment throughout his life, as is evident in the fact that he enlisted Carnap, who had emigrated from Prague to take a position in the philosophy department at the University of Chicago in 1936,¹⁹ to lecture at the School of Design.²⁰ Other members of the

¹⁷ László Moholy-Nagy, *Von Material zu Architektur*, 196.

¹⁸ László Moholy-Nagy, *The New Vision*, 1938, 163.

¹⁹ Peter Galison, "Aufbau/ Bauhaus: Logical Positivism and Architectural Modernism," *Critical Inquiry* 16, no. 4 (Summer 1990): 746. In this article, Galison documented the relationship between the Vienna Circle and the Bauhaus and revealed that, although Moholy-Nagy may have appreciated Rudolf Carnap through his writings, his Bauhaus lectures took place soon after Moholy-Nagy had resigned in 1928. During that period, due in part to an antagonistic relationship between Moholy-Nagy and Hannes Meyer, during informal discussions with Carnap, the work of Moholy-Nagy's *Metallwerkstatt* (Metal Workshop) became an object example of the need to purge the remaining traces of metaphysics in Bauhaus designs.

²⁰ Moholy-Nagy, *Vision in Motion*, 1938, 70.

Vienna Circle, including Charles Morris, also taught at the New Bauhaus and even assisted in crafting the curriculum to engage the arts and sciences in mutual exploration. For the "Prospectus for the New Bauhaus" (1937), Morris wrote: "Moholy-Nagy knew of the interest of Rudolf Carnap and myself in the unity of science movement. He once remarked to us that his interest went a stage farther: his concern was with the unity of life."²¹

SYNTHESIS

Moholy-Nagy took the Vienna Circle's dedication to a unified science into the artistic world in his understanding of the notion of *Gesamtkunstwerk*. In a section entitled "Tafelbild, Architektur und 'Gesamtkunstwerk'" (Easel Painting, Architecture and *Gesamtkunstwerk*) in *Malerei, Fotografie, Film*, Moholy-Nagy described contemporary art as moving out of leisure into life through an emphasis on the process of creation found in Cubism and Constructivism that was capable of producing an internal, vital coherency.²² This analysis was followed by a discussion of the *Gesamtkunstwerk* in architecture in which Moholy-Nagy expanded from architecture to life:

„Kunst“ entsteht, wenn der Ausdruck ein Optimum ist, d. h. wenn er in seiner Höchstintensität im Biologischen wurzelnd, zielbewußt, eindeutig, rein ist. Der zweite Weg war, daß man versuchte, die voneinander isolierten Werke oder einzelnen Gestaltungsgebiete in eine Einheit zusammenzufassen. Diese Einheit sollte das „Gesamtkunstwerk“, die Architektur sein, als die Summe aller Künste. (Stijl-Gruppe, Holland; erste Periode des Bauhauses.) Der Gadanke eines Gesamtkunstwerkes war leicht verständlich, gestern, in der Zeit größter

²¹ Charles Morris, "Prospectus for the New Bauhaus," *American School of Design*, 10, an excerpt may be found in Peter Galison, "Aufbau/ Bauhaus: Logical Positivism and Architectural Modernism," 747.

²² László Moholy-Nagy, *Painting, Photography, Film*, trans. Janet Seligman, 2nd ed. (Cambridge, MA: MIT Press, 1987), 16–17, originally published as *Malerei, Photographie, Film* (Munich: Albert Langen Verlag, 1925).

Spezialisierungen. Diese hatten durch ihre Verästelungen und ihre alle Gebiete zerstückelnde Wirkung jeden Glauben an die Möglichkeit vernichtet, die Gesamtheit aller Gebiete, die Totalität des Lebens erfassen zu können. Da das Gesamtkunstwerk aber nur eine Addierung, wenn auch eine organisiert ist, können wir uns heute damit nicht begnügen. Was wir brauchen, ist nicht das „Gesamtkunstwerk“, neben dem das Leben getrennt hinliebt, sondern die sich selbst aufbauende Synthese aller Lebensmomente zu dem alles umfassenden Gesamtwerk (Leben), das jede Isolierung aufhebt, in dem **alle individuellen** Leistungen aus einer biologischen Notwendigkeit entstehen und in eine **universelle** Notwendigkeit münden.²³ ('Art' comes into being when expression is at its optimum, i.e. when at its highest intensity it is rooted in biological law, purposeful, unambiguous, pure. The second way consisted in an attempt to bring together into one *entity* singular works or separate fields of creation that were isolated from one another. This entity was to be the 'Gesamtkunstwerk', architecture, the sum of all the arts. [The De Stijl Group, Holland; first period of the Bauhaus.] The concept of the total work of art was readily intelligible, yesterday, at the period when specialisation was at its height. With its ramifications and its fragmenting action in every field, specialisation had destroyed all belief in the possibility of embracing the totality of all fields, *the wholeness of life*. Since, however, the *Gesamtkunstwerk* is only an addition, albeit an organised one, we cannot be satisfied with it today. What we need is not the 'Gesamtkunstwerk', alongside and separated from which life flows by, but a synthesis of all the vital impulses spontaneously forming itself into the all-embracing *Gesamtwerk* [life]

²³ László Moholy-Nagy, *Malerei, Fotografie, Film*, 2nd ed. (Munich: Albert Langen Verlag, 1927), 15.

which abolishes all isolation, in which **all individual** accomplishments proceed from a biological necessity and culminate in a **universal** necessity.)²⁴

Founding director of the Staatliches Bauhaus and architect, Walter Gropius had also used the term *Gesamtwerk* in his description of the educational program for the Staatliches Bauhaus in Weimar in his 1923 promotional pamphlet, "Idee und Aufbau des Staatlichen Bauhauses Weimar" (Idea and Construction of the State Bauhaus Weimar),²⁵ published as a standalone piece, and in the exhibition catalog, *Staatliches Bauhaus Weimar 1919–1923* (**Figure 0.4**). These publications appeared shortly after Moholy-Nagy had been appointed as Johannes Itten's replacement in the Preliminary Course and as the *Formmeister* (Master of Form) in the *Metallwerkstatt* (Metal Workshop).²⁶ In the section entitled, "Die Bühne" (The Stage), Gropius described the theater (*Bühnenwerk*, stage work) as being the art that is most similar to architecture (*Werk der Baukunst*, work of the art of building), since both are collective endeavors that stem from metaphysical desires to produce a unified, or total work of art.²⁷

²⁴ László Moholy-Nagy, *Painting, Photography, Film*, 17.

²⁵ Walter Gropius, *Idee und Aufbau des Staatlichen Bauhauses*, (Munich: Bauhausverlag, 1923) and also included in the exhibition catalogue edited by Walter Gropius, *Staatliches Bauhaus Weimar 1919–1923*, (Weimar and Munich: Bauhausverlag, 1923), 7–18. For more discussion of the relation of *Gesamtkunstwerk*/*Gesamtwerk* to Moholy-Nagy, see Oliver A. I. Botar, "Gesamtwerk," in *Sensing the Future: Moholy-Nagy, Media and the Arts* (Zürich: Lars Müller Publishers, 2014), 59–79 and "Taking the 'Kunst' out of 'Gesamtkunstwerk: Moholy-Nagy's conception of the Gesamtwerk," in Doménico Chiappe, Luisa Lucuix, Herrán Coombs, Emilio Ruiz-Mateo, eds., *László Moholy-Nagy: The Art of Light* (Madrid: La Fábrica Editorial, 2010), 159–168. See also a broader contextual discussion of *Gesamtkunstwerk* in Joseph Rykwert, *The Judicious Eye: Architecture Against the Other Arts* (Chicago and London: University of Chicago Press, 2008).

²⁶ Moholy-Nagy was hired on March 31, 1923 according to Lloyd C. Engelbrecht, *Moholy-Nagy: Mentor to Modernism* (Cincinnati, OH: Flying Trapeze Press, 2009), 1: 197–199, who referenced a microfilm copy of the typed contract held in the *Thüringisches Hauptstaatsarchiv* in Weimar.

²⁷ Gropius, *Idee und Aufbau des Staatlichen Bauhauses*, 11 and *Staatliches Bauhaus Weimar 1919–1923*, 17.



Figure 0.4: László Moholy-Nagy, (left) Cover Design, *Staatliches Bauhaus Weimar, 1919–1923*, Weimar, Munich, Bauhausverlag, 1923 + (right) Pamphlet Design, Walter Gropius, *Idee und Aufbau des Staatlichen Bauhauses*, Munich, Bauhausverlag, 1923.

Such a synthesis was further described by Bauhaus faculty and harmonic specialist Gertrud Grünow in her contribution to the same exhibition catalog, “Der Aufbau der lebendigen Form durch Farbe, Form, Ton” (Construction of Living Form through Color, Form, Sound, 1923). Grünow called for artists and scientists to examine the sensations of appearances, their nature and origins, in order to understand the powerful physical and psychological effects of sound and color on a human being (*menschlichen Organismus* [human organism], *menschlichen Geiste* [human spirit]).²⁸ Through an accumulation of direct observation, an artist could discover the nature of the synaesthetic relationship between light and sound based on experience and scientific experiment. Promoted by and allied to Johannes Itten, Grünow had an impact on the pedagogy of the Bauhaus, especially in her belief that she could deeply empathize with each

²⁸ Gertrud Grünow, “Der Aufbau der lebendigen Form durch Farbe, Form, Ton,” *Staatliches Bauhaus Weimar 1919–1923*, Walter Gropius, ed., (Weimar and Munich: Bauhausverlag, 1923), 20–24. An English translation of this section as “The Creation of Living Form as Color, Form and Sound” may be found in Hans M. Wingler, ed., *The Bauhaus: Weimar Dessau Berlin Chicago*, trans. Wolfgang Jabs and Basil Gilbert (Cambridge, MA: MIT Press, 1969), 69–71, originally published as *Das Bauhaus* (Cologne: Verlag Gebr. Rasch & Co., 1962).

student to such a profound effect that she could see the shape of their inner talent, as a form in itself, building upon such theories of light, Grünow wrote: "Wesen richtet sich nach dem Lichte und geht in eine Form ein, zeitlich-räumlich, räumlich-zeitlich."²⁹ ("Every organic being accommodates itself to light and enters into a form, according to time-space and space-time.")³⁰

Moholy-Nagy contributed his own essay to the exhibition catalog, "Die neue Typographie" (The New Typography), and also created the typographic design for the book and its cover.³¹ While this very short text focused on the advantages of new forms of typography using photographic reproduction, Moholy-Nagy clearly absorbed the messages of *Gesamkunstwerk* and *Gesamtwerk* taking a critical, more encompassing stance in *Malerie, Fotografie, Film* and in his essay on the total, synaesthetic theater entitled "Theater, Zirkus, Varieté" (Theater, Circus, Variety) in *Die Bühne im Bauhaus*, both published two years later in 1925:

Ebenso muß das Theater der Totalität mit seinen mannigfaltigen Beziehungskomplexen von Licht, Raum, Fläche, Form, Bewegung, Ton, Mensch — mit allen Variations- und Kombinationsmöglichkeiten dieser Elemente untereinander — künstlerische Gestaltung: ORGANISMUS sein.³² (Even so the theater of totality with its manifold complex relationships of light, space, planes,

²⁹ Grünow, "Der Aufbau der lebendigen Form durch Farbe, Form, Ton," *Staatliches Bauhaus Weimar 1919–1923*, 20.

³⁰ Grünow, "The Creation of Living Form as Color, Form and Sound," *The Bauhaus: Weimar Dessau Berlin Chicago*, trans. Wolfgang Jabs and Basil Gilbert, 69.

³¹ László Moholy-Nagy, "Die neue Typographie," *Staatliches Bauhaus Weimar 1919–1923*, Walter Gropius, ed., (Weimar and Munich: Bauhausverlag, 1923), 141. An English translation of this section as "The New Typography" may be found in Moholy-Nagy, Richard Kostelanetz, ed., Sibyl Moholy-Nagy, trans., (New York: Praeger, 1970), 75–76.

³² Moholy-Nagy, "Theater, Zirkus, Varieté," in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *Die Bühne im Bauhaus*, 50.

form, movement, tone, human — with all variations and combinations of possibilities of these elements one another — artistic formation must be: ORGANISM.)³³

These theories of the unity of art, science, and life were in keeping with the writings of the Vienna Circle, as well as with his Bauhaus colleagues Walter Gropius, Gertrud Grünow, and Wassily Kandinsky, and reveal an early blossoming of their kindred spirit. However, these ideas of oneness and totality were not uncommon at the turn of the twentieth-century perhaps equally, if not more closely, inspired by the theoretical writings of the musical composer Richard Wagner, who revived the term, *Gesamtkunstwerk*, in two texts published in 1849, *Die Kunst und die Revolution* (Art and Revolution) and *Das Kunstwerk der Zukunft* (The Art-Work of the Future).³⁴ Appropriately, Wagner opened *Die Kunst und die Revolution* with an epigram that is excluded in later English translations: "Wo einst die Kunst schwieg, begann die Staatsweisheit und Philosophie: wo jeßt der Staatsweise und Philosoph zu Ende ist, da fängt wieder der Künstler an."³⁵ (Where once art was silent, the wisdom of the state and philosophy began: where the way of the state and the philosopher comes to an end, then the artist begins again.)³⁶ This statement heralded the role of the artist to take up the unfinished business of the state and philosophers, to step out of the perceived boundaries of art and to step into life.

³³ Translated by author.

³⁴ Although Moholy-Nagy did not mention Richard Wagner by name, the themes of Wagner's work permeated contemporary artistic discourse in German-speaking countries. See Richard Wagner, "Art and Revolution," and "The Art-Work of the Future," both texts were translated into English by William Ashton Ellis, in *The Art-Work of the Future*, in the first volume of *Richard Wagner's Prose Works* (publisher unknown, 1895), both essays were originally published 1849 as, respectively, *Die Kunst und die Revolution* and *Kunstwerk der Zukunft*. See also Oliver Botar, "Gesamtwerk," *Sensing the Future* (Zürich: Lars Müller Publishers, 2014), 59–79.

³⁵ Richard Wagner, *Die Kunst und die Revolution* (Leipzig: Otto Wigand, 1850), title page.

³⁶ Translated by author.

In the chapter entitled "Grundzüge des Kunstwerkes der Zukunft" (Principles for the Art-Work of the Future), Wagner described the freedom made possible through an integration of all of the arts into a common art-work:

Der künstlerische Mensch kann sich nur in der Vereinigung aller Kunstarten zum gemeinsamen Kunstwerke vollkommen genügen: in jeder Vereinzelnung seiner künstlerischen Fähigkeiten ist er unfrei, nicht vollständig das, was er sein kann; wogegen er im gemeinsamen Kunstwerke frei, und vollständig das ist, was er sein kann.³⁷ (Artistic Man can only fully content himself by uniting every branch of Art into the common Artwork: in every segregation of his artistic faculties he is unfree, not fully that which he has power to be; whereas in the common Artwork he is free, and fully that which he has power to be.)³⁸

Wagner described the task for architecture as lying firmly within the space of dramatic action, in which the highest potential of art is reached when and only when the actor is subsumed by and into the audience. Poetry, dance, music, and painting within architecture must come together, literally into one another, to produce an audience-penetrating (cathartic) representation of life. Wagner attached this life-altering experience of art to the total art-work, a dramatic performance: "Nicht eine reich entwickelte Fähigkeit der einzelnen Künste wird in dem Gesamtkunstwerke der Zukunft unbenützt verbleiben, gerade in ihm erst wird sie zur vollen Geltung gelangen."³⁹ (Not a single sumptuous capability of the separate arts will remain unused in the *Gesamtkunstwerk* of the Future; only in it will they first reach to their full value.)

³⁷ Richard Wagner, *Das Kunstwerk der Zukunft*, (Leipzig: Otto Wigand, 1850), 186.

³⁸ Richard Wagner, *The Art-Work of the Future*, William Ashton Ellis, trans., in *Richard Wagner's Prose Works I* (London: Kegan Paul, Trench, Trübner & Company, 1895), 75.

³⁹ *Ibid.*, 197.

While Wagner popularized the term, *Gesamtkunstwerk*, it first appeared in *Ästhetik oder Lehre von Weltanschauung und Kunst* (Aesthetics or Studies on Worldview and Art, 1827) by psychologist and theologian Karl Friedrich Eusebius Trahdorff.⁴⁰ In more ways than one, Wagner's *Das Kunstwerk der Zukunft* echoed the content and arrangement of Trahdorff's earlier essay including the concept of the *Gesamtkunstwerk*:

Dieß wird begründet sein darin, daß die Gestalten, an denen es gebunden wird, nicht für sich als Kunstwerke gelten sollen, sondern nur als integrirende Theile des Gesamtkunstwerkes von dem die Rede ist; sie müssen also, als Gestalten für die Gebilde der Mimik und Tanzkunst den innern teleologischen Lebenszusammenhang der Welt festhalten und an sich darstellen, dieser wird aber, wie wir in der Malerei gesehn haben, durch die Farbe bezeichnet.⁴¹ (This will be grounded in the fact, that the forms, to which it is bound, should not be regarded as works of art in themselves, rather only as integrating parts of the *Gesamtkunstwerk* of which there is talk; they must therefore, as forms for the images of mimicry and dance, capture and represent the inner teleological life-connection of the world, but this will, as we have seen in painting, be designated by color.)⁴²

From these descriptions, Gropius, and, in turn, Moholy-Nagy, dropped the focus on art in *Gesamtkunstwerk* to deepen a broader insistence on the unity of life in *Gesamtwerk*. However, that is not to say that Moholy-Nagy abandoned art or theater for another path. These both remained a key testing ground for his theories about light and movement in the service of the

⁴⁰ Karl Friedrich Eusebius Trahdorff, *Aesthetik oder Lehre von Weltanschauung und Kunst* (publisher unknown, 1827).

⁴¹ *Ibid.*, 318.

⁴² Translated by author.

construction of vision in space-time. In fact, one of his key explorations in this vein, perhaps the ultimate, was the *Exzentrik*, which engaged all of the spatial senses as he had described them later in *Von Material zu Architektur*: “*gesichtssinn* (sense of sight), *gehörsinn* (sense of hearing), *gleichgesichtssinn* (sense of balance) and *bewegung* (movement).”⁴³

In the *Exzentrik*, the audience would be fully immersed in the forms, movements, lights, and sounds, and transformed in the Wagnerian sense of the cathartic experience of the *Gesamtkunstwerk*. The *Exzentrik* is perhaps what Sirató meant in the *Manifeste dimensioniste*, when he referred to “Théâtre Synos-Sens” (Syno-Sense Theater, or Synaesthetic Theater), the interpenetration of the arts as a sensual experience producing a vaporization of sculpture in the third dimension,⁴⁴ and the penetration of the audience’s awareness and understanding of the world in order to train their sense perception to see beyond Euclidean space into Bolyai’s non-Euclidean space and realizing Einstein’s and Minkowski’s notions of space in four dimensions.

⁴³ Moholy-Nagy, *Von Material zu Architektur*, 196.

⁴⁴ Sirató, “Manifeste Dimensioniste,” in *La Revue N + 1*, 1936, insert. In his “Concept for the First International Dimensionist Exhibition,” Sirató organized artists and their works into his dimensional categories. Moholy-Nagy’s work appears in all four categories. Notably, in the category entitled “Non-Euclidean Art IV,” Sirató listed Moholy-Nagy’s “Total Theater (Berlin, 1927),” presumably a reference to Moholy-Nagy’s article entitled “A jövő színháza a teljes színház” (Total Theater is the Theater of the Future) appearing in *Dokumentum* (March 1927), 6–7. For an English translation, see Krizstina Passuth and László Moholy-Nagy, *Moholy-Nagy*, trans. Éva Grusz, et al. (New York: Thames and Hudson, 1985), 299–301. In this article, Moholy-Nagy called for the realization of the total theater through the expression of interrelated thoughts using simultaneous, synoptic, and synacoustic means, which may have provided the basis for Sirató’s own theories about theater of the five senses (c. 1928) and his ideas about the fourth dimension in art. Since Sirató expressed that he found inspiration in this article and in almost all of [Moholy-Nagy’s] works” and “aspirations” in the seventh section of his *Dimensionist Album* (1966), Sirató may have also been made aware of, perhaps even seen a copy of, Moholy-Nagy’s *Exzentrik*, since this article was a summary of parts of Moholy-Nagy’s chapter, “Theater, Zirkus, Variété” (Theater Circus Variety) in *Die Bühne im Bauhaus* (Munich: Albert Langen Verlag, 1925), especially since the titles of the Bauhausbücher series were advertised in the first two issues of *Dokumentum*.

Moholy-Nagy addressed each of these particular senses (sight, hearing, balance, and movement) in the columnar structure of the *Exzentrik*.

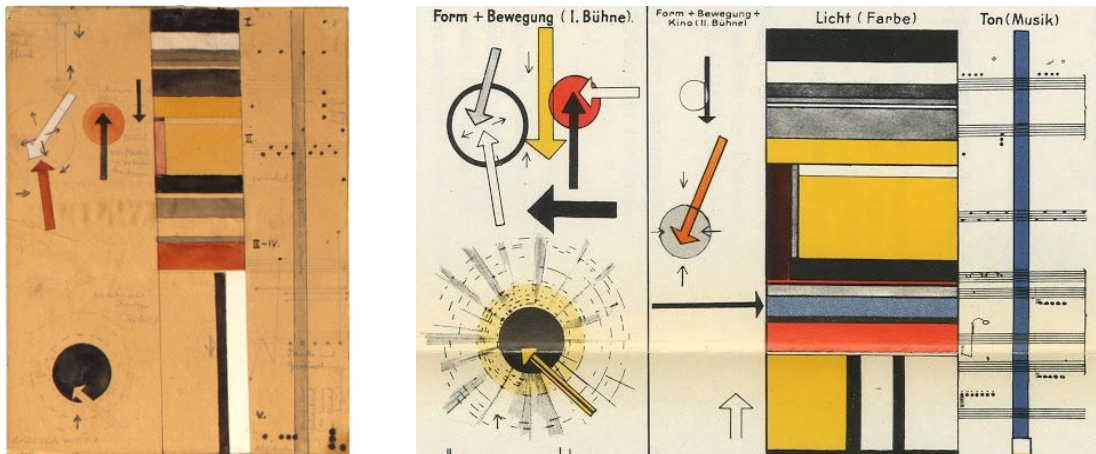


Figure 0.5: László Moholy-Nagy, (left) Untitled, c. 1924 + (right) *Partiturskizze zu einer mechanischen Exzentrik* (Score-Sketch for a mechanical Eccentric), 1925, for complete captions see notes to Figures 0.1 + 0.2.

The hybrid drawing of the *Exzentrik* was organized into three columns, comparable due to their many similarities to the four columns of the printed version of the *Exzentrik* (**Figure 0.5**). Now barely discernible over the first column of the hybrid drawing, Moholy-Nagy wrote: "Form Bewegung" (Form Movement). This heading was duplicated over the first two columns of the printed version: the first column having the heading, "Form + Bewegung (I. Bühne)" (Form + Movement (1st Stage)) and the second column having a similar heading "Form + Bewegung + Kino (II. Bühne)" (Form + Movement + Film (2nd Stage)). The third column of the hybrid drawing has the heading "Musik" (Music), also corresponding to the heading of the fourth column of the printed version, "Ton (Musik)" (Sound (Musik)). While the second column of the hybrid drawing does not appear to have a title, the third column of the printed version, containing remarkably similar colored bands is entitled "Licht (Farbe)" (Light (Colors)). Given the formal similarities

between the hybrid drawing and printed version of the *Exzentrik*, it is likely that the text and notes apply to both, filling in some of the questions raised in the hybrid version. In the printed text, Moholy-Nagy explained that these columns run sequentially vertically from the top to bottom and are simultaneous with each other horizontally.

Examining the six panels of the hybrid *Exzentrik*, it is evident that the first panel served as a prelude to the other five panels, for it appears to summarize the actions in the lower panels (**Figure 0.6**). Bolstering this assumption are the five Roman numerals prominently drawn in black ink in the third "Musik" column on the first panel, apparently denoting five acts of the performance. Although the Roman numerals do not continue onto the other panels, each of the five lower panels may correspond to the five numerals on the first panel, as they also appear, in certain instances, to elaborate on a portion of the first panel (**Figure 0.1**). Additionally, almost all of the notations are contained to the first panel, with only two notations on the lower panels leading to the assumption that any further instructions would merely reiterate those in the prelude.

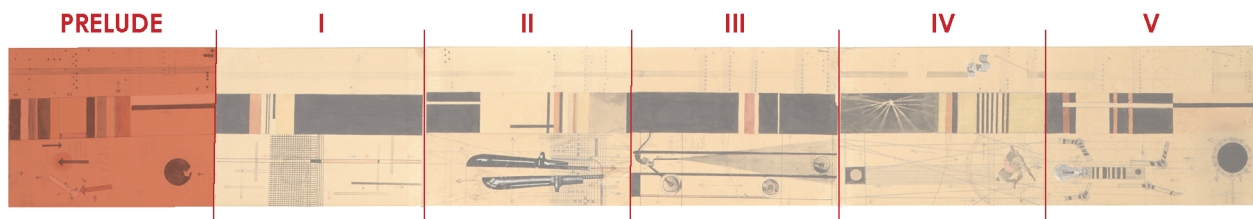


Figure 0.6: Diagram (by author) of divisions present in László Moholy-Nagy, Untitled, c. 1924.

CONSTRUCTION

As mentioned earlier, Rudolf Carnap posited that the world is neither real nor imagined, rather its realities are constructed to suit a particular situation. In this vein in *Der Raum*, Carnap provided a comprehensive list of spatial types, entitled “Übersicht der Raumarten” (Overview of Types of Spaces), in which he elaborated on his three main types of space: *Formalen-* (formal), *Anschaungs-* (perceptual, visual, intuitive), and *Physikerräume* (physical spaces) (**Figure 0.7**). In practice, the qualities of space described by these categories do not have strict boundaries. Formal space is not entirely formal, it may also be simultaneously intuitive. However, these boundaries served as useful categories from which to discuss spatial *Unterarten* (subtypes), encompassing historical and contemporary types of ordering (measuring) systems. As such, for the purpose of analysis, each of these main types could then be divided into three-dimensional and n-dimensional spaces, each of which may be topological, projective, or metric with many subtypes. Under three-dimensional spaces, Carnap included isotropic spaces that may be heterogenous or homogenous. The latter had three additional subtypes, one Euclidean and two non-Euclidean: “hyperbolic (Lobachevsky),” “parabolic (Euclid),” or “elliptical/ spherical (Riemann).”⁴⁵ Under n-dimensional spaces, which Carnap referred to as “Der Raum mit beliebig vielen Abmessungen” (Space with as many dimensions as you like), the list was much shorter; under the three categories of topological, projective, or metric there was one *Unterarten*, “non-isotropic space” with a reference to Albert Einstein.⁴⁶

This list served as a summary on which Carnap spent a significant portion of the remaining chapters of *Der Raum* elaborating both philosophically and mathematically concluding that, in the great debate between philosophers and mathematicians over the nature of space, the adherents of each ideological position were not even remotely discussing the same thing. In

⁴⁵ Carnap, *Der Raum: Ein Beitrag zur Wissenschaftslehre*, 15. Translated by author.

⁴⁶ Carnap, *Der Raum: Ein Beitrag zur Wissenschaftslehre*, 15. Translated by author.

other words, each party's understanding of space, in terms of spatial measurement systems, were constructed separately and not sufficiently related to each other to make a comparative argument.⁴⁷ From Carnap's position, without realizing it, they were arguing over two different things as if they were the same thing.

Übersicht der Raumarten.

(Die Einteilung ist die gleiche für den formalen Raum R , den Anschauungsraum R' , den physischen Raum R'' .)

Der Raum mit 3 Abmessungen: (Kontinuum 3. Stufe)

topologischer Raum R_{st}
 projektiver Raum R_{sp}
 metrischer Raum R_{sm}
 (gekennzeichnet durch das Krümmungsmaß k)

Der Raum mit beliebig vielen Abmessungen: (Kontinuum n . Stufe)

topologischer Raum R_{nt}
 projektiver Raum R_{np}
 metrischer Raum R_{nm}

seine Unterarten:

isotrope Räume: (in jedem Punkt 3 gleiche Werte für k)
 nicht isotrope Räume:

nicht homogene Räume: R_i (allgemeinster Fall: alle Werte von k ungleich)

homogene Räume: (in allen Punkten dieselben 3 Werte für k)
 R_h (Raum konstanter Krümmung; Kongruenzraum)

Unterarten:

$R_{h<} (k < 0)$ (Lobatschewskij) hyperbol. Raum
 $R_{h=} (k = 0)$ (Euklid) parabol. Raum
 $R_{h>} (k > 0)$ (Riemann) ellipt. Raum (Abart: sphär. Raum)

[Winkelsumme in Dreieck:
 $< 180^\circ$, $= 180^\circ$, $> 180^\circ$]

definition des raumes?

bei der definition des raumes herrscht heute eine große unsicherheit. schon an unserem sprachgebrauch wird diese unsicherheit deutlich, und eben dieser sprachgebrauch vergrößert sie noch.
 was man im allgemeinen vom „raum“ weiß, ist wenig geeignet, ihm eine reale faßbarkeit, eine handgreifliche existenz zu geben.

die verschiedenen arten von „raum“ ●

man spricht heute von dem:

matematischen	projektiven	
fysischen	metrischen	
geometrischen	isotropen	
euklidischen	topologischen	
nichteuklidischen	homogenen	
architektonischen	absoluten	
tänzerischen	relativen	
malerischen	fiktiven	
szenischen	abstrakten	
filmischen	realen	
sfärischen	imaginären	
kristallinischen	endlichen	
kubischen	unendlichen	
hyperbolischen	grenzenlosen	
parabolischen	universalen	
elliptischen	ätern	
körper-	innen-	
flächen-	außen-	
linearen	bewegungs-	
drei-	hohl-	
zwei-	luftleeren	
ein-	formalen usw.	
	stufigen	raum.

● siehe auch: dr. rudolf carnap: der raum/kantstudien, berlin 1922, und der logische aufbau der welt/weltkreisverlag, berlin-schlachtensee 1928.

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Figure 0.7: Rudolf Carnap, *Der Raum: Ein Beitrag zur Wissenschaftslehre*, Berlin: Reuther & Reichard, 1922, 15 + László Moholy-Nagy, *Von Material zu Architektur*, 1929, 194.

Once more, in keeping with Carnap's critique, Moholy-Nagy also posited spatial systems as interchangeable realities in his section in *Von Material zu Architektur* entitled, "raum ist realität"

⁴⁷ Ibid., 64.

(Space is Reality), suggesting that the perceptual reality of space is a matter of choice, a material to be manipulated, ordered as a means of expression (**Figure 0.7**).⁴⁸

When comparing the lists of spaces included in Carnap's *Raumarten* with Moholy-Nagy's "die verschiedene arten von raum" (Different Types of Space),⁴⁹ some types appear on both lists; however, there are many additions to, or elaborations on, Carnap's types of spaces. Although Carnap provided a systematic hierarchy of spatial types and subtypes including corresponding mathematical formulae and proofs, Moholy-Nagy created a simplified, non-mathematical, running list with undifferentiated groupings of related types, such as the series "hyperbolischen" (hyperbolic), "parabolischen" (parabolic), and "elliptischen" (elliptical) or "innen-" (inner) followed by "außen-" (outer).⁵⁰ Moholy-Nagy appears to have interpreted Carnap's mathematical formulae, in particular the angles of a triangle in three-dimensional and n-dimensional spatial systems, as "mathematischen" (mathematical) and "geometrischen" (geometric) spaces. Moholy-Nagy translated Carnap's references to Nikolai Lobachevsky and Bernhard Riemann as "nichtEuklidean" (non-Euclidean) types of space and, for Carnap's "nicht isotrope Räume" (non-isotropic space), Moholy-Nagy used the term "relativen" (relative). Moholy-Nagy added the following types to Carnap's succinct list: "architektonischen, tänzerischen, malerischen, szenischen, filmischen, kristallischen, kubischen, körper-, flächen-, linearen, zwei- und ein-stufigen, absoluten, fiktiven, abstrakten, realen, imaginären, endlichen, unendlichen, grenzenlosen, universalen, áter-, innen-, außen-, bewegungs-, hohl-, and lufteeren"⁵¹ (architectonic, dance, painterly, scenic, filmic, crystalline, cubic, bodily, linear, one- and two-dimensional, absolute, fictive, abstract, real, imaginary, finite, infinite, limitless, universal

⁴⁸ László Moholy-Nagy, *Von Material zu Architektur*, 195 and, in English translation, László Moholy-Nagy, *The New Vision*, 1938, 162.

⁴⁹ Ibid.

⁵⁰ Moholy-Nagy, *Von Material zu Architektur*, 195.

⁵¹ Ibid.

ethereal, inner, outer, movement, and vacuum).⁵² At the time, these additional types of spaces represented those with which artists and scientists, like himself, were experimenting.

Notably, there were two *Raumarten* that Moholy-Nagy did not include in his list: n-dimensional and non-homogenous. While it could be argued that non-homogenous, or heterogeneous, space may be embodied in a few of the particular types of spaces that he mentioned such as *körperraum* or *relativenraum*, the omission of the n-dimensional type is underlined by the fact that Moholy-Nagy specifically listed the lower dimensional spaces based on one, two, or three dimension(s). Even more curious is that Moholy-Nagy later altered the list in the 1938 English translation, published under the title, *The New Vision: Fundamentals of Design Painting Sculpture Architecture*.⁵³ In this translation and expanded edition, Moholy-Nagy replaced “*filmischenraum*” with “n-dimensional space,” restoring Carnap’s category.⁵⁴ Since Moholy-Nagy supervised this translation and added to the content himself, this change was unlikely merely a matter of a translator’s inadvertent error. Additionally, this omission and later reinstatement of any overt mention of higher dimensional space characterizes the differences between Moholy-Nagy’s early works compared to his later writings, in which he more fully developed his space-time theories.⁵⁵ However, in his art and design work, Moholy-Nagy appears to have consistently

⁵² Translated by author.

⁵³ In the previous English translation, by the same translator, *filmischenraum* was translated as cinema and n-dimensional space was not yet added to the list; László Moholy-Nagy, *The New Vision: From Material to Architecture*, translated by Daphne M. Hoffmann (New York: Brewer, Warren & Putnam, Inc., n.d. [c. 1932]), 155. For each of his English translations (1932, 1938, 1946, and 1947), Moholy-Nagy update the content even adding his New Bauhaus students’ works starting with the 1938 edition.

⁵⁴ Although the English translation was prepared by Daphne M. Hoffmann, Walter Gropius and Moholy-Nagy continued to serve as the editors of *The New Bauhaus Books* series published by W. W. Norton & Company (New York) and would, therefore, have supervised the English translations.

⁵⁵ Moholy-Nagy’s early reticence to overtly discuss higher dimensions of space led Lynda Dalrymple Henderson to initially question his stance on the fourth dimension, interpreting his later embrace of the topic as a somewhat superficial popularizer, as the concepts became fashionable again, in her published dissertation: *The Fourth Dimension and Non-Euclidean Geometry in Modern Art* (Princeton, NJ: Princeton

questioned the nature of dimensional space through representation and demonstration. This initial omission may point to his own doubts about the nature of space, or spaces, or merely to his stated position that filmic space is equivalent to space-time analogies, perhaps encompassing n-dimensional space; alternatively, he may have been avoiding a social stigma related to discussion of n-dimensions, often linked to Theosophy, among his colleagues at the Bauhaus.⁵⁶ This alteration suggests a shift in his outward embrace of higher dimensional space, perhaps emboldened by signing the *Dimensionist Manifesto* in the company of many great, like-minded artists who had also committed to promoting explorations of n-dimensional space and, in 1938, Moholy-Nagy was in Chicago, removed from the ideological battles in Europe, presenting his ideas to a new, perhaps more receptive, audience. Regardless of his reasons for his early hesitancy, this otherwise comprehensive list of spatial types demonstrates that Moholy-Nagy portrayed an openness toward multiple interpretations of space in keeping with Carnap's thesis on the validity of various spatial realities.

University Press, 1983). In her "Reintroduction" to the second revised edition, Henderson elaborated on Moholy-Nagy's writings and artworks on the fourth dimension, citing *Vision in Motion* (1947) as "the single most influential source on space-time and modern art." However, Henderson maintained that, although he became one of three figures that she dubbed as "Keepers of the Flame," Moholy-Nagy had adopted Einstein's position that time was the fourth dimension: Linda Dalrymple Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*, 2nd, rev. ed. (Princeton, NJ: Princeton University Press, 1983; Cambridge, MA: MIT Press, 2013), 36, overlooking his abiding investment in a variety of types of spatial explorations.

⁵⁶ American architect and theosophist Claude Bragdon's *A Primer of Higher Space* (Rochester, NY: Manas Press, 1913) was circulating at the Bauhaus in Weimar; evident in several drawings in a sketchbook of Moholy-Nagy's predecessor in the *Vorkurs* (Preliminary Course), Johannes Itten, who partially copied several of Bragdon's plates, including number nineteen entitled, "Man as seen by a Clairvoyant (4-Dimensional Vision)." In this plate, Bragdon depicted a glowing, x-ray image of a man standing next to a normal man, although dressed as an ancient Egyptian. Itten also copied portions of the magic cube of three and the tesseract, a four-dimensional form, from plates twenty-five and twenty-seven.

From Bertrand Russell's *Our Knowledge of the External World as a Field for Scientific Method in Philosophy* (1914), Carnap realized that it was not through analysis that one could create a reality, or a system, from the chaos of sensory experience, rather realities were constructed using a "principle of abstraction."⁵⁷ In his *Aufbau*, Carnap constructed three-dimensional space, and the visual object in three-dimensional space, relying on the bodily senses to describe discrete sensations, distinguishing between the construction of the world of physics and the world of perception as autopsychological, understood through one's own experience, or heteropsychological, understood through another's descriptions of their experiences.⁵⁸

In describing the possibilities of a constructive system, Carnap first addressed the constructional step from a two-dimensional planar world of visual perception to a three-dimensional world of visual objects in space, attributing the ability to extend this process to the "sogleich die ganze, alle Vorgänge umfassende, vierdimensionale Raum-Zeit-Welt aufbauen" (entire four-dimensional space-time world which comprises all events).⁵⁹ Carnap concluded that, "[w]ir haben in der Konstitutionstheorie erkannt, daß diese zweidimensionale Ordnung ebenso wie die dreidimensionale als abgeleitet anzusehen ist und daher ein Problem ihrer Konstitution aufgibt" ("[c]onstruction theory has shown us that this two-dimensional order, just as the three-dimensional one, must be considered derived; thus, the problem of its construction is posed").⁶⁰ Furthermore, Carnap claimed that, although Bertrand Russell began with the construction of objects, he would begin from the autopsychological perception to construct that which was un-

⁵⁷ A. W. Carus, "Carnap's Intellectual Development," in Michael Friedman and Richard Creath, eds., *The Cambridge Companion to Carnap* (Cambridge: Cambridge University Press, 2007), 8.

⁵⁸ Carnap, *The Logical Structure of the World*, Rolf George, trans., 191.

⁵⁹ Carnap, *Der logische Aufbau der Welt*, 164 and *The Logical Structure of the World*, Rolf George, trans., 191–192.

⁶⁰ Carnap, *Der logische Aufbau der Welt*, 164 and *The Logical Structure of the World*, Rolf George, trans., 193.

perceived, as opposed to Russell's inferring the visual existence of the invisible.⁶¹ In other words, Carnap proposed his constructional method, in order to build an understanding of the invisible from the sensations of the visible, and, from his point of view, constructing, as an inductive process, was different from, and preferable to, inferring, a deductive process.

To demonstrate the deduction of the invisible in his *Our Knowledge of the External World*, Russell memorably described his perceptual encounter with a table:

A table viewed from one place presents a different appearance from that which it presents from another place. This is the language of common sense, but this language already assumes that there is a real table of which we see the appearances. Let us try to state what is known in terms of sensible objects alone, without any element of hypothesis. We find that as we walk round the table, we perceive a series of gradually changing visible objects. But in speaking of "walking round the table," we have still retained the hypothesis that there is a single table connected with all the appearances. What we ought to say is that, while we have those muscular and other sensations which make us say we are walking, our visual sensations change in a continuous way, so that, for example, a striking patch of colour is not suddenly replaced by something wholly different, but is replaced by an insensible gradation of slightly different colours with slightly different shapes. This is what we really know by experience, when we have freed our minds from the assumption of permanent "things" with changing appearances. What is really known is a correlation of muscular and other bodily sensations with changes in visual sensations.⁶²

⁶¹ Ibid.

⁶² Bertrand Russell, *Our Knowledge of the External World as a Field for Scientific Inquiry in Philosophy* (London: Open Court, 1914; London: George Allen & Unwin, 1922), 77.

While Carnap must have appreciated Russell's systematic analysis of sensory experience, his desire was to take the next step to construct realities of the invisible from the visible, based upon serviceable spatial ordering systems. Proceeding to the construction of the fourth dimension, Carnap used the term, *Weltpunkte* (world points), to designate points in n-dimensional space, n-tuples, to which he would assign sensations such as, color, or other sense modalities. According to Carnap, the first coordinate is the time coordinate, the next three are space coordinates; the present is physical space, past and future spaces are abstract spaces. World points are considered simultaneous, if their time coordinates are equal. In this way, Carnap used standard arithmetical relationships between coordinates in a coordinate system.⁶³

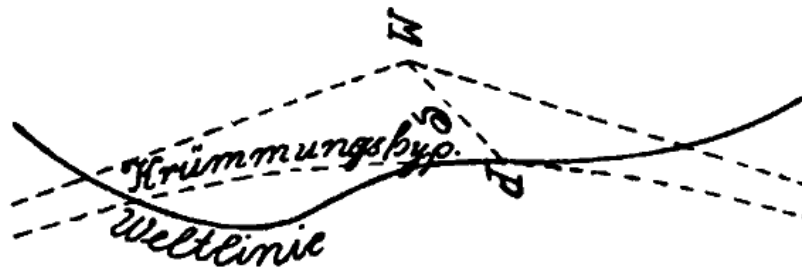


Figure 0.8: Hermann Minkowski, *Raum und Zeit*, *Jahresbericht der Deutschen Mathematiker-Vereinigung*, 1909.

It should be noted that Carnap was not the first to use the words, *Weltpunkte* (world points) and *Weltlinie* (world lines). In 1908, physicist and mathematician Hermann Minkowski first developed a mathematical foundation for higher dimensions of space including the idea of world points

⁶³ Carnap, *The Logical Structure of the World*, Rolf George, trans., 194–195.

and world lines in his essay, "Raum und Zeit" (Space and Time, lectured 1908, published 1909)

(Figure 0.8).⁶⁴

Likely building upon Minkowski's thesis, Carnap described his *Raum-Zeit-Welt* as:

Eine Weltlinie ist eine stetige Kurve bzw. ein Kurvenbogen, von dem zu jedem Wert der Zeitkoordinate innerhalb eines bestimmten Intervalls genau ein Weltpunkt gehört, und zwar ein gesehener oder ein nichtgesehener Farbpunkt. Innerhalb des Intervalls ist jede Raumkoordinate des Bogens eine einwertige, stetige Funktion der Zeitkoordinate.⁶⁵ (A world line is a continuous curve or curve segment such that precisely one world point belongs to each value of the time coordinate within a given interval; the world point may either be a seen or unseen color spot. Within the interval, each space coordinate of the segment is a single-valued, continuous function of the time coordinate.)⁶⁶

Lending sensation to Minkowski's mathematical, spatial-temporal world-lines, Carnap determined that a world-line originates inside the head, presumably where vision is processed in the brain, reducing the phenomenon of binocular visual perception to a single point of view, from a psychological standpoint. Carnap described the physical body as always near to its point of view, yet a viewer's own body cannot be seen in total by the viewer her/himself.

⁶⁴ Hermann Minkowski, who was not only Albert Einstein's teacher but also mathematician Hans Hahn's, a founding member of the first Vienna Circle in which Carnap became a significant figure, originally delivered his lecture, "Raum und Zeit" at the 80th Meeting of the Natural Scientists in Cologne, September 21, 1908. This lecture was soon published in two journals: *Physicalische Zeitschrift* 10, (1909), 104–111 and *Jahresbericht der Deutschen Mathematiker-Vereinigung* 18 (1909), 75–88. An English translation of this lecture may be found in *Space and Time: Minkowski's Papers on Relativity*, trans. Fritz Lewertoff and Vesselin Petkov, ed. Vesselin Petrov (Montreal: Minkowski Institute Press, 2012), 112–125.

⁶⁵ Rudolf Carnap, *Der logische Aufbau der Welt*, (Hamburg: Felix Meiner Verlag, 1928), 167–168.

⁶⁶ Carnap, *The Logical Structure of the World*, Rolf George, trans., 196.

Complementing vision, a body's sense of touch is used to understand objects in space; its kinesthetic sense is associated with the motion of the body itself; and additional senses are related to the sensory organs, hearing, smelling, and tasting.⁶⁷ In a similar manner, as visible color spots describe an object, touched touch spots describe the location of objects, including the invisible color points of a body. Therefore, the invisible portions of one's body are constructed by a combination and coordination of visual color spots and touched touch spots to be perceived as a closed body, a complete thing. Additionally, pain and pleasure become the extreme sensations of hot and cold; as such, Carnap included emotions as sense classes.⁶⁸

Moholy-Nagy followed Carnap's description of space, spatial relationships, and sensations in *Aufbau* very closely in *Von Material zu Architektur*, progressing from objects in space, relationships between objects, to their sensory perception, even listing sense experiences in the same order as Carnap. Although he simplified Carnap's terminology and added some particular types of spatial understandings that would aid artists in making the connections from space relationships to their own work, in the section entitled, "das organische raumerlebnis" (Organic Spatial Experience, reorganized under the sub-heading "The means" in the 1938 English translation), Moholy-Nagy used remarkably similar statements matching nearly point for point with Carnap's text. The relevant matching sentences in Moholy-Nagy's text are isolated below:

dem menschen wird der raum — die lagebeziehungen der körper — zuerst mittels seines gesichtssinnes bewußt. dieses erlebnis der sichtbaren lagebeziehungen kann durch bewegung: veränderung der eigenen lage — und mittels des tastsinnes parallel erlebt, kontrolliert werden. weitere raumerlebnis-möglichkeiten liegen im akustischen und gleichgewichtsorgan; ferner in anderen raumerlebend funktionierenden empfindsamkeiten unseres körpers, deren lokalisierung nach

⁶⁷ Carnap, *The Logical Structure of the World*, Rolf George, trans., 198–200.

⁶⁸ *Ibid.*, 201–202.

heutigem wissen noch sehr ungewiß ist. sie gehören wahrscheinlich in die gruppe jener sinnestätigkeiten, die atmosphärisches und telepathisches aufnehmen und weiter leiten.⁶⁹ (Each of our senses which can record the position of bodies allows a grasping of space. Thus space is known to man, first of all by means of his sense of vision. This experience of the visible relations of positions of bodies may be checked by movement—alteration of position—and by means of touch; it may be verified by another sense too. ... Further possibilities for experiencing space lie in the organs of hearing and of balance, also in other space-experiencing sensory centers of our body, imperfectly localized according to our present knowledge.)⁷⁰

Once again, between the German text and the 1938 English translation, there was a significant alteration to the last sentence pointing to the evolving nature of Moholy-Nagy's relationship to aspects of an 'extra-sensory' space-time.⁷¹ In the original German, Moholy-Nagy referred to "atmosphärisches und telepathisches" (atmospheric and telepathic) senses, while in the English translation, he was less specific mentioning "other space-experiencing centers," which could suggest extra-sensory abilities or, merely, proprioceptive and interoceptive senses⁷² leaving the open-ended statement up to the reader's interpretation. In this case, his terminology became

⁶⁹ Moholy-Nagy, *Von Material zu Architektur*, 195–196.

⁷⁰ Moholy-Nagy, *The New Vision*, 1938, 163–164.

⁷¹ For further discussion of the influence of Theosophy on the Bauhaus and on Wassily Kandinsky, in particular, see Joseph Rykwert, "The Dark Side of the Bauhaus," *The Necessity of Artifice* (New York: Rizzoli International Publications, 1982), 44–49. Originally published in 1982 by Academy Editions, London.

⁷² See Oliver Botar's discussion of Moholy-Nagy's broad understanding of what constitutes the human senses in "Sensory Training," *Sensing the Future: Moholy-Nagy, Media, and the Arts*, 21–22, especially his admiration of Charles Scott Sherrington's terminology, which he added to the 1938 English translation of *The New Vision*, 24. See also Sherrington, *The Integrative Action of the Nervous System* (New Haven, CT: Yale University Press, 1910); originally published in 1906.

less explicit about a potential, spiritual interpretation of spatial realities, after emigrating to Chicago to direct the New Bauhaus.

Building upon sensory experience, Carnap described the consciousness as comprised of basic experiences creating more complex constructions and, in the same vein, the unconsciousness as comprised of un-experienced experiences (similar to unseen, or invisible, color spots). Both are in the domain of the autopsychological, that which is experienced directly, as distinct from the heteropsychological, that which is reported as experienced by others. By analogy, unconsciousness, comprised of unexperienced experiences, is constructed from the experienced consciousness, just as invisible color spots are constructed from visible color spots.⁷³ Extending the same analogy, sensations that were constructed from past experiences may be assigned to remote objects. For example, sweetness may be assigned to the world lines of sugar without tasting the crystals in the present moment. The sense qualities of emotion and volition may also be constructed on the world lines of a remote object. Further extending the analogy, Carnap determined that “[d]ie ganze Raum-Zeit-Welt mit den Zuschreibungen der Sinnesqualitäten zu den einzelnen Weltpunkten bezeichnen wir als ‘Wahrnehmungswelt’” (“[t]he entire space-time world [may be constructed], with the assignment of sense qualities to the individual world points, we call the perceptual world”).⁷⁴

In a manner similar to the way that he added some specifics to Carnap's axiomatic *Raumarten*, Moholy-Nagy embellished Carnap's spatial sensations in the *Von Material zu Architektur*, relating Carnap's sensory experiences to what he saw as relevant artistic production including dance, theater, circus, variety, and architecture:

⁷³ Carnap, *The Logical Structure of the World*, Rolf George, trans., 203–205.

⁷⁴ Carnap, *Der logische Aufbau der Welt*, 179 and *The Logical Structure of the World*, Rolf George, trans., 205–207.

von der Seite des Subjekts aus ist also raum am unmittelbarsten erlebbar durch bewegung, auf einer höheren stufe durch den tanz, der tanz ist gleichzeitig ein elementares mittel zur erfüllung raumgestalterischer wünsche. er kann den raum verdichten, ihn gliedern: der raum dehnt sich, sinkt und schwebt — fluktuierend in allen richtungen. (From the side of the subject, space can be experienced most immediately through movement, on a higher level through dance, simultaneously dance is an elementary medium fulfilling a desire for the formation of space. It can intensify space, subdivide it: space lengthens itself, sinks and floats — fluctuating in all directions.)⁷⁵

Below these statements, Moholy-Nagy listed four ways to experience space with corresponding lists of figures, peppered throughout the text, that illustrate his position:

primitiv formuliert erfaßt der mensch also den raum: von seinem gesichtssinn..., von seinem gehörsinn...; von der bewegung...; von seinem gleichgewichtssinn (man perceives space: through his sense of sight..., through his sense of hearing..., through his sense of equilibrium..., and through means of locomotion)⁷⁶

Elaborating on each of these four senses, Moholy-Nagy gave the reader a clue as to how he constructed a sensory experience of space through his artworks. Under the "sense of sight," he wrote, "aus in erscheinungen wie: weite Perspektiven..., sich treffende, schneidende flächen, ecken, klare durchsichten..., durchdringungen..., maßverhältnisse, licht" ("in such things as: sticks, rods, wiring; columns; bodies...; surfaces meet and cut one another...; interpenetrating

⁷⁵ Moholy-Nagy, *Von Material zu Architektur*, 1929, 195. Translation by author.

⁷⁶ Moholy-Nagy, *Von Material zu Architektur*, 1929, 195 and, in translation, Moholy-Nagy, *The New Vision*, 1938, 164.

objects...; wide perspectives...; relationships of mass, light; shadow...; transparency; reflection; mirroring.")⁷⁷

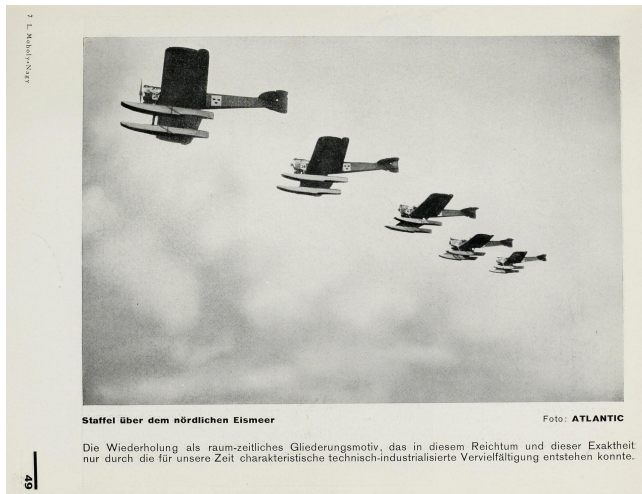


Figure 0.9: László Moholy-Nagy, (left) Malerei, Fotografie, Film, Munich, Albert Langen Verlag, 1925 + (right) Von Material zu Architektur, Munich, Albert Langen Verlag, 1929.

Although Moholy-Nagy had already been working on many such experiments exploring the sensory perception of space, he was apparently prudent in how many of these illustrations were featured his own work. The only image referenced in the list of sensory experiences of space that was created by him was an uncredited photograph, “übereinander gelagerter verkehr” (san diego / kalifornien) (Superimposed Traffic) attributed to an illustrated magazine in Berlin called *Weltspiegel* (World Mirror) (**Figure 0.9**). As the caption suggests, the image features several levels of moving vehicles: cars on a lower level going under a bridge, a train on a raised trestle, pedestrians on the sidewalks, and, miraculously, a string of amphibious airplanes flying in

⁷⁷ Ibid.

formation in the sky.⁷⁸ In the English translation, the image, actually a photomontage, was attributed to Moholy-Nagy. As was his practice to recycle his photographs, *Photograms*, and *Photoplastiks*, Moholy-Nagy had included one of the source images, the photograph of the amphibious airplanes, in his earlier *Bauhausbuch, Malerie, Fotografie, Film* as an example of a space-time repetition. Its caption read: "**Staffel über dem nördlichen Eismeer:** Die Wiederholung als raum-zeitliches Gliederungsmotiv, das in diesem Reichtum und dieser Exaktheit nur durch die für unsere Zeit charakterische technisch-industrialisierte Vervielfältigung entstehen konnte"⁷⁹ ("Flight over the Arctic Ocean: Repetition as a space-time organisational motif, which, in such wealth and exactitude, could be achieved only by the technical, industrialised system of reproduction characteristic of our time") (**Figure 0.9**).⁸⁰

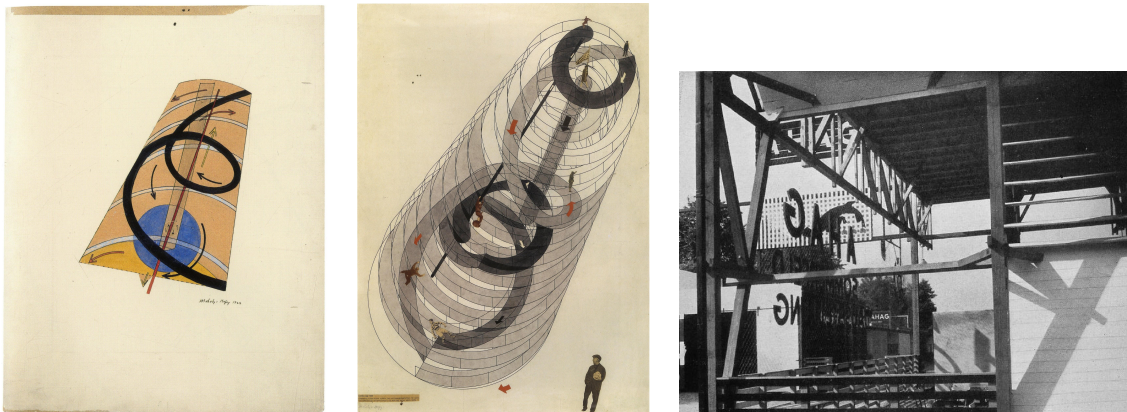


Figure 0.10: László Moholy-Nagy, (left) *Kinetisches Konstruktive System* (Kinetic Constructive System, 1922) + (middle) *Kinetisches Konstruktive System: Bau mit Bewegungsbahnen für Spiel und Beförderung* (Kinetic Constructive System: Structure with Moving Tracks for Play and Conveyance, 1922, rendered in 1928 by Stephan Sebök) + (right) AHAG Exhibition designed with Walter Gropius (Berlin, 1928).

⁷⁸ Moholy-Nagy, *Von Material zu Architektur*, 210 and *The New Vision*, 1938, 169.

⁷⁹ Moholy-Nagy, *Malerie, Fotografie, Film*, 1927, 49.

⁸⁰ Moholy-Nagy, *Painting, Photography, Film*, 51.

Not only did Moholy-Nagy modify the text between the German and English versions of *Von Material zu Architektur* and *The New Vision*, but he also included many more images of his and his students projects from both the Bauhaus and the New Bauhaus in the 1938 translation. In the previously mentioned list of sensory experiences of space, in addition to the traffic image, he featured his painting of the *Kinetisches Konstruktive System* (Kinetic Constructive System, 1922),⁸¹ *Kinetisches Konstruktive System: Bau mit Bewegungsbahnen für Spiel und Beförderung* (Kinetic Constructive System: Structure with Moving Tracks for Play and Conveyance, 1922, rendered in 1928 by Stephan Sebök), AHAG Exhibition designed with Walter Gropius (Berlin, 1928), and special effect film props that Moholy-Nagy designed for H. G. Wells' "Things to Come" (1936) **(Figures 0.10 + 0.11)**. These images have in common a play on the senses. The first two drawings depict two versions of a spiral structure in which people are moving through the levels of space by climbing up and sliding down several rotating ramps and a vertical pole. The third is the multi-layered photomontage of traffic with the inhabitants of the vehicles experiencing space at multiple levels and varying speeds, a good illustration of a compelling example used by Albert Einstein's to explain the idea of moving coordinate systems in his relativity theory to the general public.⁸² The fourth photograph depicts a view of their AHAG exhibit seen through the layers of

⁸¹ According to Oliver Botar, a note, not in Moholy-Nagy's hand, had been added to *Kinetisches Konstruktive System* and is often used as a subtitle for the piece: "Schematische Darstellung einer beweglichen Lichtspirale für die Zentralbühne eines Totaltheaters" (Schematic Representation for a Moving Light Spiral for the Center Stage of a Total Theater). See also László Moholy-Nagy and Alfréd Kemény, *Dynamisch-konstruktives Kraftsystem* (Dynamic-Constructive Energy System), *Der Sturm* 12 (December 1922), 186; translated into English by Oliver Botar in *Technical Detours: The Early Moholy-Nagy Reconsidered*, 171.

⁸² In his exhaustive biographical study of Moholy-Nagy's life and works, *Moholy-Nagy: Mentor to Modernism* (Cincinnati: Flying Trapeze Press, 2004, 351–352), Lloyd C. Engelbrecht documented that Einstein "was a member of the Kuratorium [Board of Trustees] of the Kreis der Freunde des Bauhauses [Circle of Friends of the Bauhaus]" and that Einstein actively supported the effort to keep the Bauhaus in Weimar in 1924, which aligned with his overall opposition to the far-right politicians, leading Moholy-Nagy to discuss, in person, the possibility of a Bauhaus book to be authored by Einstein.

structure and painted glass suggesting Moholy-Nagy's notion of transparency as a space-time architecture, in particular the constantly changing interplay of light and shadow produced by this transparency. The fifth photographic example shows an arrangement of several of the architectural props that Moholy-Nagy produced for the film adaptation of H. G. Wells' futuristic science fiction fantasy, *The Shape of Things to Come* (1933).⁸³ While these props were not incorporated in the film, Moholy-Nagy made use of this and other arrangements in his later writings including the cover art for a program brochure for the New Bauhaus (**Figure 0.11**).⁸⁴

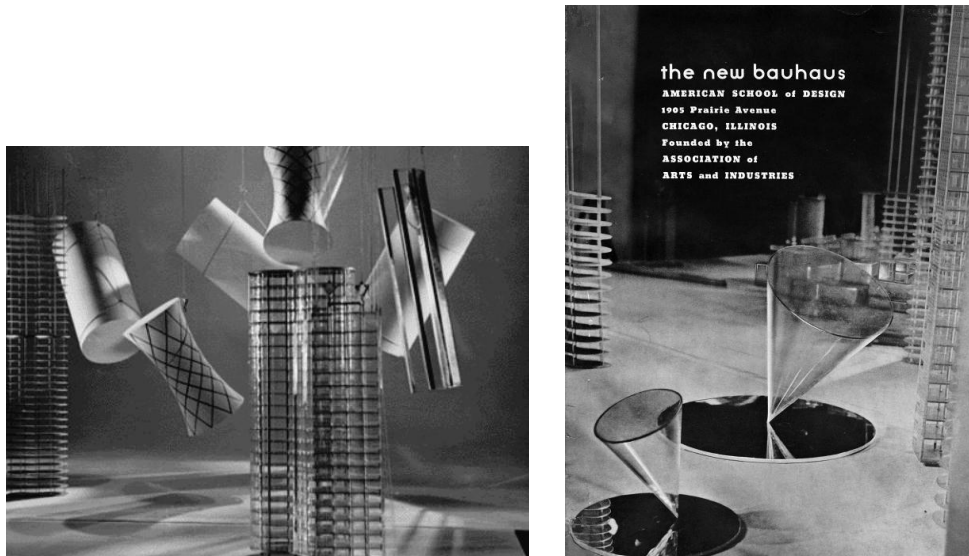


Figure 0.11: László Moholy-Nagy, (left) Film Props designed for H. G. Wells' *Things to Come*, 1936 + (right) Brochure Design for the New Bauhaus.

⁸³ H. G. Wells, *The Shape of Things to Come: The Ultimate Revolution* (London: Hutchison & Company, 1933). Linda Henderson categorized H. G. Wells as one of a group of prominent literary figures working with the fourth dimension in *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*, Rev. Ed., 98.

⁸⁴ Cover Art for a 1937 brochure for the New Bauhaus program.

Of all of the types of sensory experiences of space listed in *Von Material zu Architektur*, Moholy-Nagy's construction of vision, in particular, had the most numerous and various means to perceive space, in some cases, overlapping with the other senses, in particular, with the "means of locomotion by different directions in space (horizontal, vertical, diagonal); intersections; [and] jumps."⁸⁵ He further related hearing to "acoustical phenomena" and, interesting for his own work on kinetic theater spaces, connected "equilibrium" to circles, curves, [and] windings (spiral stairways).⁸⁶ Multiplying spatial dimensions in his own stage set designs and theatrical productions, Moholy-Nagy did not rely on vision alone; rather, he supplemented colored lights and projected image displays with human and mechanical actors, music and sounds, and even a shower of scented powders in the case of the *Exzentrik*.

Building upon sensual perception and apperception, Moholy-Nagy created theatrical performances in the tradition of the ancient Greek theater in which the citizen came together for civic reinvestment and a cathartic release.⁸⁷ In Moholy-Nagy's conceptions, this release took the form of a synaesthetic extravaganza, with such intensity that the catharsis was capable of expanding sensory perception to higher dimensions. If it had been realized, Moholy-Nagy's mechanical *Exzentrik* would have attempted to create such an experience, systematically

⁸⁵ Moholy-Nagy, *The New Vision*, 1938, 164.

⁸⁶ Ibid., 164. For more information on Moholy-Nagy's work on sensory training through a derangement of the senses, see Oliver A. I. Botar, "Moholy-Nagy et la vue aérienne," *Vues d'en Haut*, Christof Asendorf, Thierry Gervais, and Laure Jaumouillé, eds., Centre Georges Pompidou-Metz (Metz, France: Centre Pompidou-Metz, 2013). Botar delivered this paper in part as a keynote presentation for the Frascari Symposium III, *Ceilings and Dreams: The Architecture of Levity*, (Washington Alexandria Architecture Center, Virginia Tech, April 21–22, 2017) and generously provided an English translation of the essay: "Sensory Derangement or Training the Senses for Modernity: The Art of Illinx and the European Avant-Garde" (unpublished manuscript, University of Manitoba, Winnipeg, n.d.).

⁸⁷ Aristotle described the sense of purgation of emotion was similar to the medical term, *Κάθαρσις* (a cleansing or purification leading to a cure), in *The Poetics*, S. H. Butcher, trans. (London and New York: MacMillan and Company, 1898), 1449b.

constructing the visual experience with the periodic introduction of additional sensory interventions. The hybrid drawing for the *Exzentrik* remains enigmatic and requires interpretation to decipher Moholy-Nagy's intentions. Although a version of the drawing was published in *Die Bühne im Bauhaus* (The Stage of the Bauhaus, 1925), as a quadri-fold sheet accompanied by a title, brief textual description, and a diagram of the arrangement of three stages, this text remains rather cryptic, more suggestive than explanatory. In addition to the printed diagram, Moholy-Nagy first prepared a mixed media, hybrid drawing/painting/collage, during the year prior to publication. Each has a vibrant energetic quality, with a variety of colors. However, the printed version had been significantly shortened and the muted red and yellow hues of the *Photoplastik* were translated into bright primary colors (**Figure 0.2**).

Moholy-Nagy used a variety of media in this work including graphite pencil, colored pencils (silver, and maybe red for the final blush light effect), inks/watercolors (black, red, yellow, white, and a very small light wash of green on the wrestler's trousers), and collaged pieces from black and white newspapers and color magazines. In a similar manner as his other *Photoplastiks*, he painted and drew over these collaged elements fully incorporating them into his composition. The hybrid *Exzentrik* contains textual notes throughout written in graphite pencil, which give further clues to his intentions.

Lacking explicit directions in the handwritten and printed texts, Moholy-Nagy's other writings on space creation, sensory perception, and synaesthetic theater, as well as his extensive references to inspirations found in the work of others, must provide the basis on which to decipher the *Exzentrik*. For instance, in one such source, in *Von Material zu Architektur*, Moholy-Nagy explained that consciousness expanding experiments in space creation are especially possible in immersive temporary venues:

raumgestaltung als ausdrucksform des menschen, aus innerem trieb — wie
malerei, plastik, musik, dichtung — gibt es nach landläufigen begriffen nicht,

doch wäre erst eine solche konzeption die richtige Umkreisung des räumlichen gestaltungsproblems. damit die konstituierung dieser möglichkeit nicht leere gedankenbildung bleibe, sei gleich darauf hingewiesen, daß das teater, und auch der film — manchmal sogar ausstellungsbauten — gelegenheit genug zur realisierung dieses Wunsches bieten, aber über diese möglichkeiten hinaus ist eine eingehende beschäftigung mit diese, vorstellungskreis wichtig, weil sich hier neue sfären der befreiung für den heutigen menschen auftun und von der befreiung dieser menschlichen energien her auch der zweckverkoppelten architektur hilfe kommen kann; d. h. letzten endes dem menschen, der in seinem alltag dieser zweckverkoppelten architektur eingeordnet ist.⁸⁸ (With the exception of dance, space creation as a form of human expression, from an inner urge—like painting, sculpture, music, poetry—does not exist according to current understanding.... In order that the presentation of this possibility shall not remain an empty picture of the imagination, it may be mentioned that the circus, variety, theater, and the motion picture, as well as occasional exposition buildings, afford sufficient practical opportunity. Not only because of the possibilities offered the architect, a serious consideration of these temporary structures is important, since new avenues of release for the modern man emerge; from the freeing of human energies in this sphere assistance may also be rendered to utilitarian architecture, that is, in the last analysis, to man, since in his daily life he is subordinated to the architecture of utility.)⁸⁹

It is on this position, that theatrical performances provide the vehicle for consciousness expanding synaesthetic experiences that one can begin to decipher and interpret the words

⁸⁸ Moholy-Nagy, *Von Material zu Architektur*, 215–216.

⁸⁹ Moholy-Nagy, *The New Vision*, 1938, 193.

and images of the *Exzentrik*, as a representation of an inner urge toward higher dimensional space creation constructed upon sensory perceptions and apperceptions.

APPERCEPTION

In his *Photoplastiks*, Moholy-Nagy explored questions about the nature of perception in the representation of space-time dimensions. In *Malerei Fotografie, Film*, Moholy-Nagy established that photographic representations hold the power to change spatial perception by neutralizing the tendency of the intellect to interpret spatial relationships, a phenomenon described by German psychologist Wilhelm Wundt as apperception. According to Wundt's sensory experiments, the human brain has the tendency to interpret sensory stimuli, at times seeing or hearing something that is not there.⁹⁰

In one particularly effective image looking down on a sunbathing woman reclining in the sand, Moholy-Nagy demonstrated that the view from above obliterates any reference to a horizon, allowing the image to be rotated and, thereby, changing the balance of the composition without appearing to be upside down (**Figure 0.12**).⁹¹ Functioning similarly to dream imagery, these oblique views foster new spatial relationships based on a new interpretation of visual stimuli.

⁹⁰ László Moholy-Nagy, *Painting, Photography, Film*, Janet Seligman, trans., 29. See also Wilhelm Wundt, *An Introduction to Psychology*, translated by Rudolf Pinter (London: George Allen & Unwin, [1911] c. 1925).

⁹¹ Moholy-Nagy, *Painting, Photography, Film*, 29.

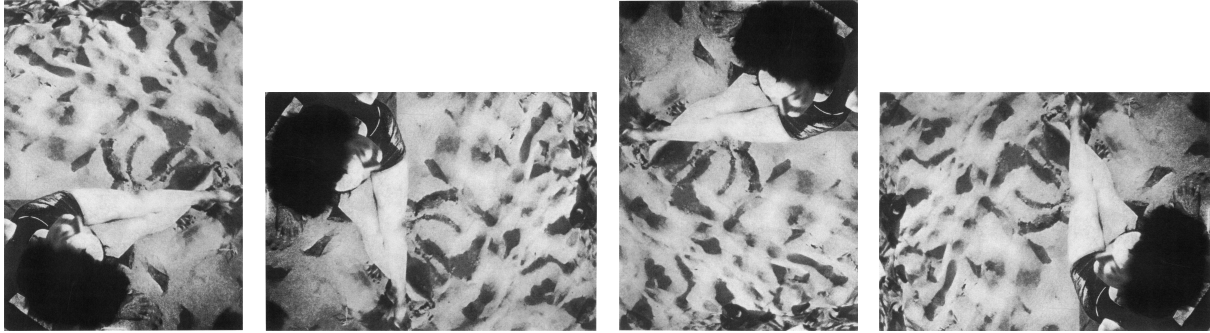


Figure 0.12: László Moholy-Nagy, *Im Sand* (In the Sand), in *Malerie, Fotografie, Film*, Munich, Albert Langen Verlag, 1925.

In a footnote in "a new instrument of vision" (*telehor*, 1936), Moholy-Nagy related a story about the imperfection of the eye as an optical instrument in which the German physio-psychologist Hermann von Helmholtz reportedly told his students that if an optician had come to him after creating the eye, his response would have been that he had done a bad job of it.⁹² From Moholy-Nagy's point of view, the camera had many advantages over the naked eye, even harboring the potential to retrain the fallible eye to see beyond its current limitations. As such, Moholy-Nagy identified eight types of vision improved by the photographic camera: (1)

⁹² Moholy-Nagy, "a new instrument of vision," in *telehor*, (Brno, nos. 1–2, 1936): 34–36; see also French translation as "photographie forme objective de notre temps," 13–15, and Czech translation as "fotografie, objektivni forma viděni naší doby," 68–74. First appearing in Hungarian as "A fotográfia: napjaink objective látási formája," in *Korunk*, no. 12, 1933, 911–913, the English translation was republished in an anthology of Moholy-Nagy's articles and letters by Krizstina Passuth, in *Moholy-Nagy*, trans. Éva Grusz, Judy Szöllősy, László Baránszky Jób, Mátyás Esterházy, Kenneth McRobbie, and Ilona Jánosi, (New York: Thames and Hudson, 1985), 327. In a lecture entitled, "The Recent Progress of the Theory of Vision," published in the *Pruessischer Jahrbuch* in 1868 and translated into English by Pye Smith on page 227 in Hermann von Helmholtz, *Popular Lectures on Scientific Subjects*, (New York: D. Appleton and Company, 1885), Helmholtz wrote: "'For the eye has every possible defect that can be found in an optical instrument, and even some which are peculiar to itself ; but they are all so counteracted, that the inexactness of the image which results from their presence very little exceeds, under ordinary conditions of illumination, the limits which are set to the delicacy of sensation by the dimensions of the retinal cones.'"

“abstract seeing,” as in direct light exposures in Photograms; (2) “exact seeing,” such as documentary photography, (3) “rapid seeing” with successive snapshots, (4) “slow seeing” with prolonged exposures leaving temporal traces, (5) “intensified seeing” with evidence from micro-photography and filtered-light photography, such as infrared lenses, (6) “penetrative seeing” in x-rays, (7) “simultaneous seeing” with superimposed images, (8) “distorted seeing” including optical jokes and distortions created using a prism lens or through chemical processing.⁹³ In this article, Moholy-Nagy was demonstrating the unrealized possibilities in experimenting with diverse types of photography.⁹⁴

Moholy-Nagy was very clear about the ability of the photograph to change to way that someone sees the world through a process of retraining the way that the brain processes the visual stimuli, thwarting the phenomena of apperception. In particular, in *Malerei, Fotografie, Film*, Moholy-Nagy described this capability of the photographic image in the section entitled, “Fotografie” (Photography):

Das Geheimnis ihrer Wirkung ist, daß der fotografische Apparat das rein optische Bild reproduziert und so die optisch wahren Verzeichnungen, Verzerrungen, Verkürzungen usw. zeigt, während unser Auge die aufgenommenen optischen Erscheinungen mit unserer intellektuellen Erfahrung durch assoziative Bindungen formal und räumlich zu einem **Vorstellungsbild** ergänzt. Daher besitzen wir in dem fotografischen Apparat das verlässlichste Hilfsmittel zu Anfängen eines objektiven

⁹³ Moholy-Nagy, “a new instrument of vision,” in *telehor*, (Brno, nos. 1–2, 1936): 35. This list was reproduced in *Vision in Motion*, 207, and was preceded by the reference to Helmholtz critique of the eye as an optical instrument. In the same passages, Moholy-Nagy succinctly summarized his long-held position as, 206–207: “Such scientific and technological advances almost amount to a psychological transformation of our vision, since the sharpness of the lens and its unerring accuracy have now trained our powers of observation to a higher standard of visual perception than ever before. Photography imparts a heightened and increased power of sight in terms of time and space.”

⁹⁴ *Ibid.*

Sehens. Ein jeder wird genötigt sein, das Optisch wahre, das aus sich selbst Deutbare, Objektive zu sehen, bevor er überhaupt zu einer möglichen subjektiven Stellungnahme kommen kann. Damit wird die seit Jahrhunderten unüberwundene Bild und Vorstellungssuggestion aufgehoben, die unserem Sehen von einzelnen hervorragenden Malern aufgeprägt worden ist. Wir sind — durch hundert Jahre Fotografie und zwei Jahrzehnte Film — in dieser Hinsicht ungeheuer bereichert worden. **Man kann sagen, daß wir die Welt mit vollkommen anderen Augen sehen.** Trotzdem ist das Gesamtergebnis bis heute nicht viel mehr als eine visuelle enzyklopädische Leistung. Das genügt uns aber nicht. Wir wollen planmäßig **produzieren**, da für das Leben das Schaffen neuer Relationen von Wichtigkeit ist.⁹⁵ (The secret of their effect is that the photographic camera reproduces the purely optical image and therefore shows the optically true distortions, deformations, foreshortenings, etc., whereas the eye together with our intellectual experience, supplements perceived optical phenomena by means of association and formally and spatially creates a **conceptual image**. Thus in the photographic camera we have the most reliable aid to a beginning of objective vision. Everyone will be compelled to see that which is optically true, is explicable in its own terms, is objective, before he can arrive at any possible subjective position. This will abolish that pictorial and imaginative association pattern which has remained un superseded for centuries and which has been stamped upon our vision by great individual painters. ... **We may say that we see the world with entirely different eyes.** ... This is not enough. We wish to **produce** systematically, since it is important for life that we create new relationships.)⁹⁶

⁹⁵ Moholy-Nagy, *Malerei, Fotografie, Film*, 1927, 26–27.

⁹⁶ Moholy-Nagy, *Painting, Photography, Film*, [1969] 1987, 28–29.

From this passage, the images accompanying the text take on a new role: to retrain the eyes. On the page before this collection of images, Moholy-Nagy stated his deliberate intention to separate the images from the text, writing in the first person, for the first and only time, seeming to speak directly to the reader: "Ich lasse das Abbildungsmaterial getrennt vom Text folgen, da es in seiner Kontinuität die im Text erörterten Probleme VISUELL deutlich macht."⁹⁷ ("I have placed the illustrative material separately following the text because continuity in the illustrations will make the problems raised in the text VISUALLY clear.")⁹⁸ This statement suggests that the visual essay in *Malerei, Fotografie, Film* was intended to have the thwarting effect described, to retrain the processing of visual stimuli in order to "see the world with different eyes" by "systematically" creating "new relationships."⁹⁹

In his *Popular Lectures on Scientific Subjects* in the section entitled, "The Recent Progress of the Theory of Vision" (1868), Helmholtz provided an easily digestible description of current scientific thinking related to optics and psycho-physiology. Helmholtz discussed the physiology of the eye, the imperfections of the anatomical reception of sensation, and the psychology of the processing of perception in the brain. Being a popular version of his more exacting researches, in this text, Helmholtz focused his explanations on his experiments in spatial sensory awareness using paintings, photographs, and stereoscopic photographs.¹⁰⁰ In this way, the reader could verify or test his conclusion with their own eyes by recreating his revelatory experiments. While Helmholtz expected his readers to find their own images, Moholy-Nagy provided the materials necessary to carry out his visual training exercises with the images provided in the second half of the book.

⁹⁷ Moholy-Nagy, *Malerei, Fotografie, Film*, 1927, 45.

⁹⁸ Moholy-Nagy, *Painting, Photography, Film*, [1969] 1987, 47.

⁹⁹ *Ibid.*, 29.

¹⁰⁰ Hermann von Helmholtz, *Popular Lectures on Scientific Subjects*, trans. Pye Smith (New York: D. Appleton and Company, 1885), 197–316. Originally delivered as a series of lectures in Frankfurt and Heidelberg, date unknown. First published in the *Preussischer Jahrbuch*, 1868.

Helmholtz recognized that, while perception appears to be a simultaneous process of seeing and knowing, there is actually a near simultaneous process of translation at work, an interpretation of color spots on the retinae by comparing these relationships to the inventory of memories, reading the spots as signs in themselves. On this psycho-physical process, Helmholtz wrote:

We must not be led astray by confounding the notions of a phenomenon and an appearance. The colours of objects are phenomena caused by certain real differences in their constitution. They are, according to the scientific as well as to the un instructed view, no mere appearance, even though the way in which they appear depends chiefly upon the constitution of our nervous system. A 'deceptive appearance' is the result of the normal phenomena of one object being confounded with those of another.¹⁰¹

Relating an amusing anecdote describing the implications of this phenomenon of mental interference, in *Kant and his Platypus*, semiotician Umberto Eco analyzed Marco Polo's description of his encounter with unfamiliar animals on his travels in Asia as a misinterpretation of visual signs.¹⁰² Through his scribe and fellow prisoner, the romantic writer Rustichello da Pisa, Marco Polo remembered his initial confusion when he encountered a rhinoceros:

They have many wild elephants and they also have unicorns enough which are not at all by any means less than an elephant in size. And they are made like this, for they all have the hair of the buffalo; it has the feet made like the feet of an elephant. It has one horn in the middle of the forehead very thick and large and black. And I tell you that it does no harm to men and beasts with its horn, hurt

¹⁰¹ Helmholtz, *Popular Lectures on Scientific Subjects*, trans. Pye Smith, 260.

¹⁰² Umberto Eco, *Kant and the Platypus: Essays on Language and Cognition*, trans. Alastair McEwen (San Diego, New York, London: Harcourt, 1999), 57–59, originally published 1997 as *Kant e l'ornitorinco*.

only with the tongue and knees, or on its tongue it has very long spines and sharp; so that when they wish to hurt anyone they trample and press him down with the knees, afterwards inflicting the harm which it does with [its] tongue. It has the top of the head made like a wild boar and always carries its head bent towards the ground, and stays very willingly amongst lakes and forests in the mud and in the mire like swine. It is a very ugly beast to see and unclean. And they are not so as we here say and describe, who say that it lets itself be caught in the lap by a virgin girl; but I tell you that it is quite the contrary of that which we believe that it was.¹⁰³

Since Polo had not known of such an animal as a rhinoceros, he related it to a mythic animal that had a horn in the middle of its forehead, the unicorn. In this passage, Polo compared what he saw to what he knew from legendary illustrations and descriptions of unicorns. The one similarity, the horn, was itself completely different from descriptions of a unicorn's horn leading Polo to surmise that artists and writers had incorrectly described a unicorn as white, horse-like, delicate creature, when it was, in front of his eyes, a dark, boar-like, destructive beast. In fact, writers had been confusing the rhinoceros and the unicorn for centuries. In the *Etymologiae*, a collection of sources from literature and lore written down by seventh-century Bishop Isidore of Seville, including a section describing categories of animals, he had also related the *rhinoceron* as the Greek word also used for *monoceron*, or the unicorn.¹⁰⁴ This example of the application of

¹⁰³ Originally published in Old French c. 1299 as *Livres des Merveilles du Monde*. Marco Polo and Rustichello da Pisa, *The Description of the World*, trans. A. C. Moule and Paul Pelliot (London: George Routledge & Sons, 1938), 1: 166.

¹⁰⁴ Isidore of Seville, *The Etymologies of Isidore of Seville*, trans. Stephen A. Barney, et al. (Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo: Cambridge University Press, 2006), 252, originally published c. 636 as *Etymologiae*: "The rhinoceros (rhinoceron) is named with a Greek word; in Latin it means 'horn on the nose.' This is also the monoceron, that is, the unicorn (unicornus), because it has a single four-foot horn in the middle of its forehead, so sharp and strong that it tosses in the air or impales whatever it attacks. It often fights with the elephant and throws it to the ground after wounding it in the

a mental image to decipher an unknown being, or in the case of the rhinoceros-unicorn, points to the interference of subjective mental conventions that Moholy-Nagy hoped the photograph would disrupt in its presentation of an objective image.

Having been formulated in part in order to establish a science of metaphysics, Immanuel Kant laid bare the constructed nature of popular notions of space and time in his *Kritik der reinen Vernunft* (Critique of Pure Reason, 1781, revised 1784):

Wir haben also sagen wollen, dass alle unsere Anschauung nichts als die Vorstellung von Erscheinung sei; dass die Dinge, die wir anschauen, nicht das an sich selbst sind, wofür wir sie anschauen, noch ihre Verhältnisse so an sich selbst beschaffen sind, als sie uns erscheinen; und dass, wenn wir unser Subject oder auch nur die subjective Beschaffenheit der Sinne überhaupt aufheben, alle die Beschaffenheit, alle Verhältnisse der Objecte im Raum und Zeit, ja selbst Raum und Zeit verschwinden würden, und als Erscheinungen nicht an sich selbst, sondern nur in uns existiren können. Was es für eine Bewandniss mit den Gegenständen an sich und abgesondert von aller dieser Receptivität unserer Sinnlichkeit haben möge, bleibt uns gänzlich unbekannt. Wir kennen nichts als unsere Art sie wahrzunehmen, die uns eigenthümlich ist, die auch nicht nothwendig jedem Wesen, obzwar jedem Menschen zukommen muss.¹⁰⁵ (All our intuition is nothing but the presentation of appearance. The things that we intuit are not in themselves what we intuit them as being. Nor do their relations in themselves have the character that they appear to us as having. And if we annul

belly... It has such strength that it can be captured by no hunter's ability, but, as those who have written about the natures of animals claim, if a virgin girl is set before a unicorn, as the beast approaches, she may open her lap and it will lay its head there with all ferocity put aside, and thus lulled and disarmed it may be captured."

¹⁰⁵ Immanuel Kant, *Kritik der reinen Vernunft* (Leipzig: F. Meiner, 1919), 95–96.

ourselves as subject, or even annul only the subjective character of the senses generally, then this entire character of objects and all their relations in space and time—indeed, even space and time themselves—would vanish; being appearances, they cannot exist in themselves, but exist only in us. What may be the case regarding objects in themselves and apart from all this receptivity of our sensibility remains to us entirely unknown. All we know is the way which we perceive them.)¹⁰⁶

In other words, sensory perception of space and time have been **constructed on the subjective interpretation of appearances** and do not necessarily exist in themselves outside of sensory perception. This realization called into question the *a priori* nature of space and time, forming the basis of Kant's divisions of *noumena* – things-in-themselves – and *phenomena* – things as they appear to the senses.¹⁰⁷

In his *Vier Paradoxa* (Four Paradoxes, 1846), philosopher and early psychophysicist Gustav Theodor Fechner, writing under the pseudonym, Dr. Mises, theorized the hypothetical existence of an invisible dimension of space.¹⁰⁸ A fourth dimension had been conceptualized previously by

¹⁰⁶ Immanuel Kant, *Critique of Pure Reason: Unified Edition (with all variants from the 1781 and 1787 editions)*, trans. Werner S. Pluhar (Indianapolis and Cambridge: Hackett Publishing Company, 1996), 94, originally published 1781 as *Kritik der reinen Vernunft*.

¹⁰⁷ Ibid. Without knowing exactly when or even if Moholy-Nagy read Kant, or Fechner, or Wundt, it is clear from his extensive references and citations in *Vision in Motion* (1947) that Moholy-Nagy was well-read in the areas of criticism, literature, history, philosophy, psychology, science, and mathematics and assumed that he was motivated to stay abreast of current topics of discussion given the circles in which he moved. Although Kant published his *Critique of Pure Reason* over one hundred years before Moholy-Nagy was born, he referenced a special supplement to *Kantstudien*, a periodical devoted to the writings of Kant, his predecessors and his influence, when citing Carnap's *Der Raum*.

¹⁰⁸ According to her extensive research, Linda Henderson claimed that Fechner may have recorded the first discussion of two-dimensional beings who were entirely unaware of the existence of higher dimensions as an analogical proof of a possible fourth dimension in his *Vier Paradoxa* (Leipzig: Leopold Voss, 1846). See Linda Dalrymple Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art* (Princeton,

various mathematicians and physicists including astronomer and mathematician Joseph-Louis Lagrange (née Giuseppe Lodovico Lagrangia), who had already posited time as equivalent to a fourth spatial dimension in his section on dynamics in *Mécanique analytique* (Analytical Mechanics, 1788), revived and refined almost eighty years later in a lecture by mathematician Bernhard Riemann in "Über die Hypothesen welche der Geometrie zu Grunde liegen" (On the Hypotheses that Lie at the Bases of Geometry, 1854).¹⁰⁹ However, these works were highly technical, while Fechner's text was provocative, for an audience interested in the metaphysical implications of a fourth dimension. Fechner described two-dimensional beings who were entirely unaware of the existence of higher dimensions as an analogical proof of the possibility of a fourth dimension of space. His characters were colorful, two-dimensional shadow men, projections on paper using a *camera obscura* inspired by Plato's *Allegory of the Cave*.¹¹⁰ Bound by two-dimensional perception, shadow men were unaware of and unable to visualize a third dimension. This trope recurred in subsequent popularizing expositions on the fourth dimension such as Charles Hinton's "What is the Fourth Dimension?" published in the *Dublin University Magazine* (1880) and Edwin Abbott's *Flatland* (1895).

NJ: Princeton University Press, 1983), 119 for a summary of this text in English. See also an anonymous English translation of the second paradox may be found at this URL address, uploaded by Gabriel Brias Buendía, <https://www.scribd.com/document/165083251/The-Space-Has-Four-Dimensions-english-Gustav-Theodor-Fechner>. Accessed on April 4, 2018.

¹⁰⁹ Joseph-Louis Lagrange, *Analytical Mechanics*, trans. Auguste Boissonnade and Victor N. Vagliente (Dordrecht: Springer, 1997), iv and 183–186, originally published 1788 as *Mécanique analytique* and Bernhard Riemann, "On the Hypotheses which Lie at the Bases of Geometry," William Kingdon Clifford, trans., *Nature*, v. VIII, nos. 183–184, 14–17 and 36–37.

¹¹⁰ Fechner, *Vier Paradoxa*, 1846. In the first edition of *The Fourth Dimension and Non-Euclidean Geometry in Modern Art* (Princeton, NJ: Princeton University Press, 1983, 12–19), Linda Dalrymple Henderson noted that Helmholtz also used the example of two dimensional beings moving on the surface of a sphere to describe a world in which parallel lines would not exist and was probably inspired by Carl Friedrich Gauss.

Fechner succinctly formulated why his contemporaries have difficulty visualizing a fourth dimension in describing two groups of sceptics, naturalists and philosophers, as “bei denen, die nichts glauben, als was sie sehen, und bei denen, die nichts sehen, als was sie glauben” (those who believe nothing but what they see and those who see nothing but what they believe), respectively.¹¹¹ In this criticism, Fechner connected mental interference to the physical limitations of sensory perception as obstacles to visualizing the world in itself, beyond its appearance.

In *An Introduction to Psychology* (1911), Wundt demonstrated that apperception becomes undetectable and, therefore, synonymous with perception. Using examples of visual, auditory, and tactile phenomena, Wundt determined that a person naturally organizes multiples into groupings with degrees of emphasis even when there is no hierarchy provided. From these observations, Wundt described the psychological processes of perception, apperception, and apprehension citing examples of rhythmical beats, arrangements of dots, symbols, letters, and the system developed for the Braille alphabet.¹¹² Wundt demonstrated that, not only is sensory perception limited by the sensory organs themselves as well as the mental interference of apperceptive tendencies, but a person is generally wholly unaware of these limitations.

Through the phenomenon of apperception, Moholy-Nagy believed that the sense organs including the intellect could be retrained to perceive the world objectively. While in *Malerei, Fotografie, Film*, the photograph would have the potential to retrain the eye; in the *Exzentrik*, the synaesthetic performance would retrain all of the senses of the audience. In the text accompanying the printed version of the *Exzentrik*, “Theater, Zirkus, Varieté,” Moholy-Nagy defined apperception as:

¹¹¹ Fechner, *Vier Paradoxa*, 17.

¹¹² Wilhelm Wundt, *An Introduction to Psychology*, trans. Rudolf Pinter (1911; repr., London: George Allen & Unwin, c. 1925), 74–75.

“Apperzeptionell” soll hier dem “Assoziativen” gegenübergestellt eine elementare Stufe der Wahrnehmung und Begriffsbildung (psychophysische Aufnahme) bedeuten. Z. B. eine Farbe aufnehmen = apperzeptioneller Vorgang. Das menschliche Auge reagiert ohne vorherige Erfahrung auf Rot mit Grün, auf Blau mit Gelb usw. Ein Objekt = Farbe + Stoff + Form aufnehmen = mit geübten Erfahrungen in Verbindung bringen = assoziativer Vorgang.¹¹³ (“Apperception” should be here “Association” understood as an elementary stage of perception and conceptualization (psychophysical recording). I. e. a color recording = apperceptive process. The human eye responds without previous experience to red with green, to blue with yellow and so on. An object = color + material + form recording = bringing past experiences in connection = associative process.)¹¹⁴

In this section, Moholy-Nagy described how the mechanical nature of the *Exzentrik* would breakdown “logisch-gedanklichen Werte” (“logical intellectual values”), apperceptive associations, between color and form, sound and smell, allowing the actor and audience to fully experience the transformative performance.¹¹⁵

In addition to these positions on dimensional space staked out by mathematicians, philosophers, and psychologists, there are those who claimed that the fourth dimension is temporal not spatial, while others maintained that the distinction between time and space is arbitrary in itself. Had the *Exzentrik* been realized, had an audience experienced the proposed synaesthetic extravaganza, this theatrical performance of form, movement, light, color, sounds, music, and odors, would have provided Moholy-Nagy with a vehicle for and potentially evidence of the

¹¹³ László Moholy-Nagy, “Theater, Zirkus, Varieté,” in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *Bauhausbuch*, ed. Walter Gropius and László Moholy-Nagy, vol. 4, *Die Bühne im Bauhaus* (Munich: Albert Langen, 1925), 48.

¹¹⁴ Translated by author.

¹¹⁵ Moholy-Nagy, “Theater, Zirkus, Verieté,” *Die Bühne im Bauhaus*, 1925, 48–49.

possibility of re-training an audience's perceptions; and, in light of his later writings on space and time, the *Exzentrik* would have perhaps unlocked the audience's ability to see other spatial realities after overcoming their penchant for Euclidean space in three dimensions.

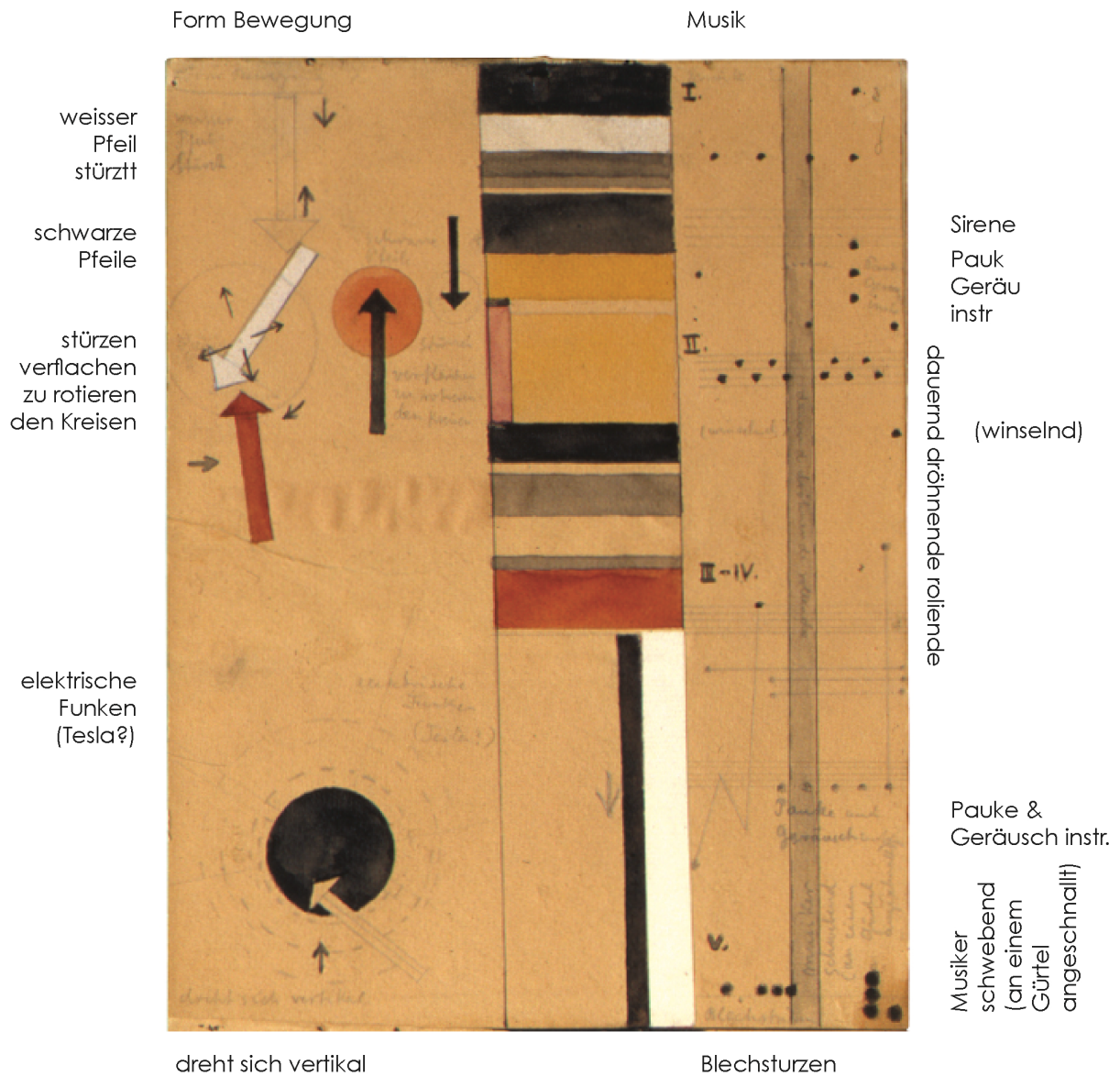


Figure 0.13: László Moholy-Nagy, Untitled, c. 1924, for complete caption see note to Figure 0.1.

As a prelude, the first panel of the hybrid drawing contained hints of the what was to come in the following acts: circles, arrows, alternating lights, and rhythmic musical notes. The handwritten notes provide further insights into the sometimes-enigmatic images below. Reading the notations vertically from top to bottom, on the left edge of the panel in the first column, denoting the forms and movements, was written, "weisser | Pfeil | stürzt" (white arrows falling down) (**Figure 0.13**). This notation is adjacent to an outlined arrow and slightly above a white arrow; both are pointing down. There is also a red arrow pointing upward with its head meeting the head of the downward pointing white arrow in the outlined circle. These three arrows are supplemented by eight smaller arrows with their directions suggesting movements and countermovements. The next notation slightly lower and to the right reads "schwarze | Pfeile" (black arrows), aptly placed next to two black arrows, one pointing up and into the light red circle and the other down with another notation at its head: "stürzen | verflachen | zu rotieren | den Kreisen" (falling flatten to rotate the circles). The next notation is above and to the right of a large black circle surrounded by the dashed outlines of radiating circles. This notation provides yet another clue that the first sheet summarizes the lower sheets because it states, "elektrische | Funken | (Tesla?)" (electric sparks (Tesla?)), since two collage elements including electric bulbs are on the third and sixth panels. The last note in the first column of the prelude reads, "dreht sich vertikal" (spins vertically).

In the first column, only two notations are on lower panels. On the fourth panel, there is a curious notation: "Düfte & | Niess | pulver | etc. | gegen | das | Publikum" (scents & sneezing powder etc. toward the audience) (**Figure 0.14**). This note is to the right of the gray cone of the aroma spray extending from a rod held by one of two tiny hands. On the lowest panel, the last black circle of the prelude is repeated with arrows radiating out and the note, "dann explodiert" (then [it] explodes).

The final notation of the prelude, "dreht sich vertikal," suggests that the light projections become vertical, perhaps projected onto the hinged glass floor plate of the third stage depicted in the printed version of the *Exzentrik* as it is rotated vertically (**Figure 0.15**).

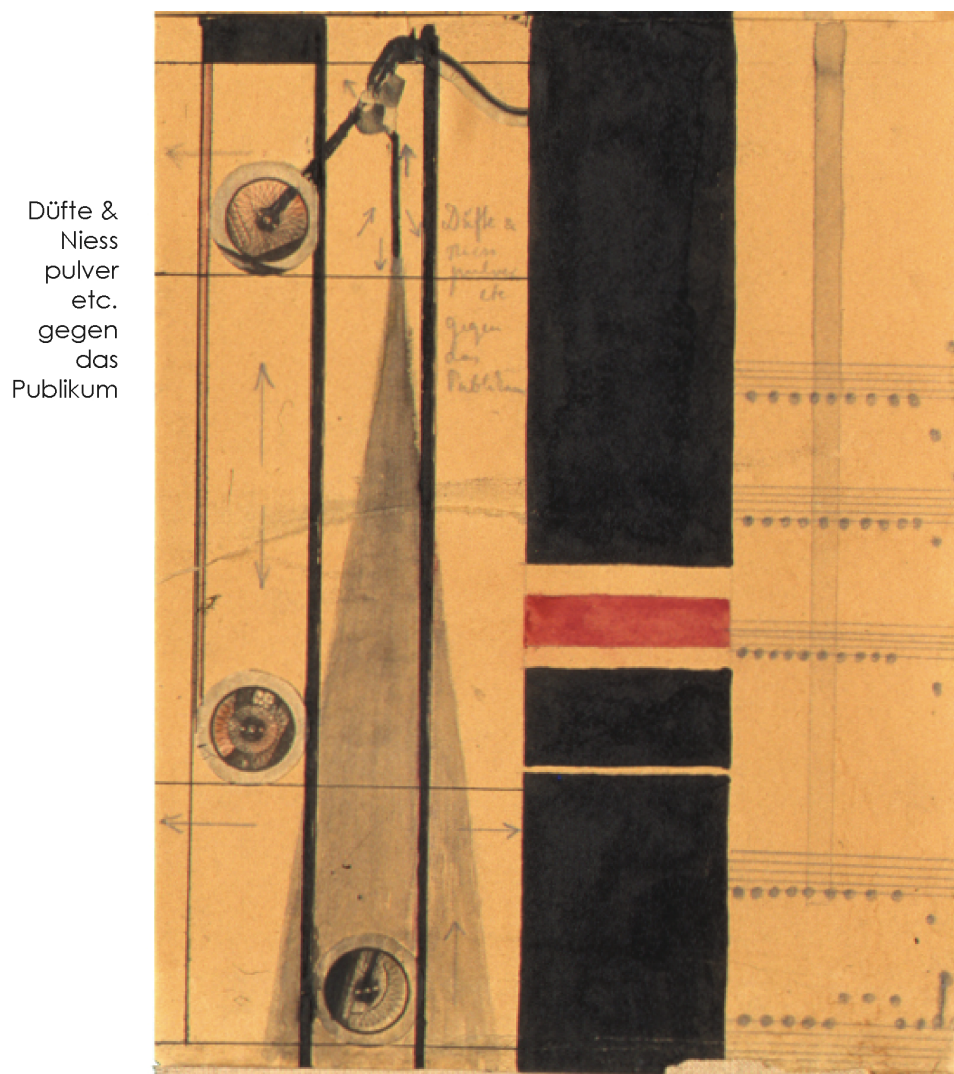
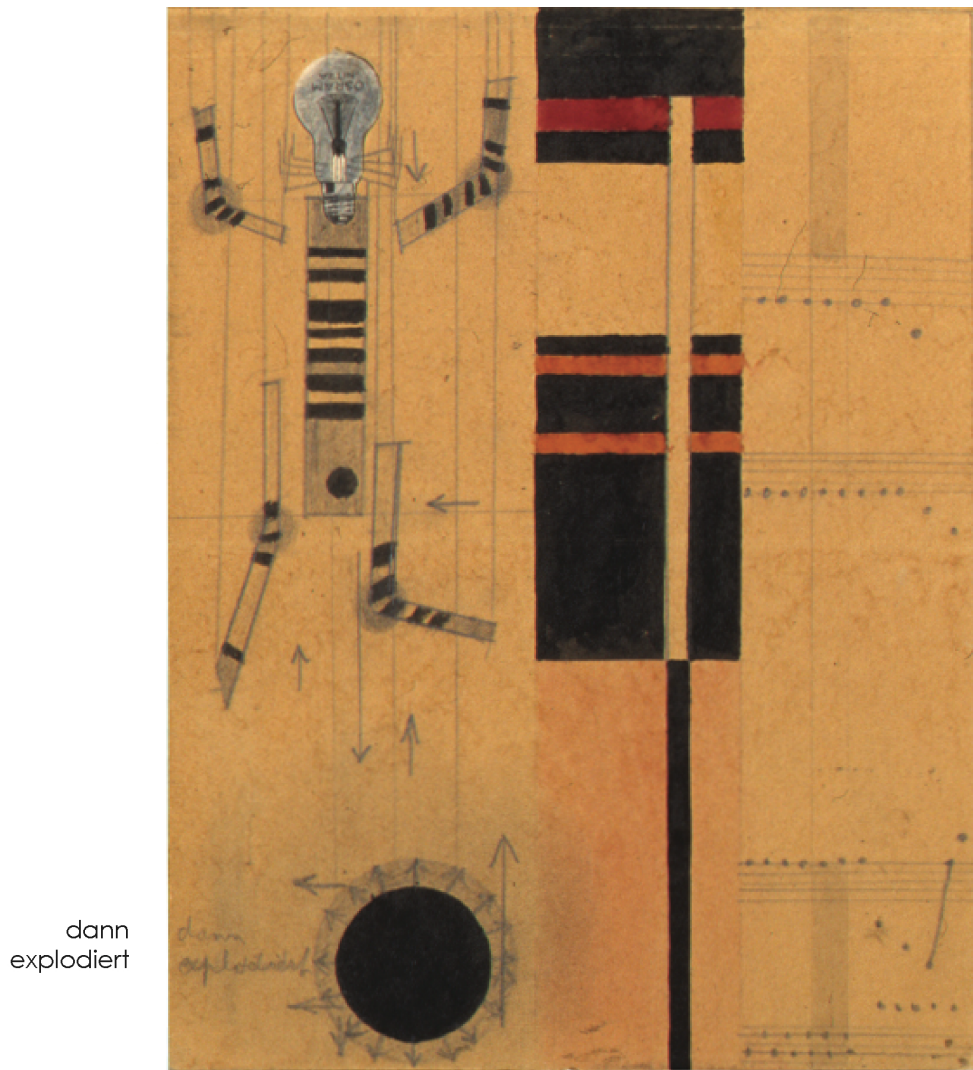


Figure 0.14: László Moholy-Nagy, Untitled, c. 1924, for complete caption see note to Figure 0.1.



dann
explodiert

Figure 0.15: László Moholy-Nagy, Untitled, c. 1924, for complete caption see note to Figure 0.1.

The remaining notations are in the third column of the first sheet starting with the title of "Musik" (Music) to the left of the upper edge corresponding to the title of the first column (**Figure 0.13**). The second column does not appear to have a title, unless the black ink had obscured it. Under "Musik" is the Roman numeral, "I." The next lower notation was written horizontally across the vertical gray bar, "Sirene" (Sirens). Immediately to the right is listed "Pauk | Geräu | Instr;" it is likely that these are abbreviations for drums, sounds, and instruments, since they are written

again below. Then, Moholy-Nagy wrote the Roman numeral, “II.” also on the left edge of the column. Just below these was written vertically within the gray bar, “dauernd dröhnende rollende” (lasting droning rolling), noting that the siren sounds are sustained with the rolling effect of crescendo–decrescendo. There is a word in parentheses to the left of these that is very faint and difficult to decipher. It may be “(winschend)” or “(winselend)” or something else close to those. Perhaps Moholy-Nagy meant wincing, describing the musical notes shown just above this word. These musical notes oscillate perhaps in a wincing manner against the droning of the sirens. He may also have intended to write wunschend for wishing or hoping. Then, the Roman numerals, “III–IV.” were hyphenated to the left edge of the column. The musical notes here are connected with lines indicating a dramatic climbing and dropping and climbing the scale. Other notes were connected horizontally indicating that they would be sustained. These horizontal, vertical, and diagonal lines connecting two musical notes are also overlapping each other, creating a musical grid. One of the lines is vertical, which may indicate that the two notes are played simultaneously or perhaps it would direct the musician to play all of the notes in between the two end notes at the same time. Under these musical bars was written, “Pauke & | Geräusch instr” (drums & sounds instruments), followed by the Roman numeral, “V.” adjacent to a notation turned ninety degrees counterclockwise somewhat spanning the third/ fourth and fifth sections: “Musiker | schwebend | (an einem | Gürtel | angeschnallt)” (musicians floating (on a belt fixed)). This note also appears to correspond with the lower panel, the last depicting the marionette, which, if these lower panels correspond to the numbers in the first sheet, would be the fifth act. The final notation at the lower left edge of the third column of the first panel reads, “Blechsturzen” (metal falling); this direction could very well correspond to the final note on the lowest panel calling for an explosion, “dann explodiert.”

These notations provide one level of interpretation of the images, colors, and musical notes. For instance, in the first column, there are three circles and fifteen arrows (**Figure 0.1**). Clustered near the top of the panel are a circle filled with a faint red tone and outlines of two empty circles.

Eleven of the arrows dance around these circles. There are two types of arrows: one type is a smaller with single, thin, black line and the other is a block arrow with a thin, black outline filled with white, red, black, or left unfilled. The corresponding notations describe "weisser | Pfeil | stürzt" (white arrow falling) and "schwarze | Pfeile" (black arrows), "stürzen | verflachen | zu rotieren | den Kreisen" (falling flatten to rotate the circles). In other words, these notes describe what is drawn and perhaps allude to projected images within the space of the stage, multi-colored arrows moving in many different ways, up and down the walls continuing onto the floor of the stage, and spinning around into circles, perhaps rotating circles. These circles could be spinning around until they form a large black circle with light radiating from its circumference much like the solar eclipse that captured the imagination of Albert Einstein. According to the next note, there would be sparks issuing from an electric apparatus somehow related to Nikolai Tesla and arrows of light continue to penetrate this circle until it explodes.

In the second column, duration and type of light effects were depicted with painted color bars. In the third column, the musical bars were drawn with graphite as are most of the notes. While the forms and movements are closely related to the lower panels, the lights and the music do not exactly duplicate in later scenes, nor do they directly correspond to the action represented in the first column. They are simultaneous supplements to the forms, lights, movements, films, actions, and odors of the first column. However, their simultaneous presence would add to the exuberance of the scenes with colored lights turning on and off sometimes with a stroboscopic effect interfering with vision. At unexpected moments, the lights darken as the crackling sparks burst forth from an induction coil; meanwhile, a film projection would be interrupted by a spray of spot lights moving into the eyes of the spectators.

Other than the omission of the fifth act, the color scheme was slightly changed in the printed version of the *Exzentrik* (**Figure 0.2**). While the hybrid drawing used red, yellow, white, and black inks, blue was added to the printed version, changing the gray vertical bar of the sirens to alternations of blue, yellow, red, and gray. In the printed version, all of the colors are brighter,

more intense, and the musical notation was also given a greater intensity with many more notes. For instance, the black square with the rosy circle in the fourth act of the hybrid was repositioned in the second column entitled, "Form + Bewegung + Kino (II. Bühne)" (Form + Movements + Film (2nd Stage)) with one of the notations to the second column being: "KINO AUF TAGES- | WAND" (Film of the Day-Wall). These clues shed light on the enigmatic nature of the hybrid drawing suggesting that the black square with the rosy circle may be a film projector and that the parallel lines at the bottom of this square would be the light of the projector (**Figure 0.16**).



Figure 0.16: László Moholy-Nagy, (left) Untitled, c. 1924 + (right) *Partiturskizze zu einer mechanischen Exzentrik* (Score-Sketch for a mechanical Eccentric), 1925, for complete captions see notes to Figures 0.1 + 0.2.

I. MOVEMENT

Visible and Invisible: Establishing and Inverting the Perspective Diagram using the Kinetic Grid of the *Partiturskizze zu einer mechanischen Exzentrik* [Act I]

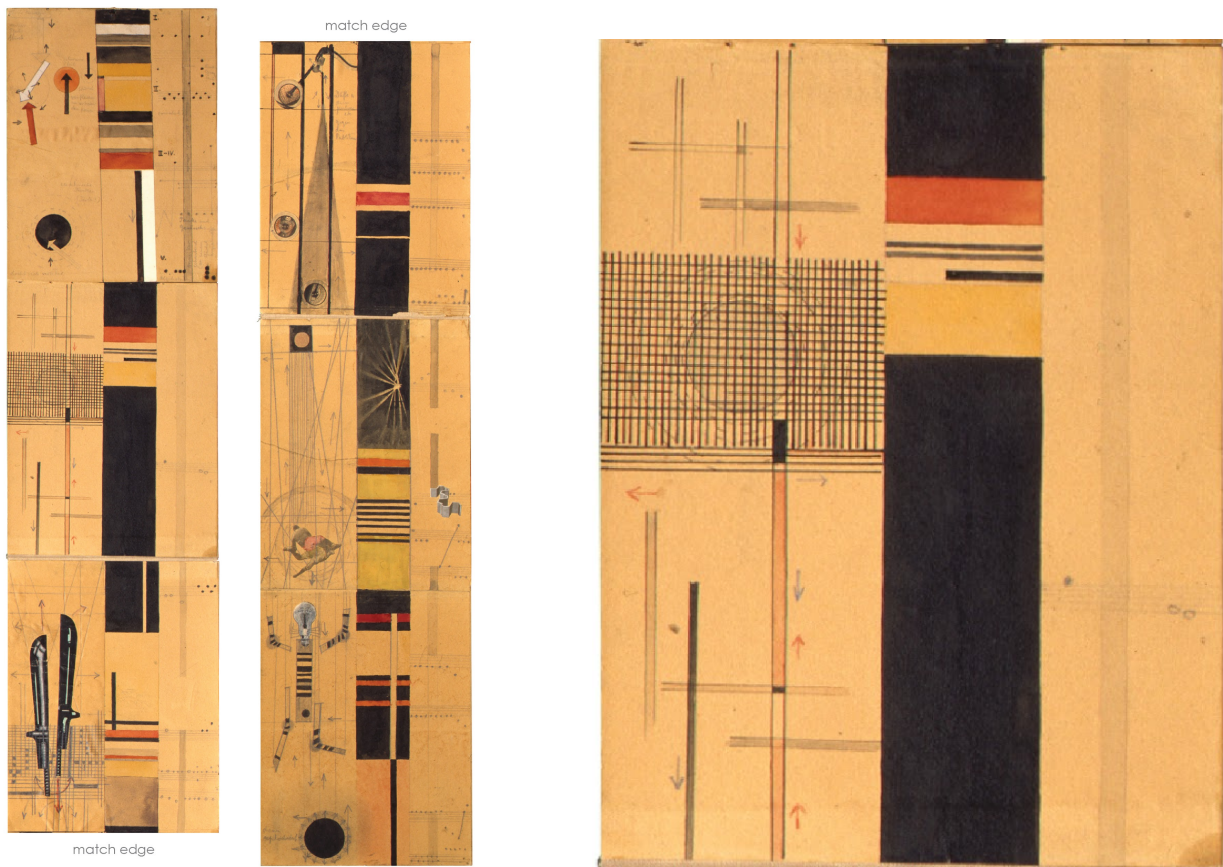


Figure 1.1: László Moholy-Nagy, (left) Untitled, c. 1924, for complete caption see note to Figure 0.1 + Act I Detail.

In his last work, published posthumously with the aid of his wife Sibyl in 1947, Moholy-Nagy had developed the concept and potential of his lifelong experiments in *vision in motion*. To paraphrase his statements closely, he described *vision in motion* as a “synonym for simultaneity and space-time” otherwise a “simultaneous grasp, as a creative performance” in which the relationship of “seeing, feeling, and thinking” were employed in the “comprehen[sion] [of] a new dimension.”¹ On the one hand, *vision in motion* was a trope disavowing the traditional notions of Renaissance perspective as a fixed monocular point of view at a fixed moment in time;² and, upon closer inspection of Moholy-Nagy's development of the perspective diagram in his *Photoplastiks*, Moholy-Nagy demonstrated a complex interplay between the construction of vision and multi-layered hidden meanings by collapsing space-time into psycho-physical inversions of a curious point of view. On the other hand, *vision in motion* fulfilled the challenge of a new vision to see the world differently, to see beyond conventional understandings of space, to see with new eyes as he presented in two of his *Bauhausbücher: Malerei, Fotografie, Film* and *Von Material zu Architektur*. In his contributions to his other *Bauhausbuch, Die Bühne im Bauhaus* (The Stage of the Bauhaus, 1925) published concurrently with the former of the two, Moholy-Nagy built upon these two aspects of *vision in motion* as he represented the first and second acts of the hybrid drawing of the *Exzentrik* immersing the audience in his conception of a new dimension.

In his effort “to comprehend a new dimension,” an invisible dimension of space, Moholy-Nagy appealed to many fields of study including psychology, physiology, mathematics, and physics, especially the space-time theories of Hermann Minkowski and, his student, Albert Einstein, whose

¹ Moholy-Nagy, *Vision in Motion*, 12 and 153.

² This aspect of the critique of perspectival representation inherent in *Vision in Motion* was demonstrated by Devin Fore in “The Myth Reversed: Perspectives of László Moholy-Nagy,” in his book, *Realism after Modernism: The Rehumanization of Art and Literature* (Cambridge and London: MIT Press, 2012), 21–74.

theory of relativity he summarized in a footnote in Vision in Motion as:

The relativity theory states: The speed of light is constant; it is the absolute speed in the universe. However, motion of objects can only be measured relative to another motion. Time is a coordinate of space. It is the “fourth dimension” — a physical measurement. Electricity and gravity combined account for all solid matter and matter and energy are interchangeable terms. This latter thesis led to the forecast of Einstein that the atom can be split thereby releasing immense energies.³

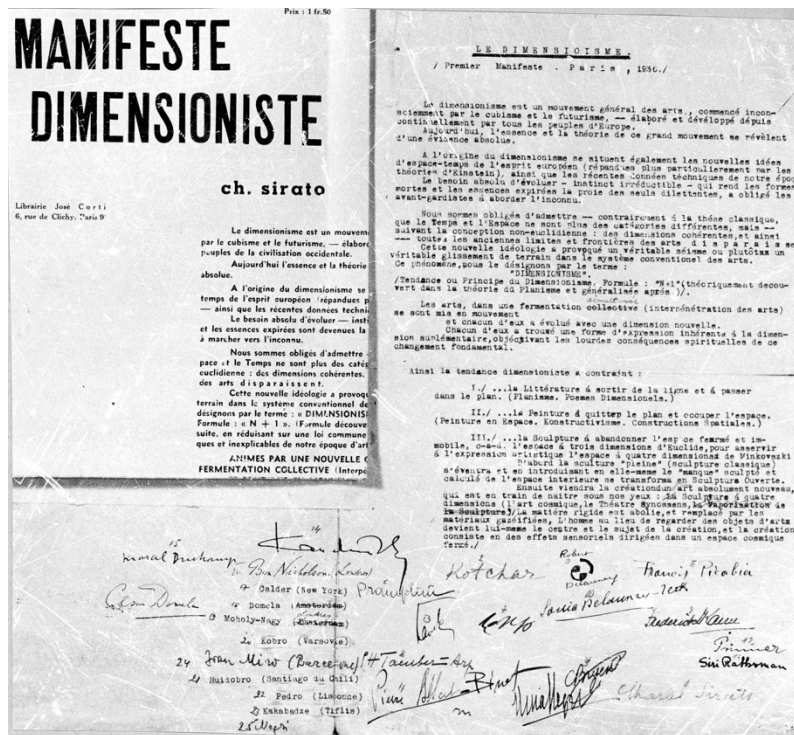


Figure 1.2: Charles Sirató, Manifeste dimensionniste, 1936, artpool.hu.

³ Moholy-Nagy, Vision in Motion, 266 in second footnote.

In the main body of the text to which the above footnote related, Moholy-Nagy acknowledged that many modern artists misused the term, space-time, to describe their work, since they were intellectually incapable of digesting its mathematical underpinnings. In most cases, space-time and relativity had entered into common parlance during the early part of the twentieth century with very different connotations depending on the context, sometimes provocatively and other times superficially, rarely with the intentions of the mathematicians or physicists. Under these circumstances, the footnote served to demonstrate that Moholy-Nagy was not using space-time in a frivolous manner and that he understood the implications of Einstein's theses, when he mentioned space-time in his own work, presumably including when signing the Manifeste dimensioniste. In relation to Einstein, Sirató's manifesto read: "A l'origine du dimensionisme se situent également les nouvelles idées d'espace-temps de l'esprit européen (répandues plus particulièrement par les théories d'Einstein) — ainsi que les récentes données techniques de notre époque."⁴ ("Equally at the origin of Dimensionism are the European spirit's new conceptions of space-time (promulgated most particularly by Einstein's theories) — and the recent technical givens of our age.")⁵ Later in the text, on the verso, Sirató also briefly mentioned the relevance of a chapter in his own book, *Le Planism* (Planism): "Nous attirons particulièrement l'attention sur le chapitre V.: La décomposition de la Littérature. Introduction du Planisme selon les nouvelles idées d'espace-temps d'Einstein et Minkovsky."⁶ (We attract particular attention to the fifth chapter, The Decomposition of Literature: Introduction to Planism according to the New Ideas of Space-Time of Einstein and Minkowski.)⁷

⁴ Sirató, "Manifeste dimensioniste," *N + 1*, insert, recto.

⁵ Charles Sirató, "The Dimensionist Manifesto," Oliver A. I. Botar, trans., *Dimensionism: Modern Art in the Age of Einstein*, Vanja M. Malloy, ed. (Cambridge, MA: MIT Press, 2019), 170.

⁶ Sirató, "Manifeste dimensioniste," *N + 1*, insert, verso.

⁷ Translated by author.

While the French version of the “Manifeste dimensioniste” referred only to the space-time theories of Einstein as capturing the essence of Dimensionism, the Hungarian version, “Dimenzionista manifesztum,” catered to a Hungarian-speaking readership potentially more familiar with the work of one of the founders of non-Euclidean geometry, Hungarian mathematician János Bolyai. The following passage was altered from the original French text to include a mention of Bolyai's founding role:

A dimenzionizmus életrehívói: — egyrészt a modern szellem teljesen új tér és idő koncepciója (geometriai, matematikai, fizikai kifejlődése Bolyaitól Einsteinen át napjainkban is folyik) — másrészt korunk technikai adottságai.⁸ (It is, on the one hand, the modern spirit's completely new conception of space and time [the development of which, in geometry, mathematics and physics -- from Bolyai through Einstein -- is ongoing in our days], and on the other, the technical givens of our age, that have called Dimensionism to life.)⁹

In his thesis, “Scientiam spatii absolute veram exhibens: a veritate aut falsitate Axiomatis XI Euclidei (a priori haud unquam decidenda) independentem: adjecta ad casum falsitatis, quadratura circuli geometrica” (The Science of Absolute Space: the veracity or falsity of Euclid's Axiom 11 [previously not ever decided] independently: adding to the case of falsity, a quadrature of spherical geometry, 1832),¹⁰ Janos Bolyai had proposed an alternate geometrical

⁸ Tamkó Sirató Károly, “Dimenzionista Manifesztum,” *A Vízöntő-kor hajnalán* (Aquarius at Dawn), Budapest, Szépirodalmi Könyvkiadó, 1969, 209-211.

⁹ Charles Sirató, “The Dimensionist Manifesto,” trans. Oliver Botar (Hungarian recto), <http://www.artpool.hu/TamkoSirato/manifeszt.html>, Art Pool, 2010. Accessed on April 27, 2016. The Hungarian translation was made from Sirató, “Dimenzionista Manifesztum,” *A Vízöntő-kor hajnalán*, 209–211.

¹⁰ János Bolyai's treatise had been inserted as an appendix at the end of the first volume of his father's *magnum opus*, Farkas Bolyai, *Tentamen juventutem studiosam in elements matheseos purse, elementaris*

system based on spherical geometries in which Euclid's controversial parallel postulate, which had been formulated based upon assumptions inherent in a planar geometry, would not hold true. Bolyai found that spherical geometry provided a coherent set of axioms of its own, in contradiction to those of Euclid. Without negating the veracity of planar geometry, which he determined was also valid, since it was also internally coherent, Bolyai composed an alternate comprehensive system or, to borrow Carnap's term, reality, in which apparently parallel lines would eventually converge at a point. This spherical world was not unlike the surface of the Earth, with a diameter so great that its curvature would be nearly impossible to detect.

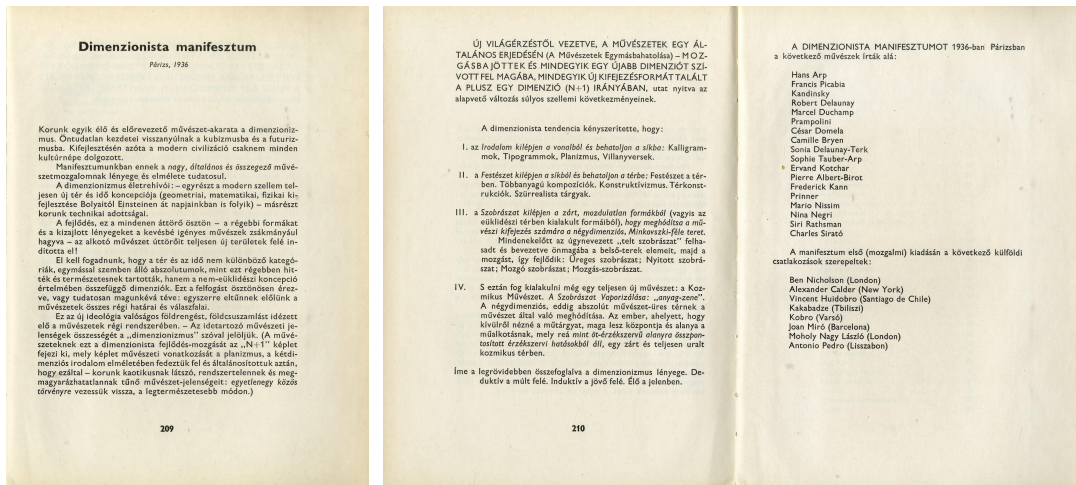


Figure 1.3: Charles Sirató, "Dimenzionista Manifesztum," *A Vízöntő-kor hajnalán*, Budapest, Szépirodalmi Könyvkiadó, 1969.

ac sublimioris, methodo intuitiva, evidenta— que huic propria, introducendi. Cum appendice triplici. Auctore Professore Matheseos et Physices Chemiaeque Publ. Ordinario. Tomus Primus. Maros Vasarhelyini. 1832. Tomus Secundus. Maros Vasarhelyini. 1833. An English translation may be found in Roberto Bonola, Nicholas Lobachevski, Federigo Enriques, and John Bolyai, *Non-Euclidean Geometry: A Critical Study of Its Development*, trans. H. S. Carlaw and George Bruce Halstead (n.p.: Dover Publications, 1955), 1–48. However, in Bonola's reprints, the page numbering is not consistent throughout the text, after page 268, the page numbering begins again with a thirty page introduction using Roman numerals.

By mentioning Bolyai in the Hungarian version of the *Dimenzionista manifesztum*, Sirató not only catered to his readership, but he also brought together two disparate areas in the development of the conception of higher dimensions of space, a theoretical and practical disconnection between mathematicians and physicists. British physicist Arthur Eddington exemplified these positions in his prologue to *Space, Time and Gravitation* in a dialogue between an experimental Physicist, a pure Mathematician, and, proposing a third category, a Relativist.¹¹ In this dialogue, it was revealed that the Mathematician is content with internally coherent systems and is willing to base his calculations on the assumption of axioms, which, in their profound truth, are unprovable. Meanwhile, physicists are also basing their truths on assumptions, such as the behavior of materials and limitations of human perception under the conditions of space-time. Eddington, a Relativist himself, had his impersona ask his companions how they might know that, as Euclid stated, the sum of the lengths of two sides a triangle is greater than the length of the third side. The Mathematician replied that he could prove the veracity of the statement, if he were allowed to base his proof upon certain presumed truths, which he would not be able to prove to be true or false. The Physicist wanted to measure the sides of a great variety of triangles and, subsequently, when challenged by the Relativist, fell into an absurd discussion of the rigidity of any measuring instrument in itself. (2–5) The Relativist then proposed that one corner of the triangle be subject to a strong magnetic field capable of warping the triangle and any measuring rod. The Physicist asked for a correction to the measure based on the action of the magnetic field upon the measuring rod, revealing his penchant for assuming the existence ideal conditions in an ideal space and time.¹² The Relativist concluded that the Physicists preference for Euclidean geometry was based on his way of measuring and was not necessarily founded on the nature of space itself:

¹¹ Arthur Stanley Eddington, "What Is Geometry?" in *Space Time and Gravitation: An Outline of the General Theory of Relativity* (London: Cambridge University Press, 1920), 1–16.

¹² Eddington, "What Is Geometry?" in *Space Time and Gravitation*, 1–7.

Our perceptions are crude measures, It is true that our perception of space is very largely a matter of optical measures with the eyes. If in a strong gravitational field optical and mechanical measures diverged, we should have to make up our minds which was the preferable standard, and afterwards abide by it. So far as we can ascertain, however, they agree in all circumstances, and no such difficulty arises. So, if physical measures give us a non-Euclidean space, the space of perception will be non-Euclidean. If you were transplanted into an extremely intense gravitational field, you would directly perceive the non-Euclidean.¹³

Faced with the futility of his position, the Physicist replied that “[n]on-Euclidean space seems contrary to reason.”¹⁴

It is in this notion, in the recognition that the limits of perception constitute the limits of what seems reasonable and what seems fantastical, that the *Exzentrik* operated. Mirroring his earlier sentiment in *Malerei, Fotografie, Film*, Moholy-Nagy continued in this section in *Vision in Motion*:

Space or space-time experience is not merely the privilege of exceptionally talented persons. It is a biological function, as important and as common as the experience of color, shape and tone. Its connotations are numerous. There is, for example, the hope that it will help in grasping future problems and vistas, enabling us to see everything in relationship, that it will furnish us with the right concept of cooperation and defense against aggression, where again space and time are inseparably intertwined.¹⁵

Space-time stands for many things: relativity of motion and its measurement,

¹³ Eddington, “What Is Geometry?” in *Space Time and Gravitation*, 10.

¹⁴ Eddington, “What Is Geometry?” in *Space Time and Gravitation*, 10.

¹⁵ Moholy-Nagy, *Vision in Motion*, 266.

integration, simultaneous grasp of the inside and outside, revelation of the structure instead of the facade. It also stands for a new vision concerning materials, energies, tensions, and their social implication.¹⁶

Attempting to expand the limits of reason, Moholy-Nagy staged a space-time experiment challenging the audience through transformations from the static conception of Euclidean geometry into the non-homogeneous, non-Euclidean, simultaneous grasp of a new dimension. When understood as a projection of light, the kinetic activation of the homogeneous coordinate system in Act I would allow the audience to perceive a non-uniform grid as it elongates and contracts moving around the stage.

COORDINATES

In a series of lectures delivered at Princeton University in 1921, Einstein explained that the tendency to overlook the influence of coordination systems on perception of physical space and time is due to the overwhelming influence of the Earth, as the ultimate reference for the development of Euclidean geometry and, subsequently, the isotropic space of the Cartesian coordinates system in three dimensions.¹⁷

For Einstein, as a physicist, distance could ideally be measured with respect to a rigid, reference body, also known as a coordinate system, if the reference body was at rest. However, as a Relativist, if the reference body was in motion with respect to the two points of two different coordinate systems, a simple measuring rod would not suffice in order to take into account

¹⁶ Moholy-Nagy, *Vision in Motion*, 268.

¹⁷ Albert Einstein, *The Meaning of Relativity: Including the Relativistic Theory of the Non-Symmetric Field*, trans. Edwin Plimpton Adams, Ernst G. Straus, and Sonja Bargmann, 5th ed. (1922; repr., Princeton, NJ: Princeton University Press, 1988), 2.

differences in the perception of time and space produced by movement.¹⁸ For these measurements, one must use the Lorentz Transformation, which mathematically accounts for the relativity of space and time making it possible to transfer measurements between two moving coordinates systems over time.¹⁹ All measures are relative to the motion of the coordinate systems from which the perceiver perceives. According to Dutch physicist Hendrik Lorentz, a rod in motion would appear shorter than an identical rod at rest, and time itself can elongate.²⁰ Underpinning Einstein's Special and General Theories of Relativity, these mutations explain the apparent annual changes in position of stars, their colors, the Doppler effect, and simultaneity in physical experiments, as well as the incongruence of an ideal with the physical world, when conducting experiments using the Galilean/ Cartesian coordinate system.²¹

In order to visualize an invisible deformation due to a powerful gravitational field, such as that of the sun, Einstein employed the physical analogy of a heated metal rod. If a heat source were applied under the center of a table on which a perfectly uniform two-dimensional grid of metal rods had been placed, the heat would warp the grid at the center of the source, tapering its deformational effect off toward the outer edges, approximating the effect of a gravitational field on an invisible isotropic grid of space,²² creating a locally non-homogeneous space.

¹⁸ Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 32–34.

¹⁹ Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 33–39. See also Hermann Minkowski, "Space and Time," in *Space and Time: Minkowski's Papers on Relativity*, trans. Fritz Lewertoff and Vesselin Petkov, ed. Vesselin Petrov (Montreal: Minkowski Institute Press, 2012), 116–117, 125: Lorentz demonstrated that moving bodies experience a decrease in the direction of motion that is not due to atmospheric friction; and from Lorentz' discovery, Minkowski deduced that there is a Postulate of the Absolute World, that has been heretofore formulated under the misleading title of the Relativity Postulate. Attempting to give credit to Lorentz, Minkowski maintained that the electromagnetic worldview was first "found" by Lorentz and "further unveiled" by Einstein.

²⁰ Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 40–42.

²¹ Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 55–60.

²² Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 92–95.

According to the General Theory of Relativity, the material of light itself is deformed by a gravitational field and slows down as it passes by this field.²³

Looking into Einstein's description of coordinate systems, and potential gravitational deformations, may give some insight into the meaning behind the rectilinear grid featured as the first act and continuing into the second act of the hybrid drawing of the *Exzentrik*.²⁴ In the first column, Moholy-Nagy drew a bold grid of black lines over the faint dashed outlines of radiating circles. **(Figure 1.1)** Below the circles some of the horizontal lines of the grid are missing, doubling and, in some areas, tripling the heights of the cells compared to their widths. Additionally, elements of the grid extend beyond its implied boundary, and these bands are filled with various colors: black, faint yellow, light red, or gray. Next to these extensions are small vectors drawn with a single black line, suggesting direction and movement, possibly alluding to the transformation of a previously homogenous grid through elongations occurring over time during the performance. If these extensions were meant to be moving bars of light, the arrows seems to denote that the colored light-bars move back and forth, perhaps expanding and contracting, continuing to follow the rectilinear quality of the grid itself. Meanwhile, the faint circles begin to appear within the kinetic grid, contrasting the rigid Euclidean geometry of the Cartesian grid with the suggestion of a non-Euclidean disturbance that pushes the cells of the grid outward from its center.

The movement of the extensions, these bars of light, also relate to the direction given in the Prelude in which colored arrows are falling and rising and cutting across the walls, where they fall again, flattened on the floor of the stage, "weisser | Pfeil | stürzt" (white arrows falling down)

²³ Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 105–107.

²⁴ Lucia Moholy claimed that they read about Einstein's theories without reading his expositions for themselves. See Lucia Moholy, *Marginalien zu Moholy-Nagy : Moholy-Nagy Marginal Notes* (Krefeld, Germany: Scherpe Verlag, 1972).

with white and red arrows meeting in the outline of a circle and many smaller arrows producing counter movements. Considering the interpretation that these movements described in the Prelude correspond to the kinetic grid of the first and second acts, these elongations of the grid, itself a projected image, may move up and down the walls of the theater, some of which Moholy-Nagy described in the printed version of the *Exzentrik* as covered with two layers of white canvas capable of receiving light projections on and through their material surfaces. These directions conjure a kinetic grid expanding and contracting with the pulsating rotations of the circle, as suggested by the dashed radiating arcs. These movements imply a deformation of the homogeneity of the grid, a phenomenon described by Einstein as occurring in the measurements of both space and time between two coordinate systems.²⁵

The relationship between movement and the perception of time and space frames the discussion of higher dimensions of space in the early twentieth century. An interpretation of movement as the deformation of the Cartesian grid in the *Exzentrik* closely aligns with this discussion centering on a revelation of the visible and invisible structures of space-time, while immersing the audience in a space that is transformed through the projection of light, sound, and colors, placing them physically and temporally in the transformation itself. The character of this metamorphic space is made more apparent, when comparing the notes accompanying the printed version of the *Exzentrik*, in which Moholy-Nagy described the movements of the grid as: "**Gittersysteme ... von Farben ... Schiessen auf - ab ... hin - her ... Gitter weiter**"²⁶ (Grid Systems of ... Colors ... Shoot Up Down ... Back Forth ... Grid continued).²⁷ The grid is not only moving, but it is also continuing, stretching in a non-uniform manner and creating elongated patterns, some of which are escaping as strips of colored light.

²⁵ Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 105–107.

²⁶ Moholy-Nagy, "Folge," in Schlemmer, Moholy-Nagy, Molnar, *Die Bühne im Bauhaus*, 1925, 44.

²⁷ Moholy-Nagy, "Sequence," in Schlemmer, Moholy-Nagy, Molnar, *The Theater of the Bauhaus*, 48.

ANALOGIES

During a lecture in 1908 at the 80th annual meeting of the Gesellschaft Deutscher Naturforscher und Ärzte (German Society of Natural Scientists and Physicians) in Cologne, mathematician Hermann Minkowski laid out his conception of "Raum und Zeit" (Space and Time) published under the same title the following year.²⁸ As it happened, Minkowski was certainly overshadowed by the worldwide prominence of Einstein's groundbreaking publications and legions of devoted followers. Between the publication of Einstein's Special and General Theories of Relativity, Minkowski published his own development of the subject under the title, *Das Relativitätsprinzip* (The Relativity Principle, 1915) in which he acknowledged and built upon Einstein's previous publication in the same *Annalen der Physik*.²⁹

Taking heart, Minkowski began his "Raum und Zeit" lecture prophetically:

M. H.! Die Anschauungen über Raum und Zeit, die ich Ihnen entwickeln möchte, sind auf experimentell-physikalischem Boden erwachsen. Darin liegt ihre Stärke. Ihre Tendenz ist eine radikale. Von Stund' an sollen Raum für sich und Zeit für sich völlig zu Schatten herabsinken und nur noch eine Art Union der beiden soll Selbständigkeit bewahren.³⁰ (Gentlemen! The views of space and time which I will present to you arose in the domain of experimental physics, and therein lies their strength. Their tendency is radical. From now onwards space by itself and time by

²⁸ Vesselin Petkov, "Preface," in Hermann Minkowski, *Space and Time: Minkowski's Papers on Relativity*, trans. Fritz Lewertoff and Vesselin Petkov, ed. Vesselin Petrov (Montreal: Minkowski Institute Press, 2012), i. See also Galina Weinstein, *Einstein's Pathway to the Special Theory of Relativity* (Newcastle-upon-Tyne: Cambridge Scholars Publishing, 2015), 311. Accessed March 8, 2019. ProQuest Ebook Central.

²⁹ Petkov, "Preface," in Hermann Minkowski, *Space and Time*, i. *Das Relativitätsprinzip* was based on a lecture that he had given in 1907 to the Mathematical Society of Göttingen.

³⁰ Hermann Minkowski, "Raum und Zeit," in *Jahresbericht der Deutschen Mathematiker: Vereinigung 18* (1909), 75 reprinted in *Gesammelte Abhandlungen von Hermann Minkowski*, ed. David Hilbert, (Leipzig: Teubner, 1911), 431.

itself will recede completely to become mere shadows and only a type of union of the two will still stand independently on its own.)³¹

Mentioned previously, Minkowski had first developed a geometrical means of conceptualizing the notions of a spatial fourth dimension using *Weltpunkt* (worldpoint) and *Weltlinie* (worldline), terms that Rudolf Carnap appropriated for his *Der logische Aufbau der Welt* in 1961. According to Minkowski's terminology, a *Weltpunkt* is defined by four coordinates, (x, y, z, t) . A change in position in any of the coordinates, with time running from negative infinity to positive infinity, describes a curved *Weltlinie*, for instance, a move from one point (x, y, z, t) to another point (x', y', z', t') .³²

Wir erhalten alsdann als Bild sozusagen für den ewigen Lebenslauf des substantiellen Punktes eine Kurve in der Welt, eine Weltlinie, deren Punkte sich eindeutig auf den Parameter t von $-\infty$ bis $+\infty$ beziehen lassen. Die ganze Welt erscheint aufgelöst in solche Weltlinien, und ich möchte sogleich vorwegnehmen, daß meiner Meinung nach die physikalischen Gesetze ihren vollkommensten Ausdruck als Wechselbeziehungen unter diesen Weltlinien finden dürften.³³ (We then get an image, so to say, of the eternal course of life of the substantial point, a curve in the world, a worldline, whose points can be clearly related to the parameter t from $-\infty$ to $+\infty$. The whole world presents itself as resolved into such worldlines, and I want to say in advance, that in my understanding the laws of physics can find their most complete expression as interrelations between these

³¹ Hermann Minkowski, "Space and Time," in *Space and Time: Minkowski's Papers on Relativity*, trans. Fritz Lewertoff and Vesselin Petkov, ed. Vesselin Petrov (Montreal: Minkowski Institute Press, 2012), 111.

³² Hermann Minkowski, "Space and Time," in *Space and Time: Minkowski's Papers on Relativity*, trans. Fritz Lewertoff and Vesselin Petkov, ed. Vesselin Petrov (Montreal: Minkowski Institute Press, 2012), 112–114.

³³ Minkowski, "Raum und Zeit," in *Jahresbericht der Deutschen Mathematiker*, 76.

worldlines.)³⁴

To illustrate the relationship of Weltlinie to coordinates in space and time, Minkowski provided several provocative diagrams. One diagram in particular illustrated his *Postulat der absoluten Welt* (Postulate of the Absolute World), or Weltpostulat (World Postulate) for short, which he expressly intended to supplant the relativity postulate, since it allowed time to participate in its calculations as a fourth, equivalent spatial coordinate.³⁵ **(Figure 1.4)** In this diagram, Minkowski used hyperbolic curves defined by two great cones demonstrating the convergence of the past and the future at the midpoint, center of the foci of the hyperbolae, the zero point, the present moment in time and space. The Nachkegel (cone of the past) was constructed by all of the Weltpunkte that send light to the zero point, while the Vorkegel (cone of the future) was constructed by the light emanating from the zero point. In this way, the hyperbola as a section through these great cones retains the connection to the physical tracing of a hyperbola as the path of the tip of the shadow cast by the gnomon of a sundial. Out from the midpoint, zero point, extend two vectors with dashed lines. One vector was labeled as a raumartiger Vektor (space-type vector) and the other as a zeitartiger Vektor (time-type vector).

These two vectors, one alluding to space and the other time, belie the basic challenge in any visualization of a coordinate system in the fourth dimension, that the fourth (invisible) spatial vector must be perpendicular to the other three (visible) spatial vectors. In Minkowski's Weltpostulat diagram, there are no perpendicular vectors, each line drawn formed acute and obtuse angles with its neighbors more easily facilitating additional vectors in his two-dimensional diagrammatic representation of four dimensional space. It is at this point, in the perpendicularity of additional coordinate systems that one must visualize the fourth dimension through analogies,

³⁴ Minkowski, "Space and Time," in *Space and Time*, 112.

³⁵ Minkowski, "Raum und Zeit," in *Jahresbericht der Deutschen Mathematiker*, 82 and Minkowski, "Space and Time," in *Space and Time*, 117.

such as the shadow men projected onto a flat sheet in Fechner's camera obscura.

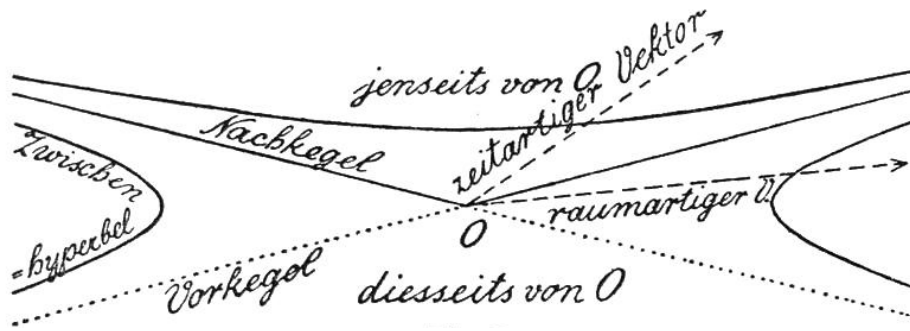


Figure 1.4: Hermann Minkowski, "Raum und Zeit," in *Jahresbericht der Deutschen Mathematiker*, 1909, (Space-Time Diagram).

In *Flatland: A Romance of Many Dimensions* (1884), theologian and schoolmaster Edwin A. Abbott conceived of several worlds in which the inhabitants were unable to realize the existence of the next higher dimension of space due to the perceptual limitations of their own existences.³⁶ In the narrative, Abbott employed analogical demonstrations to reach analogical conclusions for both his protagonist and his readers. The main character and Abbott's pseudonym, named A. Square, recounted a 'wondrous, strange' story of a two-dimensional world inhabited by two-dimensional beings, polygons of all varieties and numbers of angles from Triangles to Polygons. Although similar, this world was much more elaborate than Fechner's brief mention of shadow men with Abbott's character having female and male species at different social rankings, even inventing a generational system of social climbing for his aspirational geometric figures. When, through the generations, the number of sides of Polygon became very

³⁶ Edwin A. Abbott, *Flatland: A Romance in Many Dimensions* (London: Seeley, 1884; Mineola, NY: Dover Publications, 1992). For Abbott's connection to Charles Howard Hinton and other writers on higher spatial dimensions through his friendship with Howard Candler, see Thomas F. Banchoff's summary of the extant documentation and his own speculations in "From 'Flatland' to Hypergraphics: Interacting with Higher Dimensions," *Interdisciplinary Science Reviews* 15, no. 4 (1990): 364–372.

great in number, they were admitted to the Circular order who functioned as Priests, since they were the most refined and the most educated among the inhabitants of Flatland, where the social strata were determined by the number of one's angles.³⁷

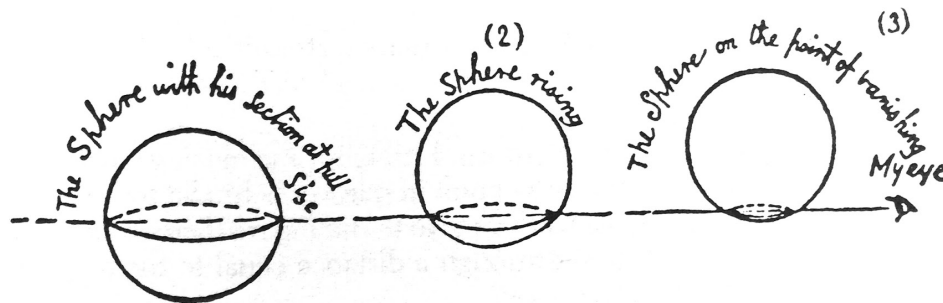


Figure 1.5: A. Square (Edwin A. Abbott), *Flatland: A Romance in Many Dimensions*, London, Seeley, 1884.

One day, the humble, four-sided A. Square encountered a Stranger who attempted to describe the world in which he lived, Spaceland, and the dimensional limitations of Flatland. However, the two dimensional being was unable to conceive of a world that was invisible to him. Undaunted, the Stranger proceeded to demonstrate the notion of a third dimension to A. Square by passing through his planar world. Since the Stranger was a sphere, A. Square perceived a circle of increasing and then decreasing diameter, which he interpreted to be growing and shrinking rather than passing through a plane. Unable to convince him by description or demonstration, the Sphere lifted A. Square out of Flatland to experience the next higher dimension, at which point, he was amazed. In his exhilaration, A. Square inquired about even higher dimensions of space angering the spherical Stranger who returned him to Flatland, where he was imprisoned for conjuring heretical ideas about alternate realities.³⁸

³⁷ *Ibid.*, Part I, 1–50.

³⁸ *Ibid.*, 64–93.

The story of a flat land was retold in abbreviated version in nearly all texts on the fourth dimension of space, across all genres, literary, philosophical, spiritual, and scientific and in many languages, often without attribution to either Abbott or Fechner. These texts include American architect Claude Bragdon's *Four-Dimensional Vistas*,³⁹ Russian philosopher P. D. Ouspensky's *Tertium Organum*,⁴⁰ and British mathematician Charles H. Hinton's *The Fourth Dimension*.⁴¹ In fact, Einstein also described two-dimensional beings living on a flat, infinite plane and contrasted their perceptions with two-dimensional beings living on the surface of a sphere. Using this analogy, Einstein demonstrated how Earth performs a similar type of perceptual limit for humans.⁴²

While elements of the *Flatland* romance persisted in later texts, it was the methods of persuasion used by the Sphere that will provide some insight into the first and second acts of the hybrid drawing of the *Exzentrik* and Moholy-Nagy's other *Photoplastiks* produced while he was teaching at the Bauhaus. In recounting how he came to experience in the existence of other dimensional worlds, Abbott's A. Square first recalled a vivid dream of a one-dimensional world

³⁹ Claude Bragdon, *Four Dimensional Vistas* (1916; repr., New York: Cosimo Classics, 2005), 39–44. In discussing orbital motion of spheres, Bragdon gave the example of a plane in motion cutting through a helix coil producing successive oval cross-sections describing the space of the coil. Then, if you shift and duplicate those cross-sections, essentially describing the movement of the cutting plane and the movement of the helix, you transform the oval cross-sections into ovoids (spheres), suggesting proof of four-dimensional space.

⁴⁰ P. D. Ouspensky, *Tertium Organum: The Third Canon of Thought, A Key to the Enigmas of the World*, trans. Nicholas Bessaroboff and Claude Bragdon (New York: Vintage Books, Random House, 1970), 51–63, originally published 1912 as *Kluck Kzaradkam*. Ouspensky developed the sensations of a one-dimensional being in a linear world and a two-dimensional being in a planar world, especially their perceptions of beings on a higher dimension passing through their worlds.

⁴¹ Charles Howard Hinton, *The Fourth Dimension* (London: Sonnenschein, 1904; Kila, MT: Kessinger Pub., c. 1996), 6–14. Hinton summarized a plane being in a plane world listing the perceptive abilities and limitations of the plane being. He then extrapolated the fourth dimension as invisible extensions of three-dimensional bodies, with portions of the bodies extend beyond three-dimensional space, in other words, before and after entering three-dimensional space, in the past and into the future.

⁴² Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 122–127.

called, Lineland. While in the dream, he attempted in vain to describe the two-dimensional nature of Flatland to the one-dimensional Monarch of Lineland.⁴³ While, by analogy, this dream symbolically prepared A. Square for his encounter with the three-dimensional Sphere, it also provided the reader with a clue as to the analogical interpretation required to believe in the possible reality of unknown and invisible dimensions of space. A. Square then stated, "From dreams I proceed to facts,"⁴⁴ the recounting of which the Sphere attempted unsuccessfully to describe the existence of a third dimension in a literal manner. After being unable to convince A. Square with facts, the Sphere followed his description with an analogical demonstration by passing himself through the plane of Flatland, in which he showed how what appears to be movement and change over time in Flatland are merely visible manifestations of an invisible third dimension. The example of a sphere, or other geometrical form such as a cube or helix coil, passing through a plane was also consistently employed to imagine the possibility of the existence of higher dimensions. Still unconvinced, the Sphere resorted to lifting A. Square out of his world, in order to directly experience the third dimension; and it was through this experience, seeing it with his own eyes, that A. Square was finally convinced that higher dimensions exist outside of his dimensional plane.⁴⁵

As a sphere passes through a plane, the circumference of the section through the sphere changes size. At first, its diameter grows until it reaches its equator, at which point the diameter shrinks again until it is gone. The growing and shrinking would appear to a two-dimensional being on a two-dimensional plane as change over time, as a circle that appears, expands, contracts, and disappears. In other words, the movement of the higher dimensional sphere is interpreted to

⁴³ Abbott, *Flatland: A Romance of Many Dimensions*, 1884, 53–63

⁴⁴ Abbott, *Flatland: A Romance of Many Dimensions*, 1884, 64.

⁴⁵ Claude Bragdon, *A Primer of Higher Space* (Rochester, NY: Manas Press, 1913; Tuscon, AZ: Omen Press, 1972), plates 14, 16 and Hinton, *The Fourth Dimension* (London: Sonnenschein, 1904; Kila, MT: Kessinger Pub., c. 1996), 24–25.

be movement, growth, change over time, prompting many Dimensionists to believe by analogy that what appears to be time-related in the third dimension is really something spatial in the fourth dimension moving through three dimensional space, which according to Bragdon in “Man the Square” may include the human life cycle itself.⁴⁶ **(Figure 1.6)** In his sketchbook, Johannes Itten had copied a few images from Bragdon's *A Primer of Higher Space*, including two images from the section, “Man the Square,” which Bragdon concluded with a long quotation from Russian Theosophist Madame Blavatsky's *The Secret Doctrine*⁴⁷ ending with the following passage:

Even so persons and things, which, dropping out of the 'to be' into the 'has been,' out of the Future into the Past—present momentarily to our senses a cross-section, as it were, of their total selves, as they pass through Time and Space (as Matter) on their way from one eternity to another; and these two eternities constitute that Duration in which alone anything has true existence, were our senses but able to recognize it.⁴⁸

In “Man the Square,” Bragdon asked his readers to visualize a transparent film, which he also called a Flatland referencing to Abbott's *A. Square of “Flatland,”* cutting through a transparent cube. **(Figure 1.6)** Where the cube passes through the film, a two-dimensional shape is formed on the film. When the cube passes through perpendicularly it forms a square. When the cube passes through obliquely, it forms points, lines, trapezoids, and other irregular shapes. If many

⁴⁶ Bragdon, “Man the Square,” *A Primer of Higher Space*, 59.

⁴⁷ H. P. Blavatsky, *The Secret Doctrine: The Synthesis of Science, Religion, and Philosophy, Cosmogogenesis*, vol. 1, (London: Theosophical Publishing Company, 1888; Pasadena, CA: Theosophical University Press, 2014), 37. Linda Dalrymple Henderson cites Rudolf Steiner's strain of Theosophy as quieting many artists interested in the fourth dimension including Kandinsky, Delaunay, and Apollinaire, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*, xxii.

⁴⁸ Bragdon, “Man the Square,” *A Primer of Higher Space*, 79.

moving cubes pass through the film with perpendicular and oblique attitudes, their sectional outlines will form various, ever-changing shapes on the film. As they move into, out of, and away, their shape on the film appears and disappears, in a manner similar to how a person is born, changes over a lifetime, and dies. This dimensional analogy for movement in the fourth dimension is one of the more difficult to comprehend, since it begs the question why a person would be unaware of their existence before and after their lifetime.

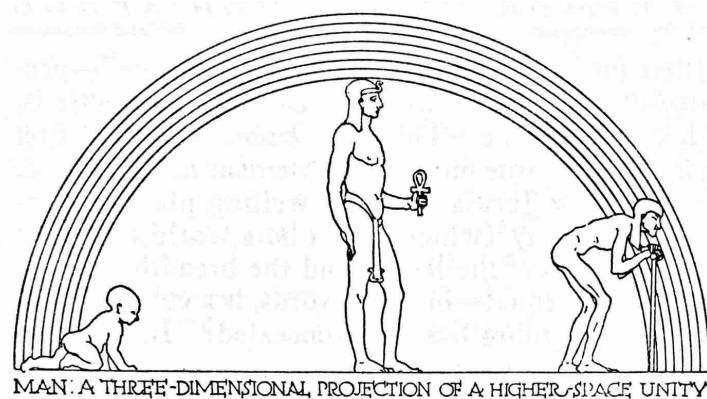


Figure 1.6: Claude Bragdon, "Man the Square," *A Primer of Higher Space*, Rochester, NY, Manas Press, 1913.

Considering the movement and intersection of human lives projected in "Das Simultane oder Polykino" (Simultaneous or Poly-Cinema) in *Malerei, Fotografie, Film*, Moholy-Nagy conceived of a very large, concave projection screen onto which different films may be projected simultaneously, ranging across the screen, and at some point they would combine. **(Figure 1.7)** One example that he gave was cars travelling, another was photogram-like light displays, and the third was the intersection of two or three lives:⁴⁹

⁴⁹ The following simultaneous ploy-cinema design is reminiscent of a film idea that Moholy-Nagy described in a section entitled, "Die Zukunft des Fotografischen Verfahrens" (The Future of the Photographic Process) in Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 34, in which a person would be filmed continuously

Um recht deutlich zu werden, teile ich eine schematische **Skizze** mit: Von links nach rechts läuft der Film des Herrn **A**: Geburt, Lebenslauf. Von unten nach oben läuft der Film der Dame **B**: Geburt, Lebenslauf. Die Projektionsflächen der beiden Filme schneiden sich: Liebe, Ehe usw. Die beiden Filme können dann entweder sich kreuzend, in durchscheinenden Geschehnisfolgen oder parallel nebeneinander weiterlaufen; oder es kann ein neuer gemeinsamer Film der beiden Personen an die Stelle der beiden ersten treten. Als dritter bzw. vierter Film könnte der Film des Herrn **C** gleichzeitig mit den Vorgängen **A** und **B** von oben nach unten oder von rechts nach links oder auch in anderer Richtung laufen, bis er die anderen Filme sinngemäß schneiden bzw. decken kann, usw.⁵⁰ (I give a schematic **drawing** to make my meaning quite clear: The film about Mr **A** runs from left to right: birth, course of life. The film about lady **B** runs from the bottom upwards: birth, course of her life. The projection surfaces of the two films intersect: love, marriage, etc. The two films can then either proceed by intersecting in translucent sequences of events or can run parallel; or a single new film about the two people make take the place of the original two. Another film, the third or fourth, about Mr **C** could run simultaneously with the episodes **A** and **B** from the top downwards or from right to left or even in another direction until it can properly intersect or merge with the other films, etc.)⁵¹

Along similar lines, Moholy-Nagy created a short film for the opera, *Hin und Zurück, Sketch mit Musik* (Here and Back: Sketch with Music, 1927) in which the action and music was played forward and then in reverse, a love story that devolved into jealousy, murder, and suicide

from birth to death and then this film would be replayed in only five minutes with potentially astonishing results.

⁵⁰ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 40.

⁵¹ Moholy-Nagy, *Painting, Photography, Film*, trans. Janet Seligman, 42.

reverses itself to create a happy ending in the beginning.⁵² In “Das Simultane oder Polykino,” Moholy-Nagy also proposed projecting moving light formations onto this screen akin to his *Photograms*. Unlike film narrative with human actors, these lights would be more easily positioned to suggest dimensional relationships with their conjoining and separating. However, conceiving of each in a similar way reveals Moholy-Nagy's analogous thinking behind these moving projections and the manner in which he constructs dimensional space in his *Photoplastiks*.

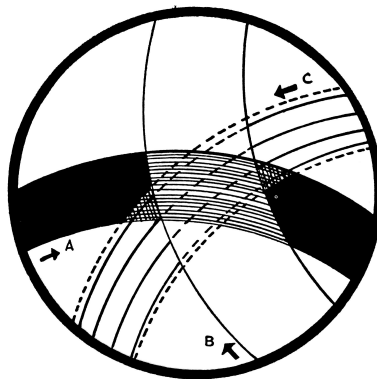


Figure 1.7: László Moholy-Nagy, *Malerei, Fotografie, Film*, München, Albert Langen Verlag, 1925.

In his essay, “fotografie ist lichtgestaltung” (Photography is Light-Formation, 1928) in *Bauhaus*, Moholy-Nagy contrasted the disorganized, shocking juxtapositions and imprecise “snippings” of Dada photomontage with what he had intended with his intentions with the *Photoplastik*:

demgegenüber ist die fotoplastik eine art organisierter spuk, sie hat ein deutliches sinn- und bildzentrum, das — obwohl oft aus verschiedenen optischen und

⁵² Lloyd C. Engelbrecht, *Moholy-Nagy: Mentor to Modernism* (Cincinnati, OH: Flying Trapeze Press, 2009), 2: 362.

gedanken Überlagerungen, verschränkungen bestehend — eine klare Übersicht der Gesamtsituation ermöglicht.⁵³ (On the contrary, the Photoplastik is a type of organized din, which has a clear center of meaning and image, that — although interweavings often consist of different optical and intellectual overlays — a clear overview of the entire situation is enabled.)⁵⁴

These “optical and thoughtful overlays” were meant to produce simultaneities inherent, though not necessarily visible, in life. In the same article, he wrote, “die sparsamere art ermöglicht eine leichtere faßbarkeit, oft ein aufblitzen des sonst verborgenen sinnes.”⁵⁵ (This more economical type enables an easier comprehensibility, often a flash of the otherwise hidden meaning.)

For his own type of photomontage as distinct from the kind created by Dadaists, Moholy-Nagy coined the term, *Photoplastik*,⁵⁶ combining the German word *Photo-* stemming from the Greek word, φως (*phos*) meaning light, with the German word for sculpture, *Plastik*. Using perspectival lines, planes, and overlapping elements to construct space, Moholy-Nagy inhabited these simultaneous spatial constructions with images of people and things from newspapers, magazines, and his own photographs such as in *Zwischen Himmel und Erde* (Between Heaven and Earth, 1923). **(Figure 1.8)** Unlike with his objective naming system for his paintings, often employing straightforward letter and number combinations, Moholy-Nagy used the title of a *Photoplastik* to suggest the hidden meaning(s). For instance, *zwischen* can indicate the relationship of two things in space and/ or in time. Between heaven and Earth, one could be floating or falling in space; on the other hand, one could be out of body and, therefore, out of

⁵³ László Moholy-Nagy, “fotografie ist lichtgestaltung,” *Bauhaus* II/1, 1928, 8.

⁵⁴ Translated by author.

⁵⁵ *Ibid.*

⁵⁶ Moholy-Nagy used the Ph-spelling for *Photo-* in his early writings and then switched to using the F-spelling later, the F-spelling is used in this dissertation, except in direct quotations.

space, such as in a dream or ecstatic vision. Providing one interpretation, with his requisite economy of means, Moholy-Nagy created the space of this Photoplastik with just two circles and three crossing lines; and he established the time sequence with four figures. Reminiscent of perspective construction lines converging to a vanishing point, in this case, the viewer is positioned to the side of this perspective diagram, viewing the receding lines and vanishing point as crossing lines, which converge only to continue past the point of infinity to diverge again.



Figure 1.8: László Moholy-Nagy, *Zwischen Himmel und Erde* (Between Heaven and Earth), 1923, Photomontage, gelatin silver prints including a photogram, photomechanical reproductions, and graphite pencil on paper: 65 x 50 cm (25.5625" x 19.6875"), Galerie Berinson, Berlin.

The two circles in *Zwischen Himmel und Erde* appear to demarcate the two locations named in the title, heaven and earth. An assumption based on Judeo-Christian theology would be that

heaven is positioned above the Earth. In this case, the lower circle representing the earth was depicted as a fireman's brigade using a large circular cloth to catch a person falling to the ground, a circle of salvation, in the sense that the person has been saved from a certain horrific demise.

Representing heaven in this interpretation, the source image for the upper circle is more obscure. It may be a circular window, a porthole, or a lamp judging by the lightness of the white center set against an ochre field. In heaven, the figures are composites. Sitting on the dark ring of the circle, the main figure is an aboriginal person with an extra set of arms and legs grafted onto his body. While the extra female legs are crossed, the arms are spread, perhaps wing-like, with one supporting the head of mirrored, or conjoined, twins. The twins' upside-down position and precarious perch seem to defy the force of gravity portrayed by the person falling into the circle below.

Another interpretation based on the popularity of Theosophical doctrines in Germany at the time may construe the aboriginal androgynous, god-like figure in the heaven circle shooting a pea or dart downward at the Earth circle as fulfilling the role of the prime mover whose creative force appears to send a person through time and space to land on Earth. The two figures "zwischen" (between) are hanging onto the crossing lines as material lines, not just perspectival projections lines. Just below the heaven circle is a female child effortlessly, playfully holding onto the lines. Further down is another composite figure, a man apparently cut in half and twisted around on itself. To further a theosophical reading, Bragdon had described in "Man the Square" the belief that "man [over his/her lifetime] is a three dimensional projection of a higher space unity," leading to the notion of the baby originating in heaven, climbing down the crossing lines connecting heaven and earth, aging as he intersects with the plane of life which bisects and twists his human form. In addition, in Christian theology, this path is also reversible through salvation; the falling man is to be saved by the fireman's brigade. Bouncing back up into the air, he ages in reverse as he enters heaven again. Therefore, by analogy, in *Zwischen Himmel und*

Erde, the circle of the fireman's brigade stands for Earth and salvation, the circle of the light source denotes heaven, and, in between the two, man as a higher-space unity passing through the third dimension over time, forwards and backwards.

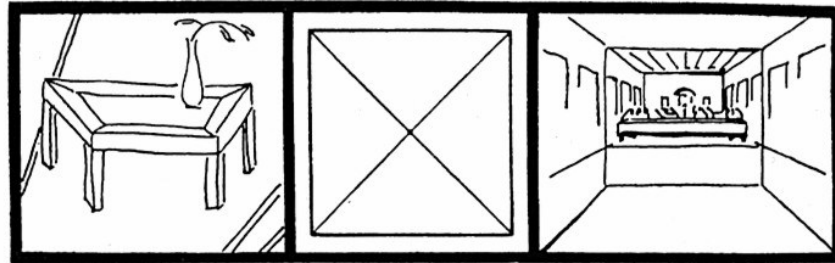


Figure 1.9: El Lissitzky, "K. und Pangeometrie," *Europa Almanach*, eds. Carl Einstein and Paul Westheim, Potsdam, Kiepenheuer Verlag, 1925.

In his article, "K. und Pangeometrie" (A. and Pangeometry, 1925), El Lissitzky described the reversibility of perspective. In the Western European tradition, such as in the paintings of Leonardo Da Vinci, the lines of elements that are perpendicular to the picture plane converged to a vanishing point or points. For the sake of his argument, Lissitzky was concerned only with views containing a single vanishing point. In the Eastern European and Asian traditions, as Lissitzky understood them, such as in Chinese painting in his example, the same perpendicular lines diverge from a point in front of the picture plane, presumably from the viewer's position. However, it is in the center diagram that Lissitzky purported the reversibility of perspective when he stated, "Die Spitze dieser Sehpyramide liegt entweder in unserem Auge, also vor dem Gegenstand, oder wir projizieren sie auf den Horizont - hinter den Gegenstand. Das erste hat der Osten gewählt, das zweite der Westen."⁵⁷ (The tip of this visual pyramid either lies in our eyes

⁵⁷ El Lissitzky, "K. und Pangeometrie," *Europa Almanach*, eds. Carl Einstein and Paul Westheim, (Potsdam: Kiepenheuer Verlag, 1925), 103–113.

— therefore in front of the object — or we project it onto the horizon — behind the object. The former concept was chosen by the East, the latter by the West.)⁵⁸ In an earlier essay in *De Stijl* on the “Proun, nicht Weltvisionen, sondern – Weltrealität,” (Proun, not World Visions, rather — World Reality, 1922), Lissitzky recognized the destruction of the role of the horizon in spatial orientation when he wrote:

4. Мы исследовали первые ступени нашего построения, заключенного в двухмерном пространстве, и обнаружили, что оно так же прочно и обладает такой же силой сопротивления, как и сама земля. Мы строим в этом пространстве точно так же, как на земле, и поэтому должны исходить из понятий гравитации и силы притяжения как основы всего, что строится на земле. В ПРОУНе взаимодействие результатов силы тяжести проявляется в новом качестве. Мы видим, что как поверхность (плоскость) картины ПРОУН прекращает свое существование и становится построением, обозреваемым со всех сторон, — рассматриваемым сверху и исследуемым снизу.

Результатом чего является разрушение единственной оси, ведущей к горизонту. Вращаясь, мы ввинчиваемся в пространство. До сих пор мы непосредственно проецировали пространство на плоскость.

Посредством ПРОУНа мы приходим к необходимости освобождения из этой проекционной плоскости. Мы придали ПРОУНу движение, получив тем самым множество проекционных осей, мы стоим между

⁵⁸ Lissitzky, “A. and Pangeometry,” in Sophie Lissitzky-Küppers, ed., *El Lissitzky: Life, Letters, Texts* (Greenwich, CT: New York Graphic Society, 1968), 343, anthology originally published as *El Lissitzky – Maler, Architekt, Typograf, Fotograf* (Dresden: Verlag der Kunst, 1967).

ними и перемещаем их. Основываясь на этом пространственном каркасе, мы должны приступить к определениям. [...]»⁵⁹ (4. We saw that the surface of the Proun ceases to be a picture and turns into a structure round which we must circle, looking at it from all sides, peering down from above, investigating from below. The result is that the one axis of the picture which stood at right angles to the horizontal was destroyed. Circling round it, we screw ourselves into space. We have set the Proun in motion and so we obtain a number of axes of projection; we stand between them and push them apart. Standing on this scaffolding in the space we must begin to mark it out. Emptiness, chaos, the unnatural, become space, that is: order, certainty, plastic form, when we introduce markers of a specific kind and in a specific relationship to each other.)⁶⁰

In this passage, Lissitzky could likewise be describing Moholy-Nagy's oblique photographs or spiraling theater ramps, as much as his own work on the *Proun*⁶¹ series. As Lissitzky described looking down and looking up at the surface of the *Proun*, a surface, as Moholy-Nagy's photographs revealed, without perspective, a new ground for representation on which to construct new dimensions. Lissitzky's intentions with the *Prounen* also have many similarities with Moholy-Nagy's statements about the *Photoplastiken* as, "eine zielgerichtete, gestaltende

⁵⁹ "Tezisy k PROUNu (ot zhivopisi k arkhitekture)" [Тезисы к ПРОУНУ (от живописи к архитектуре)] [1920]. The Russian draft of the text for what was later translated in German as "Proun, nicht Weltvisionen, sondern — Weltrealität" in *De Stijl 6* (1922) was found at the web site, <http://theory.totalarch.com/node/233>, accessed on June 18, 2018.

⁶⁰ Lissitzky, "Proun: Not world visions, BUT – world reality," 1920 in Sophie Lissitzky-Küppers, ed., *El Lissitzky: Life, Letters, Texts* (Greenwich, CT: New York Graphic Society, 1968), 343, originally published as *El Lissitzky – Maler, Architekt, Typograf, Fotograf* (Dresden: Verlag der Kunst, 1967).

⁶¹ Proun, the way-station between painting and architecture.

arbeit"⁶² (purposeful, formative work), although, unlike Moholy-Nagy, Lissitzky apparently held no pretense toward the production of a hidden meaning. In *Zwischen Himmel und Erde* and other *Photoplastiken*, Moholy-Nagy appears to be exploring Lissitzky's image of inhabiting the perspective diagram, of delineating the "axes of projection" as a "scaffolding" onto which he has literally placed figures, the small child and the bisected man in *Zwischen Himmel und Erde*, who are holding the "axes" and "push[ing] them apart."⁶³

As Lissitzky defined the circle in his *Prounen* as a point of rotation, for Moholy-Nagy in his *Photoplastiken*, the circle may have functioned in a similar way. However, the circles may have also represented a cross section of a sphere passing through a two-dimensional plane, an allusion to higher dimensions of space as described by Abbott. If this interpretation is applied to the hybrid drawing of the *Exzentrik*, in the first act, Moholy-Nagy established the two-dimensional coordinate plane with the grid, albeit a kinetic grid, and over-laid (or under-laid) the grid with the outlines of concentrically arranged circles using dashed lines. If these circles are dashed because they are ephemeral, they may represent the changing cross sections of a sphere over time, as the expanding and shrinking diameter of the circles represent a sphere as it passes through the coordinate grid.

In Abbott's romance, the Sphere is aware of itself as it passes through the plane of Flatland, before, during and after its existence. By contrast, in Bragdon's Flatland as described in his "Man the Square," the two-dimensional sections of moving cubes are generally unaware of their larger selves, as higher dimensional beings, save a few who have developed their consciousnesses to be able to communicate with and affect their cubic selves.

⁶² Moholy-Nagy, "fotografie ist lichtgestaltung," 1928, 8.

⁶³ Lissitzky, "Proun: Not world visions, BUT – world reality," 1920 in Sophie Lissitzky-Küppers, ed., *El Lissitzky: Life, Letters, Texts* (Greenwich, CT: New York Graphic Society, 1968), 343, originally published as *El Lissitzky – Maler, Architekt, Typograf, Fotograf* (Dresden: Verlag der Kunst, 1967).

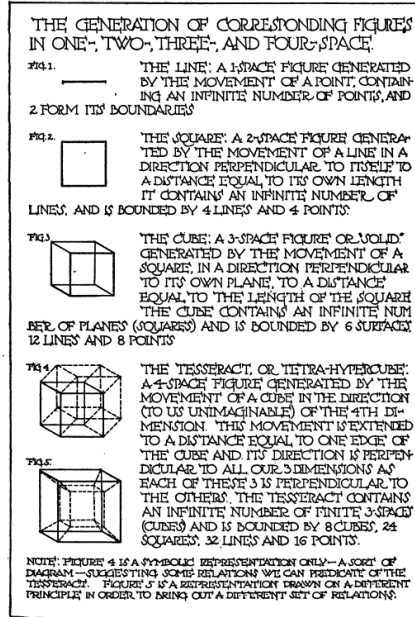
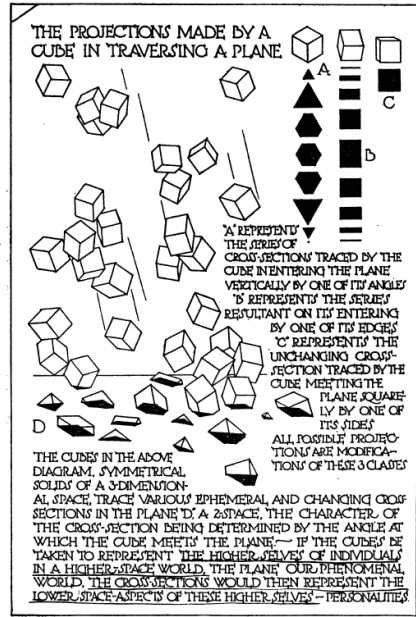


Figure 1.10: Claude Bragdon, *A Primer of Higher Space*, Rochester, NY, Manas Press, 1913.

In his *A Primer on Higher Space*, Bragdon elaborated on the generation of dimensional figures using movement as the vehicle of transferring one dimension into the next higher dimension. For instance, in his first plate, Bragdon depicted and described these movements. Moving the one-dimensional line in a direction perpendicular to itself over a distance equal to itself will create a square. If this two-dimensional square is moved in a direction perpendicular to itself over a distance equal to one of its sides, it will form a cube. Similarly, if this three-dimensional cube were moved, in such a way, that is perpendicular to itself over a distance equal to itself, it would become a tesseract, a fourth dimensional figure. Bragdon gave two symbolic representations of this tesseract, one using orthographic projection and the other using a perspective construction, since the tesseract moves in a direction that is "to us unimaginable"⁶⁴

⁶⁴ Claude Bragdon, *A Primer of Higher Space* (Rochester, NY: Manas Press, 1913; Tuscon, AZ: Omen Press, 1972), Plate 1.

without this kinetic, geometric analogy.

Views of the Tesseract.

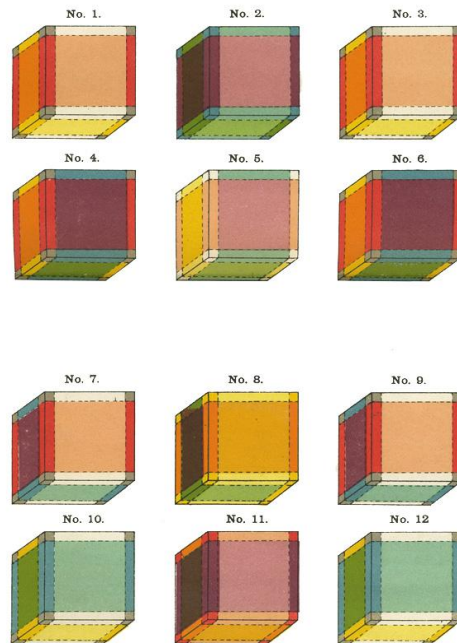


Figure 1.11: Charles Hinton, "Views of the Tesseract," *The Fourth Dimension*, London, Sonnenschein, 1904.

In his treatise on *The Fourth Dimension* (1904), British mathematician Charles Howard Hinton demonstrated how three-dimensional representations do not adequately present all of the elements of matter, only its three spatial coordinates, leaving change over time represented by supplemental charts, graphs, or diagrams, in order to contemplate the internal, invisible forces at work. Hinton's work furthered that of Immanuel Kant who recognized that our assumptions of universal laws of nature are based on our perception of the world and, therefore, may be valid only from that particular vantage and not describe the universal. After realizing the subjectivity of perception of the world, Hinton believed that man was positioned to be able to perceive

beyond his/her own limitations. At which point, Hinton developed several means by which to conceive of fourth dimensional figures, creating a language of space with an alphabetic or a color code to describe a tesseract.

Akin to Bragdon's exacting descriptions, Hinton methodically went through the representation of a two-dimensional figure in a single dimension, a three-dimensional figure in two dimensions, a four-dimensional figure in three dimensions, and a fifth dimensional figure in "four dimensions," which is represented by a series of transformations. Each of these figures are symmetrical and able to be repeated in a manner that completely fills that dimension (i.e., a hexagon can fill a plane).⁶⁵ In order to assist the reader to visualize the higher dimensional tesseract, especially to visualize its spatial movements, Hinton developed a color system to describe the points, lines, and planes within a cube. He recommended that the reader create the cubic visual aids necessary to follow his more complicated descriptions. Hinton provided a color fold-out poster of the cubes of the tesseract to aid the erstwhile reader to create his/her own set of cubes. Alternatively, sets of pre-made cubes were also available for purchase from the publisher.⁶⁶ Using these visual aids, Hinton could more easily describe the perception of a planar being aware of the cube through its movements in a rotation, bisecting and passing a plane. From any lower dimension, a higher dimensional figure is revealed as movement, such are the limitations of perception, interpreting the tesseract in three-dimensional space and over one-dimensional time.⁶⁷

For Hinton, "the process by which a plane being would gain a notion of a solid" was through two-dimensional interpretations of three-dimensional objects as movement and duration. From

⁶⁵ Charles Howard Hinton, *The Fourth Dimension* (London: Sonnenschein, 1904; Kila, MT: Kessinger Publishing, 1996), 122–135.

⁶⁶ Hinton, *The Fourth Dimension*, 126–143.

⁶⁷ Hinton, *The Fourth Dimension*, 143–150.

there, Hinton extended these colored points, lines, and planes of cubes into a fourth dimension describing movements along the edges of the cubes moving through the adjacent colors. In so doing, Hinton laid out a nomenclature for the higher dimensions of a tesseract with eight bounding cubes, twenty square faces, thirty two lines, and sixteen points.⁶⁸ Lastly, the movement of the tesseract itself would be revealed to a three dimensional being as movement, as a planar rotation, a turning itself inside out. In painstaking detail and exacting sequentiality, Hinton went through a discussion of each cube of the tesseract as it passes through three-dimensional space along the fourth-dimensional axis (colored blue) and/or exists partially in three-dimensional space. In the end, Hinton recognized a possible flaw in his system, his presumption of his accuracy in his intuition of a fourth dimension based upon his limited perception from the third dimension.⁶⁹ While Hinton's descriptions were very difficult to follow even with the visual aids, his tesseract cubes were a significant attempt to go beyond the analogical understanding of the intellect to reveal the fourth dimension to his reader in a more visceral way. One can imagine that the reader would run his/her finger along the edges of the colored cubes tracing the transformation intellectually and physically.

In addition to his work on *Photoplastiks*, Moholy-Nagy had been experimenting with the intersection of lines, planes, and circles in his paintings, such as *Gelber Kreis und schwarzes Quadrat* (Yellow Circle and Black Square, 1921). In *Gelber Kreis und schwarzes Quadrat*, Moholy-Nagy constructed dimensional space: perpendicular diagonal red lines representing the x and y axes with the black square and left leaning diagonal expressing perspectival depth as two receding planes, denoting the z axis, the space of our existence. In this painting, the bright yellow circle may connote a fourth axis, representing the fourth dimension, that is perpendicular

⁶⁸ Hinton, *The Fourth Dimension*, 150–156. This color system is reminiscent of Hinton's "Language of Space," in which he attempted to create a system to more easily speak about and conceptualize fourth dimensional figures.

⁶⁹ Hinton, *The Fourth Dimension*, 178–188.

the other three dimensions, a fourth dimension of space.

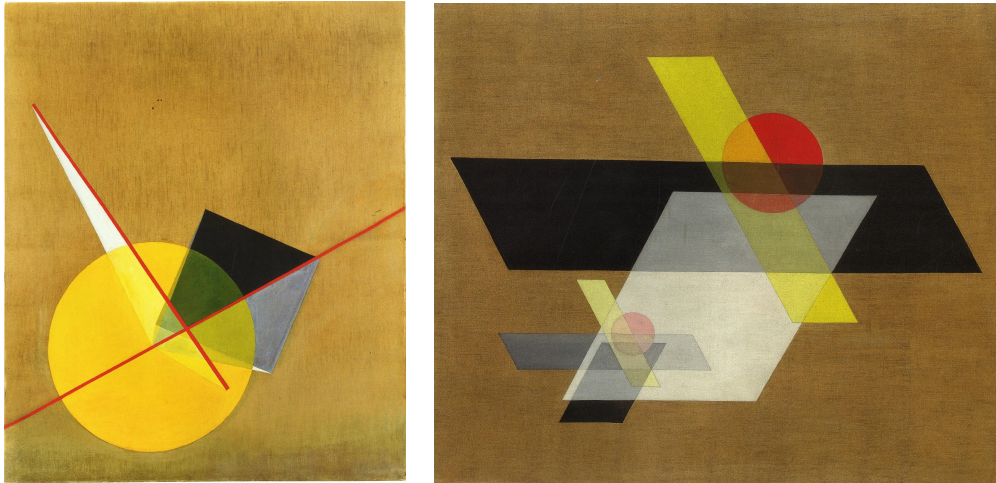


Figure 1.12: László Moholy-Nagy (left) *Gelber Kreis und schwarzes Quadrat* (Yellow Circle and Black Square), 1922, Oil and graphite on canvas: 135 x 114.3 cm (53.125" x 45"), The Museum of Modern Art, New York, The Riklis Collection of McCrory Corporation, 1050.1983 + (right) *All (Construction A II)*, 1922. Oil and graphite on canvas: 115.8 x 136.5 cm (45.625" x 53.625"), Solomon R. Guggenheim Museum, New York, Solomon R. Guggenheim Founding Collection, 43.900.⁷⁰

In *Der Sturm*, With described Moholy-Nagy's intentions in these paintings of intersecting dimensional planes:

[In these paintings] form elements seem to float through an undefined space, as if weightlessly suspended and of such transparent substance as to allow freely balanced intersections to penetrate superimposed planes. [The paintings were] reflective in a way of the wondrous achievement of modern technology and science to have freed man from both the law of gravity and the pedestrian view

⁷⁰ Although the Guggenheim dates these paintings at 1921, Oliver Botar has stated that they are both more likely from the year 1922.

of individual perspective.⁷¹

Writing on Moholy-Nagy's series of paintings exhibited at Der Sturm in February 1923, Ludwig Hilberseimer commented:

Im Sturm in Berlin waren interessante Versuche *Ladislau Moholy-Nagy* zu sehen die Transparenz raumkonstruktiv auszunutzen. Durch Darstellung der Licht- und Farbigkeitsveränderung transparenter, über einander liegender Flächen wird statt eines flächenhaften Aufeinander ein räumliches Hintereinander erreicht, mit ein flächenhaften Mitteln eine intensive Raumwirkung ermöglicht, gleichzeitig eines der wichtigsten Materialprobleme, einstweilen nur mit den Mitteln der Malerei, in das Bereich künstlerischer Gestaltung einbezogen.⁷² (In Der Sturm in Berlin are to be seen interesting experiments by László Moholy-Nagy utilizing transparency to create space. Through the rendering of the light and color alterations of transparent, overlapping planes, rather than merely the appearance of planes lying over each other, an intensive spatial effect is made evident, and thus one of the most important perceptual problems is brought into the realm of artistic creation, utilizing only the medium of painting.)⁷³

In *Komposition All* (Composition All, 1924), Moholy-Nagy had shifted from the axes and perspective planes of *Gelber Kreis* to isometric planar intersections, while retaining the circle as a representation of the fourth dimension. **(Figure 1.12)** The overlapping trapezoidal forms suggest a spatial perpendicularity without fully demonstrating the angles of intersection, allowing the circle to occur an indeterminate dimension, perhaps simultaneously perpendicular to all spatial

⁷¹ Quoted in Botar, *Sensing the Future*, 2013, 130.

⁷² Ludwig Hilberseimer, "Bildenende Kunst," *Sozialistische Monatshefte*, vol. XXIX, no. 4 (April 24, 1923), 257; quoted in Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 181–182.

⁷³ Translation by Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 181–182.

intersections. This hypothesis is supported by Wassily Kandinsky, Moholy-Nagy's Bauhaus colleague, to Will Grohmann in 1930, in which he described the "circle ... [as] a synthesis of the greatest oppositions. It combines the concentric and the excentric [sic] in a single form, and in equilibrium. Of the three primary forms [triangle, square, circle], it points most clearly to the fourth dimension."⁷⁴

In the *Exzentrik*, Moholy-Nagy also appears to have been attempting to demonstrate the fourth dimension to his audience using circles. As described earlier, he established the coordinate system through a light projection highlighting certain squares with colors. As the sphere penetrated the coordinate system, the grid was transformed, elongated in regions and extended into bar-like lines that would travel outward and onto the audience and the walls of the theater. Corresponding to these forms and movements in the first act, the stage would have been darkened with only a brief moment of flashing red, white, and yellow light effects; thereby, focusing the audience on the coordinate grid as the only sources of light, color, and form. Meanwhile, there would have been a faint continuous sound, perhaps unnoticeable at first, suggested by a light gray vertical bar, and then building to a crescendo in later scenes. Other than the faint tone, there are just three notes shown three quarters of the way into the scene: a short high note and, after a pause, two sustained low notes. Both the grid and the faint sound continue into the next act with many more rhythmically arranged notes. In these ways, the first act is establishing elements that will build up to a cathartic crescendo in later acts. In his *Dynamisch-Konstruktives Kraftsystem* (Dynamic-Constructive System of Forces, 1922), co-authored with Alfréd Kemény, Moholy-Nagy described his intention with an audience who participate in a work of art:

⁷⁴ Wassily Kandinsky, Letter to Will Grohmann, October 12, 1930, quoted in Angelica Zander Rudenstein, *The Guggenheim Museum: Paintings 1880–1945*, vol. 1 (New York: Solomon R. Guggenheim Foundation, 1976), 310. See also Henderson, "The Dimensionist MANifesto and the Multi-valent Fourth Dimension in 1936," *Dimensionism: Modern Art in the Age of Einstein*, Vanja Malloy, ed., 136.

Die dynamische Einzel-Konstruktion weitergeführt ergibt das DYNAMISCH-KONSTRUKTIVE KRAFTSYSTEM, wobei der in der Betrachtung bisheriger Kunstwerke rezeptive Mensch in allen seinen Potenzen mehr als je gesteigert, selbst zum aktiven Faktor der sich entfaltenden Kräfte wird.⁷⁵ (Carrying further the unit of construction, a dynamic constructive system of force is attained, whereby man, heretofore merely receptive in his observation of works of art, experiences a heightening of his own faculties, and becomes himself an active partner with the forces unfolding themselves.)⁷⁶

As such, beginning with the sensory calmness of this first act, Moholy-Nagy methodically constructed spatial systems that would allow the audience to engage in the performance by building upon their existing spatial understandings, in order to comprehend a new dimension that heretofore had only been imagined or experienced in a dream, or hallucinatory, state. Moholy-Nagy also appears to have built his *Photoplastiks* in a similar manner, combining recognizable spatial constructions with challenging visual tricks. For instance, in the hybrid drawing of the *Dynamisch-Konstruktives Kraftsystem*, Moholy-Nagy used both types of perspective described as Eastern and Western by Lissitzky.⁷⁷ **(Figure 0.10)** While the spiral appears to diverge from a viewpoint positioned above and to the right of the image, suggesting an inverted perspective, the sizes of the various figures suggest that the base of the spiral is closer to

⁷⁵ Alfréd Kemény and László Moholy-Nagy, "Dynamisch-konstruktives Kraftsystem" [Dynamic-Constructive System of Forces], *Der Sturm* XIII, no. XII (December 1922): 186. Herwarth Walden also published a review of Max Zerbst's "Die vierte Dimension" in his periodical for *Der Sturm* (October 28, 1911); see Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*, xxiii.

⁷⁶ Alfréd Kemény and László Moholy-Nagy, "Dynamisch-konstruktives Kraftsystem" [Dynamic-Constructive System of Forces], *A New Vision*, Moholy-Nagy, trans., 1938, 138. See also English translation by Oliver A. I. Botar, *Technical Detours*, 171.

⁷⁷ See also Peter Yeardon's digital model of the *Dynamisch-Konstruktives Kraftsystem* in Botar, *Technical Detours*, 175 and Botar, *Sensing the Future: Moholy-Nagy, Media and the Arts*, 86–89.

the viewer and that the spiral is converging in perspective with the more narrow top. While this drawing was constructed by Stephan Sebök, Moholy-Nagy's preliminary drawing also suggests a double reading. The blue circle appears frontal, in plan view, while the inner and outer spirals are in perspective and isometric view, respectively. In both drawings, this reversibility proposes a transparency seeing inside and outside simultaneously.

SIMULTANEITIES

At a conference held at the Institut général Psychologique in Paris in 1901, Henri Bergson, a vocal critic of Einstein and his theories of relativity, wondered about the nature of perception during his lecture entitled, "Le rêve," when he asked: "Mais alors, où est la différence entre percevoir et rêver? Qu'est-ce que dormir?"⁷⁸ (But precisely what is the essential difference between perceiving and dreaming? What does it mean to sleep?)⁷⁹ Citing experiments with instantaneous sensory recognition, Bergson concluded that a person interprets visual information using memories to assign meanings. In other words, memory informs perception, especially in the identification of the source of sensory stimuli, performing a similar function in dreams. For Bergson, the difference between waking perception and dreaming would be found in the state of mind of the subject. While a person in a waking state is at attention, constantly deciphering sources of sensory stimuli, a dreamer is relaxed allowing free associations to form meaningful relationships between dream stimuli, primarily joining together recent and distant memories into new combinations.⁸⁰

⁷⁸ Henri Bergson, *L'Énergie spirituelle: Essais et Conférences* (Paris: Librairie Félix Alcan, n.d.), 108.

⁷⁹ Henri Bergson, *The World of Dreams*, trans. by Wade Baskin, (New York: Philosophical Library, 1958), 45. First published in 1901 as "La rêve" in the *Reveu Scientifique*. Lecture delivered at the Institut général Psychologique on March 26, 1901.

⁸⁰ *Ibid*, 44–51.

In the relaxed state of the dreamer, these mnemonic associations are loosened allowing for multiple and varied meanings that would otherwise fall away in the mental vigilance of a waking state.⁸¹ At the boundary of consciousness, Bergson described the waking self, turning around to confront the dreaming self,⁸² an internal space-time inversion tethered to the external world in the flash of an instant. It is in this moment, when the sources of sensory stimuli evade recollection, and reason is weakened, that spatial and temporal understandings are expanded in the sub-conscious.

While studying law at the *Királyi Magyar Tudományegyetem* (Royal Hungarian University) in Budapest beginning in 1913, Moholy-Nagy was inducted into the *Galilei Kör* (Galileo Circle), where he may have first been introduced to Bergson's philosophy through his acquaintance with Bergson's student, Valéria Dienes, philosopher, dancer, and choreographer.⁸³ After returning to Budapest in 1912, Dienes began translating many of Bergson's writings into Hungarian beginning with *A nevetés : tanulmány a komikus jelentéséről és négy lélektani értekezés* (*Le Rire : essai sur la signification du comique [Laughter: An Essay on the Meaning of the Comic]*)⁸⁴ followed by *Tartam és egyidejűség hozzászolás Einstein elméletehez* (*Durée et simultanéité [Duration and Simultaneity]*, 1923)⁸⁵ and *Idő és szabadság : tanulmány eszméletünk közvetlen adatairól* (*Essai sur les données immédiates de la conscience [Time and Free Will: An Essay on the Immediate Data of Consciousness]*, 1925).⁸⁶ Presumably, Dienes would have

⁸¹ *Ibid.*, 53.

⁸² *Ibid.*, 48.

⁸³ Botar, *Technical Detours: The Early Moholy-Nagy Reconsidered*, 18–20.

⁸⁴ Henri Bergson, *Idő és szabadság : tanulmány eszméletünk közvetlen adatairól* (*Essai sur les données immédiates de la conscience [Time and Free Will: An Essay on the Immediate Data of Consciousness]*), trans. Valéria Dienes (Budapest: Revai, 1913).

⁸⁵ Henri Bergson, *Tartam és egyidejűség hozzászolás Einstein elméletehez* (*Durée et simultanéité [Duration and Simultaneity]*), trans. Valéria Dienes (Budapest: Pantheon, 1923).

⁸⁶ Henri Bergson, *Idő és szabadság : tanulmány eszméletünk közvetlen adatairól* (*Essai sur les données*

discussed Bergson's philosophy of comedy during the gatherings of the *Galilei Kör* while she was producing the translation, perhaps incorporating Bergson's and Albert Einstein's temporal theories as she . Although separately, both Moholy-Nagy and Dienes left Hungary during the reactionary and violent period known as "White Terror," in which many thousands of Hungarian Communists were imprisoned or killed. Nevertheless, the philosophical debate over the nature of time between Bergson and Einstein exerted influence over the ideas of Dimensionism.⁸⁷

In his *Photoplastiks*, Moholy-Nagy explored similar questions about the nature of perception and its relationship to dreaming in the representation of space-time dimensions. In *Malerei Fotografie Film*, Moholy-Nagy established that photographic representations hold the power to change spatial perception by neutralizing the tendency of the intellect to interpret spatial relationships, a phenomenon described by Wilhelm Wundt as apperception.⁸⁸ In one particularly effective photographic image looking down on a sunbathing woman reclining in the sand, he demonstrated that the view from above obliterates any reference to a horizon, allowing the image to be rotated, changing the balance of the composition without appearing to be upside down.⁸⁹ **(Figure 0.12)** Functioning similarly to dream imagery, these oblique views foster new spatial relationships based on a fresh interpretation of visual stimuli.

In a manner similar to this photograph from above, the grid in the hybrid drawing of the *Exzentrik* is suggestive of a plan view, lacking a reference to the horizon line, the audience would

immédiates de la conscience [Time and Free Will: An Essay on the Immediate Data of Consciousness], trans. Valéria Dienes (Budapest: Franklin, 1925).

⁸⁷ Botar, "Charles Sirtó and the Dimensionist Manifesto," *Dimensionism: Modern Art in the Age of Einstein*, Vanja Malloy, ed. 20, 26, and 30.

⁸⁸ László Moholy-Nagy, *Painting, Photography, Film*, Janet Seligman, trans. (Cambridge, MA: The MIT Press, 1969), 29. Originally published as *Malerei, Fotografie, Film*, Bauhausbücher 8, Walter Gropius and László Moholy-Nagy, eds. (München: Alfred Langen Verlag, 1925). Wilhelm Wundt, *An Introduction to Psychology*, trans. Rudolf Pinter (1911; repr., London: George Allen & Unwin, c1925), 1–40.

⁸⁹ Moholy-Nagy, *Painting, Photography, Film*, 29.

experience the ubiquity of the grid. **(Figure 1.13)** In the printed version of the *Exzentrik*, Moholy-Nagy included a small diagram of the arrangement of three planar stages at three levels. While the stages were arranged vertically into three levels, their various shapes, two squares and a rectangle, would only partially overlap each other. **(Figure 1.13)** He designated the lowest and largest square stage as the first stage where forms and movements would take place. The second and highest stage was also square, albeit smaller and transparent, would also have smaller forms and movements. The second stage would be hinged to be able to rotate into a vertical position for the projection of films. The third and middle stage was rectangular and would host the musical instruments. Moholy-Nagy directed that some of the theater walls would be covered in two layers of canvas onto and through which lights would be projected. While the position of the audience was not mentioned in the facing text, the essay following the diagram also gives some clues as to the nature of this performance and the position of the spectators:

Es muß endlich eine Aktivität entstehen, welche die Masse nicht stumm zuschauen läßt, sie nicht nur im Innern erregt, sondern sie zugreifen, mittun und auf der höchsten Stufe einer erlösenden Ekstase mit der Aktion der Bühne zusammenfließen läßt.⁹⁰ (It must finally emerge, an activation, in which the masses are not allowed to watch speechlessly; they are not only excited on the inside, but rather, they grab onto, act with, and, from the highest level of a cathartic ecstasy, are allowed to flow together with the action of the stage.)⁹¹

Moholy-Nagy then described the possible continuities and interactions between unorthodox spaces of the spectator and his planar stages that could be achieved with connected planes, overhead bridges, trains, ramps, rotating spaces, and other ideas. From the position of the

⁹⁰ Moholy-Nagy, "Theater, Zirkus, Varieté," in Schlemmer, Moholy-Nagy, and Molnar, *Die Bühne im Bauhaus*, 1925, 54–55.

⁹¹ Translated by author.

spectator, presumably all around the stage, next to, over, and under the horizontal planes of the stage, they would receive different impressions, seeing through various overlays and their presence, actions and reactions, would impart another spontaneous, improvised element within each performance. Additionally, in this interpretation of the position of the spectators, the elongating and moving bars of light emanating from the coordinate grid would travel across the floor of the first and third stages and up onto the audience themselves and the vertical canvas planes of the walls of the theater, transforming the space, while engaging the viewer and opening their vision to see differently with fresh, newly awakened eyes. Without being locked into theater seats, the audience would be able to follow the bands of light, not only with their eyes, but also by physically moving within the theater space.

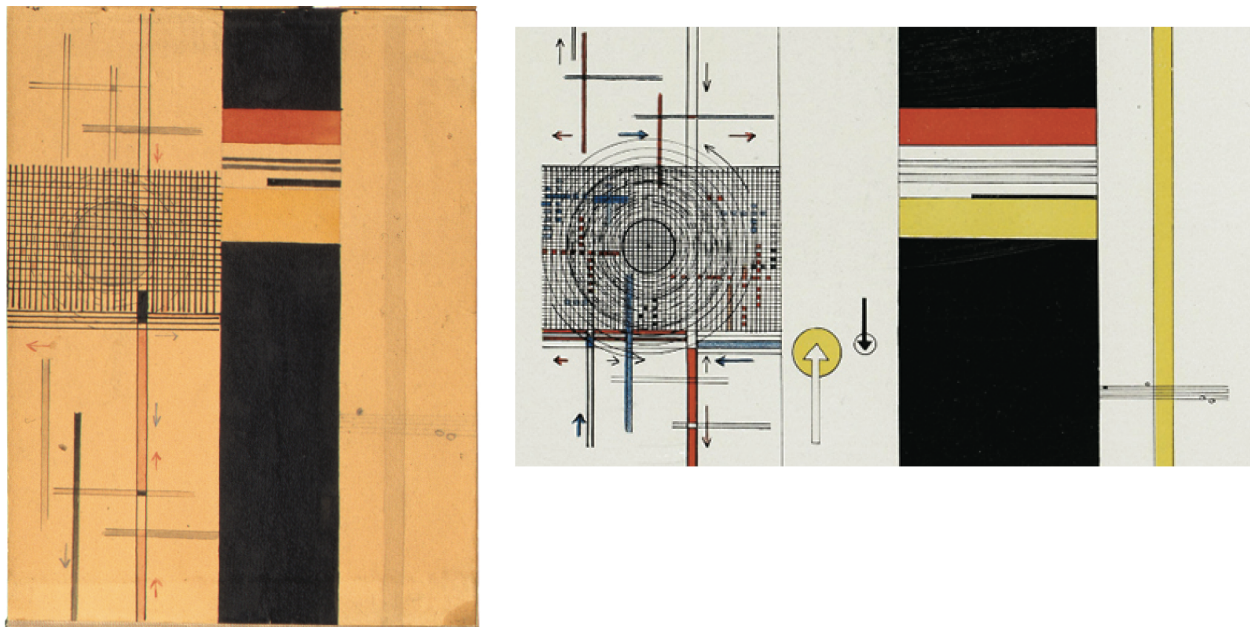


Figure 1.13: László Moholy-Nagy, (left) Untitled, c. 1924, for complete caption see note to Figure 0.1 + (right) *Partiturskizze zu einer mechanischen Exzentrik* (Score-Sketch for a Mechanical Eccentric), 1925, for complete caption see note to Figure 0.5.

Concurrently, Moholy-Nagy brought his "mit vollkommen anderen Augen sehen" (entirely new [photographic] eyes) to bear witness in creating his other *Photoplastiks*.⁹² In "fotografie ist lichtgestaltung" (Photography is Light-Formation), Moholy-Nagy described *Photoplastiks*, a German conjunction that translates to 'light-sculptures,' as "eine art organisierter spuk" (a type of organized din), like a fugue with many elements working together.⁹³ Already an interesting conception, in this analogy, Moholy-Nagy paired his visual creations with auditory arrangements that themselves are constructed by overlapping repetitive verses. Moholy-Nagy also equated a similar combinatorial process in film-montage to that of dreaming, juxtaposing photographic elements from different times and spaces into one image, while obscuring previous contextual relationships and suggesting new associations.⁹⁴ In this sense, he intended for his *Photoplastiks* to represent something inherent, yet invisible, about reality by superimposing diverse spaces and times. When reading a *Photoplastik*, similar to the role of the imagination in deciphering dream imagery, the recombination of these adjacencies and simultaneities produce the sensation of continuity from the combination of discontinuous representations.

Moholy-Nagy embedded hidden meanings in his *Photoplastiks* in the revelation of an inversion within a title, or in some cases, across multiple titles, often invoking a tragicomic levity. One example is the title of his *Photoplastik*, "Untersehboot" (c. 1928),⁹⁵ homophonous with the

⁹² Moholy-Nagy, *Malerei, Fotografie, Film*, 27.

⁹³ László Moholy-Nagy, "fotografie ist lichtgestaltung," *Bauhaus II*, no. I (1928), 8 and "Photography Is Creation with Light," in *Moholy-Nagy*, by Krizstina Passuth and László Moholy-Nagy, trans. Éva Grusz, Judy Szölluósy, László Baránszky Jób, Máttyás Esterházy, Kenneth McRobbie, and Ilona Jánosi. (New York: Thames and Hudson, 1985), 302–305.

⁹⁴ László Moholy-Nagy, "Space-Time and the Photographer," in *American Annual of Photography*, vol. LVII, no. 152, 1943.

⁹⁵ Irene-Charlotte Lusk first developed the meanings within the titles of this *Photoplastik* in *Montagen ins Blaue: Laszlo Moholy-Nagy, Fotomontagen und -collagen 1922–1943 (Anabas): 92–93*. However, Lusk provides another plausible interpretation of the intersecting planes as representing visible light projections produced by advertising light cannons, akin to but more powerful than a film projector. In her

German term meaning 'the submarine,' das *Unterseeboot*. **(Figure 1.13)** "Untersehboot" depicts a man looking up through two intersecting trapezoidal planes at two women sitting atop one of the edges of the planes. Its title strengthens the impression of the position of the perspectival viewer as below the women, whose bathing suits and caps support the sense of being underwater. However, the substitution of seh- for See changes the meaning of the title to 'under-seeing-boat,' highlighting the irreverence of the viewing position looking up and under the legs of the women.

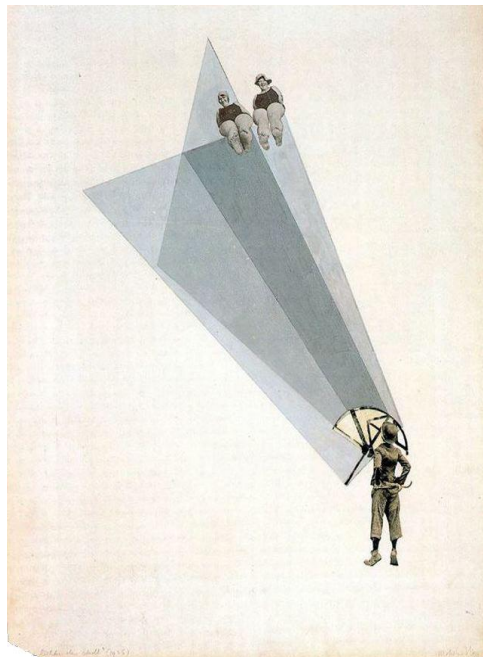


Figure 1.14: László Moholy-Nagy, *Die Lichter der Stadt* (City Lights) aka *Untersehboot* (Under Seeing Boat), c. 1928, Photomontage, photomechanical reproductions, and tempera on board: 61.5 x 49.5 cm (24.1875" x 19.5"), Bauhaus Archiv Berlin, 771.

interpretation, Lusk surmises that the two women may be projected images onto clouds or plumes of smoke overhead. In addition, Lusk documents the discrepancy in the Bauhaus-Archiv's dating of this *Photoplastik* as circa 1926. Since Lusk discovered that Chaplin's image was from an advertisement for *The Circus*, released in 1928, the earliest date for this collage would be circa 1928.

Moholy-Nagy gave "Untersehboot" the alternate title of "Die Lichter der Stadt,"⁹⁶ a German translation of the film title, *City Lights*, by Charlie Chaplin.⁹⁷ In this *Photoplastik*, the perspectival viewer is Chaplin himself as the ever-curious tramp character. However, this particular image of the tramp on the tips of his toes is not from *City Lights*, but another film, *The Circus*,⁹⁸ a substitution that builds upon the theme of mistaken identity in both films, by mis-identifying the title of the film that was, in turn, dealing with the theme of sensory mis-identification. Cut out of a newspaper advertisement, in which the tramp peering through a hole in a circus tent, framing the beautiful trapeze artist with whom he has fallen in love. **(Figure 1.14)** Meanwhile, she is looking at herself in the frame of a handheld mirror, doubling herself as the object of his gaze and hers in reverse. In the final scene, the audience peers through a similar hole, when the field of vision is narrowed to a small disk focused on the departure of the lonely, heartbroken vagabond. Calling attention to the frame in the cone of vision, projected on and yet virtually passing through the movie screen, breaks the cinematic spell of the fourth wall, as the audience is awakened, as if from a dream within a dream.

The third title for this *Photoplastik* is "Da stehst du machtlos vis-a-vis" (There you are/stand powerless face to face).⁹⁹ Overcoming the vertical distance between the two women facing forward and Chaplin facing backward, the notion of "standing face to face" hints at the spatial

⁹⁶ Irene-Charlotte Lusk in *Montagen ins Blaue: Laszlo Moholy-Nagy, Fotomontagen und -collagen 1922–1943* (anabas): 92–93.

⁹⁷ *City Lights*. Produced and directed by Charlie Chaplin. Performed by Charlie Chaplin, Virginia Cherrill, Florence Lee, and Harry Myers. (New York: Janus Films, 1931. Online Video at amazon.com.

⁹⁸ *The Circus*. Produced and directed by Charlie Chaplin of Charles Chaplin Productions. Performed by Allan Garcia, Merna Kennedy, and Charlie Chaplin. (New York: Janus Films, 1928). Online Video at amazon.com. According to Irene-Charlotte Lusk in *Montagen ins Blaue: Laszlo Moholy-Nagy, Fotomontagen und -collagen 1922–1943* (anabas): 92–93, the image was cut from the *Arbeiter-Illustrierte-Zeitung* (A-I-Z), VII, 1928, n. 4, 13.

⁹⁹ Lusk, *Montagen ins Blaue*, 92–93, an image caption listed a third title for this *Photoplastik* as "Da stehst du machtlos vis-a-vis" (There you stand powerless face to face).

dimension produced by turning the perspective diagram of the cone of vision on its side. With shades of blue, the cone is delineated by two intersecting, transparent planes. Playing off these visual superimpositions, a pair of crossing lines creates a section through the cone of vision, designating the picture plane, which appears to project forward from the picture plane of the *Photoplastik* itself, instead of receding further into the depth of the view in relation to the perspectival viewer. Subsequently, while the tramp is clearly looking through a viewing apparatus, he appears to be behind and facing away from the two women, inverting the cone of vision.

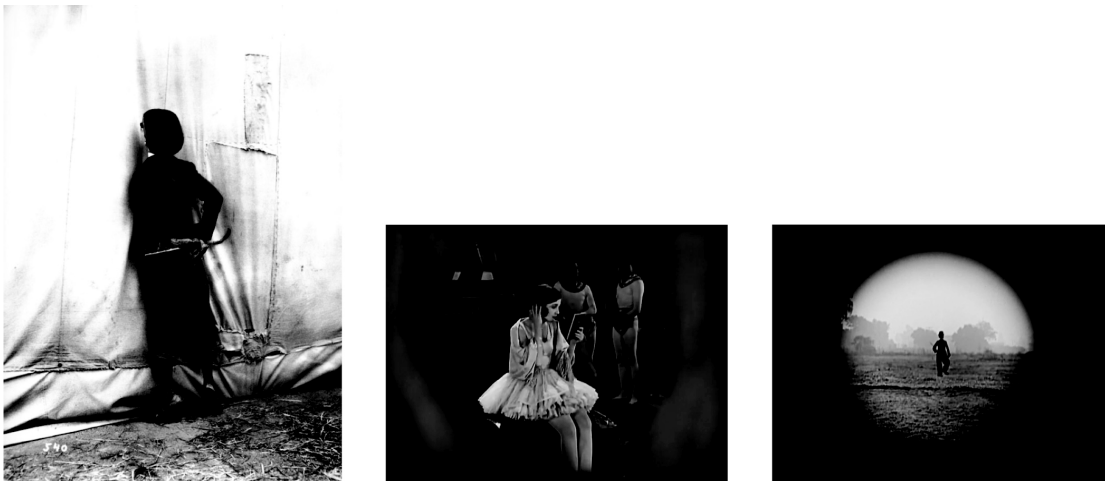


Figure 1.15: *City Lights*, Produced and directed by Charlie Chaplin, Performed by Charlie Chaplin, Virginia Cherrill, Florence Lee, and Harry Myers, New York, Janus Films, 1931.

In *Traumdeutung*, Sigmund Freud cautioned, "the fact that at this point in the dream something is represented as inverted must have a meaning; and the inversion must apply to some other relation to the dream-thoughts and the dream-content," indicating that such inversions harbor sexual content, repressed desires stemming from childhood and/or other traumatic

experiences.¹⁰⁰ The creation of an inversion (dream-displacement) is a form of psychic censorship that produces a transference between dream-content and dream-thought and provides the structure for building an interpretation through an understanding of this correlative relationship.¹⁰¹

For Moholy-Nagy, early traumatic life events stem from his experiences in the Austro-Hungarian army during World War I, when he was conscripted into an artillery unit in the first round of the draft. During the war, Moholy-Nagy drew his surroundings, people and places, on military cards and other papers, recording both the mundane and the horrific events around him in a tangle of thick black arcs, such as a landscape entitled *Drahtverhau* (Barbed Wire Entanglement, c. 1918).¹⁰² According to Moholy-Nagy's brother, Jenő Nagy, his detailed and useful survey maps were sent to military headquarters in Vienna, after which he was promoted to first lieutenant in October 1918, later receiving the Bronze Medal of Valor and the Karl Company Cross. His military service ended with an early discharge due to injuries both physical, a shattered thumb, and psychological, a traumatic disorder, known in the early twentieth century as shell-shock.¹⁰³

Under these circumstances, the thick lines of the apparatus through which Chaplin is peering at the two women, the manifest dream-content, are reminiscent of artillery sighting instruments, such as a gunner's quadrant. **(Figure 1.16)** Being on the front lines of World War I, Moholy-Nagy would have deeply experienced the futility of the military face-off, entrenched and desperately attempting to match each projectile with the intended target, while receiving enemy fire in return. This latent dream content, or possible dream interpretation of "stand[ing] face to face,"

¹⁰⁰ Sigmund Freud, *The Interpretation of Dreams*, A. A. Brill, trans. (New York: Macmillan Company, 1913), 275–279. First published as *Traumdeutung*, 1899.

¹⁰¹ *Ibid.*, 295.

¹⁰² Botar, *Technical Detours: The Early Moholy-Nagy Reconsidered*, 35 and 44.

¹⁰³ Jenő Nagy, "Interview Transcript from October 25, 1975," in Passuth, *Moholy-Nagy*, 385.

provides a compelling explanation for the third title.

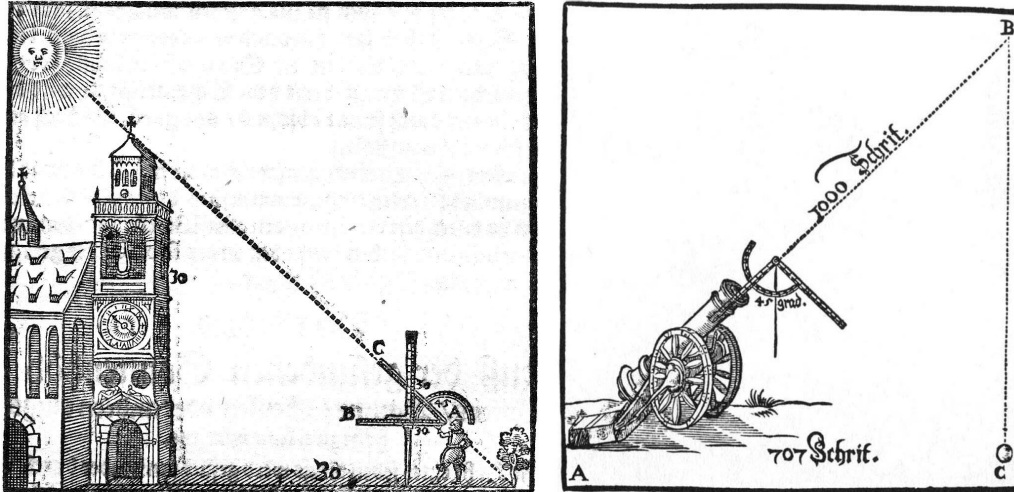


Figure 1.16: Niccolo Tartaglia, *La Nova Scientia*, Venice, 1537.

Upon closer examination of the viewing apparatus, Moholy-Nagy lifted the overlapping bars and arcs from an earlier, untitled *Photogram* containing what appears to be a silhouette of geometric, wireframe figures. **(Figure 1.17)** As a gunner, Moholy-Nagy could have made this visual connection and perhaps identified the formal relationship between these bars in the *Photogram* and a quadrant. In a sense, this form of visual recognition resembles the relaxed mental state in a dream allowing connections to form with only the faintest visual suggestion. As a dream-displacement, an inversion of a wire figure with a military device, the third title appears to refer to the futility of war, the powerlessness felt, face to face with the enemy, while sighting a large ammunition barrel.

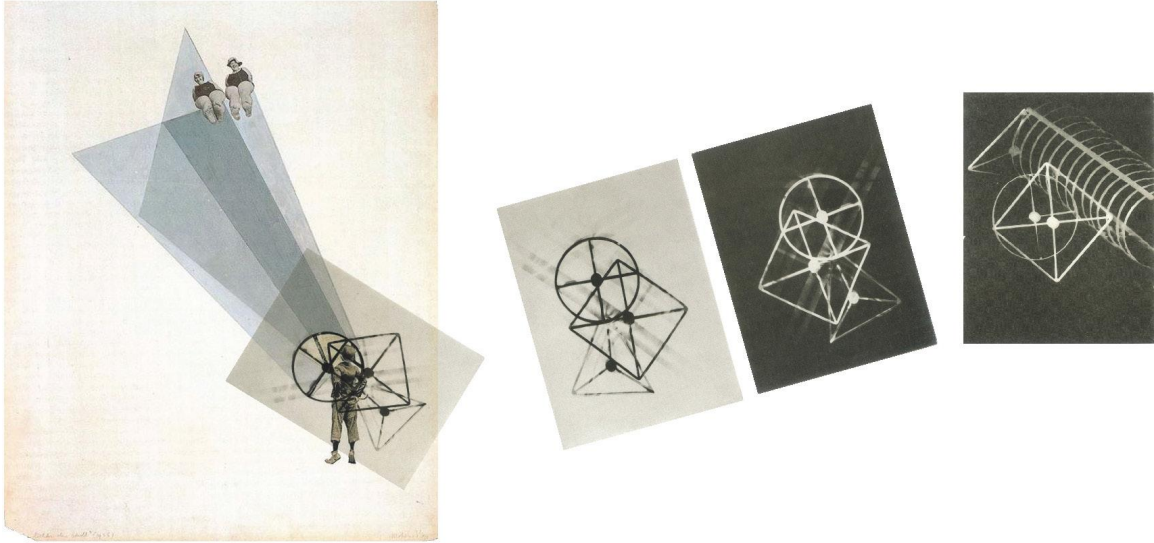


Figure 1.17: László Moholy-Nagy, (left) *Die Lichte der Stadt (City Lights) aka Untersehboot (Under Seeing Boat)*, c. 1928, for full caption see note to Figure 1.14 + (middle left) *Untitled*, 1925, Reversed Photogram on Developing Paper: 22.8 x 17.8 cm, The Museum of Fine Arts Houston, 84.232 + (middle right) *Untitled*, 1925, Photogram on Developing Paper: 24 x 18 cm, lost + (right) *Untitled*, 1925, Photogram on Developing Paper: 23.7 x 17.7 cm, Collection of William Larson, Prakapas Gallery, Sotheby's New York.

INVERSIONS

Looking beyond the expansive titles, into the inversions present in “Untersehboot,” the spatial ambiguity constructed around the experimental use of the perspective cone of vision serves to reveal otherwise invisible spatial dimensions. According to Russian polymath Pavel Florensky (*Ikonostas*, 1922), dreams offer entry into an invisible world in which there is an unexpected experience of time and space. This region exists outside the visible world of appearances wherein dream-time turns itself inside out, flowing forwards and backwards, at the boundary between sleeping and waking. In the dream, the visible world penetrates this boundary when an external stimulus coincides with an event within the dream. From this occurrence, Florensky concluded that dream-time is experienced twice, once forwards in a logical series of events in the dream and then backwards recoiling from the intrusion of the external stimulus. In equating

the dream with spiritual encounters, Florensky related the imaginary space of the dream as an encounter with a fourth dimension. This notion of time, turned inside out in the dream, calls into question an experience of time as having a unidirectional flow and proposed another experience of time as spatial in the fourth dimension, produced by a symmetrical inversion between the visible and the invisible.¹⁰⁴

Florensky's inversion between the visible and invisible in dreams can be further understood in the context of his writings on perspective representation, prepared for a lecture delivered to his new colleagues in the Byzantine section of MIKHIM (Moskovskii institut istoriko-khudozhestvennykh izyskanii i muzevedeniia [Moscow Institute of Historical and Artistic Researches and Museology]) in 1920.¹⁰⁵ Florensky appropriated his title, "Obratnaja perspektiva," and two main examples from Oskar Wulff's "Die umgekehrte Perspektive und die Niedersicht: Eine raumanschauungsform der altbyzantinischen Kunst und ihre Fortbildung in der Renaissance" (Inverted Perspective and the Lowly View: a Form of Spatial-View and Picture-Making in the Renaissance, 1907).¹⁰⁶ Building upon Wulff's arguments and examples, Florensky questioned the meaning and value of perspective representation, the nature of its relationship to vision. After praising ancient Egyptian and Chinese paintings and reliefs for their culturally relevant spatial depictions, Florensky condemned the development of Renaissance perspective views as originating through the visual illusions created for the theater, a deception that required the spectator to be fixed at a

¹⁰⁴ Pavel Florensky, *Iconostasis*, trans. Donald Sheehan and Olga Andrejev (Crestwood, NY: St. Vladimir's Seminary Press, 1996), 45, originally published 1922 as *ikonostas*.

¹⁰⁵ Pavel Florensky, *Beyond Vision: Essays on the Perception of Art*, trans. Wendy Salmond, comp. Nicoletta Mislner (London: Reaction Books, 2002), 199.

¹⁰⁶ Pavel Florensky, *Beyond Vision: Essays on the Perception of Art*, trans. Wendy Salmond, comp. Nicoletta Mislner (London: Reaction Books, 2002), 199, and Oskar Wulff, "Die umgekehrte Perspektive und die Niedersicht. Eine raumanschauungsform der altbyzantinischen Kunst und ihre Fortbildung in der Renaissance," in Heinrich Weizsäcker, ed., *Kunstwissenschaftliche Beiträge, August Schmarsow gewidmet zum fünfzigsten semester seiner akademischen Lehertätigkeit* (Leipzig: Hiersemann, 1907), pp. 1–40.

point, like the prisoners in Plato's allegory of the cave.¹⁰⁷ Similarly, Florensky argued that Albrecht Dürer's four drawing machines demonstrated that perspective is a theoretical contrivance and not a model of visual perception.¹⁰⁸ **(Figure 1.18)** However, a close study of Dürer's machines would have enabled his understanding of the perspective diagram as a reversible cone of vision between the viewer and the viewed. This conceptual relationship, once revealed, was able to be manipulated to produce new spatial understandings.



Figure 1.18: Albrecht Dürer, *Underweysung der Messung, mit dem Zirckel und richtscheyt, in Linien, Ebenen und gantzen Corporen, durch Albrecht Dürer zusammen gezogen un[d] durch jn selbs (als er noch auff erden war) an vil orten gebessert, in sonderheyt mit xxii figuren gemert...* [Nürnberg], [Formschneider], 1538.

Applying the theoretical work of Florensky, Russian architect and artist El Lissitzky further examined these perspective inversions in his essay, "K. und Pangeometrie" (A. and Pangeometry). In his opening statement, Lissitzky declared that "[d]as Sehen ist nämlich auch

¹⁰⁷ Florensky, *Beyond Vision: Essays on the Perception of Art*, trans. Wendy Salmond, 208–211. See also Plato, *The Republic of Plato*, trans. Benjamin Jowett (360 BCE; repr., London: Oxford University Press, 1888), 217.

¹⁰⁸ Florensky, *Beyond Vision: Essays on the Perception of Art*, trans. Wendy Salmond, 242–260.

eine K." ([s]eeing is namely also an A.)¹⁰⁹ Lissitzky asserted that the Western European concept of perspective space projected the tip of the visual pyramid back to the horizon, while "Eastern" traditions pulled the apex forward into the eye of the beholder. Building upon Florensky's notion of imaginarieness in *Mnimosti v geometrii*, Lissitzky stated that the Suprematists moved the tip of the visual pyramid to infinity creating a spatial representation in which there existed only orthographic lines.¹¹⁰ Although he may not have written explicitly about the reversibility of the perspective diagram, Moholy-Nagy appears to have been working through these ideas in his *Photoplastiks* and in his near simultaneous articles republished in *Malerei, Fotografie, Film* on the nature of apperception.¹¹¹

In addition to the preparatory studies in which Moholy-Nagy inverted the light and dark shades of the Photogram, he also produced at least two reversible draft versions of "Untersehboot" (**Figure 1.19**). In both, he experimented with the perception of space by inverting and manipulating the perspective diagram, suggesting inversions present in *The Circus*. In the opening scene, the female trapeze artist is viewed from below by Chaplin, her father, and the audience. This directional relationship was reversed when Chaplin climbed a pole to escape the donkey and walked the tightrope to impress her. While it is clear in "Untersehboot" that Chaplin is the viewer and not the viewed, in the draft versions, this relationship was reversed. In fact, Moholy-Nagy experimented with using the aforementioned photograph of a sunbathing female

¹⁰⁹ In this quote, A. is translated from the German K., which stood for *Kunst* meaning 'art.' Sophie Lissitzky-Küppers, ed., *El Lissitzky: Life, Letters, Texts* (Greenwich, CT: New York Graphic Society, 1968), 348, originally published as *El Lissitzky – Maler, Architekt, Typograf, Fotograf* (Dresden: Verlag der Kunst, 1967). "K. und Pangeometrie" was first published in *Europa Almanach*, Carl Einstein and P. Westheim, eds., (Potsdam: Gustav Kiepenheuer Verlag, 1925).

¹¹⁰ Sophie Lissitzky-Küppers, ed., *El Lissitzky: Life, Letters, Texts*, 348–350. Here, Lissitzky was referring to the eye of the viewer, as the tip of the visual pyramid, being moved to infinity, similar to the assumption that sunlight projects shadows with parallel lines because it is infinitely distant from the object.

¹¹¹ Wilhelm Wundt, *An Introduction to Psychology*, trans. Rudolf Pinter (1911; repr., London: George Allen & Unwin, c1925), 1–40.

figure positioned on the crossing lines of the picture plane inverting the cone of vision. Similar to this horizon-less photograph that Moholy-Nagy claimed retained plausibility even after turning it around, this draft of “Untersehboot” can also be turned, inverting the cone of vision in its re-positioning relative to the viewer.

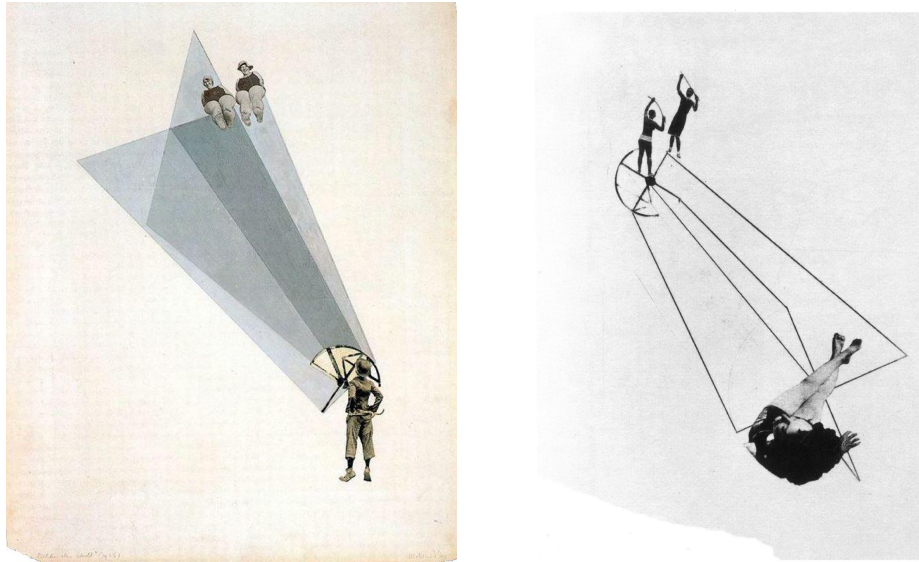


Figure 1.19: László Moholy-Nagy, (left) *Die Lichter der Stadt (City Lights) aka Untersehboot (Under Seeing Boat)*, c. 1928, for full caption see note to Figure 1.14 + (right) *Untitled*, 1926/28. Photomontage, photomechanical reproductions on paper, Published in Julie Saul, ed. *Moholy-Nagy Fotoplastiks: The Bauhaus Years*, Bronx Museum of the Arts, 1983.

Using the cone of vision to establish and invert spatial relationships, Moholy-Nagy depicted a warped four-dimensional space in a two-dimensional representation. By turning the cone of vision, revealing the perspective diagram, as well as revealing the anamorphic nature of space-time, Moholy-Nagy used the position of the viewer and viewed to destabilize space, inverting the impression of the foreground and background by obfuscating the apparently transparent planes of the cone of vision. In this sense, “Untersehboot” is akin to turning Dürer’s etchings of the draughtsman drawing the reclining nude ninety degrees clockwise, placing the artist with his

drawing machine looking up at his female subject with her legs exaggerated in the foreground of his view. Rotated in this manner, the grid of strings is reminiscent of those grids used to project perspective illusions onto irregular surfaces.

While Renaissance perspective located the viewer in relation to the image as if seen through a window, as with Dürer's drawings of perspective machines, turning the depth of view sideways, as if it is a measurable dimension, brings the viewer and viewed simultaneously present.

Therefore, if traditional Renaissance perspective is depicting three dimensions, then Moholy-Nagy's perspective demonstrates the fourth dimension using warped cones of vision collapsing time and inverting spatial relationships.

II. LIGHT

Electric Sparks and Buzzing Sounds:
A Continuation of the Kinetic Grid in
Awakening the Senses in the *Partiturskizze*
zu einer mechanischen Exzentrík [Act II]

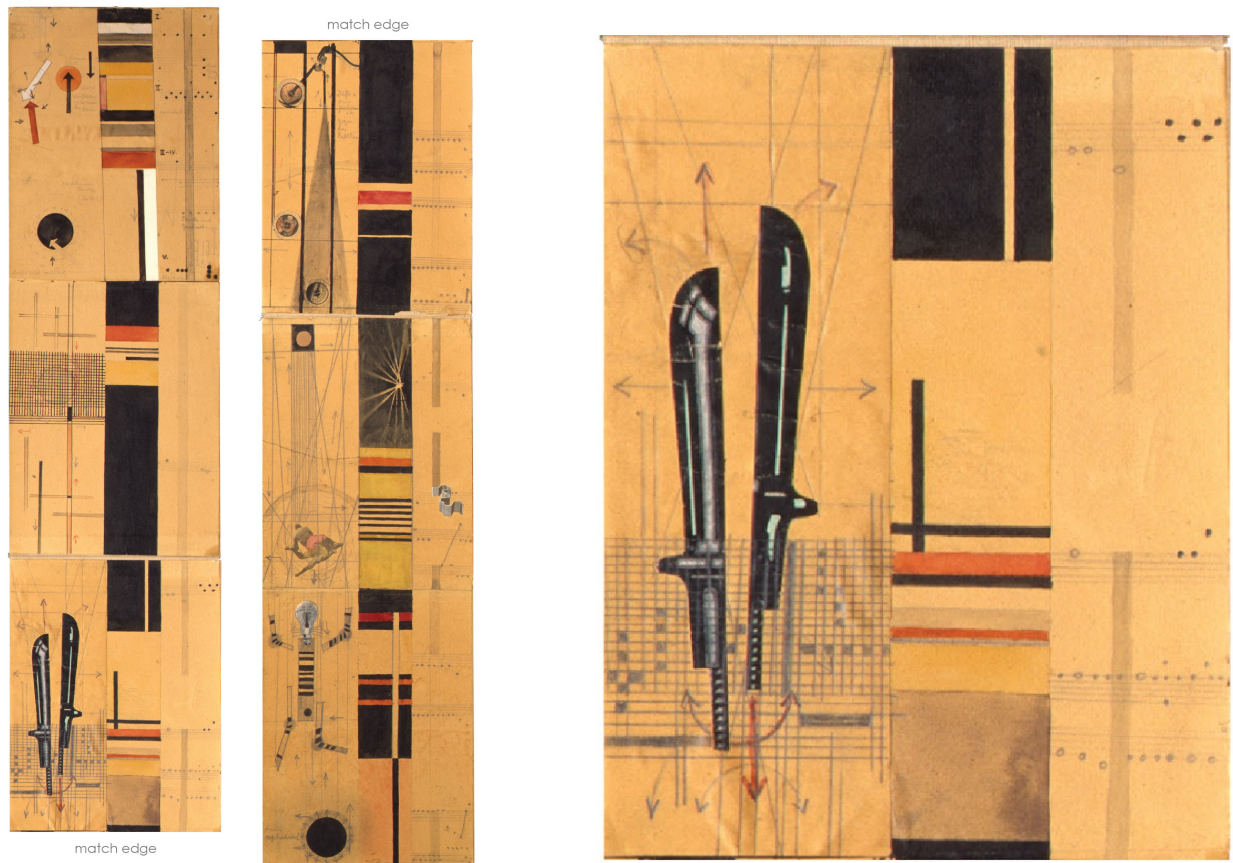


Figure 2.1: László Moholy-Nagy, Untitled, c. 1924, for full caption see Figure 0.1 + Act II
Detail.

According to Plato, the four material elements were derived from a common source or *prima*

materia (first matter), associated with chaos, which alchemists later assigned to the first element used in the alchemical process of turning metals into gold, justifying their pursuits to know the unknowable by referring to the Allegory of the Cave in Book VII of Plato's *The Republic*, a dialogue between Socrates and Plato's older brother Glaucon (whose name means 'bright-eyed' in tribute to Athena). In this allegory, Socrates described prisoners chained in a cave facing a wall. From their totally immovable vantage, the prisoners perceived and named shadows as things in themselves projected on the wall from objects mysteriously passing in front of a fire set behind them. In such a position, the prisoners had invented their own interpretations of the two-dimensional shadows and their movements. When finally set free, they would come to accept a new reality in the light of day, only after their eyes adjusted to the bright light of the sun and their minds became accustomed to a three-dimensional world of objects in space to which Socrates concluded:

Ταύτην τοίνυν, ἦν δ' ἐγώ, τὴν εἰκόνα, ὦ φίλε Γλαύκων, προσπτόον ἅπασαν τοῖς ἔμπροσθεν λεγομένοις, τὴν μὲν δι' ὄψεως φαινομένην ἔδραν τῆ τοῦ δεσμωτηρίου οἰκίσει ἀφομοιοῦντα, τὸ δὲ τοῦ πυρὸς ἐν αὐτῇ φῶς τῆ τοῦ ἡλίου δυνάμει· τὴν δὲ ἄνω ἀνάβασιν καὶ θέαν τῶν ἄνω τὴν εἰς τὸν νοητὸν τόπον τῆς ψυχῆς ἄνοδον τιθεὶς οὐχ ἀμαρτήσῃ τῆς γ' ἐμῆς ἐλπίδος, ἐπειδὴ ταύτης ἐπιθυμεῖς ἀκούειν. θεὸς δὲ που οἶδεν, εἰ ἀληθῆς οὔσα τυγχάνει. τὰ δ' οὖν ἐμαὶ φαινόμενα οὕτω φαίνεται, ἐν τῷ γνωστῷ τελευταία ἢ τοῦ ἀγαθοῦ ἰδέα καὶ μόγις ὀρᾶσθαι, ὀφθεῖσα δὲ συλλογιότεα εἶναι ὡς ἄρα πᾶσι πάντων αὕτη ὀρθῶν τε καὶ καλῶν αἰτία, ἐν τε ὀρατῷ φῶς καὶ τὸν τούτου κύριον τεκοῦσα, ἐν τε νοητῷ αὕτη κυρία ἀλήθειαν καὶ νοῦν παρασχομένη, καὶ ὅτι δεῖ ταύτην ἰδεῖν τὸν μέλλοντα ἐμφρόνως πράξειν ἢ ἰδίᾳ ἢ δημοσίᾳ.¹ (This entire allegory, I said, you may now append, dear Glaucon,

¹ Plato, *Plato's Republic: The Greek Text*, ed. Benjamin Jowett and Lewis Campbell (364 BCE; repr., Oxford: Clarendon Press, 1894), 1: 297–298.

to the previous argument; the prison-house is the world of sight, the light of the fire is the sun, and you will not misapprehend me if you interpret the journey upwards to be the ascent of the soul into the intellectual world according to my poor belief, which, at your desire, I have expressed whether rightly or wrongly God knows. But, whether true or false, my opinion is that in the world of knowledge the idea of good appears last of all, and is seen only with an effort; and, when seen, is also inferred to be the universal author of all things beautiful and right, parent of light and of the lord of light in this visible world, and the immediate source of reason and truth in the intellectual; and that this is the power upon which he who would act rationally, either in public or private life must have his eye fixed.)²

It was this shift in an understanding of the world based upon the opening up of previous limitations on both perception and conception that appealed to Dimensionist philosophers and artists, especially those who were drawn to the Eastern traditions of meditation that were underpinning several varieties of Spiritualism in Europe. Socrates' allegorical revelation was that the captives, who were physically restrained, unable to even move their heads, were not very different from the type of imprisonment that all humankind experiences in the "prison-house of sight."³ In Plato's view, the light of the fire and the light of the sun are no different in that each reveals, or makes visible, mere shadows of the things themselves, while the larger, invisible truth lies outside of sensual perception. For theorists of higher dimensions, Plato's Allegory of the Cave provided the solid philosophical foundation on which to build their arguments and allegories, with many referencing or even retelling the allegory in their writings.⁴

² Plato, *The Republic of Plato*, trans. Benjamin Jowett (360 BCE; repr., London: Oxford University Press, 1888), 217.

³ Ibid.

⁴ For references to Plato's *Allegory of the Cave*, see Claude F. Bragdon, *A Primer of Higher Space*, 1913, 19, Charles Howard Hinton, *The Fourth Dimension* (London: Sonnenschein, 1904; Kila, MT: Kessinger Publishing,

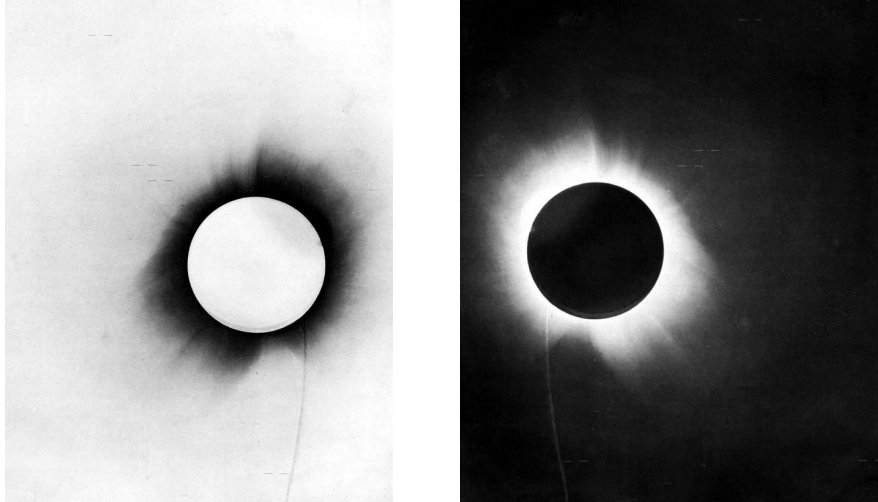


Figure 2.2: Frank W. Dyson, Arthur S. Eddington, and Charles Davidson, "A Determination of the Deflection of Light by the Sun's Gravitational Field, from Observations Made at the Total Eclipse of May 29, 1919," *Philosophical Transactions of the Royal Society of London, Series A*, 1920.

In addition to these philosophical underpinnings of the early higher dimension theorists, in 1919, Arthur Eddington's photographic confirmation⁵ of Albert Einstein's assumptions about the invisible effects of gravitation on the material of light, a most ephemeral material. Einstein's groundbreaking publications, "Zur Elektrodynamik bewegter Körper" (On the Electrodynamics of Moving Bodies), known later as his Special Theory of Relativity, and his "Die Grundlage der allgemeinen Relativitätstheorie" (The Foundation of the General Theory of Relativity),⁶ supported

1996), 1–3 and P. D. Ouspensky, *Tertium Organum: The Third Canon of Thought, A Key to the Enigmas of the World*, trans. Nicholas Bessaroboff and Claude Bragdon (New York: Vintage Books, Random House, 1970), chapter 14, originally published 1912 as *Kluck Kzaradkam*.

⁵ Albert Einstein et al., *The Principle of Relativity: A Collection of Original Memoirs on the Special and General Theory of Relativity*, comp. Arnold Sommerfeld, trans. W. Perrett and George Barker Jeffrey (Methuen and Company, 1923; Mineola, NY: Dover Publications, 1952). Einstein first published "Zur Elektrodynamik bewegter Körper" in *Annalen der Physik*, 17, 1905 and "Die Grundlage der allgemeinen Relativitätstheorie" debuted in *Annalen der Physik*, 49, 1916.

⁶ Arthur S. Eddington, "Appendix," in Benjamin Harrow et al., *From Newton to Einstein: Changing*

visually by Eddington's images of the solar eclipse, contributed scientific evidence for their belief in the existence of invisible higher dimensions of space, revealed in the third dimension as time, potentially a chiaroscuro projection from the fourth spatial dimension. **(Figure 2.2)**

In *A Primer of Higher Space*, Claude Bragdon demonstrated that lower space forms may be shadows of higher space forms cast into lower dimensions: **(Figure 2.3)**

For example, the sphere (a 3-space form) can only be represented in plane space by a circle of a diameter equal to the diameter of the sphere, and in linear space by a line of a length equal to the said diameter. These lower-dimensional representations may be conceived of as the shadows cast by higher-space forms on lower-space worlds.⁷

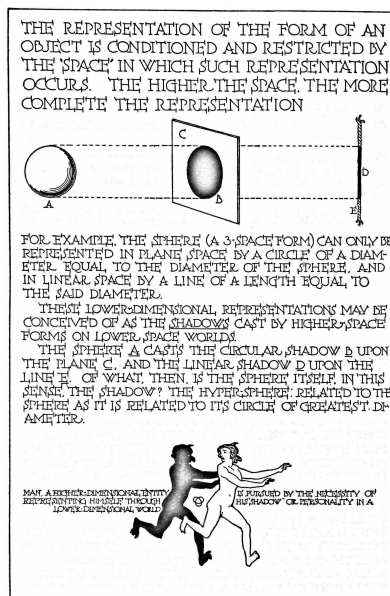


Figure 2.3: Claude Bragdon, *A Primer of Higher Space*, 1913, Dimensional Shadows.

Conceptions of the Universe (New York: D. Van Nostrand Company, 1920), 114–115.

⁷ Bragdon, *A Primer of Higher Space*, 1913, plate 12.

In a manner similar to Eddington's revealing images of the solar eclipse, photography, with the aid of powerful lenses, could make visible for the general public microscopic particles, even invisible living creatures that surprisingly coexist on a human body, and far distant galaxies and constellations. While microscopic and telescopic lenses had been available to European scientists for centuries, who had distributed their findings through printed drawings, the photograph elevated the evidentiary quality of the discoveries for the public, revealing a higher truth about the world. Akin to Socrates' discussion of the intellectual pursuit of the invisible, these images changed the accepted understanding of the world. Many such images abounded in magazines and newspapers to the amazement of the reader. Moholy-Nagy even reproduced several of these images in his *Malerei, Fotografie, Film*: the feet of a barnacle, a head louse, and constellations.⁸

Several decades later, in his book entitled *Cosmic View: The Universe in 40 Jumps* (1957), Dutch engineer Kees (Cornelius) Boeke demonstrated the concept of scalar relationships through incrementally zooming out to the macrocosmic scale of the visible universe and zooming in to the microscopic scale of the nucleus of a sodium atom. **(Figure 2.4)** Beginning with a drawing of a young girl holding a white cat in a school yard, half of the forty drawings jump up and out in scale to portray the universe after which, the other half jump down and inward to a mosquito on the girl's hand and then into her skin penetrating into her skin cells. For Boeke, the concept of a cosmic view would illustrate the interconnectedness of everything, positioning the experience of humans within a continuum of perceptible and imperceptible worlds.

⁸ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 50–51 and 62–63.

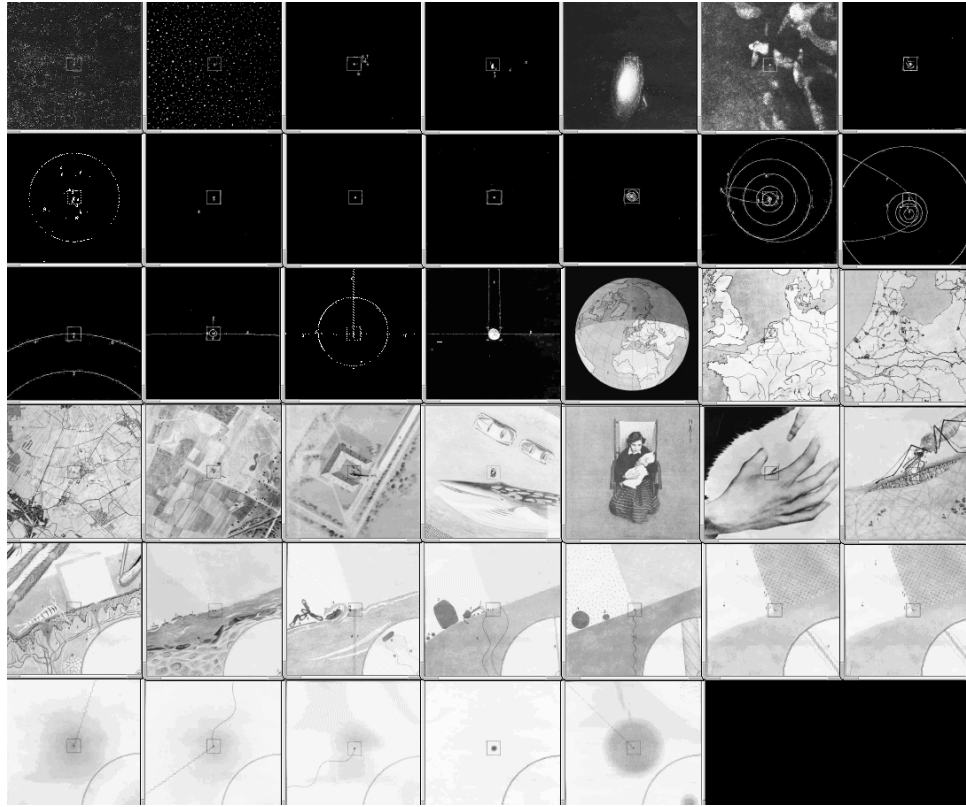


Figure 2.4 Kees Boeke, *Cosmic View: The Universe in 40 Jumps* (London: John Day Company) 1957.

The structure and premise of *Cosmic View* was closely reinterpreted into two film versions by architects Charles and Rae Eames. Set in Miami, Florida, the first version of the film was created in 1968 and called *A Rough Sketch for a Proposed Film Dealing with the Powers of Ten and the Relative Size of Things in the Universe*.⁹ The title of the second and more well-known version of the film was *Powers of Ten: A Film Dealing with the Relative Size of Things in the Universe and the Effect of Adding Another Zero*, which was set in Chicago, Illinois, on the shore of Lake Michigan in 1977 with a couple enjoying a summer picnic.¹⁰ Very similar to Boeke's drawings, the Eames'

⁹ Charles Eames and Rae Eames, dirs., *A Rough Sketch for a Proposed Film Dealing with the Powers of Ten and the Relative Size of Things in the Universe*, narrated by Judith Bronowski, 1968.

¹⁰ Charles Eames and Rae Eames, dirs., *Powers of Ten: A Film Dealing with the Relative Size of Things in the*

zoomed out beyond the universe and into the nucleus of an atom of a corporeal cell. Beginning with film documentation, the Eames' then seamlessly extended the visible using animated drawings of moving cellular structures and galaxial relationships of solar systems, with the special effect of appearing to be actual film footage of astronomic and atomic movements. This combination of real footage and representations of real footage testifies to the powerful nature of the photograph as a faithful copy of reality.

Considering the potential of photography as a means of creative formation, as "lichtgestaltung," as designing with light, Moholy-Nagy questioned the limited use of photography simply as capturing a mimetic image of nature, and, furthering his writing analogy, just as language harbors more potential than merely faithfully describing events as they occur. In his essay, "fotografie ist lichtgestaltung," Moholy-Nagy detailed the possibilities:

"in der erweiterung des sehbildes ist selbst das heutige, unvollkommene objektiv schon nicht mehr an die engen grenzen unseres auges gebunden. ... obwohl die fotografie schon über hundert jahre alt ist, hat der entwicklungsgang es doch erst in den letzten jahren erlaubt, über das spezifische hinaus die gestaltungskonsequenzen zu sehen. erst in letzten jahren ist unser sehen reif geworden für die erfassung dieser zusammenhänge. ... nicht der schrift-, sondern der fotografie-unkundige wird der analfaber der zukunft sein."¹¹ (With the expansion of visible images, the currently imperfect lens is already no longer bound by the narrow limits of our eye. ... Although photography is already over a hundred years old, it has allowed development only in the last years, to see beyond the specifics to the consequences of formation. Only in the last years, has our vision become mature, for the recording of these relationships. ... Not the

Universe and the Effect of Adding Another Zero, narrated by Philip Morrison, by Elmer Bernstein, IBM, 1977.

¹¹ László Moholy-Nagy, "fotografie ist lichtgestaltung," *Bauhaus II*, no. I (1928), 4–5.

illiterate, but rather the photography-ignorant will be the ass-maker of the future.)¹²

In "Light: A Medium of Plastic Expression" (1923), Moholy-Nagy pointed to particular developments in photography that aided in the maturing of vision: oblique angles producing objective views, electromagnetic rays, and moving images, through the depiction of moving subjects as well as experimentation with moving filters, reflecting and refracting the light with a variety of liquids, as well as mirrors, crystals, and translucent tissues.¹³ In this article, Moholy-Nagy mentioned both electromagnetic rays and x-rays. For practical reasons, electromagnetic radiation of varying wavelengths was given different names, including visible, ultraviolet, and infrared light, x- and gamma-rays, and micro- and radio-waves to name a few. Whenever Moholy-Nagy collected his thoughts on the potential of photography, as he often did, he mentioned x-ray images, labeled these as space-time images, featured examples of x-ray photographs, related x-rays to superimpositions to *Photoplastiks*, and, in the second act of the hybrid drawing of the *Exzentrik*, included what appears to be a cathode tube hovering over a continuation of the kinetic grid from the first act, having further transformed itself. **(Figure 2.1)** Moholy-Nagy considered superimpositions, representations of motion over time, transparencies, and x-rays to be related forms of representation. In *Vision in Motion*, he included thirteen separate references to x-rays, an example being the following:

In x-ray photos, structure becomes transparency and transparency manifests structure. The x-ray pictures, to which the futurist has consistently referred, are among the outstanding space-time renderings on the static plane. They give simultaneously the inside and outside, the view of an opaque solid, its outline, but

¹² Translated by author.

¹³ László Moholy-Nagy, "Light: A Medium of Plastic Expression," *BROOM: An International Magazine of the Arts*, March 1923, 283–284.

also its inner structure.¹⁴

Moholy-Nagy then related these attributes of transparency to his “light painting[s],” such as those on manipulated acrylic sheets allowing light to pass through the pigmented scratches and painted images on the surface onto a rear projection plane, thereby, incorporating ever-changing shadow effects in his explorations.¹⁵ **(Figure 2.5)**

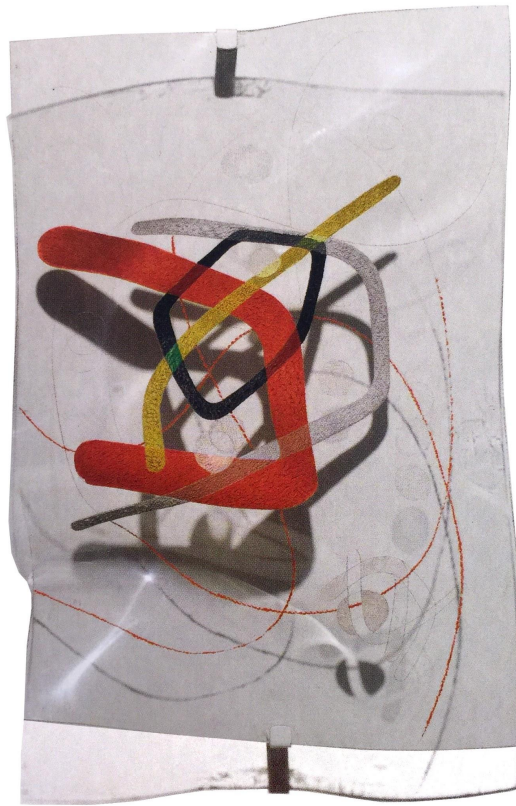


Figure 2.5: László Moholy-Nagy, *B 10*, 1942, Oil and Incised Lines on Plexiglas in Original Frame 42.9 x 29.2 x 6 cm (16 7/8 x 11 1/2 x 2 3/8 in.), Solomon R. Guggenheim Museum, New York Solomon R. Guggenheim Founding Collection.

¹⁴ Moholy-Nagy, *Vision in Motion*, 1947, 252.

¹⁵ *Ibid.*

Moholy-Nagy continued:

Different space and time levels usually appear in photographic rendering as superimpositions. The reflections and transparent mirrorings of the passing traffic in the windows of motor cars or shops are one example. Mirroring means in this sense the changing aspects of vision, the sharpened identification of inside and outside penetrations. In such renderings there is a blending of independent elements or events into a coherent whole. Superimpositions of photographs and distortion by reflection, as frequently seen in motion pictures, can be applied as a new visual language to represent dreams, acting as a space-time symbol, even synonym.¹⁶

With these descriptions, Moholy-Nagy included a chronophotograph by Harold Edgerton of acrobats (1940), one tossing the other, rotating head over feet, up into the air, and an enlargement of that chronophotograph focusing of the changing facial expressions of the acrobat, a "Pluralistic Head" by Xanti Schawinsky (1945), a dream sequence film montage possibly featuring Orson Welles (n. d.), a photograph of a transparent jellyfish, and three x-ray photographs, an x-ray of the profile of a man shaving by L. F. Ehrke and Dr. C. M. Slack of Westinghouse Research Laboratories (1941) and two x-rays images of the atomic structure of metal by Prof. Laue (1929). In this section, Moholy-Nagy included another stroboscopic photograph by Edgerton of a person exercising with a club (1937) as well as a precursor to Edgerton's work, a chronophotographic image of a man pole-vaulting produced by the American painter Thomas Eakins during his brief collaboration with the pioneering photographer Eadweard Muybridge (1881–1884). In addition, Moholy-Nagy also reproduced several paintings dealing with motion: "Le Forze di una Strada" (The Power of the Street, 1911) by Italian Futurist Umberto Boccioni, the "Nu descendant un escalier n° 2" (Nude Descending the Stairway, 1912)

¹⁶ Ibid.

by French Surrealist painter Marcel Duchamp, and "Guernica" (1936) by Spanish artist Pablo Picasso. Along with Moholy-Nagy, Duchamp had joined the signatories of Sirató's "Manifeste dimensioniste" in Paris in 1936 and his "Nu descendant un escalier n° 2" represented one of the most well-known examples of Cubism's fascination with depicting vision in motion, the superimposition of changing images through space and over time. On the other hand, "Guernica" required further explanation. According to Moholy-Nagy, these ghastly figures in an urban setting did not represent the superimposition of moments in time, but rather were transformed step-by-step as in a series, more literally transfigured, into psychological representations. Therefore, each figure sequentially became transparent, like an x-ray of a soul's anguish. Moholy-Nagy claimed that "Guernica" revealed the sense of psychological anguish on the outside and the physical destruction of the city on the inside, thereby turning the inside out and the outside in, to render "space-time as transparent as an x-ray photograph."¹⁷

In each of these compelling examples, Moholy-Nagy supported his verbal argument for the potential inherent in exploring space-time visual constructs through superimpositions and transparencies that, in turn, abolish the visual boundaries of physical objects and psychological states. Within these invisible states of mind, Moholy-Nagy included the dream state through "[s]uperimpositions of photographs and distortion by reflection, as frequently seen in motion pictures, ... applied as a new visual language to represent dreams, acting as a space-time symbol, even synonym."¹⁸

In the second act of the hybrid drawing of the *Exzentrik*, the grid from the first act continued with the addition of alternating darkened cells and several vertical and horizontal bars apparently achieved through pencil rendering. In front of and above the grid, perhaps even merging with the grid, is a severed cathode tube surrounded by many arrows swinging around in all directions,

¹⁷ Moholy-Nagy, *Vision in Motion*, 1947, 249–252.

¹⁸ *Ibid.*

suggesting that it can be raised and lowered, as it is suspended on wires. The image of the bulb is split in half vertically with the left section positioned lower than the right; however, above the left section is an arrow highlighted in red color pencil pointing up, while below the right section of the bulb is a similar arrow with a more intense coloring pointing down. Two arrows centered on the grid below the sections indicate a twisting, rotating one way and then the other; and an arched set of arrows at the top of the bulb predict another rotation outward like the opening of a bloom of a flower. Nevertheless, according to a note within the prelude panel, "elektrische Funken (Tesla?)" (electric sparks [Tesla?]), the severed electromagnetic apparatus would still be able to spark and crackle against the silence. According to the second column depicting the changes in colors of light, the effect would be enhanced by pulsating alternations between white, red, and yellow lights against the darkness. In the notes to the printed version of *Exzentrik*, Moholy-Nagy described an "elektro-apparate, blitz donner, gittersysteme von farbe, schiessen auf - ab, hin -her, phosphoreszenz, riesen-apparate schwingen, blitzen" (electro-apparatus, lightning thunder, grid system of colors, shoot up - down, back - forth, phosphorescence, giant-apparatus swinging, lightning). While these notes suggest an electrical generator capable of creating lightning sparks as the famous induction coil designed by the Serbian physicist Nikola Tesla, the image of the bulb appears to match more closely to a cathode tube capable of rendering the invisible visible, sending out x-ray waves. This visual and textual ambiguity is another instance of Moholy-Nagy's attempting to generate multiple, simultaneous meanings through the use of the titling in his *Photoplastiks* and, at the same time, the splitting of the cathode tube suggests a literal double, a mirror image.

DOUBLES

With many of his photographs, *Photograms*,¹⁹ and *Photoplastiks*, Moholy-Nagy produced

¹⁹ Moholy-Nagy's has been accused, most notably by El Lissitzky, of appropriating the idea of his

positive and negative prints from the same image. Reversing light and dark shades provided visual training to see the chiaroscuro renderings as something other than the source objects; this visual training is similar to reversing figure ground relationships, both of which would aid in the recognition and development of potential alternate meanings, provocative superimpositions, of context and atmospheric effects that combine to suggest new possibilities. However, these images also create mirror images of themselves revealing the reversibility of the image in the development of a photograph.²⁰

In addition to the variety of revelatory time-lapse, transparent, and x-ray images in *Malerei, Fotografie, Film*, Moholy-Nagy included one example of a photograph in which he inverted the positive and negative light values, although he had many other examples from which to choose. In this untitled image, the camera is pointed down from an aerial vantage point on a woman who is, in turn, also looking down from an elevated position on a low wall along a shoreline, creating the sense of *mise en abyme* also present in "Untersehboot" where the viewer

Photogram from Man Ray, who nearly simultaneously published his first rayograms. However, Lloyd C. Engelbrecht traced the publication dates and commentaries in personal correspondences and found that it was Christian Schad who was actually the first of the three competing artists to publish a schadogram in Tristan Tzara's March 1920 issue of Dada magazine, entitled *Dadaphone*. (176–177) Lucia Moholy and László Moholy-Nagy both maintain that they were unaware of Ray's rayograms until Tzara showed them some examples at the Jena/Weimar Congress, after LMN had already published "Produktion–Reproduktion" in *De Stijl* and also after they had been approached to submit four photograms for the *Broom* issue, which also included four rayograms. Believing that Tzara had given Moholy-Nagy the idea of a photogram from Ray, in a letter to his wife Sophie, Lissitzky fumed but confused the dates of the Jena/Weimar Congress claiming that it took place in the spring of 1922, when it had been in late September, after the publication of "Produktion–Reproduktion." Lloyd C. Engelbrecht, *Moholy-Nagy: Mentor to Modernism* (Cincinnati, OH: Flying Trapeze Press, 2009), 1: 172–177.

²⁰ In black and white photography, the negative image in which the lights and darks are reversed is first exposed and then developed on the film. After the film dries, light is projected through the negative image onto a surface coated in light sensitive chemicals. When these chemicals are exposed to light of various intensities over time, they react and turn dark through a series of chemical baths, reversing the reversed image approximately back to the effects of light on the original scene.

of the *Photoplastik* is duplicated by another viewer within the *Photoplastik* itself.²¹ However, Moholy-Nagy focused the reader's attention on the light effects created by the positive/negative inversion: "Die Umkehrung der Tonwerte kehrt auch die Verhältnisse um. Die geringe Menge von Weiß tritt überaus aktiv in Erscheinung und bestimmt dadurch das ganze Bild."²² (The reversal of the tonal values also turns around the circumstances. The slight amount of white [creates an] exceedingly active appearance and determines the whole image.) With this caption, Moholy-Nagy directed the viewer to the shadow cast by the woman's foot, which, when invert, appears to glow with a bright white light; the inversion of all of the shadows in the photograph lends an ethereal glow to the female figure.

Moholy-Nagy may have happened upon the idea of inverting these light effects while developing his photographs and examining the negative films produced. However, he also realized the potential of the negative image – to defy expectations by rendering white shadows – when creating his *Photograms*, in which the light sensitive chemicals react directly to exposure to the the light source making the light areas dark and the darks shadows light with a reversal of all of the intermediary graytones in between. In a section on "Fotographie ohne Kamera: das 'Fotogram'" (Photography Without a Camera: the Photogram) in *Malerei, Fotografie, Film*, Moholy-Nagy elaborated on additional means to experiment with directly casting electromagnetic rays on sensitive paper, or other materials:

Dieser Weg führt zu Möglichkeiten der Lichtgestaltung, wobei das Licht als ein neues Gestaltungsmittel, wie in der Malerei die Farbe, in der Musik der Ton, souverän zu handhaben ist. ... Ein anderer Weg des Ausbaues zur Produktion wäre die Untersuchung und Verwendung verschiedener chemischer Mischungen, welche für das Auge nicht wahrnehmbare Lichterscheinungen

²¹ Similar to Albrecht Dürer's depictions of various perspective drawing machines.

²² Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 96.

(elektromagnetische Schwingungen) festhalten können (wie z. B. die Röntgenfotografie). Ein weiterer Weg ist der Bau neuer Apparate, erstens mit Benutzung der Camera obscura, zweitens bei Ausschaltung der perspektivischen Darstellung. Apparate mit Linsen- und Spiegel-vorrichtungen, die den Gegenstand von allen Seiten gleichzeitig umfassen können, und Apparate, die auf anderen optischen Gesetzen aufgebaut sind als unser Auge.²³ (This way leads to possibilities of light formation, whereby light as a new medium of formation, as with color in painting, with tone in music, is superior to manipulate. ... Another way of building toward production would be the investigation and use of different chemical mixtures, which could record imperceptible light phenomena (electromagnetic vibrations) for the eye (like, for example, x-ray photographs). One further way is the building of new apparati, firstly with use of the camera obscura, secondly with the elimination of perspective representation. Apparati with lenses and mirror-devices, which can encompass the object from all sides at the same time, and apparati, which are constructed on other optical laws than our eye.)²⁴

Not only recognizing the potential for the Photogram to use a broader range of the wavelengths of the electromagnetic spectrum, Moholy-Nagy proposed modifications and innovations to the equipment of the camera itself. One idea, the idea of viewing an object from all sides at once, was in some manner, achieved with x-ray images recording the skeletal and metallic structures with bright clarity and the flesh with a ghostly ephemerality. The superimposition of many views of the same object or person, such as the "simultanen Porträts" of the German artist Hannah Höch overlaying her front and a profile image, would also seem to partially satisfy this desire; however, to view all of the exterior surfaces of an object at the same time would utterly break

²³ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 30.

²⁴ Translated by author.

open the notion of perspective, even the notion of the point of view. **(Figure 2.6)** In a similar vein, Moholy-Nagy's repeated use of the double image, the twin, was another means to eliminate the perspective point of view as well as introduce imagery that participates in the representation space-time.



Figure 2.6: László Moholy-Nagy, (left) Untitled, 1925 (Photograph of Ellen Frank) + (right) Untitled, 1925, *Malerei, Fotografie, Film*, München, Verlag Albert Langen, (Photograph of Hannah Höch).

In the *Photoplastik* entitled, "Traum des Mädchenpensionats" (Dream of the Boarding School Girl, 1925/29), Moholy-Nagy depicted twin-like contortionists in identical costumes, hairstyles, and poses, each with one arm outstretched and the other arm securing her leg to the back of her head. They are positioned within a faint gray arc with the outermost edges of their limbs defining the inner and outer edges of the arc. **(Figure 2.7)** The pose of these women roughly mirrors the posture of the group of men jumping over invisible hurdles, whose arms and legs are also contorted into gestures that appear to be both bending back and reaching out. Behind the men and facing forward are the school girls arranged in an 'h' formation and wearing identical dresses and hats.

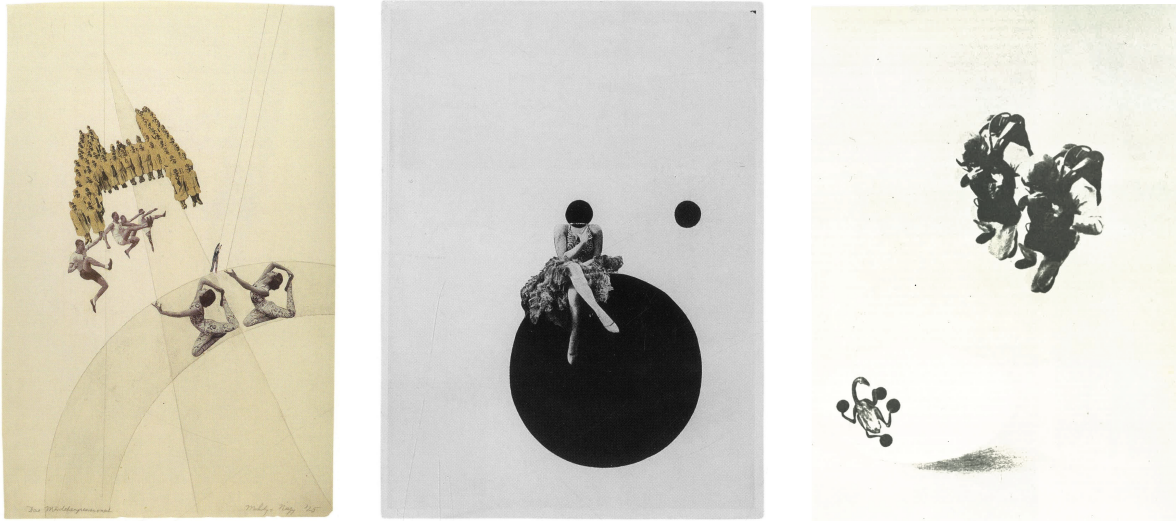


Figure 2.7: László Moholy-Nagy, (left) *Traum des Mädchenpensionats* (Dream of the Boarding School Girl), 1925/29, Photomontage, gelatin silver prints, photomechanical reproductions, ink, and graphite pencil on paper: 48 x 30.8 cm (18.875" x 12.125"), Museum Folkwang, Essen, 14/2 + (middle) *Olly and Dolly Sisters*, 1925, Gelatin silver print of a photomontage: 37.5 x 27.5 cm (14.75" x 10.8125"), The J. Paul Getty Museum, Los Angeles, 84.XM.997.24 + (right) *Die Leistung ehrt das Wachsende* (Achievement Honors Growth), Photomontage.

Another *Photoplastik* featuring twins, literally, the infamous Hungarian performers, Rózsika and Janka Deutsch, known professionally as the The Dolly Sisters, is the "Olly and Dolly Sisters" (c. 1925). **(Figure 2.7)** In this *Photoplastik*, one of the twin sisters appears sitting atop a black circle in a frilly stage dress. In place of her head is a smaller black circle, to the right of which is another equal sized black circle. While the second small circle likely stands in for the twin sister's head, her body is missing. Therefore, it is in the title and notoriety of the performers that Moholy-Nagy revealed the absence of one half of the twins. Without his title, one may not recognize the headless woman and not wonder about the implications of the missing body. In his compilation, *L. Moholy-Nagy: 60 Fotos, 60 Photos, 60 Photographies*, Franz Roh referred to this *Photoplastik* as "Satire auf die vorgespiegelte Verwandtschaft der Varieté- und Zirkusleute"²⁵ (Satire of the

²⁵ Franz Roh and Ed Grazda, eds., *60 Fotos: László Moholy-Nagy*, comp. Jeffrey Ladd (New York: Errata

Pretended Relationships of Varieté and Circus People). Unlike the contortionist near-twins in “Traum des Mädchenpensionats,” the Dolly sisters were actually twin sisters. As such, the absence of one of the twins feels like a terrible loss, a mortal reminder, or it could be a humorous commentary on the twins’ desire to embark on solo careers, that were largely considered to have been unsuccessful compared to their global stardom as a duo.

Between the inversions and reflections, Moholy-Nagy’s deeper obsession with doubles is seen in the two women in identical bathing caps and suits in “Untersehboot.” Without finding the exact image source, it is not out of the realm of possibilities that Moholy-Nagy found the photograph of the two women in his own collection of seaside photographs, or he may have happened upon the image in *AIZ* (*Arbeiter-Illustrierte-Zeitung*), a popular Berlin magazine featuring illustrations of sport and outdoor activities where he found other source materials. One such *Photoplastik*, “Die Leistung ehrt das Wachsende” (Achievement Honors Growth, 1927), doubled an image of a skydiver from a 1931 *AIZ* cover above an x-ray of a bird.²⁶ **(Figure 2.7)** One also finds that doubles abound in Chaplin’s film, “The Circus,” inverting up, down, viewer, and viewed. For instance, in one of several chase scenes, Chaplin tumbled over a low wall into the laps of two well-dressed, fur-clad ladies toppling them and their chairs, their legs went up into the air in such a manner that the horizontal view in the film becomes reminiscent of the vertical view in the *Photoplastik*.

In addition, a view from below with legs extended is repeated many times in the trapeze scenes. During the title sequence, the melancholy trapeze artist is swinging on her ropes above the center ring while the song, “Swing Little Girl,” performed by Chaplin himself, emphasized the

Editions, 2011), 20, originally published as *L. Moholy-Nagy: 60 Fotos, 60 Photos, 60 Photographies* (Berlin: Klinkhardt & Biermann, 1930).

²⁶ Lusk, *Montagen ins Blaue*, 90–91. While Lusk identified the bird as a swan, Moholy-Nagy listed it as a chicken in the image credits for *Malerei, Fotografie, Film*, [1925] 1927, 139.

vertical dimension of looking up to find rainbows. After a few verses, she slipped her legs into the rings while swinging forward with her protruding legs suggesting the position of the two bathing women in the *Photoplastik*. This similarity suggests yet another interpretation of this doubling as two sequential moments in time of a single woman swinging on a trapeze. If so, for Moholy-Nagy, this twinning represents an early attempt to represent vision in motion by portraying one woman in two different positions, over time. **(Figure 2.8)** This phenomenon was described in the work of French scientist Etienne Jules Marey as chronophotography, which produced the record of motion through the superimposition of sequential photographs.²⁷



Figure 2.8: *City Lights*. Produced and directed by Charlie Chaplin. Performed by Charlie Chaplin, Virginia Cherrill, Florence Lee, and Harry Myers. (New York: Janus Films, 1931). Superimposition by author.

²⁷ Etienne Jules Marey, "The History of Chronophotography," in *Annual Report of the Board of Regents of the Smithsonian Institution Showing the Operations, Expenditures, and Condition of the Institution for the Year Ending June 30, 1901*, comp. Board of Regents, Smithsonian Institution (Washington, DC: Government Printing Office, 1901), 317, originally published as *Exposition d'instruments et d'images relatifs à l'Histoire de la Chronophotographie, par le Docteur Marey, Membre de l'Institute* (Paris, 1900).

According to Freud, either-or relationships should be more properly viewed as both-and scenarios in dream-thoughts. Describing the contradictions occurring in dream-material or between dream-thoughts, he conjectured:

Der Traum nimmt sich ja auch die Freiheit, ein beliebiges Element durch seinen Wunschgegensatz darzustellen, so dass man zunächst von kleinem eines Gegentheilsfähigen Elemente weiss, ob es in den Traumgedanken positiv oder negativ enthalten ist.²⁸ (The dream also takes the liberty of representing any element whatever by its desired opposite, so that it is at first impossible to tell about any element capable of having an opposite, whether it is to be taken negatively or positively, in the dream thoughts.)²⁹

Citing the work of comparative philologist Karl Abel, Freud related this type of doubling to the origin of languages in which binary pairs were once expressed as conditions of a single term.³⁰ In ancient Greece, twin-gods abound often personifying these antithetical terms dividing the singular in thought into the double in experience, or vice versa. Among other pairings, for instance, the fraternal personifications of sleep, Hypnos, and death, Thanatos, born of night, Nix,³¹ embodied the mysterious boundary between life and death, consciousness and unconsciousness. Unraveling a meaningful link between waking and dreaming, Freud defined Traumarbeit (dream-work) as a double process of identifying any distortions from the dream-

²⁸ Sigmund Freud, *Die Traumdeutung* (Leipzig and Wien: Franz Deuticke, 1900), 218.

²⁹ Sigmund Freud, *The Interpretation of Dreams*, 296.

³⁰ Karl Abel, *Über die Gegensinn der Urwörter* (On the Antithetical Meanings of Primal Words), 1884 as paraphrased by Freud, *The Interpretation of Dreams*, 304, footnote.

³¹ Hesiod, *The Works of Hesiod, Callimachus, and Theognis*, trans. James Davies, John Hookham Frere, H. W. Tytler, and Charles Abraham Elton (London, 1879), 38–39 and “Then to Death and gentle Sleep, [s]wift-bearers both, twin-born, he gave the charge, [w]ho placed it soon in Lycia's wealthy realm.” Homer, *The Iliad of Homer*, trans. William Cowper (New York, 1860), 413.

content to dream-thoughts and of interpreting by reversing the path of distortion to elucidate the transference procedure(s) leading from dream-thoughts to dream content. These processes involved uncovering meaning through the recognition of egoistic procedures, "condensation" and "displacement." Unlocked like a rebus containing odd scalar relationships, uncanny abilities, remarkable positions, mysterious declarations, and peculiar alpha-numerical expressions, the meaning of seemingly nonsensical dream-content may be logically interpreted, after uncovering the correct key in the dream-thought.³²

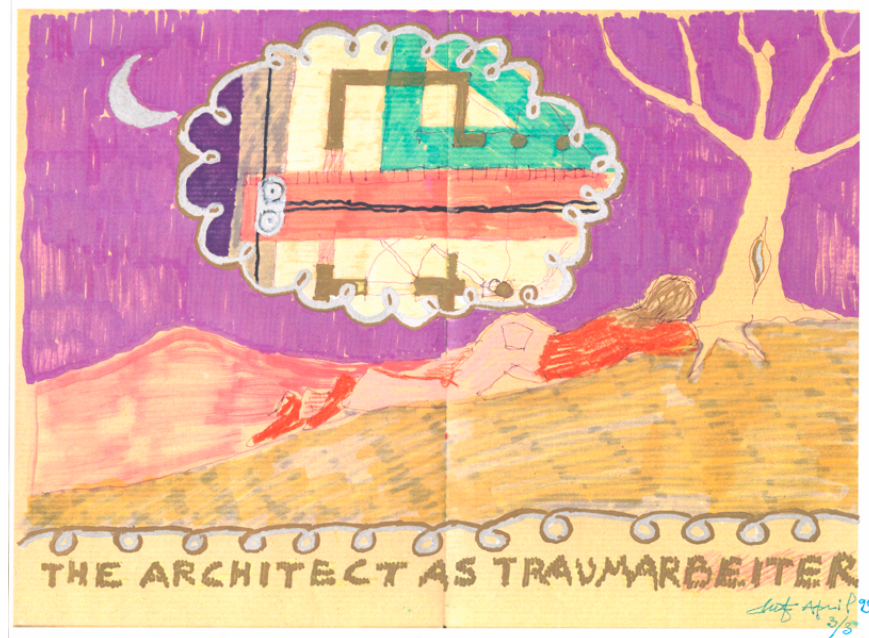


Figure 2.9: Marco Francari, "Architect as Traumarbeiter," 1995.

In his sketch entitled "Architect as Traumarbeiter," Marco Francari depicted a person napping under a leafless tree (Hypnos, Thanatos), while overhead, bounded by gold and white curling lines, a dream cloud contains the partial view of an architectural plan on a drafting table.

³² Freud, *The Interpretation of Dreams*, 268–270.

(Figure 2.9) In his *Eleven Exercises*, Frascari described the architectural imagination as establishing an in-between condition of awareness able to create productive perceptions.³³

Dreamscapes, as metaphors, are fundamentally important for architects. ... [T]he “dream” is a hypothetical design of the unknown; thus, it is a substantial tool for acquiring knowledge. The dream is a rhetorical procedure, that sets the labyrinth of the imagination where architects wonder about the material and hypothetical possibilities of things.³⁴

The architect as the *Traumarbeiter* (dream-worker) performed a similar reversible process of production and interpretation, which may be why Frascari suggested a double reading of the term, *Traumarbeiter*. By crossing out part of the compound term, the architect is both the *Traumar* (similar to *Träumer* [dreamer, one who dreams]) and *Traumarbeiter* (dream-worker, or one who interprets meaning through the revelation of dream-thoughts). A duplication of the curling lines at the base of the sketch suggests that the dream-work of the architect, as a dreamer, occurs in deciphering the dream within the dream.

In “Untersehboot,” Moholy-Nagy extended the sensation of *mise en abyme* residing within the swirling mis-identifications of the tramp character who is both rich and poor, somebody and nobody, comic and tragic. Using the title, “City Lights,” Moholy-Nagy appropriated the particular type of mis-identification in this film, blindness, rendering the view out of sight, or beyond sensory perception.

Through this process of dream production and interpretation in his *Photoplastiks*, Moholy-Nagy experimented with the visualization of higher dimensional space fuelled by the productive

³³ Marco Frascari, *Eleven Exercises in the Art of Architectural Drawing: Slow Food for the Architect's Imagination*, (London and New York: Routledge, 2011, 152.

³⁴ *Ibid.*, 152.

ambiguity of an oblique point of view. In particular, in "Untersehboot," as a condensation of a transference of "City Lights" and "The Circus," the tramp becomes twinned both spatially and temporally through multiple mis-identifications in and between the two films. In this sense, the dream-content has been further inverted by the presence of these n-dimensional twins: the mis-identified tramps at the base of a visually warped perspective diagram and the visually doubled, time-displaced, women above.

In his writings on dreams, second-century oneiromancer Artemidorus stated that: "[w]hen judging dreams, the dream interpreter must regard some of them from the beginning to the end; some, from the end to the beginning. For sometimes the beginning indicates the end, which is obscure and not to be grasped as a whole; sometimes, however, the end shows the beginning."³⁵ After examining ideas of dreaming and perceiving to uncover hidden meanings in "Untersehboot," it is important to return to Bergson's question, "Qu'est-ce que dormir?"³⁶ (what does it mean to sleep?)³⁷

In "La rêve," Bergson characterized sensory impressions during sleep as follows:

On ne peut même pas dire que notre perception se rétrécisse quand nous dormons ; elle élargit plutôt, dans certaines directions au moins, son champ d'opération. Il est vrai qu'elle perd en tension ce qu'elle gagne en extension. Elle n'apporte guère que du diffus et du confus. Ce n'en est pas moins avec de la

³⁵ Artemidorus, *The Interpretation of Dreams: Oneirocritica*, trans. Robert J. White, 2nd, rev., exp. ed. (Park Ridge, NJ: Noyes Press, 1975; Torrence, CA: Original Books, 1990), 33. Originally written in the second century C.E.

³⁶ Henri Bergson, *L'Énergie spirituelle: Essais et Conférences* (Paris: Librairie Félix Alcan, n.d.), 108.

³⁷ Henri Bergson. *The World of Dreams*. Translated by Wade Baskin. New York: Philosophical Library, 1958, 45. First published in 1901 as "La rêve" in the *Reveu Scientifique*. Lecture delivered at the Institut Psychologique on March 26, 1901.

sensation réelle que nous fabriquons du rêve.³⁸ (Our faculty of sensory perception, far from shrinking in every respect when we are asleep, broadens its field of operations. It is true that it often loses in energy and tension what it gains in extension, for it rarely brings us anything other than vague impression. These impressions are the materials with which we build our dreams.)³⁹

Motionless, the sleeping figure simultaneously perceives both the physical and dream world, visible and invisible, akin to the subterranean cave of Thanatos and Hypnos, who had three sons, known as the Oneiroi, dreams, with Pasithea, the youngest of the Graces and goddess of relaxation and meditation: Morpheus, the winged god of dreams; Phobetor, the god of nightmares; and Phanatos, the god of illusions, or fantasies suggesting a familial connection between dreaming and imagining, or daydreaming. Although Bergson found a mnemonic connection between perceiving and dreaming, his contemporary and critic, Gaston Bachelard, later challenged this notion in *L'Air et les Songes (Air and Dreams)*, writing that, "[p]ercevoir et imaginer sont aussi antithétiques que présence et absence. Imaginer c'est s'absenter, c'est s'élancer vers une vie nouvelle."⁴⁰ (perceiving and imagining are as antithetical as presence and absence. To imagine is to absent oneself, to launch out toward a new life).⁴¹ Both theorists delved into the nature of consciousness in search of clues to the connection between waking perception and the dreaming imagination, grounding and, at the same time, lifting our understanding of body, space, and time in the doubling of these blurry antithetical states.

³⁸ Henri Bergson, *L'Énergie spirituelle: Essais et Conférences* (Paris: Librairie Félix Alcan, n.d.), 100.

³⁹ Bergson, *The World of Dreams*, 32–33.

⁴⁰ Gaston Bachelard, *L'air et les songes: Essai sur l'imagination du mouvement* (1943; repr., Paris: Librairie José Corti, 1990), 13.

⁴¹ Gaston Bachelard, *Air and Dreams: An Essay on the Imagination of Movement*, Edith R. Farrell and C. Frederick Farrell, transes. (Dallas: The Dallas Institute, 1988) 3. Originally published as *L'Air et les songes, essai sur l'imagination du mouvement*, Paris, Librairie José Corti, 1943.

In Dessau 1926, around two years before he created "Untersehboot," Moholy-Nagy and his wife, photographer Lucia Moholy, moved into a duplex house designed by Walter Gropius for the Bauhaus masters. Most of Lucia Moholy's interior photographs of the Masters' houses published in Gropius' *Bauhausbauten Dessau* (Bauhaus Building Dessau, 1930) were of her own house.⁴²

(Figure 2.10)



Figure 2.10: Lucia Moholy, c. 1924, Photograph of Her Living Room, Master House, Dessau.

These images of their living room had been altered to remove a ceiling light fixture, presumably Gropius disapproved. Upon examining the un-doctored images, a unique and prominent lighting fixture on the ceiling of their living room is composed of five tubular bulbs that appear to be mounted on two intersecting boards with each side of the board painted a different color, perhaps echoing the primary colors found in two paintings, which contain a similar motif of crossing lines that were hanging on the adjacent walls: "A 19" (1927) and "Konstruktion Z 1"

⁴² Walter Gropius, *Bauhausbauten Dessau*, ed. Walter Gropius and László Moholy-Nagy, *Bauhausbücher* 12 (München: Albert Langen Verlag, 1930), 145.

(1922–23).⁴³ Each of the paintings, containing similar motifs as *Gelber Kreis und schwarzes Quadrat* (Yellow Circle and Black Square), were positioned above reclining sofas, perfect for napping, with the light fixture placed on the ceiling between the living room and the atelier above, the place where sensory perception entered into the dream. **(Figure 1.12)**

As in Frascari's "Architect as Traumarbeiter" with the dreamer positioned within the dream, in "Konstruktion Z 1," Moholy-Nagy depicted dimensional space and its reflection. On the raw linen canvas, perpendicular black and blue lines, yellow rectangle, and two squares, one red and one black, reinforce the two-dimensionality of the field, the flatness of the picture plane. While this composition occupies the left side of the painting, its lighter double was askew on the right side, perhaps inspired by an actual reflection producing an anamorphic projection of itself with the glare of sunlight through a window, a double image. The converging lines of this trapezoidal double suggest an inversion of perspective space, akin to anamorphic projections such as the skull in Hans Holbein's *Jean de Dinteville and Georges de Selve* (known as *The Ambassadors*, 1533), as if the viewer was positioned obliquely to the lower right of the field with his head resting on the throw pillows adorning the reclining sofa in order to truly see beyond the dimensional diagram. In this setting, the dreamer occupies three-dimensional space as it merges with the two-dimensional dimensional representation.

In keeping with Forensky's notion of the inversion of space-time in the dream, and similar to Artemidorus' reversal, in *Vision in Motion*, Moholy-Nagy identified that reflections and reflecting images in photographs and film represent dreams as space-time symbols, that the juxtaposition of objects and elements from different spaces and various times in photomontage has a similar effect, while the photogram is literally a space-time continuum.⁴⁴ In "Konstruktion Z 1," the mirror

⁴³ Lloyd C. Engelbrecht, *Moholy-Nagy: Mentor to Modernism* (Cincinnati, OH: Flying Trapeze Press, 2009), 2: figures 126, 156–159.

⁴⁴ László Moholy-Nagy, *Vision in Motion*, 4th ed. id Book, (Chicago: Paul Theobald, 1947), 252–256.

projection of the canvas onto itself may be a painting equivalent of the photogram, a recording of light, suggesting *mise en abyme*, of the space between the canvas and window, that was demonstrated in the mis-identifications of the tramp in "Untersehboot" and *City Lights*. In *Die Traumdeutung*, Freud stated that:

Das in der Nähe liegende, interessante Problem, was dadurch ausgedrückt wird, wenn ein gewisser Inhalt im Traum selbst als "geträumt" bezeichnet wird, das Rätsel des "Traumes im Traume" hat W. Stekel durch die Analyse einiger überzeugender Beispiele in ähnlichem Sinne gelöst. Das "Geträumte" des Traumes soll wiederum entwertet, seiner Realität beraubt werden; was nach dem Erwachen aus dem "Traum im Traume" weiter geträumt wird, das will der Traumwunsch an die Stelle der ausgelöschten Realität setzen. Man darf also annehmen, daß das "Geträumte" die Darstellung der Realität, die wirkliche Erinnerung, der fortsetzende Traum im Gegenteil die Darstellug [sic] des bloß vom Träumer Gewünschten enthält.⁴⁵ (An interesting problem allied to this, namely, the meaning of the fact that sometimes a certain content is designated in the dream itself as 'dreamed'—the riddle of the 'dream within the dream'—has been solved in a similar sense by W. Stekel 1W through the analysis of some convincing examples. The part of the dream 'dreamed' is again to be depreciated in value and robbed of its reality ; that which the dreamer continues to dream after awakening from the dream within the dream, is what the dream-wish desires to put in place of the extinguished reality. It may therefore be assumed that the part 'dreamed' contains the representation of the reality and the real reminiscence, while, on the other hand, the continued dream contains the representation of what the dreamer wished. The inclusion of a certain content

⁴⁵ Sigmund Freud, *Die Traumdeutung*, 3rd ed. (1900; repr., Leipzig and Wien: Franz Deuticke, 1911), 265.

in a 'dream within the dream' is therefore equivalent to the wish that what has just been designated as a dream should not have occurred. The dream-work utilises the dream itself as a form of deflection.)⁴⁶

Through the recording of light shown through an actual window, this reflection of a painting on a painting repudiates the Albertian notion of a painting as a perspectival representation through a window, similar to the anamorphic subversion of the section through the cone of vision as seen in Nicéron's manipulation of Dürer's grid of strings. In the repetition of crossed lines in his work, these chiastic structures appear to establish dimensional space onto which Moholy-Nagy pondered the representation of higher dimensions of space. In Lucia Moholy's photographs, the light cast across the living room floor from the windows, out of the view, is a reminder of the invisible fenestration that produced the reflection of the canvas on itself, adding another mirror upon which to reflect. In this living room, the ceiling plane, like the picture plane, became the fourth wall between dreamer and the dream-worker above. Demarcating the ceiling plane with his dimensional diagram, Moholy-Nagy created a spatial scenario for dreaming in the fourth dimension, inhabiting his own diagram as a Traum | ar | beiter.

ELECTRICITY

Since Moholy-Nagy often incorporated hanging elements in his realized stage designs, such as marionettes and other objects in his designs for Jacques Offenbach's "Hoffmanns Erzählungen," in the mechanical *Exzentrik*, the image of the severed cathode tube with diagonal lines extending from it to the top of the sheet of paper suggests that it is hanging within the theater space over the first stage and over the kinetic grid. The image is from a magazine with a slight glossy sheen to its pages and teal green highlights aiding in the definition of its shape. While the

⁴⁶ Sigmund Freud, *The Interpretation of Dreams*, trans. A. A. Brill, 313.

notations about sparks and light effects also suggest that there would be real sparks extending out from the tube, the tube itself is split in half, suggesting that the sparks may be stagecraft created by the flashing alternations of colored lights. In this image, the grid projected onto the floor of the theater extended from the first act is drawn over the lower portion of the tube juxtaposing two dimensions of space in an unexpected order. One way to interpret this ordering is that the grid is projected all around the space, as such, immersing the audience in its dynamic transformations, allowing them to see all sides of an object at the same time. Another interpretation may be that the cathode tube is the three-dimensional manifestation of the circles that passed through the grid in the first act, rising up above the audience.

In his 1923 essay, "Produktion Reproduktion," later republished in *Malerei, Fotografie, Film*, Moholy-Nagy established that the ideal state of a human being is when all of the sensual and intellectual faculties are engaged in the moment in the pursuit of understanding, from what is known to what is unknown. Ongoing experimentation is important to satisfy the need for new impressions; however, the results are valuable only when they yield new knowledge of previously unknown relationships.⁴⁷ In the service of these efforts, Moholy-Nagy elaborated on various photographic avenues of exploration:

Wenn wir auf dem Gebiete der Fotografie eine Umwertung in produktiver Richtung vornehmen wollen, müssen wir die Lichtempfindlichkeit der fotografischen (Bromsilber) Platte dazu benutzen: die von uns selbst (mit Spiegel oder Linsenvorrichtungen, durchsichtigen Kristallen, Flüssigkeiten usw.) gestalteten Lichterscheinungen (Lichtspielmomente) darauf zu fixieren. Als Vorgänger für diese Art Gestaltungen können wir die astronomischen sowie die Röntgen- und Blitzaufnahmen betrachten (S. 61 bis 70).⁴⁸ (If we want to make a re-evaluation of

⁴⁷ Moholy-Nagy, "Produktion Reproduktion," in *Malerei, Fotografie, Film*, [1925] 1927, 30.

⁴⁸ Moholy-Nagy, "Produktion Reproduktion," in *Malerei, Fotografie, Film*, [1925] 1927, 31.

the area of photography in a more productive direction, we must make use there of the photosensitivity of the photographic (silver bromide) plate: that of ourselves (with mirrors or lenticular devices, transparent crystals, liquidities, and so forth) to fix thereon formative light phenomena (moments of light-play). As a predecessor for these types of formations, we could consider the astronomical such as the shots of Röntgen and lightning [pages 61 to 70].)

On the pages that are referenced at the end of this directive are various examples of such photographs: a time-lapse recording of the “Lichtspuren” (light trails) of automobile and tram lights traced in a public square in Bremen, a similar image of the spectral trails of stars seen through a prismatic lens, a spiral nebula, “Elektrische Entladung (Teslaströme)” (an electrical discharge from the currents of Tesla) as ‘solidified fire,’ three lightning shots, four x-ray images of six hands, a frog, and two seashell, and a photogram with a spiral and the letters ‘OW,’ with the ‘W’ being also mirrored below itself. **(Figure 2.11)** This particular sequence of images referenced in “Produktion Reproduktion,” are vivid examples of the new vision, using photographic recording as a revelation of otherwise invisible phenomena. For instance, Moholy-Nagy wrote, in *Vision in Motion*, that the spiral is a visual symbol of space-time as well as sky-writing, bent plastic edges, wire structures, transparency, light penetrations, and an interpenetrations of forms.⁴⁹ In particular, Moholy-Nagy included the spectacular visual experience of the induction coil in his second act for the hybrid drawing of the *Exzentrik*, as well as in the printed version.

According to the image caption, the x-ray photograph of the hands was taken from *Einführung in die Röntgenfotografie* by German physical chemist John Eggert, who, while also holding a professorship at the University of Berlin, took a position with the photography company Agfa in 1921 in Berlin and later in 1928 joined the research department of Filmfabrik Wolfen.⁵⁰

⁴⁹ Moholy-Nagy, *Vision in Motion*, 1947, 256.

⁵⁰ “John Eggert, *Historisches Lexikon der Schweiz*, accessed on May 30, 2018, <http://www.hls-dhs->

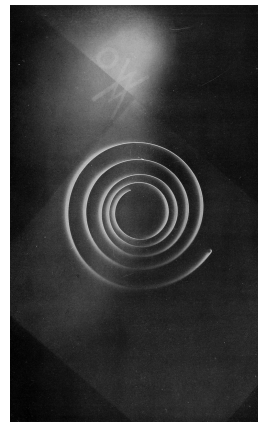
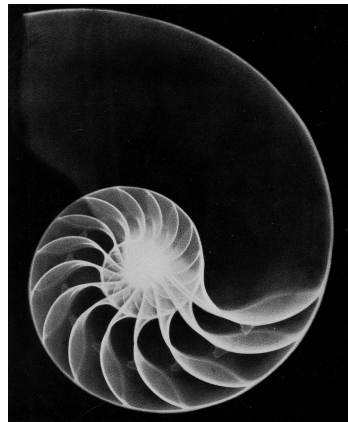
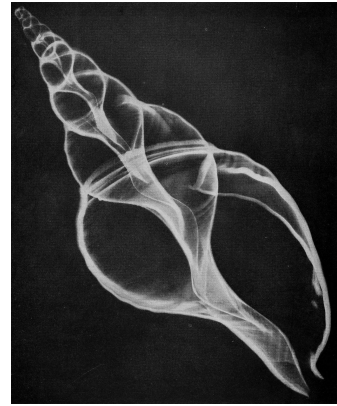
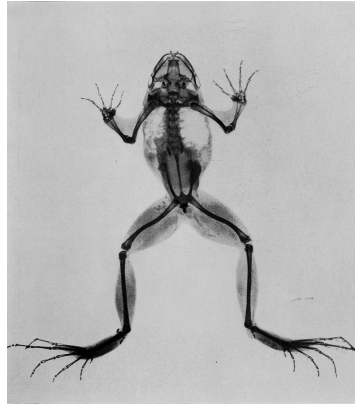
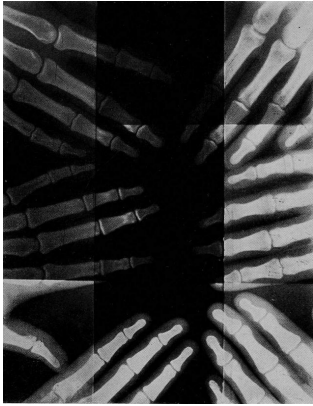
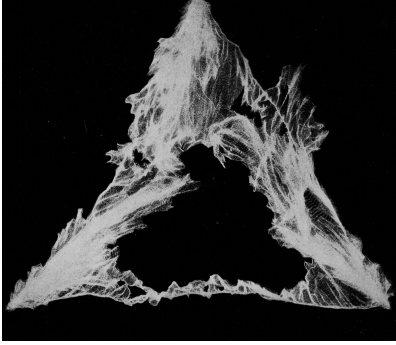


Figure 2.11: László Moholy-Nagy, *Malerei, Fotografie, Film*, München, Verlag Albert Langen, 1925.

English physicist William Crookes developed a cathode ray tube between 1869–1875; twenty years later, in 1895, Wilhelm Röntgen discovered x-rays by passing a spark from an induction coil through a Crookes tube that accidentally created images on light sensitive plates stored in boxes in his laboratory. Röntgen performed many experiments with x-rays realizing which materials appeared transparent to these electromagnetic rays.⁵¹ Röntgen specifically praised the use of a conductor and transmitter designed by Tesla for its ability to provide transmit a spark into the evacuated Crookes tubes without reducing the density of the vacuum.⁵² Since cold cathode x-rays tubes were in common medical usage until the 1920s and were even encountered as fitting devices in shoe stores,⁵³ Moholy-Nagy and his audience would have recognized this object as a piece of medical equipment used to produce x-ray images. While the notes mention “elektrische Funken (Tesla?)” (electric sparks [Tesla?]), the image of the cathode ray suggests that the audience itself would be penetrated by the electromagnetic light emanating from the broken glass bulb. This type of physical penetration with light rays mirrors the type of psychological penetration that Moholy-Nagy elaborated on his his essay “Theater, Zirkus, Variété”:

Im heutigen Theater sind BÜHNE UND ZUSCHAUER zu sehr voneinander getrennt, zu sehr in Aktives und Passives geteilt, um schöpferisch Beziehungen und Spannungen zwischen den beiden zu erzeugen. Es muß endlich eine Aktivität entstehen, welche die Masse nicht stumm zuschauen läßt, sie nicht nur im Innern

⁵¹ Wilhelm Konrad Röntgen, George Gabriel Stokes, and J. J. Thomson, *Röntgen's Rays: Memoirs by Röntgen, Stokes, and J. J. Thomson*, trans. and ed. George F. Barker (New York and London: Harper Brothers and Publishers, 1899), 3–21. See Linda Dalrymple Henderson, “Francis Picabia, Radiometers, and X-rays in 1913,” *The Art Bulletin* 71, no. 1 (March 1989): 114–123.

⁵² Röntgen, Stokes, and Thomson, *Röntgen's Rays: Memoirs by Röntgen, Stokes, and J. J. Thomson*, trans. and ed. Barker, 17.

⁵³ C. B. Meinhold, “One Hundred Years of X Rays and Radioactivity: Radiation Protection: Then and Now,” International Congress of the International Radiation Protection Association (Vienna: April 1996).

erregt, sondern sie zugreifen, mittun und auf der höchsten Stufe einer erlösenden Ekstase mit der Aktion der Bühne zusammenfließen läßt.⁵⁴ (In contemporary theater, the STAGE AND the SPECTATORS are very separated from one another, to play in very active and passive roles, with creative relationships and tensions produced between both. It must finally emerge an activation, which the mass is not left to watch in silence; they, not only excited on the inside, but rather, they grab, act with and, from the highest level of a redeeming ecstasy with the action of the stage, are allowed to flow together.)

In addition to the energetic effects of movement, critical to this achievement, this “redeeming ecstasy,” was the role of sound and light formations in the new medium of the theater. In the same essay, perhaps corresponding to the flashing lights in the second act and the sparking electromagnetic cathode tube, Moholy-Nagy wrote:

Dazu gesellt sich die Verwendbarkeit von reflektorischen Projektionen zu Flächenfilmen und Raumlichtspielen, die AKTION DES LICHTES als höchst gesteigerter Kontrast und die durch die heutige Technik gegebene Gleichwertigkeit auch dieses Mittels (Licht) neben allen anderen. Es ist noch verwendbar als unerwartete Blendung, als Aufleuchten, Phosphoreszieren, ganz In-Licht-tauchen des Zuschauerraumes mit der gleichzeitigen Steigerung oder dem vollkommenen Erlöschen aller Lichter der Bühne.⁵⁵ (To that, the utilization of reflecting projections onto planes of film and spatial light plays positions itself, the ACTION OF THE LIGHTS as [the] highest spiritual contrast and it, through the contemporary technique, is also given an equivalence of this medium (light) next to all others. It is still usable as unexpected glare, as flashes, as phosphorescence,

⁵⁴ Moholy-Nagy, “Theater, Zirkus, Varieté,” *Die Bühne im Bauhaus*, 1925, 54–55.

⁵⁵ Moholy-Nagy, “Theater, Zirkus, Varieté,” *Die Bühne im Bauhaus*, 1925, 54.

complete light-immersion of the space of the spectator with the simultaneous heightening or of the complete termination of all lights of the stage.)

This type of electric light spectacular was in keeping with the trademark showmanship, with which Nikola Tesla first presented his special induction coil to the American Institute of Electrical Engineers in 1891.⁵⁶ The fantastic sparks emanating from his induction coil continued to attract attention and define his reputation. In his lecture at the Franklin Institute in Philadelphia in February of 1893, "On Light and Other High Frequency Phenomena," Tesla described the instant that the coil released its lightning, as a pent-up energetic discharge of electrical arcs:

When the conductors are charged to a certain potential, the air, or insulating space, gives way and a disruptive discharge occurs. There is then a sudden rush of current and generally a large portion of accumulated electrical energy spends itself. The condensers are thereupon quickly charged and the same process is repeated in more or less rapid succession.⁵⁷

With his invention, Tesla attempted to provide a modern answer to the question, "What is light?," which he determined to be an electromagnetic phenomenon that, on the whole, included other forms of radiant heat.⁵⁸ After describing his many experiments producing incandescence and/or phosphorescence in solids and gases, Tesla concluded:

It is very likely that resonant vibration plays a most important part in all manifestations of energy in nature. Throughout space all matter is vibrating, and all rates of vibration are represented, from the lowest musical note to the highest

⁵⁶ Nikola Tesla, *The Electrical World*, July 11, 1891.

⁵⁷ Nikola Tesla, *On Light and Other High Frequency Phenomena* (Start Publishing, 2012), location 169, digital file accessed using a Kindle Cloud Reader. Originally published in 1893.

⁵⁸ *Ibid.*, location 124.

pitch of the chemical rays, hence an atom, or complex of atoms, no matter what its period, must find a vibration with which it is in resonance. When we consider the enormous rapidity of light vibrations, we realize the impossibility of producing such vibrations directly with any apparatus of measurable dimensions, and we are driven to the only possible means of attaining the object of setting up waves of light by electrical means and economically, that is, to affect the molecules or atoms of a gas, to cause them to collide and vibrate.⁵⁹

With his room-sized induction coil, Tesla used these vibrations to wirelessly illuminate light bulbs, conducted electricity through bodies, both animate and inanimate, and created large theatrical displays of light with a certain degree of caution and restraint due to the potential for danger to human life. However, in his small-scale experiments, Tesla pushed the limits of a material to withstand increased vibrations to produce light. Tesla described how he was able to produce a fine stream of small sparks in a partially evacuated an oblong glass bulb containing two aluminum terminals; however, by increasing the pressure caused by the vibrations of air particles remaining in the bulb, even minutely, the glass would crack releasing the partial vacuum. Thereby, he imagined a glass capable of repairing itself as it cracked. Without such a glass, he concluded that a liquid under pressure may perform better than air; however, producing less dramatic sparks, it would have been, nonetheless, impressive to witness such "a solid... rendered incandescent, or phosphorescent."⁶⁰ Through his stated preference for the theatrics of vaudeville and circus performances, Moholy-Nagy may have witnessed one of the many popular side shows recreating the electrical experiments of Tesla and others and may have even seen these experiments gone awry, with bulbs cracking and shattering eliciting gasps from the audience.

⁵⁹ Ibid., location 1167–1174.

⁶⁰ Ibid., locations 287–327.

In the section “On Phenomena Produced by Electrostatic Force,” Tesla described in gruesome detail what could happen if an amateur misunderstood the narrow limits of the tolerance of the human body for electrical conductance:

When two conducting bodies are insulated and electrified, we say that an electrostatic force is acting between them. This force manifests itself in attractions, repulsions and stresses in the bodies and space or medium without. So great may be the strain exerted in the air, or whatever separates the two conducting bodies, that it may break down, and we observe sparks or bundles of light or streamers, as they are called.⁶¹

Tesla then described his careful approach to the apparatus holding a bar of metal eventually causing the current to arc through his body agitating his cells and the air particles around him and producing small wisps of illumination on parts of his body that felt like pin pricks. However, if the conditions were not calibrated perfectly, his skin would violently rupture and his blood would spray forth from the great pressures.⁶² If he touched the metal bar to the first terminal and brought his other hand close to the brass sphere of the second terminal, light streamers would extend from his fingertips to the sphere. If too close to the sphere, the sparks would return from the sphere back to his hand, causing injury. **(Figure 2.12)** Tesla purported that he could envelop a human body in a “sheet of flame” up to 3,00,000 volts, without injury, due to the high frequency and amplitude of the vibrations; however, at other frequencies, a much smaller amount of electricity would easily kill a person.⁶³ Tesla explained the phenomenon as follows:

The reason why no pain in the body is felt, and no injurious effect noted, is that

⁶¹ Ibid., location 400.

⁶² Ibid., location 414.

⁶³ Ibid., locations 420–432.

everywhere, if a current be imagined to flow through the body, the direction of its flow would be at right angles to the surface; hence the body of the experimenter offers an enormous section to the current, and the density is very small, with the exception of the arm, perhaps, where the density may be considerable.⁶⁴

The notion that the electrical energy would flow “at right angles” from the surface of the body is reminiscent of descriptions of higher dimensions of space, that a fourth dimension of space would be simultaneously perpendicular to all three lower dimensions of space.

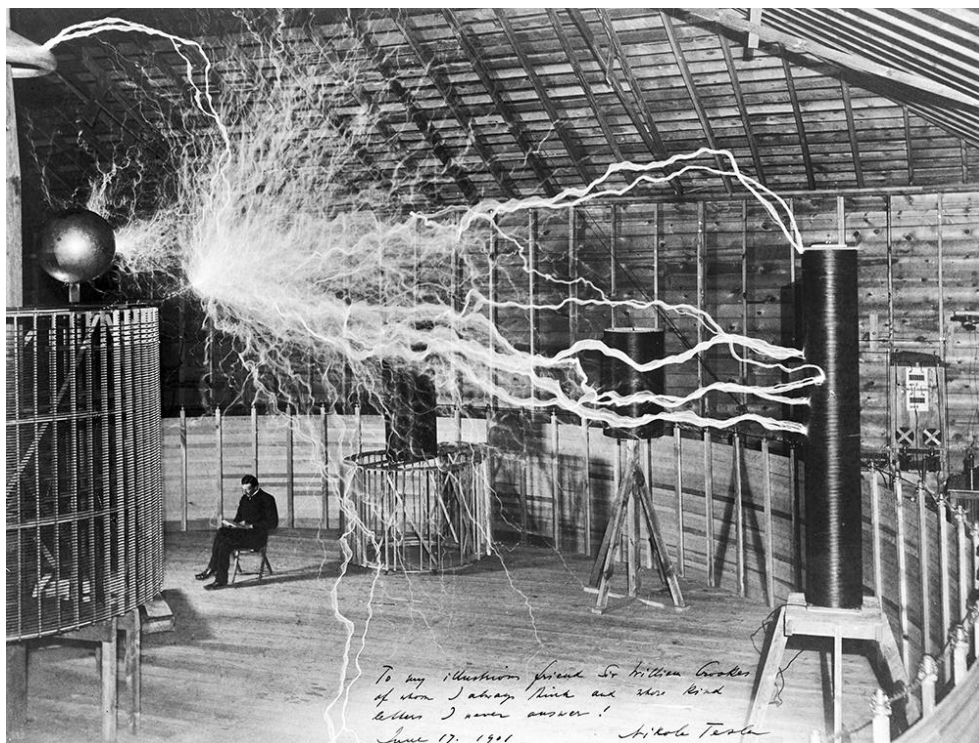


Figure 2.12: Photograph of Nikolai Tesla, 1901.

⁶⁴ Ibid., location 432.

In another experiment, Tesla placed two circular brass plates a certain distance apart and was able to produce streamers of such intensity that the two feet of air between the two plates appear uniformly illuminated. Citing Crookes' observations with this experiment, Tesla stated that, if the current is maintained for a prolonged period of time, it will produce both large quantities of ozone and nitrous acid, severely burning the respiratory tract and, eventually, suffocating the audience with highly toxic air; on the other hand, if the current is briefly held, the ozone created would be refreshing, similar to the sensation of fresh air felt after a thunderstorm.⁶⁵ In fact, since it was invigorating, ozone was added to the air system during performances at Radio City Music Hall in Rockefeller Center, New York.⁶⁶

If the proposed "elektrische Funken (Tesla)" reference in the prelude to the hybrid drawing of the *Exzentrik* were meant to be a true demonstration of Tesla's induction coil, these electrical streams would generate ozone and, as such, would produce this sense of freshness in the audience. The release of electrical sparks would not only visually excite the audience and freshen the air, but may have also been intended to penetrate and agitate the molecular cells of the audience flowing at right angles to the surface of their skin and producing small illuminations on each person.

Building upon the human body's capacity to conduct electricity in the section "On Current or Dynamic Electricity Phenomena," he described an experiment in which he illuminated a bulb using only electrostatic induction, in other words without wires. The glass bulb glowed even brighter when touched by a hand, because of the additional capacity delivered by the human

⁶⁵ Ibid., location 456.

⁶⁶ See also Ross Melnick, *American Showman: Samuel "Roxy" Rothafel and the Birth of the Entertainment Industry, 1908-1935* (New York: Columbia University Press, 2012).

body.⁶⁷ For each type of bulb, Tesla described the arrangements necessary to produce light through the conductance of the human body: an evacuated incandescent bulb containing a carbon button incandesces, a bulb containing a phosphorescent body phosphoresces, a partially exhausted bulb alone incandesces or phosphoresces, or holding a bare wire is bathed in luminous film.⁶⁸

In his lecture to the Franklin Institute, Philadelphia, Pennsylvania in February 1893, Tesla began his discussion of light with some introductory thoughts on the nature of the eye, as a receiver of light. Without a doubt, Tesla privileged vision as the most sensitive of the bodily senses and remarked on its relationship to the imagination.⁶⁹ According to Tesla, the retina of the eye is stimulated by the vibrations of light which produce a reflex action. Tesla appeared to also suggest that this reflex action may be stimulated by other means, such as applied pressure, or even by the imagination. Citing an unsubstantiated claim made by physician-physicist Hermann von Helmholtz that he could see his arm moving while in complete darkness, Tesla agreed that the fundi of the eye produce light in themselves, which Tesla interpreted as a luminosity emanating from the fluorescence of the intellect,⁷⁰ describing the physical reaction created by the intellect, or the imagination, necessary to produce the phenomena of apperception, as described by Wilhelm Wundt and interpreted as an associative process by Moholy-Nagy in "Theater, Zirkus, Variété."

Moholy-Nagy may have intended to capitalize on one last feature of the induction coil,⁷¹ which

⁶⁷ Ibid., locations 576–582.

⁶⁸ Ibid., locations 1014–1021.

⁶⁹ Ibid., locations 12–22.

⁷⁰ Ibid., locations 22–33. Tesla's optical theories of the light produced by the intellect build upon extramission theories of vision.

⁷¹ As a high school award, Moholy-Nagy received Rezső Hajós' Hungarian translation, *Modern villamosság* (Budapest: Franklin Társulat, 1913), of Charles R. Gibson's *Electricity Today: Its Work and Mysteries Described*

Tesla discovered in attempting to control to direction and rates of discharge over various distances. In addition to the apparent artistic interest inherent in the powerful light displays, the rates of the discharges were capable of creating musical sounds.⁷² These remarkable discoveries were described by Tesla below:

The rapidity of the interruptions of the current with a magnet depends on the intensity of the magnetic field and on the potential difference at the end of the arc. The interruptions are generally in such quick succession as to produce a musical sound. Years ago it was observed that when a powerful induction coil is discharged between the poles of a strong magnet, the discharge produces a loud noise not unlike a small pistol shot. It was vaguely stated that the spark was intensified by the presence of the magnetic field. It is now clear that the discharge current, flowing for some time, was interrupted a great number of times by the magnet, thus producing that sound. The phenomenon is especially marked when the field circuit of a large magnet or dynamo is broken in a powerful magnetic field.⁷³

This type of music produced by induction coils would have had more of a buzzing sound than a musical tone and, if magnets were employed, could have been punctuated with loud cracks, like a gunshot, startling the audience during a performance of the *Exzentrik*. The sounds would have been rhythmic as the terminal would power up to overcome the insulative property of the surrounding air. The musical range would also have been limited by the conditions of the atmosphere and the equipment. All of these circumstances appear to match the curious

in *Non-Technical Language* (London: Seeley & Co., 1907). See Botar, *Technical Detours: The Early Moholy-Nagy Reconsidered*, 27 and 178n36 and also Botar's source, Péter, 1972, 63–64.

⁷² *Ibid.*, location 182–189.

⁷³ *Ibid.*, locations 201–209.

musical notations in the third column of the hybrid drawing of the *Exzentrik*.

OPTOPHONETIC

In the hybrid drawing of the *Exzentrik*, the faint siren heard in the first act continued into the second act. This light gray, vertical bar of the siren was overlaid with three sustained low notes, followed by five oscillating mid-scale notes: (low) buzzzzz, (low) buzzzzz, (lower) buzzzzz, then more quickly a (high) buzz, (mid) buzz, (high) buzz, (mid) buzz, and (high) buzz. In the second column, the darkness continues from the first act with the addition of a single vertical strip of white light. One could interpret this vertical white bar as similar to the vertical gray bar of the siren noise, as a white beam breaking through and disturbing the serenity of the darkness. The siren grows a bit louder until halfway through the act, it abruptly ceases. Just before it stops, a period of white light begins, pierced by a vertical black bar, mirroring the initial darkness that was pierced by a bar of light. Although it is more difficult to imagine darkness within light than light within darkness, it may be more important to experience the mirroring also evident in the severed cathode tube as each half becomes a mirror-image of the other half. Following a period of silence, the siren begins again and then a burst of electro-musical sounds are accompanied by horizontal bands depicting flashes of red, yellow, and white lights alternating with darkness (black) and dimness (gray).

In "Theater, Zirkus, Variété," Moholy-Nagy described the potential use of "electric arc lamps" in his conception of the theater of the future as follows:

Die TONGESTALTUNG wird sich in Zukunft der verschiedenen Schallapparate mit elektrischem und anderem mechanischen Betrieb bedienen. An unerwarteten Stellen auftretende Schallwellen — z. B. eine sprechende oder singende Bogenlampe, unter den Sitzplätzen oder unter dem Theaterboden ertönende Lautsprecher, Schallverstärker — werden u. a. das akustische

Überraschungsniveau des Publikums so heben, daß eine auf anderen Gebieten nicht gleichwertige Leistung enttäuschen muß. (The TONE-FORMATION will, in the future, attend to itself, the different sound apparati with electrical and other mechanical operations. At unexpected places will be intermittent sound waves – i. e. a speaking or singing electric arc lamp, under the seats or under the theater floor a resounding loud speaker, sound amplifier — would so elevate the acoustic level of surprise of the audience overall, that one of another areas of equivalent performance must not disappoint.)⁷⁴

Revisiting a similar theme, in *Vision in Motion*, Moholy reflected on the synaesthetic potential of light, color, and sound, when he wrote:

Nothing is achieved without effort. One must never become tired of observing the simple or rich phenomena of light and color offered by the daily routine at home, on the stage, in the street and in the laboratory. One must explore their genuine characteristics, their peculiar qualities. Then all endeavors will point—as Raoul Hausmann previsioned—in one direction, to an optophonetic art. This will allow us to see music and hear pictures simultaneously; a startling articulation of space-time. The first steps to it—a mural art of this age—lead most probably through photography, cinema and television.⁷⁵

In 1921, with Hans Arp and Ivan Puni, Moholy-Nagy signed onto Raoul Hausmann's "Aufruf zur elementaren Kunst" (Invocation to Elemental Art),⁷⁶ a manifesto calling for bold innovation

⁷⁴ Translated by author.

⁷⁵ Moholy-Nagy, *Vision in Motion*, 1947, 168.

⁷⁶ Documentation of the sole authorship with possible input from Kurt Schwitters was provided by Lloyd C. Engelbrecht, *Moholy-Nagy: Mentor to Modernism* (Cincinnati, OH: Flying Trapeze Press, 2009), 1: 131 including an examination of the typed manuscript and two pieces of correspondence between Schwitters–Hausmann (October 10, 1921) and van Doesburg–Hausmann (October 26, 1921).

recognizing that art is elementary, within the individual, and born out of the work of the artist who vitally connected to the 'energy of the time,' not out of philosophizing:

Dieses Manifest gilt uns als Tat: Erfaßt von der Bewegung unserer Zeit verkünden wir mit der elementaren Kunst die Erneuerung unserer Anschauung, unseres Bewußtseins von den sich unermüdlich kreuzen den Kraftquellen, die den Geist und die Form einer Epoche bilden und in ihr die Kunst als etwas Reines, von der Nützlichkeit und der Schönheit Befreites, als etwas Elementares im Individuum entstehen lassen. Wir fordern die elementare Kunst! gegen die Reaktion in der Kunst!⁷⁷ (This manifesto is for us an act: grasped by the movement of our time, we proclaim with elemental art the renewal of our intuition, of our consciousness out of itself tirelessly crossing the sources of power that constitute the spirit and form of an epoch, and in it art as something pure, liberated from utility and beauty, as something elemental arises in the individual. We demand elemental art! Down with reaction in art!).⁷⁸

While Moholy-Nagy was merely a signatory to Hausmann's manifesto, "Aufruf zur elementaren Kunst" marked the beginning of their fidelity and his reference to Hausmann's work in optophonetics in *Vision in Motion* testified to its endurance over time, a relationship of kindred sentiments and explorations into the intersections between art and science in the phenomena of color and sound. Moholy-Nagy elaborated on the development of motion studies of color light and sound in two sections of *Malerei, Fotografie, Film*, including extensive praise for Hausmann's optophonetics: "Eine vollkommeneren — weil wissenschaftlich fundierbare Arbeit

⁷⁷ Raoul Hausmann, Hans Arp, Ivan Puni, and László Moholy-Nagy [sic], *De Stijl* 4, no. 10 (Leiden, October 1921), 156.

⁷⁸ Raoul Hausmann et al., "Manifesto of Elemental Art," in *Moholy-Nagy*, by Krizstina Passuth and László Moholy-Nagy, trans. Éva Grusz, et al. (New York: Thames and Hudson, 1985), 286, previously published as "Aufruf zur elementaren Kunst," *De Stijl*, no. 10 (October 1921).

bietet die Optofonetik, zu deren theoretischem Ausbau die ersten Schritte der großzügige Dadaist Raoul Hausmann getan hat."⁷⁹ (A more perfect — because scientifically grounded work is offered by Optofonetik, to which the generous Dadist Raoul Hausman has completed the first steps of the theoretical construction.) On to this bold prediction, Moholy-Nagy attached a description of "audible colors" by Walter Brinkmann:

Die elementare Physik definiert etwa so: Töne sind "Schwingungen der Luft," das Licht aber "Schwingungen des Äthers;" die Ausbreitung des Schalles ist ein Vorgang, der in Körpern und nur in Körpern erfolgt, dagegen geschieht die Ausbreitung des Lichts nicht in Körpern oder mindestens nicht nur in Körpern usw. Eine negative Beantwortung der Frage nach den näheren Beziehungen zwischen Licht und Schall wäre unter diesen Voraussetzungen also eigentlich schon gegeben. Trotzdem aber ist eine solche unbedingte Festlegung, daß irgendwelche "Entsprechungen" zwischen beiden überhaupt nicht möglich sein können, nach den neueren physikalischen Einsichten — nachdem wir uns schon daran gewöhnt haben, die Optik als nur ein Spezialgebiet der Elektrizitätslehre zu betrachten und möglichst alle Dinge elektrodynamisch zu erklären — heute nicht mehr angebracht.⁸⁰ (Elementary physics defines something thus: tones are "vibrations of the air," the light but "vibrations of the ether;" the propagation of sounds is an action, that takes place in bodies and only in bodies, however the propagation of light does not happen in bodies or at least not only in bodies and so forth. A negative answer to the question about the closest relationships between light and sound would actually already so exist under these premises. Nevertheless, such an unconditional determination, that any such

⁷⁹ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 20.

⁸⁰ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 20–21.

“correspondence” between both cannot be at all possible, after the more recent physical insights — after which we already have become used to that, to regard optics as only a special area of electricity studies and to preferably explain all things electrodynamic — no longer appropriate today.)⁸¹

Moholy-Nagy subsequently related these scientific ideas in Alexander Scriabin's *Prometheus* (1916), Thomas Wilfred's *Clavilux* (c. 1920), Walter Ruttmann, Viking Eggeling's *Diagonal-Symphonie* (1923), Hans Richter, and Man Ray, at the same time, recognizing that none of these artistic works reached the level of integration of light and sound vibrations as described by the physicists studying electromagnetism. In their writings, the wavelength was recognized as common to both light and sound, and its frequency and magnitude resulted in varieties of color and tone.

It is perhaps a further indication of Moholy-Nagy's antipathy toward “mystical” knowledge systems that Moholy-Nagy does not mention the work of his colleague at the Bauhaus, Russian painter Wassily Kandinsky, who wrote extensively of the correspondence between physical vibrations caused by colors and sounds and psychic vibrations.⁸² In *Über das Geistige in der Kunst* (Concerning the Spiritual in Art, 1911), he demonstrated that color and form produced vibrations felt by the spirit, more specifically that color has a “psychic effect” on the soul causing a distinct vibration. “So ist es klar, daß die Farbenharmonie nur auf dem Prinzip der zweckmäßigen Berührung der menschlichen Seele ruhen muß. ... So ist es klar, daß die Formenharmonie nur auf dem Prinzip der zweckmäßigen Berührung der menschlichen Seele

⁸¹ Translated by author.

⁸² Lynda Dalrymple Henderson maintains that Rudolf Steiner's incorporation of the fourth dimension in his popular strain of Theosophy, known as Anthroposophy, contributed to the waning of fourth dimensional study in Germany; see Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*, rev. ed., 99–100.

ruhen muß."⁸³ ([So] it is evident therefore that colour harmony must rest only on a corresponding vibration in the human soul; and this is one of the guiding principles of the inner need. ... So it is evident that form-harmony must rest only on a corresponding vibration of the human soul; and this is a second guiding principle of the inner need.)⁸⁴ According to Kandinsky, these vibrations make impressions on the soul of the viewer, lending a deeper sensation to each color. For instance, the vibration of red can bring to mind the feeling of the warmth of a fire. More importantly, in some viewers, who are more sensitive than others, this vibration excites multiple sensory impressions through a reverberation from one sense to another. As an example, he related the experience of a man who would see the color blue when eating a particular sauce; and others in which colors produce particular sounds or scents.⁸⁵

Foreshadowing the sentiment of Hausmann's "Aufruf zur elementaren Kunst," Kandinsky declared that to be an artist is a calling, to deeply express oneself, one's age, one's nation, and the cause of art, which is timeless. While artistic styles are merely a fleeting product of an epoch, an artist should seek to express only his own inner need, the inner vibration.⁸⁶ Raoul Hausmann revisited this sentiment in his manifesto written with Viking Eggeling, "Zweite präsentistische Deklaration: Gerichtet an die internationalen Konstruktivisten" (Second Presentist Declaration: Directed at the International Constructivists, 1923):

Hieraus ergibt sich die dynamische Naturanschauung und die allgemeine
Erweiterung aller menschlichen Funktionen, eine Anschauungsform wird
geschaffen, die sich von der Dreidimensionalität als allzumenschlicher

⁸³ Wassily Kandinsky, *Über das Geistige in der Kunst insbesondere in der Malerei*, 3rd ed. (München: Verlag R. Piper & Company, 1912), 49 and 54.

⁸⁴ Wassily Kandinsky, *Concerning the Spiritual in Art*, trans. Michael T. H. Sadler (New York: Dover Publications, 1977), 26–29, originally published 1911 as *Über das Geistige in der Kunst*.

⁸⁵ Kandinsky, *Concerning the Spiritual in Art*, trans. Sadler, 23–26.

⁸⁶ Kandinsky, *Concerning the Spiritual in Art*, trans. Sadler, 33–36.

Hilfs-konstruktion löst, ebenso wie sie die Vorstellung von der Trägheit aller Materie ablehnt. Der General-nenner aller unserer Sinne ist der Zeit-Raum-Sinn. Die Sprache, der Tanz und die Musik waren Höchst-leistungen der intuitiven Zeit-Raum-Funktionalität, und die Optik, Haptik etc. müssen auf einem neuen Wege nachfolgen, für den Ernst Marcus^^ im Problem der exzentrischen Empfindung wichtige Vorarbeit geleistet hat. Das Zentralorgan Gehirn ergänzt ge-wissermaßen einen Sinn durch den andern, es vervoll-kommet jeden durch gegenseitige Schwingungs-steigerung unter Zeitübereinstimmung der Größe von Frequenz und Amplitude. Die dynamische Natur- anschauung kennt hierfür nur ein Funktionalitäts-prinzip der Zeit, die als kinetische Energie Raum und Materie bildet.⁸⁷ (This results in the dynamic perception of nature and the general expansion of all human functions, will create a form of perception, that dissociates itself from three-dimensionality as all-too-human construction aids, just as it rejected the notion of the inertia of all matter. The general name of all of our senses is time-space-sense. The language of dance and music had been the most powerful of the intuitive functionality of time-space, and optics, haptics, etc. must follow a new path, for which Ernst Marcus has achieved important preliminary work in the problem of eccentric sensation. The central organ of the brain expands, in a certain manner, one sense through another, it becomes full each through mutually increasing vibrations under the time-coincidence of the magnitude of the frequency and amplitude. The dynamic perception of nature recognizes heretofore only a principle of functionality that forms as a kinetic energy of space and matter.)⁸⁸

⁸⁷ Raoul Hausmann and Viking Eggeling, "Zweite präsentistische Deklaration: Gerichtet an die internationalen Konstruktivisten," MA 8, no. 5/6 (1923): 5.

⁸⁸ Translated by author.

In other words, light and sound vibrations can amplify each other increasing their impression on the spectator. It is this amplification that Moholy-Nagy would have counted on in the *Partiturskizze zu einer mechanischen Exzentrisk* penetrating the audience with electromagnetic vibrations produced using an induction coil and cathode tube to create visible and invisible, audible and inaudible, sparks of light and sound as well as x-rays, to resonate with their inner self, generating the energy of an inner vibration, exciting their molecules, and opening them up to see and hear and feel the world differently.

III. TIME

Against the Audience: Catharsis in the
Synaesthetic (Syno-Sense) Theatrical
Experience in the *Partiturskizze zu einer
mechanischen Exzentrik* [Act III]

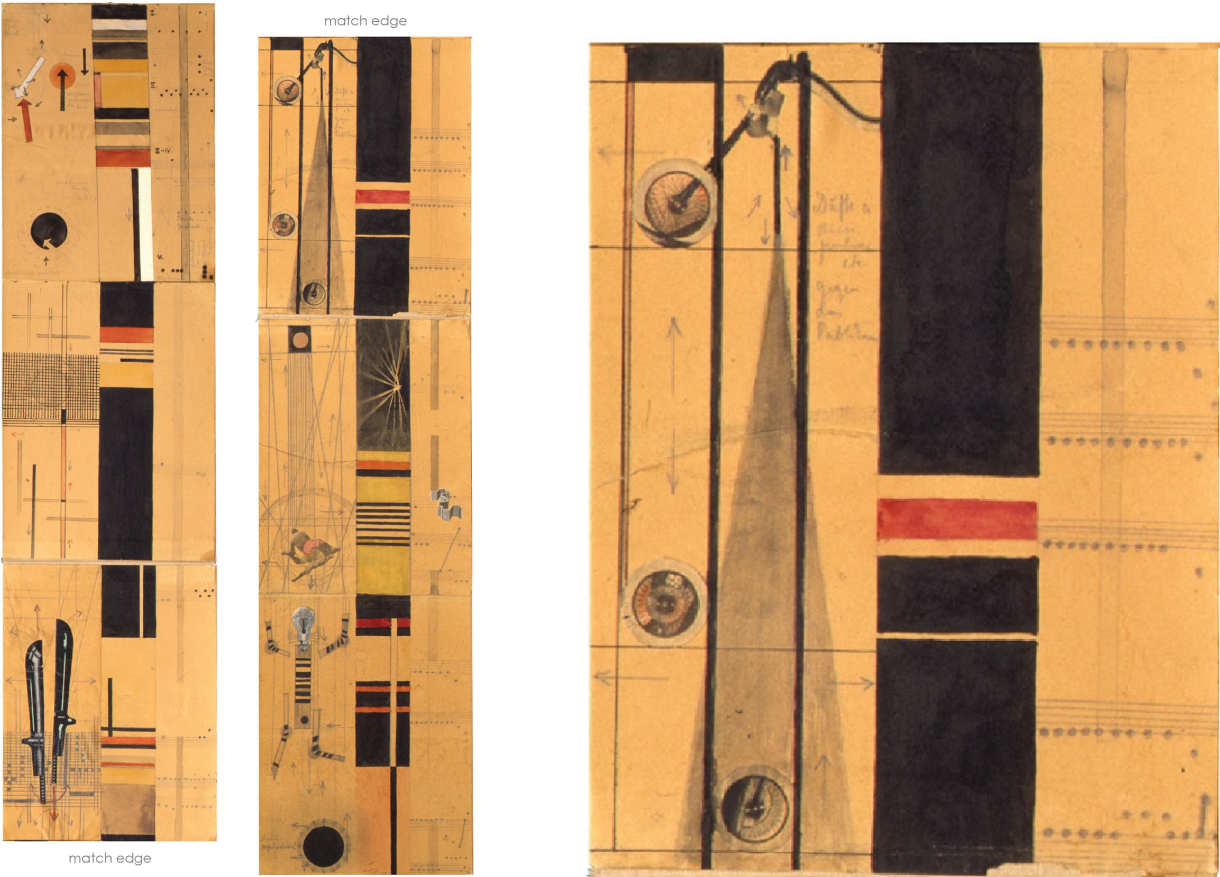


Figure 3.1: László Moholy-Nagy, Untitled, c. 1924, for complete caption see Figure 0.1 + Act III Detail.

Supporting his declaration in *Vision in Motion* that the photogram, as a “diagram of the motion of light,” is a space-time continuum, Moholy-Nagy added a footnote through which he both illuminated and obfuscated his claim; the footnote was a slightly paraphrased statement from James Joyce’s *Ulysses*: “a very short space of time through a very short time of space.”¹ By eloquently inverting a phrase, Joyce’s chiasm perfectly reproduced the commutative property of equalities in Aristotelian rhetoric, projecting a reflected symmetry between each ‘term,’ in this case, between the products of the dimensions of space and time (anagôgê, reduction:² $a \times b = b \times a$). As per his *modus operandi*,³ often playing on the phonetic similarities between words and between languages, Joyce multiplied the potential readings of his multi-lingual combinations to the point of *reductio ad absurdum*; in fact, through these absurdities, he revealed the universal relationships between particulars. In this sense, perhaps knowingly, Joyce had tapped into deeper etymological meanings underlying spatial and temporal assignments in languages, and subsequently in the terminology that Aristotle, perhaps also knowingly, developed in his collection of works within the *Organon*, permeating his system of logical, algebraic equalities. To denote the basic elements in any proposition, Aristotle used the word, ὅρος (*horos*),⁴ which was later translated to the Latin, *terminus*, from which the English word, ‘term’ was derived.

¹ Moholy-Nagy, *Vision in Motion*, 1947, 256 quoting a portion of James Joyce, *Ulysses*, episode 3 [37]. The unedited passage was “I am, a stride at a time. A very short space of time through very short times of space.” Both Joyce’s *Ulysses* (1922) and *Finnegans Wake* (1939) would feature prominently in the curriculum of the New Bauhaus with several lectures by Leslie L. Lewis.

² Robin Smith, “Aristotle’s Logic” in *The Stanford Encyclopedia of Philosophy*, ed. Edward N. Zalta (Metaphysics Research Lab, Stanford University, 2018), section 13, accessed July 7, 2018, <https://plato.stanford.edu/archives/spr2018/entries/aristotle-logic/>.

³ Brendan O. Hehir and John M. Dillon, *A Classical Lexicon for Finnegans Wake: A Glossary of the Greek and Latin in the major works of Joyce, including Finnegans Wake, the Poems, Dubliners, Stephen Hero, A Portrait of the Artist as a Young Man, Exiles, and Ulysses* (Berkeley: University of California Press, 1977), 515–590.

⁴ Robin Smith, “Aristotle’s Logic” in *The Stanford Encyclopedia of Philosophy*, section 13.

Ὅρος broadly refers to a limit or boundary, (ὄριο, *ório*). As such, *horos* may generally allude to portions of either space or time, becoming more specific as accents and suffixes were added and meanings were concretized. For instance, since Joyce played with pronunciations of sounds and words in his writings, when pronounced with an English/ Irish accent, ὄρος could be considered to be phonetically similar to the words used for a boundary stone (ὄρος, *horos*), a dancing floor (χορός, *horos, khoros, choros*), and an hour (ὥρα, *hóra*), which is still preserved in English words like horology, the study of time. Having received an extensive classical education, Moholy-Nagy would very likely have understood the etymological roots of words in Greek and Latin and even read the ancient texts in their original languages.⁵ While studying law at the University of Budapest, Moholy-Nagy would likely have studied logic through the classical texts, in particular the *Organon* of Aristotle, which remained the definitive source on logic into the nineteenth century.⁶ Through this education, Moholy-Nagy was positioned to enjoy Joyce's use of a logical construction to put forward a seemingly illogical inversion for the purpose of revealing the chiasmic structure of language in space-time experience.

However, it may be that Moholy-Nagy would have connected Aristotle's terminology with the crossing of multiple spatial and temporal meanings of *horos*, the etymology of this word reveals another expression of the space-time continuum, similar to what Moholy-Nagy saw in the

⁵ While making a documentary film, entitled *Architekturkongress Athen*, of the fourth Congrès internationaux d'architecture moderne (CIAM, July 29 – August 14, 1933) on the topic of "The Functional City," Moholy-Nagy wrote to his wife Sibyl that visiting the ruins in Athens reminded him of his classical studies mentioning the works on Socrates and by Plato, Themistocles, Pericles, and Aristophanes (letter dated August 2, 1933 and held in the Archives of American Art, Washington, DC on microfilm reel 951 [frames 0076–0081]). In addition, Moholy-Nagy's school grade reports testify to his training in classical languages, including eight years of Latin, four years of Greek, and six years of German, as documented by Lloyd C. Engelbrecht in *Moholy-Nagy: Mentor to Modernism*, 15, with Athens portion of CIAM trip on 383–384. See also Chris Blencowe and Judith Levine, *Moholy's Edit: The Avant-garde at Sea August 1933* (Zürich: Lars Müller Publishers, 2019).

⁶ George Boole, *The Laws of Thought* (1854; repr., Buffalo, NY: Prometheus Books, 2003).

photogram as a diagrammatic recording of space-time, "a very short space of time through a very short time of space." Using the example of Pablo Picasso's technique of portraying a still life as if it were slightly out of focus, in order to "see 'more,'" Moholy-Nagy claimed that Joyce's language also attempted to "see 'more,'" by allowing words to exist slightly out of focus.⁷ Certainly, "see[ing] 'more'" was an endeavor that Moholy-Nagy himself had also pursued in terms of *vision in motion* and his own creative works. It was in this sense that Moholy-Nagy saw *Finnegans Wake* as a "daydream," less focused on the details, or recognizing that the details are intended to be less in focus, to allow for the discovery of new relationships,⁸ such as those found in Joyce's cross-lingual, space-time wordplays, especially instances where the hyper-polyglot Joyce subtly worked in Hungarian meanings. Moholy-Nagy discovered one such chiasmic relationship in the passage, "takes a szumbath for his weekend and wassarnap for his refreskment."⁹ In Moholy-Nagy's analysis:

The sentence plays with Hungarian words which [Joyce] enlarges with new connotations. He accomplishes this by juggling three languages, Hungarian, English and German. Through his conjuring trick the words logically follow each other in their new implications much as they did in their original meaning.

"Szombat" is Saturday, "vasarnap" is Sunday. "Nap" has a double meaning "day" and "sun." Joyce makes "sunbath" (szumbath) out of "Szombat" (Saturday), indicating that one usually takes a sunbath at the weekend. Sunday (vasarnap) follows a Saturday (szombat) just after a sunbath one takes a dip as a "frisky" refreshment. "Wassarnap" can be understood as a "nap in the water" if

⁷ Moholy-Nagy, *Vision in Motion*, 1947, 344.

⁸ *Ibid.*, 345.

⁹ James Joyce, *Finnegans Wake*, 4th ed. (1939; repr., New York: Viking Press, 1945), 129. *Finnegans Wake* was originally published in installments in the journals, *transition* and *transatlantic review*, in 1924 under the title "fragments from Work in Progress." *Finnegans Wake* first appeared in full and under this title in 1938.

the similarity with the German “Wasser” (water) is recognized. But “nap” is in Hungarian also “sun” so that at the end Joyce produces a most elegant pun, a crosswise identity.¹⁰

In the accompanying diagram, Moholy-Nagy demonstrated that Joyce crossed the two common word associations/ combinations sun-nap with water-bath to become sun-bath and water-nap.¹¹ While sun bathing is also an ordinary expression, a person who falls asleep in water will sink and drown. A water-nap conjures images of Ophelia, suggesting a lifeless person floating on the surface of the water. Separately, both water and a nap are inherently refreshing, yet together as a water-nap they suggest the polar opposite of fresh and turn toward decaying flesh, a *re-flesh-ment* rather than a “refreskment.” Relying on phonetic similarities to amplify the hidden meanings across languages, this passage also suggested the relationship between *καιρός* (kairos), the cyclical passage of time (sun and day), and the names that were given to the divisions (*horos*) of time (*hóra*), limitations on *χρόνος* (chronos), the linear passage of time (chronos, Saturday to Sunday).

Like Joyce, Moholy-Nagy enjoyed puns, playful, often meaningful, substitutions, from the visual puns that he highlighted in *Malerei, Fotografie, Film* to the list of Joycean puns that he listed in *Vision in Motion*.¹² A pun requires the listener or viewer to hold two or more different meanings in mind at once, alternating their perception and understanding between the two, and, thereby, gaining the ability to “see ‘more’” or to see multiple meanings. In this sense, the pun thwarts the mind’s tendency to rely too heavily on recollection, falling into the psychophysical habits that

¹⁰ Moholy-Nagy, *Vision in Motion*, 1947, 349. For an early example of Moholy-Nagy’s fascination with word play, see Botar, *Technical Detours: The Early Moholy-Nagy Reconsidered*, 27, in which he demonstrates that the last word in Moholy-Nagy’s poem, “Like a Telegraph Wire Transmitting Strange Secrets” (“Idegen titkok súrgönydrótjaként,” *Jelenkor*, no. ¼, February 1918), is *milliom*, a play on *million* and *milliohm*.

¹¹ *Ibid.*

¹² Moholy-Nagy, *Vision in Motion*, 1947, 348.

lead to apperceptions. In this manner, a pun dusts off the cobwebs formed on neural pathways. Perhaps more importantly, puns turn words into productive forces, generating layers of meaning though the manipulation of the words themselves similar to the type of hidden meanings that Moholy-Nagy embedded in his *Photoplastiks*.

Meanwhile, returning to the scene surrounding the previous space-time statement in *Ulysses*, Joyce added layers of meaning related to interpretation of sensory stimuli, questioning the apparent constancy of visual perception. In this scene, Stephen Dedalus was blinded and fearfully groping in the dark, as he was walking along the treacherous shoreline pondering the limits of the visible world, followed by the limits of the audible world, "the diaphane:"¹³

Ineluctable modality of the visible: at least that if no more, thought through my eyes. Signatures of all things I am here to read, seaspawn and seawrack, the nearing tide, that rusty boot. Snotgreen, bluesilver, rust: coloured signs. Limits of the diaphane. But he adds: in bodies. Then he was aware of them bodies before of them coloured. How? By knocking his sconce against them, sure. Go easy. Bald he was and a millionaire, maestro di color che sanno. Limit of the diaphane in. Why in? Diaphane, adiaphane. If you can put your five fingers through it it is a gate, if not a door. Shut your eyes and see. Stephen closed his eyes to hear his boots crush crackling wrack and shells. You are walking through it howsomever. I am, a stride at a time. A very short space of time through very short times of space.¹⁴

Deepening the revelation of the dominance of the conception of space over time to the hegemony of vision over the other senses, Dedalus shifted his perception away from his sense of

¹³ James Joyce, *Ulysses*, episode 3.

¹⁴ James Joyce, *Ulysses*, episode 3 [37].

vision, by closing his eyes, which were otherwise quite useless in the dark, in order to hear his way, navigating by the sounds of the seashells rhythmically crushed beneath his feet and the counter-rhythm of the crashing waves of the sea drawing an audible line in the sand. When he reached his destination, Dedalus was unsure if, when he opened his eyes, the visible world would still exist as it was:

Rhythm begins, you see. I hear. A catalectic tetrameter of iambs marching. No, agallop: deline the mare. Open your eyes now. I will. One moment. Has all vanished since? If I open and am for ever in the black adiaphane. Basta! I will see if I can see. See now. There all the time without you: and ever shall be, world without end.¹⁵

While in Paris during the month of July 1925, the Moholy-Nagys may have met James Joyce through a mutual friend, American composer George Antheil with whom both men were collaborating. While a physical encounter was not recorded, the Moholy-Nagys would have heard about Joyce's ground-breaking new publication, *Ulysses*. Not only was George Antheil a close friend and collaborator of Joyce, they were working together on an opera at the time and his studio was above the bookstore that first published the controversial text in full, Shakespeare & Company owned by Sylvia Beach. Although Moholy-Nagy had not yet learned to read or speak English fluently, both Antheil and Joyce were fluent in German, which would have facilitated their conversation. Days later, on vacation at Belle-Île-en-Mer, Moholy-Nagy recommended Joyce's *Ulysses* to Carola Giedion-Welcker who recorded their conversation in her diary. Unlike Moholy-Nagy at the time, Giedion-Welcker was able to read in English and eventually became a leading Joyce scholar.¹⁶

¹⁵ James Joyce, *Ulysses*, episode 3.

¹⁶ Through a careful examination of personal correspondences and diary entries, the possibility and probability of an encounter among the three men on the 20th and/ or the 21st of July 1925 at Antheil's

Supporting the likelihood of the Paris Moholy-Nagy–Joyce meeting, in Berlin 1923, Moholy-Nagy had been working with Antheil to establish a sound laboratory funded by a German manufacturer with the purpose of producing phonographic records by directly inscribing grooves on a disk. Commonly, sound recordings were created during live performances. Using a diaphragm, the sound vibrations were captured and these movements were transferred to an etching stylus on a rotating malleable surface, thus, duplicating sounds that could be played back by reversing the process and allowing the stylus to travel in the grooves forming vibrations in the diaphragm, which could be heard through a sound box. Moholy-Nagy recognized that, with the gramophone, a stylus could just as easily produce sound vibrations from any type of grooves, even hand-cut grooves; as such, he was proposing a new instrument for making music. For a period of time, Moholy-Nagy and Antheil collaborated on the potential of this new instrument. While Moholy-Nagy abandoned the effort shortly after starting to teach at the Bauhaus, Antheil continued the experiments and eventually composed the score for *Ballet Mecanique* using, in part, holes cut into in the paper scrolls that control a pianola.¹⁷

In another sound experiment, although the materials are lost, Moholy-Nagy scratched the alphabet onto film stock producing *Tönendes ABC* (The Sound ABC) with Oskar Fischinger.¹⁸ The film's visuals were produced by projecting the images of the scratched alphabet, while also hearing those same images interpreted as sounds. This sound film was shown to audiences in

studio above the Shakespeare and Company bookstore in Paris was well-documented by Lloyd C. Engelbrecht in *Moholy-Nagy: Mentor to Modernism*, 282. In reference to Giedion-Welcker's writings, in *Vision in Motion*, Moholy-Nagy mentioned her article on Joyce, "The Function of Language in Contemporary Poetry" in *transition* (November 22, 1933). Henderson also includes George Antheil among musicians working in the fourth dimension: see Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art*, rev. ed., xix–xx.

¹⁷ Oliver A. I. Botar, "Films by László Moholy-Nagy," review of a film, *Journal of the Society of Architectural Historians* 67, no. 3 (September 2008): 461. See also Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 279–282.

¹⁸ Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 429–430.

London at the Tivoli Palace Theater as “ABC in Sound;” a description in the *Film Society Programme* stated that the film was re-photographed and the images corresponded to the sounds, allowing the moving images to dance on the screen while the sounds mirrored the images.¹⁹ As a consequence of his excitement over this research, Sibyl recalled that Moholy-Nagy would ask their guests if they would like for him to play their profile, tracing their silhouette to play as sounds,²⁰ thereby, joining the activity of the photogram and phonograph, a casting of light portrayed as a casting of sound with a audio projector using light to read the shadows as sounds.

In the third act of the hybrid drawing of the *Exzentrik*, Moholy-Nagy would attempt to engage multiple senses of the audience (synaesthetic, or multi-sense perception), minimizing the visual experience while heightening the auditory, tactile, and olfactory experiences. Accordingly, Moholy-Nagy indicated almost complete darkness in the theater except for a brief moment of light alternating one bar of red light in between two bars of white light approximately two-thirds of the way through the act. As when Stephen Dedalus closed his eyes to hear his way along the shoreline, the audience would have been blinded in order to heighten the receptivity of their other senses. The brief flashes of light would have increased the sensation of blindness by forcing their irises to constrict again, thereby, letting in a very small amount of light. At the same time, the faint siren sound from the previous acts gradually fades away, while rhythmic tones pulse out of the sparking induction coil, an electric instrument.

At first, the monotone rhythm created by the induction coil sparks would have been consistent, containing nine identical notes followed by one low note and then one high note. This musical phrase was repeated twice with notes in a third phrase drawn closer together, perhaps in another space-time cross-over indicating a change in tempo corresponding to the completion

¹⁹ Ibid., 430.

²⁰ Ibid.

of the flashing bars of light. In a fourth and final phrase in this act, the notes begin by marking the same rhythm; however, they quickly jump to a higher tone, then back again. Before the end of this phrase, Moholy-Nagy drew a vertical line extending from one of the notes to a much higher note indicating a 'slide' from the first to the second note. As such, this notation would suggest that the frequency of the electric arc lamp should be quickly, but gradually, altered without letting off the current, producing a continuous sliding tone from the mid range to a very high tone.

In this third act, there are no projected images in the first column of the *Photoplastik*, since a visual display would counteract the sensation of blindness, but rather there are three wheels on horizontal and vertical tracks. One of the wheels is connected to a hose from which is emanating a gray tone that fades away, or becomes lighter, further from its source. These three wheels appear to move across and up and down according to the arrows along the tracks, which would perhaps be built above the stage, overhead, or perhaps along the walls of the theater. In a handwritten note next to the nozzle of the hose, Moholy-Nagy wrote: "Düfte & | Niess | pulver | etc. | gegen | das | Publikum" (odors & sneezing powder etc. toward the audience). In this scene, it appears that the hose would have sprayed the audience with sneezing and perhaps other aromatic powders. As such, willingly or unwillingly, the audience becomes a participant in the performance, since the sneezing would become a part of the musical performance adding to the noises with all variety of exhalations. In addition to the all of the sneezing, the audience, either in glee or anger, would likely become raucous. As the audience would become more clamorous, the siren faded out.

In this third act, vision has been extinguished and replaced by other sensory experiences of hearing, smelling, tasting, and touching with the tempo of the notes and the sneezing increasing reaching the traditional theatrical crescendo at which point the audience has been awakened, body and spirit, ready to open their eyes 'to see if they can see,' like Stephen Dedalus to see whether the visible world still exists.

DURATION

Requiring a similar shift of perception, or rather a recognition of a misperception, Henri Bergson dissected the relationship between space and time in his dissertation, *Essai sur les données immédiates de la conscience* (Time and Free Will: An Essay on the Immediate Data of Consciousness, 1889), in which he challenged the notion of time as a fourth spatial dimension in response to Einstein's theories of relativity. Questioning the nature of cognition itself, Bergson opened with the statement: "Nous nous exprimons nécessairement par des mots, et nous pensons le plus souvent dans l'espace."²¹ (We necessarily express ourselves by means of words and we usually think in terms of space) making it difficult to experience time without resorting to spatial tropes.²² Through the inherent spatiality of number, Bergson examined how language reveals a prejudice for thinking spatially²³ that is evident in the representation of time as visual sequences in space, when he wrote:

On retrouverait en architecture, au sein même de cette immobilité saisissante, certains effets analogues à ceux du rythme. La symétrie des formes, la répétition indéfinie du même motif architectural, font que notre faculté de percevoir oscille du même au même et se déshabitue de ces changements incessants qui, dans la vie journalière, nous ramènent sans cesse à la conscience de notre personnalité: l'indication, même légère, d'une idée suffira alors à remplir de cette idée notre Ame entière. Ainsi l'art vise à imprimer en nous des sentiments plutôt qu'à les exprimer; il nous les suggère, et se passe volontiers de l'imitation de la

²¹ Henri Bergson, *Essai sur les données immédiates de la conscience*, ed. Félix Alcan (Paris: Ancienne Librairie Germer Baillière & Cie, 1889), vii.

²² Henri Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, trans. F. L. Pogson (Mineola, NY: Dover Publications, 2001), xix, originally published 1889 as *Essai sur les données immédiates de la conscience*.

²³ *Ibid.*

nature quand il trouve des moyens plus efficaces.²⁴ (We find in architecture, in the very midst of this startling immobility, certain effects analogous to those of rhythm. The symmetry of form, the indefinite repetition of the same architectural motive, causes our faculty of perception to oscillate between the same and the same again, and gets rid of those customary incessant changes which in ordinary life bring us back without ceasing to the consciousness of our personality: even the faint suggestion of an idea will then be enough to make the idea fill the whole of our mind. Thus art aims at impressing feelings on us rather than expressing them; it suggests them to us, and willingly dispenses with the imitation of nature when it finds some more efficacious means.)²⁵

Bergson identified this spatial understanding of time as an apperception, in part, a tendency of the human intellect to construct an interpretation of the invisible, duration, using the visible, position and number. In this conception of time as a succession of moments, establishing a spatial rhythm, the imagination is inclined to perceive objects that are set side by side spatially as one object changing its position in space. This act of interpretation for Bergson illuminated the manner in which art impresses itself on the viewer, through the suggestion of temporal experience, tapping into preconceived notions of visuality and spatiality for the viewer to interpret as temporality.

For several decades before Bergson published his thesis, *Essai sur les données immédiates de la conscience*, fellow Parisian and physiologist Etienne-Jules Marey had been deeply engrossed in the measurement of the passage of time as corporeal rhythms, in particular recording the rise

²⁴ Henri Bergson, *Essai sur les données immédiates de la conscience*, ed. Félix Alcan (Paris: Ancienne Librairie Germer Baillière & Cie, 1889), 12.

²⁵ Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, trans. F. L. Pogson, 16.

and fall of blood pressure and pulse rates.²⁶ With these studies, Marey invented various machines to document changes over time, such as the wearable sphygmograph, which translated a pulse found in the wrist into movements of a quill drawing a continuous white line on charcoal coated paper. **(Figure 3.2)** In other words, through automatic drawing, Marey made visible and measurable the vital rhythms that were nearly imperceptible to a person without exerting a higher level of concentration; beyond the sun-dial and myriad versions of timepieces, he gave time itself a graphic presence in its direct translation into space-time charts.

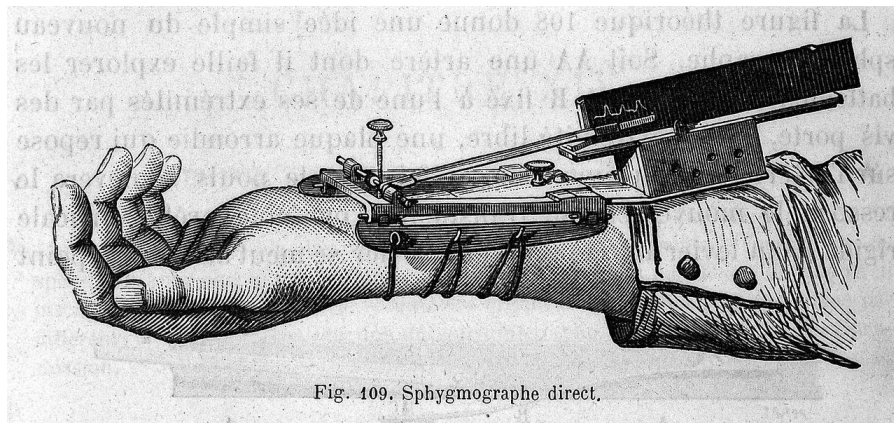


Fig. 409. Sphygmographe direct.

Figure 3.2: Etienne Jules Marey, *Études physiologiques sur les caractères graphiques des battements du cœur* (Physiological Studies of the Graphic Characteristics of Heartbeats, 1865).

Turning his attention to other animal species, in 1872, Marey had been the first to scientifically prove that all four legs of the horse left the ground, while traversing at higher speeds, the long-

²⁶ See Etienne-Jules Marey, *Physiologie médicale de la circulation du sang* (Medical Physiology of the Circulation of Blood, 1863), *Études physiologiques sur les caractères graphiques des battements du cœur* (Physiological Studies of the Graphic Characteristics of Heartbeats, 1865), and “Du mouvement dans les fonctions de la vie” (Movement in the Functions of Life) published in *La Revue scientifique* in 1866 and in *Germer-Baillière* in 1868, among other later works.

disputed theory of unsupported transit.²⁷ To the naked eye, a horse's legs in full gallop moved too quickly to know with certainty whether one hoof was always in contact with the ground at all times. This sensory limitation was predominantly an artistic concern with the accuracy of mimetic representations of horses in painting and not necessarily of any significant scientific importance. However, approaching the claim as a scientific hypothesis in need of irrefutable evidence, Marey had outfitted a horse's hooves with pneumatic sensors connected to elastic tubes held by the rider, thereby, providing a record of the moment that each hoof struck the ground. Although Marey had his verifiable proof, the American photographer Eadweard Muybridge and horse breeder/ politician Leland Stanford attempted to further bolster his conclusions with photographic evidence.²⁸ While their photographs nearly eclipsed Marey's part in the initial discovery, Marey remained a supporter of Muybridge's works,²⁹ as a subscriber to his research publications and even signing his name to Muybridge's book, *Descriptive Zoöpraxigraphy, or the Science of Animal Locomotion Made Popular*.³⁰ In addition to his admiration, Marey also reserved sincere criticism of Muybridge's lack of scientific rigor in terms of

²⁷ Etienne-Jules Marey, "Des Allures de cheval, étudiées par la méthode graphique," *Compte-rendus des séances de l'Académie des Sciences*, vol. 75, 1872, 884. See also Marey's other photographic studies of animals in motion including: "Du vol des oiseaux" (The flight of birds) in *La Revue scientifique* 14, on August 21, September 11, and October 2, 1869 and *La Machine animale: Locomotion terrestre et aérienne* (The Animal Machine: Terrestrial and Aerial Locomotion, 1873–1874).

²⁸ J. D. B. (Jacob Davis Babcock) Stillman, *The Horse in Motion as Shown by Instantaneous Photography with a Study on Animal Mechanics Founded on Anatomy and the Revelations of the Camera in which is Demonstrated the Theory of Quadrupedal Locomotion* (Boston: James R. Osgood and Company, 1882), 10–11.

²⁹ Marey provided several positive statements for French newspapers and journals at the time, which Muybridge reproduced in *Descriptive Zoöpraxigraphy, or the Science of Animal Locomotion Made Popular* in a section entitled, "Abbreviated Criticisms," including "'I am lost with admiration of these photographs of Mr. Muybridge.' — PROFESSOR MAREY, in *La Nature*, Paris," 21.

³⁰ Muybridge, *Descriptive Zoöpraxigraphy, or the Science of Animal Locomotion Made Popular*, ([Philadelphia]: [University of Pennsylvania], c. 1893), ii.

measuring time. In a footnote to his article, "Exposition d'instruments et d'images relatifs à l'Histoire de la Chronophotographie" (Exposition of the Instruments and of the Images Relative to the History of Chronophotography, 1900), Marey pointed out that Muybridge did not succeed in capturing images over *equal* intervals of time, due to the potential variations in the horses' galloping speed, but rather over equal intervals of space, marked out by the trip-wires used to trigger the camera shutters.³¹ **(Figure 3.3)**

In his own inventions, Marey created machines capable of maintaining precise time intervals between exposures. Rather than arranging multiple cameras in space to capture a moving animal, Marey developed a timed mechanism in 1882, which would expose portions of a revolving slotted disk. While based upon the prototype developed by French astronomer Jules Janssen's astronomical revolver, Marey's photographic gun was capable of producing images 800 times faster. **(Figure 3.3)** In addition, it was mobile, much like the sphygmograph. This camera with its motor was mounted to a shoulder stock and outfitted with a large bore barrel to control light and to assist in aiming the apparatus.³² Wielding his invention much like a shotgun, in order to follow the flight of a bird through the air, Marey's photographic gun controlled time, but did not control space. In an effort to be able to compare images and eventually to superimpose his results, whenever he was able, Marey included a scale ruler and chronometer in each image to

³¹ Etienne Jules Marey, "The History of Chronophotography," in *Annual Report of the Board of Regents of the Smithsonian Institution Showing the Operations, Expenditures, and Condition of the Institution for the Year Ending June 30, 1901*, comp. Board of Regents, Smithsonian Institution (Washington, DC: Government Printing Office, 1901), 319, originally published as *Exposition d'instruments et d'images relatifs à l'Histoire de la Chronophotographie, par le Docteur Marey, Membre de l'Institute* (Paris, 1900). According to Marey, there was just one precursor to Muybridge's chronophotographs. In 1873, Jules (Pierre-Jules-César) Janssen had developed the 'astronomical revolver' to capture the movement of Venus across the sun. Carefully controlling the equal intervals of the exposures allowed for a measurement of the speed of the orbiting planet, *ibid.*, 317–318.

³² *Ibid.*, 322 and 329.

be able to overcome any spatial variations.³³

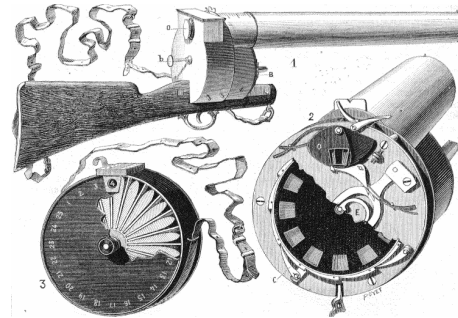
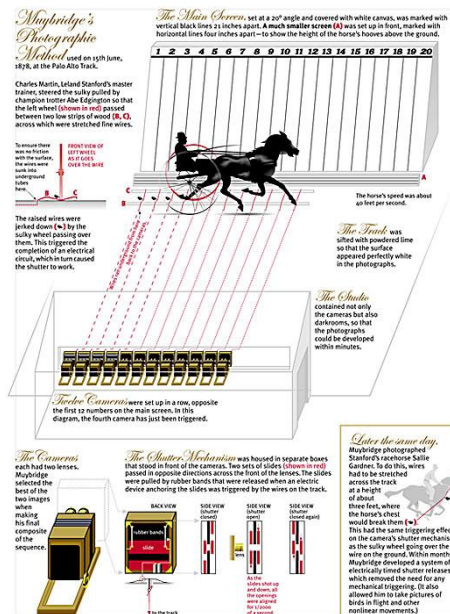


Figure 3.3: (left) Photographic Experiment by Eadweard Muybridge, Illustration by Nigel Holmes in Mitchell Leslie, "The Man Who Stopped Time: Photographer Eadweard Muybridge stunned the world when he caught a horse in the act of flying," reproduced in the *Stanford Magazine*, May/June 2001 + (right) Photographic Gun by Étienne-Jules Marey, Illustration by Louis Poyet in *Nature*, 1882

In the first section of "Exposition d'instruments et d'images relatifs à l'histoire de la chronophotographie" (Exposition of the Instruments and of the Images Related to the History of Chronophotography), Marey provided a historical summary of a photography of temporal sequences and the inventions of various cameras, beginning with Janssen's astronomical revolver, that were on display during the Paris Exposition universelle internationale de 1900 (Paris International Universal Exhibition of 1900). For this type of experimental, space-time photography, Marey coined the term *photochronographie* (photochronography), which he soon changed to

³³ *Ibid.*, 319–320.

chronophotographie (chronophotography):³⁴

On donne le nom de chronophotographie à une méthode qui analyse les mouvements au moyen d'une série d'images photographiques instantanées recueillies à des intervalles de temps très courts et équidistants. Eu représentant ainsi les attitudes et les positions successives d'un animal par exemple, la chronophotographie permet de suivre toutes les phases de ses allures et même de les traduire par de véritables épures géométriques.³⁵ (By chronophotography is meant a method which analyzes motions by means of a series of instantaneous photographs taken at very short and equal intervals of time. By thus representing, for example, the successive attitudes and positions of an animal, this art renders it possible to follow all the phases of a creature's gait, and even to construct exact drawings of it to scale.)³⁶

Marey defined chronophotography as an analytical method, not merely as the photographic artifact. As such, he focused his commentary on the innovations made with each of the machines and methods of chronophotography, attempts to capture objects in motion, control the scientific conditions, and reproduce the results. For Marey's work, these advancements

³⁴ Etienne-Jules Marey, "Exposition d'instruments et d'images relatifs à l'histoire de la chronophotographie," in *Musée centennal de la classe 12 (photographie) à l'Exposition universelle internationale de 1900 à Paris, Métrophotographie et chronophotographie* (Paris: Belin Frères, c. 1900), 9

³⁵ *Ibid.*, 9.

³⁶ Etienne Jules Marey, "The History of Chronophotography," in *Annual Report of the Board of Regents of the Smithsonian Institution Showing the Operations, Expenditures, and Condition of the Institution for the Year Ending June 30, 1901*, comp. Board of Regents, Smithsonian Institution (Washington, DC: Government Printing Office, 1901), 317, originally published as Etienne-Jules Marey, "Exposition d'instruments et d'images relatifs à l'histoire de la chronophotographie," in *Musée centennal de la classe 12 (photographie) à l'Exposition universelle internationale de 1900 à Paris, Métrophotographie et chronophotographie* (Paris: Belin Frères, c. 1900), 9–35.

included building deep sheds lined with black velvet interiors to achieve the darkest black possible for his backgrounds, synchronizing images with chronometers and measurement scales to facilitate precise comparisons, creating handheld cameras to better capture the flight of birds, etc.³⁷ In particular, in order to maintain equal time intervals on the film strips, Marey invented a mechanism of rotating mirrors on a timer, which would reflect the image onto the film as it advanced.³⁸ Through these innovations, Marey was increasingly able to control time in his work.

When these images are reproduced in sequence, Marey recognized that there is the appearance of motion;³⁹ in this sense, they represent time through the superimposition or juxtaposition of sequential images. As Bergson elaborated later, the human mind recognizes the changes as motion, interpreting the images occurring over time.

After describing the advancements in chronophotography and the inventions on display at the *Exposition universelle internationale*, in the second section to the second part of this essay, Marey proceeded to summarize his own applications of chronophotography in scientific experimentation applying increasingly strict protocols, in relation to both space and time, to be able to take direct measurements from the images, as if they were orthographic drawings to scale producing two-dimensional and even three-dimensional movement diagrams.⁴⁰ While the

³⁷ Marey, "The History of Chronophotography," 320–323.

³⁸ Marey, "The History of Chronophotography," 324.

³⁹ Marey, "The History of Chronophotography," 317.

⁴⁰ Marey, "The History of Chronophotography," 321–324. No. 5 Figures in relief obtain by the use of chronophotography— To produce a three-dimensional sculpture, Marey positioned three cameras perpendicular to each other in front of three black fields to capture three simultaneous views. No. 8 Multiplication of the number of pictures: 1. Partial photographs. 2. Dissociation of the images before the dark field. 3. Photographs on a film ribbon in motion, 1887–88.— Using a figure dressed in black with lines of silver lace, Marey was able to reduce the confusion of overlapping images and focus on the points and lines of movement. In order to create equal space intervals on the film, he reflected the image onto the

timing mechanisms and chronometers ensured an accuracy of time intervals, space was controlled through a combination of the capture and the development processes. While capturing his images, Marey included elements, segmented rulers, that he could use to establish and adjust the scale later. When developing a photograph from a negative, light is projected through the negative film and then through a magnifying lens and then onto light-sensitive paper or other chemically treated substrate, such as tin or glass. Adjusting the distance between these items controls the clarity and scale of the printed image. As a result, the printing process allows for the adjustment of scale of the images by matching the lengths of the measurement rods included in the images. As such, Marey would ensure that the images were in a 1:1 relationship to each other, eliminating the scalar problem created by not controlling the various distances between his subjects and the camera, which would be impossible in the case of the somewhat unpredictable flight of a bird.

On the other hand, in devising his earliest photographic experiments, Muybridge opted to control the space relationships, allowing variation in the time intervals. In 1872, Muybridge had been commissioned by Leland Stanford, the former Governor of California, who was also an entrepreneur and horse breeder,⁴¹ to photograph the posture of his horses in motion at his ranch in Palo Alto, California, to determine whether all four hooves left the ground while trotting and galloping. Muybridge and Stanford published their initial results in the *Alta California*, a local, daily newspaper, on April 7, 1873.⁴² Four years later, in July of 1877, they improved the conditions

film using rotating mirrors on a timer.

⁴¹ Leland Stanford served as Governor of California from January 1862 to December 1863 according to the *Dictionary of American Biography*, Vol. XVII (New York: Charles Scribner's Sons, 1935), 502.

⁴² John Ott, "Iron Horses: Leland Stanford, Eadweard Muybridge, and the Industrialised Eye," *Oxford Art Journal* 28, no. 3 (2005): 410 and Marek Pytel, "Eadweard Muybridge: Inverted Modernism and the Stereoscopic Vision," *Early Popular Visual Culture* 11, no. 1 (2013): 72. According to Pytel, Muybridge was first successful in documenting the galloping stride of Leland's horse, *Occident*, at the Sacramento Union Park Racecourse on April 7, 1873.

of their experiment, both theoretically, including multiple, sequential images, and physically with sheltered camera locations, a consistent backdrop, and improved shutter triggers. Using photographic evidence in a carefully controlled and repeatable experiment, these images provided scientific proof that a horse is suspended in the air while moving at higher speeds, briefly flying through the air, if only for an instant. The evidence was compelling; looking at a photograph was like seeing it with one's own eyes, unlike the pneumatic graphs established by Marey's experiments.

Assisted by Stanford's engineers, Muybridge designed his experiment with the express purpose of unveiling the mysteries of the movements of the legs of horses; however, the spatial-temporal arrangement of cameras and the resulting images revealed much more about the nature of space and time than he had perhaps initially intended. Within a darkened shed, twelve cameras were activated by twelve trip wires that released weighted and spring-loaded shutters on each lens as the horse broke through each wire. **(Figure 3.3)** In addition, each camera was outfitted with two lenses, each exposing a separate wet, glass plate negative.⁴³ The arrangement of the two lenses would have enabled a stereoscopic view, able to simulate three-dimensions by mimicking binocular vision;⁴⁴ however, the two lenses also served as a precaution in the case of a mechanical malfunction allowing Muybridge to select the best image from each pair. Meanwhile, the shed containing the cameras was outfitted as a dark room to ensure the best results produced while members of the press observed. Using spring-loaded camera shutters, Muybridge was able to capture a small fraction of time, reportedly one one-thousandth of a second, revealing what the eye cannot see.⁴⁵ While the arrangements of the experiment

⁴³ Anita Mozley, "Introduction to the Dover Edition," in Eadweard Muybridge, *Muybridge's Complete Human and Animal Locomotion* (Dover Publications: New York, 1979 [1887]), xvii.

⁴⁴ Pytel, "Eadweard Muybridge: Inverted Modernism and the Stereoscopic Vision," 71–76.

⁴⁵ Although the exact timing of the shutter speed is unknown, John Ott cited 1/1000th of a second in, "Iron Horses: Leland Stanford, Eadweard Muybridge, and the Industrialised Eye," *Oxford Art Journal* 28, no. 3

controlled the capture of each image as the horse traversed an equal distance in space, the time element was less controlled, relying on the unlikely consistency of the speed of the horse with each and every stride. Fulfilling their stated purpose, Muybridge and Stanford captured the variety of positions that the legs of the horse assumed, while galloping, including when all four legs leave the ground in the inelegant position of being curled up under the body.



Figure 3.4: (left) Eadweard Muybridge, *Leaping Woman*, *Animal Locomotion*, 1887.

Later in his studio in Philadelphia, Pennsylvania, inspired by this work at the horse track, Muybridge reproduced these experiments using animal and human subjects, male and female, young and old, performing everyday activities in the nude, or nearly nude, for the scientific purpose of recording the subtleties of the movements of their flesh. Like Marey, Muybridge refined the conditions of his experiments, painting the background wall and floor black with a grid of white lines to more easily measure the distances traversed. In this sense, Muybridge remained committed to the measurement of space, while Marey consistently sought to more

(2005): 410, based upon documentation in the initial newspaper articles: "Occident Photographed at Full Speed," *Alta California*, 3 August 1877, 2 and "A Triumph of Photographic Art," *San Francisco Bulletin*, 3 August 1877, 3.

accurately control time in his experiments. **(Figure 3.4)**

In 1878, Muybridge published his earliest studies under the title, *The Horse in Motion: First Successful Photographs of an Animal in Motion, Forerunner of the Motion Picture*, a modest series of six cards containing fifty-six images. Several copies of those photographic plates that were held in the United States Library of Congress made their way to the European capitals, as evidenced by the publication of critical reviews, both favorable and unfavorable.⁴⁶ In an attempt to aid in the positive spread of his ideas and inventions, in 1879, Muybridge himself published an article in the Parisian journal, *Nature*, "Photographies instantanées des animaux en mouvement" (Instantaneous Photographs of Animals in Motion).⁴⁷ Three years later, Muybridge embarked on a lecture tour making well-attended presentations in many of the major capitals.⁴⁸ At the invitation of painter Jean-Louis-Ernest Meissonnier, Muybridge visited Paris; Meissonnier had just completed a portrait of Leland Stanford.⁴⁹ During this trip, Marey hosted a presentation of Muybridge's work at his own residence.⁵⁰

⁴⁶ Eadweard Muybridge, *The Horse in Motion: First Successful Photographs of an Animal in Motion, Forerunner of the Motion Picture*, 1878, LOT 3081 (F) [P&P], Prints and Photographs Division, Library of Congress, Washington, DC. Also referenced in Eadweard Muybridge, *Descriptive Zoöpraxography, or the Science of Animal Locomotion Made Popular* ([Philadelphia]: [University of Pennsylvania], c. 1893), 21–22. Muybridge, née Edward James Muggeridge, was born in 1830 in Kingston on Thames and moved to the United States of America in 1850 at twenty years of age.

⁴⁷ Eadweard Muybridge, "Photographies instantanées des animaux en mouvement" [Instantaneous Photographs of Animals in Motion], in *Nature* (Paris), 1879, 246.

⁴⁸ From the articles cited in the "Appendix: Abbreviated Criticisms," in *Descriptive Zoöpraxography, or the Science of Animal Locomotion Made Popular*, ([Philadelphia]: [University of Pennsylvania], c. 1893), 4–34, Muybridge lectured in London, Dublin, Edinburgh, Paris, Berlin, München, and Vienna. As noted in print, these lectures were attended by artists, scientists, military officers, politicians, and royal families across Europe.

⁴⁹ Muybridge, *Descriptive Zoöpraxography, or the Science of Animal Locomotion Made Popular*, ([Philadelphia]: [University of Pennsylvania], c. 1893), 22 and John Ott, "Iron Horses: Leland Stanford, Eadweard Muybridge, and the Industrialised Eye," *Oxford Art Journal*, 415.

⁵⁰ Muybridge, "Abbreviated Criticisms," in *Descriptive Zoöpraxography, or the Science of Animal*

During his European sojourn, Muybridge unveiled his new invention, the zoöpraxiscope, an early film projector.⁵¹ Reproducing silhouettes of his chronophotographs on the outer edge of sixteen inch glass disks, the zoöpraxiscope would rotate the disks while projecting light through them, thereby reanimating the still photographs as moving images on a projection wall.⁵² The changing diameter of the glass disk required that these still images be manipulated by tapering the image, in order to overcome the radial distortions. In addition, the speed of the spinning disk produced a compression of the image lengthwise, which in turn Muybridge overcame by lengthening the image. In the end, the silhouettes were both stretched and splayed.⁵³ In the manipulation of these images, Muybridge revealed the visual distortions that persist in the perception of movement. Replaying a temporal sequence of still images, further revealed the slowness of visual perception, unable to determine the location of the legs of a galloping horse and equally unable to distinguish the individual still images when played in a quick sequence, but rather interpreting the differences in each still image as animated movements.

In conjunction with the World's Columbian Exposition in Chicago, Illinois, in 1893, Muybridge published a short treatise on *Descriptive Zoopraxography, or the Science of Animal Locomotion Made Popular*, including eleven pages of endorsements, the signatures of leading American politicians, military figures, industrialists, as well as international artists and scientists, including

Locomotion Made Popular, 50: "'Professor Marey invited to his residence a large number of the most eminent men in Europe for the purpose of meeting Mr. Muybridge, and witnessing an exhibition that should be placed before the whole Parisian public.' — *Le Globe*, Paris."

⁵¹ Of course, there were many forerunners to Muybridge's invention of the zoöpraxiscope, such as stroboscopes, kinetoscopes, and phenakistoscopes as discussed in Ott, "Iron Horses: Leland Stanford, Eadweard Muybridge, and the Industrialised Eye," 407.

⁵² At first, Muybridge used sixteen-inch glass disks, but he soon switched to a smaller, twelve-inch disk, for reasons related to durability and economy.

⁵³ In addition to selling the zoöpraxiscope machines, Muybridge created many novelty disks for sale featuring galloping horses, dancing couples, and acrobats, eventually adding figures painted with life-like colors to his repertoire.

architects H. H. Richardson and John Ruskin, sculptor A. (Auguste) Rodin, inventor Thomas E. Edison, and previously mentioned figures such as (Etienne-Jules) Marey, W. (Wilhelm) Wundt, H. v. (Hermann von) Helmholtz, and E. (Ernst) Mach testifying to the broad appeal of these visual experiments and inventions.⁵⁴

In addition to Moholy-Nagy's depictions of twins suggesting also a single person who inhabits two positions at two moments of time, akin to Muybridge's and Marey's notions of movement over time, the scientific researches of Wundt, Helmholtz, and Mach also featured prominently in the work of Moholy-Nagy, especially in relation to the perception of space-time pertaining to the potential for photography. In an appeal to artists to work closely with scientists to perform their own experiments on the psychophysical effects of time through the manipulations of the effects of light, optics, and new materials, Moholy-Nagy gave several examples to follow in a marginal note in *Vision in Motion*:

Sometimes a whole chain of successive influences can be traced from science—to technology—to art—and back again to science. Examples can be found in the research of photographic speed exposures such as that of Muybridge, Thomas Eakins, and the industrial motion studies of Taylor and Gilbreth which were transferred into art by the futurists around 1912. This in turn influenced scientific studies resulting in the stroboscopic photodiagrams of Harold Edgerton, MIT.⁵⁵

Following this statement, Moholy-Nagy provided a few further examples of productive benefits of artistically working through scientific ideas including the influence of Helmholtz's optical theories prompting Auguste Rodin to experiment with alternative chiseling techniques to achieve the effect of a transparent shadow. In an effort to overcome the over-simplified

⁵⁴ Muybridge, *Descriptive Zoöpraxography, or the Science of Animal Locomotion Made Popular*, i–xi.

⁵⁵ *Ibid.*, 31.

polarization found in popular dichotomies, such as a “chaotic nature” viewed as the antithesis of “organized machine,” Moholy-Nagy encouraged his readers to educate themselves on scientific matters, not to accept the stereotypical separation of artists and scientists.⁵⁶ At which point, he returned to elaborate on his thesis, framed by the artist as scientist (*Gesamtwerk*), that Muybridge’s photographs provided a “rendering of vision in motion... [in the sense that] [t]hese representations produce [a] visual synopsis which engenders a simultaneity of grasp.”⁵⁷ By this provocative phrase, “the simultaneity of grasp,” Moholy-Nagy appears to conjure the immediacy of direct experience, eliciting the power of the haptic experience in the “simultaneous vista,” the superimposition of multiple views over time, or alternatively through the implication of movement in space, similar to coordinating orthographic projections, and, therefore, suggesting a temporal experience in the moment of an encounter.⁵⁸ In *Malerei, Fotografie, Film*, Moholy-Nagy equated time-based distortions with the many experimental possibilities for photography, including:

Festhalten von Situationen, von Realität; Zusammenfügen und Aufeinander- und Nebeneinander-projizieren; Durchdringung; organisierbare Szenenverdichtung; Überrealität, Utopie und Scherz (hier ist der neue Witz!); objektive, aber auch expressive Porträts; Werbemittel; Plakat; politische Propaganda; Gestaltungsmittel für Foto-Bücher, d. h. Fotografien an Stelle des Textes; Typofoto; Gestaltungsmittel für flächige oder räumliche gegenstandslose absolute Lichtprojektionen; simultanes Kino usw. usw.⁵⁹ (recordings of situations, of reality; combined-, overlaid- and juxtaposed-projections; penetration; organized condensation of

⁵⁶ Ibid.

⁵⁷ Ibid., 121.

⁵⁸ Ibid.

⁵⁹ Moholy-Nagy, *Malerei, Fotografie, Film*, 1927, 34.

scenes: uber-reality, *utopia* and jests (here is the new wit!); objective, but also expressive portraits; advertising medium; posters; political propaganda; formative-medium for photo-books, that is to say, photographs in the place of texts; type-photo; formative-medium for planar or spatial objective, absolute projections of light; simultaneous film, and so forth, and so forth.)

To illustrate his points, Moholy-Nagy referenced several examples in his images section following the main text. In particular, there were two types of images depicting visual distortions corresponding to the categories (see above). In the first type, there were three images of visual jokes, duplicating and combining exposures in skillful and clever ways to create the impression of physical distortions. In one image, three identical exposures of a man's head overlap to create one monstrous head with four eyes, three noses, and three mouths. In two others, sections of the photograph are repeated producing absurdly seamless elongations: a horizontal stretching of the torso of a horse and a vertical lengthening of a man's head, achieved by stacking multiple pairs of his eyes with the curious caption, "Der Übermensch, oder der Augenbaum" (superman, or the tree of eyes). **(Figure 3.5 + 3.6)** In the second type of visual distortion, three photographs included reflective surfaces: two images of a mirrored surface of a sphere revealing an entire room in one point of view and one image of a glass vanity table with a small circular mirror each reflecting in the other. **(Figure 3.6)** These witty visuals are unsettling in a similar way to literary puns: the mind is forced to oscillate between its recognition of, for instance, the features of a human face and the visual distortions created by multiplying the eyes. In other words, these distortions require the mind to pause in order to decipher the image, attempting to reconcile what is assumed, from experience, to be a typical condition with an atypical, anomalous condition, thwarting the mind's tendency toward apperception, re-training the mind to actively and directly engage with the image.

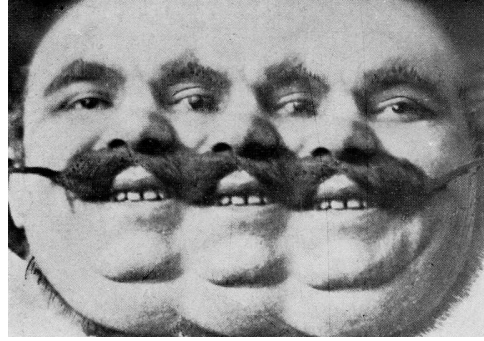
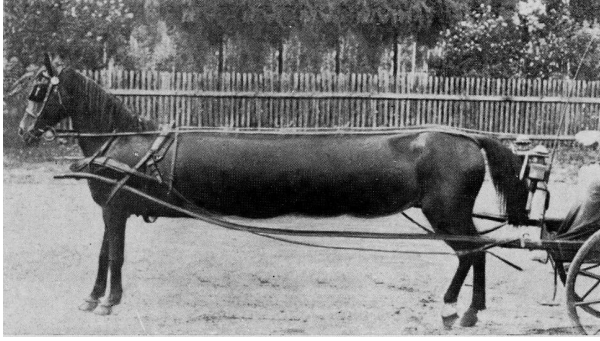


Figure 3.5: (left) "Ein Pferd, das kein Ende nimmt" + (right) "Das fixierte Lachkabinett," London, Keystone View Company aus Hackebeils Illustrierter in László Moholy-Nagy, *Malerei, Fotografie, Film*, München, Verlag Albert Langen, 1927.

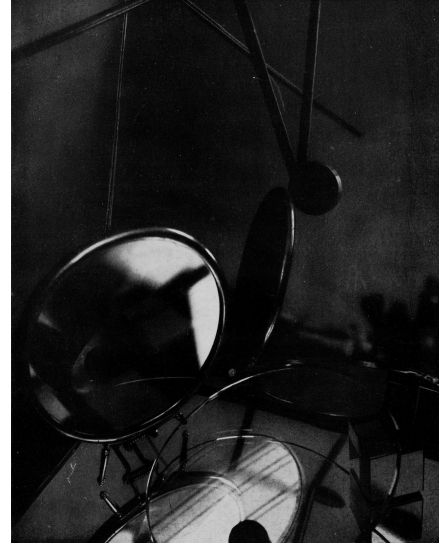
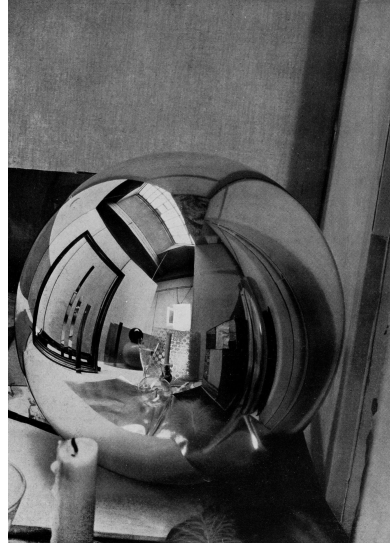
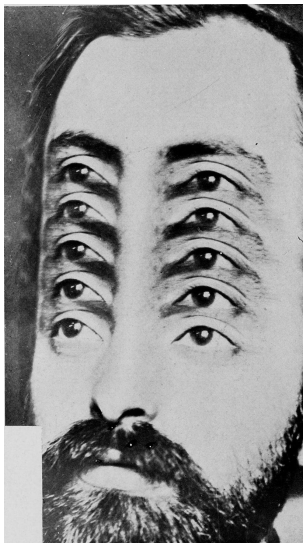


Figure 3.6: (left) "Der 'Übermensch' oder der 'Augenbaum,'" London, Keystone View Company aus Hackebeils Illustrierter + (middle) Georg Muche, "Atelier in der Gartenkugel," + (right) László Moholy-Nagy, "Spiegel und Spiegelungen," in László Moholy-Nagy, *Malerei, Fotografie, Film*, München, Verlag Albert Langen, 1927.

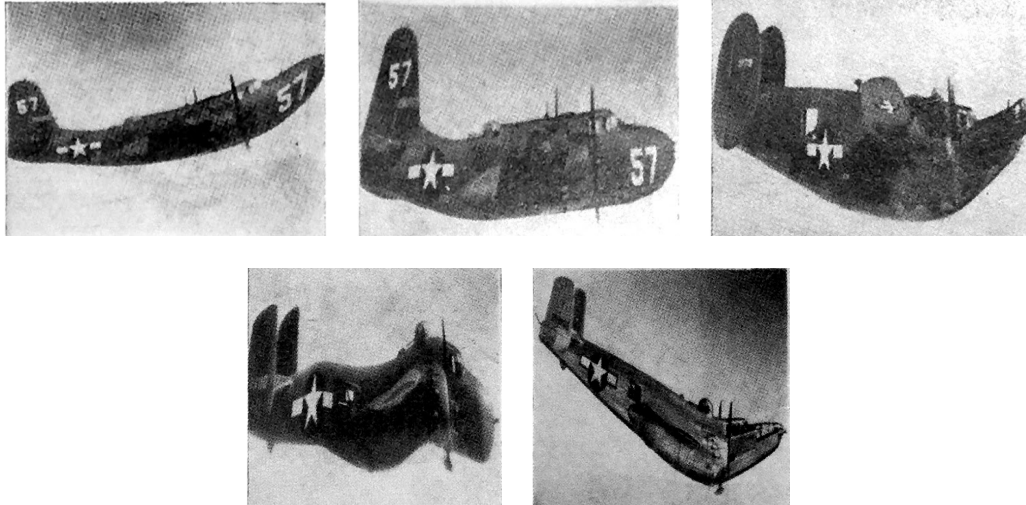


Figure 3.7: "Distortion Diagrams" in László Moholy-Nagy, *Vision in Motion*, Chicago, Paul Theobald, 1947.

In another image caption in *Vision in Motion*, Moholy-Nagy claimed that "[h]ere again: **distortion equals motion**," referring to five doctored photographs of a B-52 bomber performing aerial maneuvers, such as pulling out of a nosedive.⁶⁰ In these images, the plane was elongated, condensed, and bent in a variety of exaggerated ways depicting, not only the internal forces at work in the material structure of the plane, but also, albeit in an exaggerated manner, the revelations that Einstein described in his Special Theory of Relativity, which demonstrated that when measuring space and time on independently moving coordinate systems, distortions occur in both space and time, leading to elongations and compressions. In this sense, Moholy-Nagy may be referring to Einstein's moving coordinate systems, when he claimed that "distortion equals motion." However, on another level, the series of photographs of a single plane going through a variety of changes also suggests movement and the passage of time as described by Bergson as an intellectual tendency, an apperception, establishing rhythm in space; and, if projected in a sequence moving at twenty-four frames per second, these images could be

⁶⁰ Moholy-Nagy, *Vision in Motion*, 1947, 256.

reinterpreted by the eye to reveal the aerial acrobatics of the B-52 airplane. **(Figure 3.7)**

To play upon similar haptic distortions on the stage, in "Theater, Zirkus, Variété," Moholy-Nagy called for circus high-jinks in rhythmically contrasting spectacles in order to psychophysically engross the audience in the performance, the 'total stage action:'

Als GESAMTBÜHNENAKTION vorstellbar ist ein großer, dynamisch-rhythmischer Gestaltungsvorgang, welcher die größten miteinander zusammenprallenden Massen (Häufung) von Mitteln — Spannungen von Qualität und Quantität — in elementar gedrängter Form zusammenfaßt. Dabei kämen als gleichzeitig durchdringender Kontrast Beziehungsgestaltungen von geringerem Eigenwert in Betracht (komisch-tragisch; grotesk-ernst; kleinlich-monumental; wiedererstehende Wasserkünste; akustische und andere Späße usw.).⁶¹ (As TOTAL STAGE ACTION, a larger, dynamic-rhythmic formation-process is imaginable, which the largest masses [accumulation] of the medium clashing together with one another — tensions of quality and quantity — summarizes in an elementary crowded form. With that came, as a simultaneously more penetrating contrast, a relationship-formation of lower intrinsic value in consideration [comic-tragic, grotesque-serious, petty-monumental; resurrecting water-arts; acoustic and other jokes and so forth].)

As examples, he referenced the works performed in circus and vaudeville venues, specifically mentioning Chaplin and the Fratellini brothers, popular Italo-French circus clowns. As demonstrated, Chaplin used his comedy routines to reveal deeper sentiments about the dichotomies that often shortcut nuanced perceptions of good/ bad, beauty/ ugly, high/ low class, and wealth/ poverty.

⁶¹ Moholy-Nagy, "Theater, Zirkus, Variété," 1925, 52.

EXPANSION

In his collection of essays on comedy entitled, *Le rire: Essai sur la signification du comique* (Laughter: Essays on the Signification of the Comic, 1900), Bergson analyzed the role of laughter and the comedic in maintaining a balance between flexibility and inflexibility in adherence to societal norms, using a variety of methods related to contrast, exaggeration, and degradation,⁶² common methods used by circus performers to engage the audience, by eliciting laughter. In Bergson's analysis of the comedic, laughter was categorized as a *geste social* (social gesture), a collective response triggered by the recognition of a mechanical condition, of automatism in the words or actions of a person with the intention of training society to be, in his words, more flexible or more elastic, and, in other words, more adaptable toward the goal of maintaining acceptable social norms and shunning any hint of separatist tendencies.⁶³ Although society uses laughter, among other means, to train its members to adhere to its ideals, Bergson described the recognition of this tendency toward mechanization, this automatism, as an opportunity for comedy to play off of the machine-like mindlessness of instinctual or habitual patterns in the identification of *forms*, expectation of *attitudes*, predictions of *movements*, expectancy of *actions*, assumptions within *situations*, and, in particular, anticipation of the use of language, as it falls into well-worn patterns and phrases.⁶⁴

Expanding upon this notion of automatism as "mechanical inelasticity," Bergson gave the

⁶² Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, trans. Cloudesley Brereton and Fred Rothwell (New York: MacMillan Company, 1914), vi, originally published as *Le Rire: Essai sur la signification du comique* (Paris: Ancienne Librairie Germer Baillière et Compagnie, 1900). Due to its popularity, *Le rire* was quickly translated into English (1900), Russian, Polish, German as *Das Lachen*, by Julius Frankenberger and Walter Fränzel, was published in Jena in 1914 by Eugen Diederichs, and, as mentioned previously, Hungarian in 1913 by *Galilei Kör* member Valéria Dienes.

⁶³ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 20.

⁶⁴ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 67–68.

example of a person who stumbles and falls in the street, thereby, eliciting laughter from any nearby spectators.⁶⁵ Bergson described this person as acting in an automatic fashion, walking along mindlessly, and therefore, unable to see and to quickly adapt to changes in the terrain. While, on the one hand, this form of accidental comedy remains on a somewhat superficial level, it can play out in more profound comedic strategies, for instance, if a person were out of step with time, living in the past moment, reacting too slowly to the present situation, always out of context, in a state of comedic absentmindedness.⁶⁶ Expanding upon the idea of presence/absence, Bergson reminded the reader of what Freud had written in reference to Thales of Mileto:

Ce ne sont plus, purement et simplement, des *absences*; elles s'expliquent par la *présence* du personnage dans un milieu bien défini, quoique imaginaire. Sans doute une chute est toujours une chute: mais autre chose est de se laisser choir dans un puits parce qu'on regardait n'importe où ailleurs, autre chose y tomber parce qu'on visait une étoile.⁶⁷ (They are no longer cases of absence of mind, pure and simple; they find their explanation in the presence of the individual in quite definite, though imaginary, surroundings. Doubtless a fall is always a fall, but it is one thing to tumble into a well because you were looking anywhere but in front of you, it is quite another thing to fall into it because you were intent upon a star.)⁶⁸

In this way, every person who slips and falls participates in the absentmindedness of the star-

⁶⁵ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 8.

⁶⁶ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 8–11.

⁶⁷ Henri Bergson, *Le Rire: Essai sur la signification du comique*, ed. Félix Alcan (Paris: Ancienne Librairie Germer Baillière et Compagnie, 1900), 11.

⁶⁸ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 13.

gazer, the dreamer, the idealist, who is physically present, yet psychically absent; and, in this sense, such counter-logical mishaps inspire "hilarity capable of unlimited expansion."⁶⁹

These two laughter-inducing examples illustrate the notion of being out of sync with time and/ or space, absent in some way from body, which is merely performing in a mechanical fashion. As a social gesture, laughter brings the person back into time and space, producing a realization, an awareness of being present in the present circumstances, a self-awareness. While Bergson enigmatically used the phrase, "unlimited expansion," he may have been referring to an expansion of the present moment, as the Bergsonian concept of duration, as he described within a space-time experience:

La vie se présente à nous comme une certaine évolution dans le temps, et comme une certaine complication dans l'espace. Considérée dans le temps, elle est le progrès continu d'un être qui vieillit sans cesse : c'est dire qu'elle ne revient jamais en arrière, et ne se répète jamais. Envisagée dans l'espace, elle étale à nos yeux des éléments coexistants si intimement solidaires entre eux, si exclusivement faits les uns pour les autres, qu'aucun d'eux ne pourrait appartenir en même temps à deux organismes différents : chaque être vivant est un système clos de phénomènes, incapable d'interférer avec d'autres systèmes.⁷⁰ (Life presents itself to us as evolution in time and complexity in space. Regarded in time, it is the continuous evolution of a being ever growing older; it never goes backwards and never repeats itself. Considered in space, it exhibits certain coexisting elements so closely interdependent, so exclusively made for one another, that not one of them could, at the same time, belong to two different

⁶⁹ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 14.

⁷⁰ Henri Bergson, *Le Rire: Essai sur la signification du comique*, ed. Félix Alcan (Paris: Ancienne Librairie Germer Baillière et Compagnie, 1900), 90.

organisms: each living being is a closed system of phenomena, incapable of interfering with other systems. A continual change of aspect, the irreversibility of the order of phenomena, the perfect individuality of a perfectly self-contained series: such, then, are the outward characteristics — whether real or apparent is of little moment — which distinguish the living from the merely mechanical.)⁷¹

It may have been within this comedic notion of the mechanical, capable of eliciting a social gesture from the audience and in so doing the recognition of being alive, physically and psychically present in the moment, that Moholy-Nagy explored in the performance of the *Partiturskizze zu einer mechanischen Exzentrik*. Within this third scene, Moholy-Nagy envisioned wheels moving mechanically along tracks in order to spray “Düfte & | Niess | pulver | etc. | gegen | das | Publikum” (odors and sneezing powders, etc. toward the audience) through the nozzle of a hose was attached to one of the wheels. Both the mechanical movements of the apparatus and the fits of sneezing engage the audience body and mind, as spectators and performers in both the action and the musical accompaniment.

An extensive note in *Malerei, Fotografie, Film* may further enlighten Moholy-Nagy's aspirations for this scene, describing a means to wirelessly operate the wheels using the audible vibrations produced by the induction coil (Tesla sparks) from the previous scene. In this footnote, Moholy-Nagy outlined an invention by Danish scientist and inventor Poul La Cour known as the *Tonehjulet* (Phonic Wheel) or the La Cour Wheel.⁷² In “The History of the Phonic Wheel and Its Application to Synchronous Multiplex Telegraphy,” La Cour claimed:

1. Utilising the variable attraction between an electro-magnet and a permanently vibrating or oscillating body, such as a tuning fork, for the purpose of

⁷¹ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 88–89.

⁷² Moholy-Nagy, *Malerei, Fotografie, Film*, 1927, 23–24.

altering the period or rate of vibration or oscillation of the said body, the greater attraction giving the slower rate of vibration or oscillation substantially as described. 2. Varying the velocity of rotation of the phonic wheel by altering the distance between the polar extensions of the electro-magnets and the branches of the fork; or by varying the strength of the current that operates the tuning fork, substantially as described. 3. Regulating the velocity of rotation of the phonic wheel at the receiving station by means of a current from the transmitting station acting through a relay, whereby the strength of current operating the tuning fork at the receiving station is changed as required to render synchronous the rotation of the phonic wheel at the two stations, substantially as described.⁷³

The discovery of the *Tonehjulet* stemmed from La Cour's previous invention, which facilitated multiple simultaneous users on a single telegraphic wire patented in London in 1874, using tuning forks to sort out the frequencies of up to twelve different telegraphic operators. La Cour realized that he could use the tuning forks to activate electromagnets in such a way that these vibrations would incrementally advance the gears of a wheel, which he could synchronize across telegraphic wires. By maintaining a continuous electrical current, his invention was used to synchronize signals between telegraphic receivers.

However, playing off of this arrangement, a tuning fork could be activated periodically by sound vibrations in the air. If Moholy-Nagy intended to move the wheels wirelessly in the third scene of the *Exzentrik* using La Cour's *Tonehjulet*, he could utilize the sounds produced by the electrical arcs emanating from the proposed sparking induction coil. Each electric spark would produce a buzzing sound that could advance the wheels for that period of time, emphasizing the

⁷³ Paul [Poul] La Cour, "The History of the Phonic Wheel and Its Application to Synchronous Multiplex Telegraphy," *The Telegraphic Journal and Electric Review* XXI, no. 514 (September 30, 1887): 360. This invention was originally published in in 1878 in Danish and French pamphlets entitled: "Tonehjulet" and "La Roue phonetique."

mechanical nature of the forces at work through synchronization of the starting and stopping of the movements with the visual sparks followed by the slow anticipation of sneezes in the audience, the facial contortions, closing their eyes, wincing, and release in a cacophony of sneezes. This uncontrollable tension and release is reminiscent of Moholy-Nagy's poem, "Idegen titkok sűrgőnydrótjaként" (Like a Telegraph Wire Transmitting Strange Secrets, 1918), in which he imagines the electrical current of his desire for his lover coursing through his body, "pulsing, humming; my every moment alternating with the fire of her lust."⁷⁴

If this was Moholy-Nagy's intention, he may have further considered constructing the tracks on the ceiling, since the Phonic Wheel would work best on a vertical axle. Also, this arrangement would free the side walls of the theater for the projection of lights and images described in the notes to the printed *Exzentrik* and for the audience. In this third act, when the rhythmic sets of notes would have been played through the induction coil, as if it were a musical instrument, the wheels would move along the tracks and, perhaps when the notes jump higher at the end of each bar, the sneezing powders might have sprayed forth from the nozzle of the hose attached to one of the wheels, culminating in the final stretch of high notes, when there could have been a continuous showering of perfumed substances.

Since ancient times, sneezing powders had been created using different concoctions, mainly of toxic plant substances such as the root of the *Helleborus* (Hellebore) plant, that irritated nerve endings in the mucosal membranes of the nasal passages inducing an intense exhalation intended to expel the aggravating materials. For the Greeks and Romans, sneezing was considered a spontaneous sign from the gods that a person was speaking the truth, a belief evident in the Latin name for the white hellebore, *Veratrum album*, *verum* meaning truth, and immortalized by Homer with Telemachus' fortunate sneeze, after his mother warned her

⁷⁴ László Moholy-Nagy, "Idegen titkok sűrgőnydrótjaként," *Jelenkor*, no. 3/4, (February 1918), translated by Olver A. I. Botar in *Technical Detours: The Early Moholy-Nagy Reconsidered*, 26.

unwanted suitors of the return of her husband, Odysseus. After Penelope spoke about the vengeance that Odysseus and Telemachus would take on any who usurped his house, “Τηλέμαχος δὲ μέγ’ ἔππαρεν, ἀμφὶ δὲ δῶμα σμερδαλέον κονάβησε· γέλασσε δὲ Πηνελόπεια”⁷⁵ (Telemachus sneezed loudly, and all the room round about echoed violently. And Penelope laughed).⁷⁶ According to ancient traditions, Telemachus' sneeze was an irrefutable sign from the gods who operated through him to indicate their pleasure. In Bergson's categorization of laughter as a social gesture, Penelope laughed at the recognition of the mechanical in her son, acting as an automaton, a vessel lacking control of his own body, which was at the disposal of the gods.

Although toxic in higher doses, the sneezing effects of powders and elixirs made from the root of the *Helleborus niger* (Black Hellebore) plant had been recommended by Hippocrates to aid in childbirth, as well as expelling the afterbirth, and to cure a wide variety of psychophysical ailments including to end hiccups, to revive an unconscious person, and, through its cathartic effects, to alleviate hysteria and, even, insanity.⁷⁷ In this manner, the sneeze of the hellebore heralded a transformation within an individual.

Heightened by the initial tightening of the face, throat, and chest muscles, a sneeze produces a

⁷⁵ Homer, *The Odyssey*, transes. A. T. Murray and George E. Dimock (1919; repr., Cambridge, MA: Harvard University Press, 2004), 2: 194.

⁷⁶ *Ibid.*, 195.

⁷⁷ Hippocrates, *The Aphorisms of Hippocrates, from the Latin Version of Verhoof'd, with a Literal Translation on the Opposite Page and Explanatory Notes*, trans. Elias Marks (New York: Collins & Company, 1817), 109, 113, 127, 159. However, whether inhaled, absorbed, or ingested, all parts of the hellebore genus produce toxic alkaloids, which can result in vomiting, fever, convulsions, irregular heart rates, and cardiac arrest depending on the dosage and the health of the individual. Although these adverse effects were outlined by Hippocrates, similar conclusions were documented in more recent scientific literature, such as P. Carlier, M.-L. Efthymiou, R. Garnier, J. Hoffelt, and E. Fournier, "Poisoning with Veratrum-Containing Sneezing Powders," *Human Toxicology* 2, no. 2 (April 1, 1983): 324–325.

cathartic sensation as the lungs and nasal passages are cleared of mucus allowing breathing to feel more effortless. In this sense, a sneeze can feel like a new beginning, a fresh start, both mentally and physically. A combination of this transformative power of a sneeze and its instigation by the gods was explored in the myth of Prometheus, as it was embellished by the ancient Roman poet Ovid in his *Metamorphoses*, in which Prometheus' well-crafted clay figure of man came to life with a sneeze the moment that Athena bestowed it with wisdom.⁷⁸



Figure 3.8: Abel Gance, dir., *Le folie du Docteur Tube*, screenplay by Abel Gance, performed by Albert Dieudonné, 1915.

Avant garde director Abel Gance exaggerated the transformative effect of sneezing powders in his 1915 silent film, *Le Folie du Docteur Tube* (The Folly of Doctor Tube).⁷⁹ In this short film, a

⁷⁸ Ovid (Publius Ovidius Naso), *Metamorphoses*, ().

⁷⁹ Abel Gance, dir. *Le folie du Docteur Tube*, screenplay by Abel Gance, performed by Albert Dieudonné. 1915. In a note add to the 1927 revised edition of *Malerei, Fotografie, Film* (121), Moholy-Nagy referenced a film entitled, "Napoléon" (1927), in which Abel Gance used three film strips running simultaneously, side-by-

clown-like, mad scientist accidentally created a sneezing powder with the additional effect of changing how one sees the world. The comedy unfolds with his powdering himself, his dog, and his young assistant to their mutual hilarity. Docteur Tube then doused two unsuspecting female visitors who were horrified at what appeared to be their physical disfigurement as they examined themselves in handheld mirrors. **(Figure 3.8)** Dropping a large quantity of the powder from the window of his laboratory, Docteur Tube showered their two male suitors waiting below, prompting the men to storm into the apartment to find that their companions were also afflicted. After the effects of the powder wear off, with Docteur Tube partially confined in a large birdcage, the two couples sit down to drink and be merry, laughing at their odd experience and perhaps relieved that they were 'back to normal.' Shooting these scenes through prisms and various refracting lenses, the audience was able to see the distorted world, as if it had also been doused with the white powder.

Over the years, much like Docteur Tube, sneezing compounds had been stumbled upon by accident, such as the infamous Cachoo sneezing powder extracted from a dye made from a coal-tar derivative, that happened to make workers, who were handling the substance, sneeze, by Danish-American inventor of all manner of practical joker devices, Søren Adam Sørensen in 1910. Cachoo launched a sneezing powder craze in the United States and Germany over the next decade.⁸⁰ While operating from a different historical tradition, without the divine symbolism given by the ancients, an uncontrollable sneeze, especially a prolonged sneezing fit, when unrelated to the possibility of grave illness, elicits laughter from those nearby. Hence, the lasting prominence of the sneezing powder practical joke.

Capitalizing on the comedic and cathartic power of the sneeze, Moholy-Nagy brought the

side, as embodying some of the goals of his *Dynamik der Gross-Stadt*.

⁸⁰ Maurice Zolotow, *It Takes All Kinds* (New York: Random House, 1952). Cachoo is no longer available due to its toxicity. See also <http://qi.com/infocloud/practical-jokes> accessed on August 28, 2018.

audience to a point of climax in the action, appropriate to the third act of the *Exzentrik*, while simultaneously opening the spectators, who have become equal participants, to new sensory experiences. Succumbing to bouts of sneezing, their eyes would have been forced to close, much like Stephen Dedalus, compelled to listen his way along the shoreline, left wondering if the world around him as he knew it still existed at all. The audience of the *Exzentrik* would have been positioned to wonder about the world as they knew it, ready to open fresh eyes, as well as fresh ears, noses, tongues, and skins, capable of overcoming the tendency toward apperceptive interpretations of sensory stimuli and finally perceiving the world objectively. The sneezing fits would have been capable of re-situating the spectator in his/her body with a heightened awareness of themselves and their surroundings. In this sense, in the third act, Moholy-Nagy would have produced a "hilarity capable of infinite expansion" as described by Bergson,⁸¹ upon which point he would demonstrate the existence of the spatial fourth dimension.

In the *Manifeste dimensioniste*, Charles Sirató called for every artist to raise their work to the next higher dimension equating traditional forms of poetry with the one-dimensional, presumably the line of text, painting with the two-dimensional, due to its planar surface, and sculpture with the three-dimensional, being an object in space. In practice, these strict boundaries had already been crossed, in some cases for millenia. However, in the previous twenty years, European artists had been pushing the so-called dimensional limits with their work, and each of the signatories to the manifesto had been engaged in redefining the activities of poetry, painting, and sculpture. Sirató acknowledged as much on the verso side of the *Manifeste dimensioniste*, when he wrote:

LE DIMENSIONISME n'est pas un mouvement voulu, créé, ou dirigé; c'est une evolution qui depuis longtemps existait sous forme latente. Le Manifeste est en réalité une constatation générale, déduite des œuvres de certains artistes

⁸¹ Henri Bergson, *Laughter: An Essay on the Meaning of the Comic*, 1914, 14.

avancés, et, en même temps, un élargissement des idées initiales dérivées de la littérature à deux dimensions.⁸² (DIMENSIONISM is not a desired, created, or directed movement; it's an Evolution that long existed in latent form. The Manifesto is actually a general observation, deduced from works by certain advanced artists, and, at the same time, an enlargement of initial ideas derived from literature in two dimensions.)⁸³

Upon arriving in Paris in August of 1930, Sirató found that other artists had been laboring to break the traditional boundaries of poetry, painting, and sculpture observing affinities with his own planar poetry. To project his ideas, Sirató had written *A glogoizmus* in 1928, also known as *A Glogoista Manifesztum* (The Glogoist Manifesto), which was later translated into French as *Le Planisme* (Planism, 1936). In this manifesto, Sirató outlined the potential of poetic verse as a visual-spatial image, organizing the lines of words with geometric figures. **(Figure 3.9)** The *síkvers* (plane poem) and the *villanyvers* (electric poem) were intended to lift poetry out of its own traditions. The *síkvers* regarded the paper itself as a two-dimensional plane, a surface on which to construct ideas through the meaningful arrangement of words and images. The *villanyvers* would be exemplified by the electric advertising placard, where words and images were traced with light bulbs and tubes arranged on billboards and even on the sides or tops of buildings, therefore existing in three-dimensional space.⁸⁴

⁸² Károly Tamkó Sirató (Charles Sirató), "Manifeste Dimensioniste," inserted in *Revue N + 1*, (Paris: Librairie José Corti, 1936). Available online at artpool.hu/TamkoSirato/, last accessed on September 5, 2018.

⁸³ See Appendix A for an English translation from the French, *Manifeste dimensioniste*.

⁸⁴ Károly Tamkó Sirató, "A glogoizmus," in *Papírember* (Békéscsaba, Hungary: Tevan, 1928). See Appendix H for an English translation from the Hungarian original.

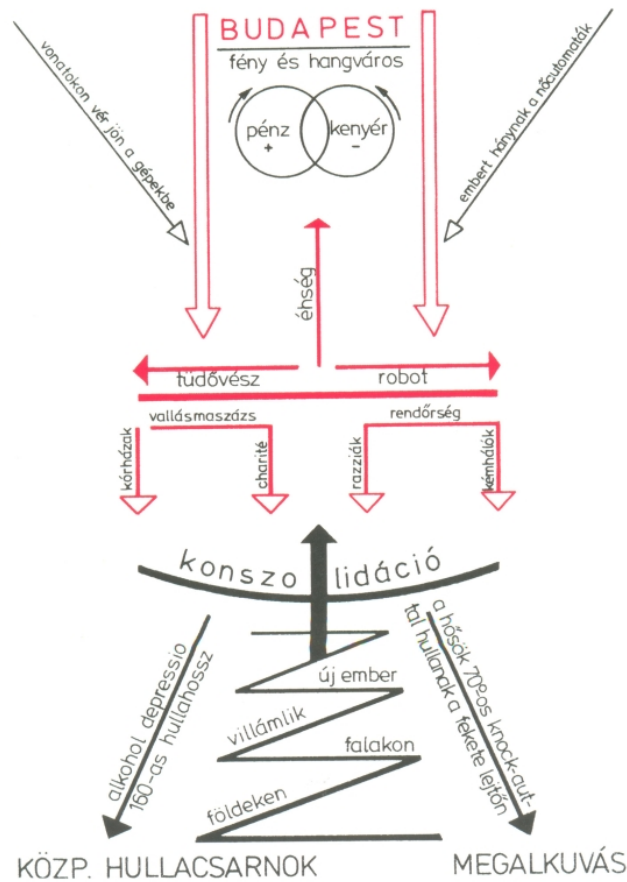


Figure 3.9: Charles Sirató, Budapest, 1927. Artpool Art Research Center, Budapest.

In Paris, Sirató recognized that this loose group of like-minded artists lacked a coherent manifesto that could guide their work and inspire the work of others, as his “A glogoizmus” had been conceived.⁸⁵ To that end, in writing the *Manifeste dimensioniste*, Sirató expanded upon the dimensional ideas that were nascent in “A glogoizmus” and deepened the clarity of their relationship to space-time analogies discussed previously in the works of Hermann Minkowski and non-Euclidean demonstrations of János Bolyai. Building upon demonstrative geometric analogies projecting the possibility of the fourth dimension as posited by mathematicians and

⁸⁵ Károly Tamkó Sirató (Charles Sirató), *Az első Dimenzionista Album*, (unpublished manuscript, 1966), accessed August 30, 2018, <http://www.artpool.hu/TamkoSirato/content.html>.

physicists, the *Manifeste dimensioniste* provided an organizational logic for potential avenues for a four-dimensional artwork, a new art based on a new vision in concert with the other senses, to which he gave the name, cosmic art:

Ensuite doit venir la création d'un art absolument nouveau: L'Art Cosmique.
(Vaporisation de la Sculpture, Théâtre Synos-Sens dénominations provisoires). La conquête totale par l'art de l'espace à quatre dimensions un « Vacuum Artis » jusqu'ici. La matière rigide est abolie et remplacée par les matériaux gazéifiés. L'homme au lieu de regarder des objets d'art, devient lui-même le centre et le sujet de la création et la création consiste en des effets sensoriels dirigés dans un espace cosmique fermé.⁸⁶ (And after this a completely new art form will develop: Cosmic Art. (The Vaporization of Sculpture, Synos-Sense Theatre, provisional denominations) [The total conquest of four-dimensional space by] / to date an artistic vacuum /. Rigid material is abolished and replaced by vaporized materials. Instead of looking at objects of art, the person becomes the center and the subject of creation, and creation consists of sensorial effects operating in a closed cosmic space.)⁸⁷

For Sirató, Dimensionism grew organically, as an undirected movement, a sentiment that he spelled out in the *Manifeste dimensioniste* and returned to in his later compilation, *Az első Dimenzionista Album* (The First Dimensionist Album, 1966). As such, according to Sirató, the *Manifeste dimensioniste* merely concentrated and called attention to what had been developing spontaneously with avant garde artists and, in his opinion, would have continued to

⁸⁶ Károly Tamkó Sirató (Charles Sirató), "Manifeste Dimensioniste," inserted in *Revue N + 1*, (Paris: Librairie José Corti, 1936). Available online at artpool.hu/TamkoSirato/, last accessed on September 5, 2018.

⁸⁷ Charles Sirató, "The Dimensionist Manifesto," trans. Oliver A. I. Botar's in Vanja Malloy, ed., *Dimensionism: Modern Art in the Age of Einstein*, 171.

strengthen through the type of cohesive leadership he could have provided if it weren't for the circumstances of his illness and the difficulties of the second world war.⁸⁸

As it happened, Sirató returned to the themes of the *Manifeste dimensioniste* thirty years later attempting to document the emergence of dimensionism from his own *síkvess*, the circumstances surrounding his time in Paris when he composed the manifesto, the conversations that he had with each signatory, and examples of dimensionist artworks. Of Moholy-Nagy, Sirató wrote that he had self-identified with all of Moholy-Nagy's work, resonating with sympathetic dimensional themes. According to a recent reconstruction of the illustrative materials from the album from photographic documentation, Moholy-Nagy's various works in painting, kinetic sculpture, and the total theater appear prominently in three of the four dimensional sections. Interestingly, in the section on non-Euclidean arts in one-dimension, Sirató had included a diagram of *Finnegans Wake* created by Leslie Llewellyn Lewis, who briefly lectured on Joyce's writings at the Institute of Design in 1945, while Moholy-Nagy was the director.⁸⁹ **(Figure 3.10)** In *Vision in Motion*, Moholy-Nagy had also featured Lewis' *Finnegans Wake* diagram and another chart outlining Joyce's *Ulysses* in his section on "Literature." In *Az első Dimenzionista Album*, Sirató recalled that, when Moholy-Nagy visited him in Paris bringing him materials for the first issue of *N + 1* (c. 1935), he had recommended to Sirató that they shared affinities with James Joyce and mentioned *Finnegans Wake*, prompting Sirató to seek out the text when he returned to Budapest and to include Lewis' diagram of *Finnegans Wake* in his album due to its affinity with his own planar poems.⁹⁰

⁸⁸ Károly Tamkó Sirató (Charles Sirató), *Az első Dimenzionista Album*, (1966), paragraph 7. Available online at artpool.hu/TamkoSirato/, last accessed on September 5, 2018.

⁸⁹ Moholy-Nagy, *Vision in Motion*, 1947, 347 and Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 619: Lewis gave five Tuesday night lectures at the Institute of Design in Chicago on March 6, 13 and April 3, 10, 17, 1945.

⁹⁰ Károly Tamkó Sirató (Charles Sirató), *Az első Dimenzionista Album*, (unpublished manuscript, 1966),

To exemplify four-dimensional non-Euclidean art, Sirató featured projective, kinetic, and magnetic sculptures, as well as transformative theater spaces.⁹¹ As such, Sirató included a still photograph of Moholy-Nagy's *Lichtrequisit einer elektrischen Bühne* (Light-Prop for an Electric Stage, 1928–30), but he admitted that his collection was limited by the contents of art journals that were available in Budapest in 1965. Sirató described his first and only album as limited and would in no way suggest that artworks that were not included lacked the Dimensionist form and/or spirit. While Sirató mentioned his own ideas for an *összérzékszerv-színház*, more literally meaning total sense-organ theater, he did not include Moholy-Nagy's *Partiturskizze zur einer mechanischen Exzentrik*, neither the *Photoplastik* nor the diagram published in *Die Bühne im Bauhaus* in 1925. The two theater designs included were translucent drawings for the total theater with translucent overlays by Farkas Molnár, also published in *Die Bühne im Bauhaus* alongside the *Exzentrik*, and a section drawing and a photograph of a solid model for a cocoon-like theater by André Bloc and Claude Parent.⁹² Molnar's translucent overlays would have appealed to Sirató's call for transparency in his "A glogoizmus." Although Molnar was killed in a bombing in 1945, it is possible that Molnar and Sirató were in touch, while Sirató was convalescing in Hungary.

Notwithstanding his apparent doubts about the direction of four-dimensional non-Euclidean art, in the printed version *Manifeste dimensioniste*, Sirató called for "[l]'Art Cosmique" (cosmic art), ultimately one that would be an exploration of four-dimensional space for which he gave two "provisional" examples: "Vaporisation de la Sculpture" (vaporization of sculpture) and "Théâtre

⁹¹ Károly Tamkó Sirató (Charles Sirató), *Az első Dimenzionista Album*, (unpublished manuscript, 1966), accessed August 30, 2018, <http://www.artpool.hu/TamkoSirato/content.html>.

⁹² Moholy-Nagy worked on the design for the *Lichtrequisit einer elektrische Bühne* for two years, enlisting the drafting assistance of Stephan Sebök and Otto Ball, soliciting funding for the construction from the Allgemeine Elektrizitäts Gesellschaft (AEG), a German electric company, and contracting its construction with the theatrical department of AEG. See Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 479–480.

Synos-Sens" (syno-sense theater).⁹³ In his chapter "Charles Sirató and the Dimensionist Manifesto," Oliver Botar argues that Sirató, inspired by art theorist and critic Arpád Mezei, brought together Bergson's duration and Minkowski's space-time in his formulation of vaporization in Dimensionism and that his friendship and collaboration with Camille Bryen brought automatism into the equation through a Surrealist "destabilization of the object."⁹⁴ In his "The History of the Dimensionist Manifesto, and Related Texts," Sirató recalled that:

Mikor aztán Bergson *Durée et Simultanéité* című könyvét elolvastam – amelyben a Minkowski-féle transzformációt elemzi és magyarázza –, akkor értettem meg korszerű koncepcióban, hogy mi tehát a síkművészet, és tulajdonképpen mi történt itt az én kétdimenziós verseimben az irodalommal.⁹⁵ (It was after I read Bergson's *Durée et Simultanéité* [Duration and simultaneity] – in which he analyzes and explains Minkowski's transformation – that I understood what planar was in a contemporary sense, and what actually happened to literature in my two-dimensional poems.)⁹⁶

Moholy-Nagy's *Lichtrequisit einer elektrischen Bühne* would suggest a vaporization of sculpture⁹⁷

⁹³ There is evidence that Sirató wavered on these two examples, which he called provisional in the printed version of the Manifeste dimensioniste. In the manuscript for this version, it appears that he, or someone, had scratched out "La Vaporization de la Sculpture." Alternatively, in the Hungarian version of the manifesto, Sirató did not include syno-sense theater, only listing "A Szobrászat Vaporizálása" (The Vaporization of Sculpture).

⁹⁴ Botar, "Charles Sirató and the Dimensionist Manifesto," in Vanja Malloy, ed., *Dimensionism: Modern Art in the Age of Einstein*, 26 and 32–33.

⁹⁵ Károly Tamkó Sirató (Charles Sirató), *Az első Dimenzionista Album*, (unpublished manuscript, 1966), accessed August 30, 2018, <http://www.artpool.hu/TamkoSirato/content.html>.

⁹⁶ Charles Sirató, "The History of the Dimensionist Manifesto, and Related Texts," translated by Oliver A. I. Botar in Vanja Malloy, ed., *Dimensionism: Modern Art in the Age of Einstein*, 199.

⁹⁷ Botar, "Charles Sirató and the Dimensionist Manifesto," in Vanja Malloy, ed., *Dimensionism: Modern Art in the Age of Einstein*, 26 and 35. Botar documents Sirató's opportunity to see the *Lichtrequisit* on display at

into the movement of lights and shadows and his *Partiturskizze zur einer mechanischen Exzentrik* would perfectly embody the notion of a syno-sense theater. The term *synos* relates to the Greek root, *σύν* (*syn*) meaning together, and *synos-sens* would then denote the bringing together of the senses in perception, which in English is often broadly referred to as *synaesthetic*, crossing traditional boundaries of the senses. In his *Zur Farbenlehre* (On Colors, 1810), German theorist Johann Wolfgang von Goethe proposed that sound and color tones shared the same frequency of vibration, explaining their sensory associations.⁹⁸ Sirato also acknowledged these vibrations:

Természetes, hogy itt nem légüres térre gondoltam, hanem földi térre, amely anyaggal és sugárzásokkal és erőmezőkkel telt. Ha pedig az ilyen tér elmozdításáról, helyesebben mozgásáról, érzékszervi variálásáról szó lehet, azt nyugodtan nevezhetjük: „anyag-zenének”. Az anyag itt tehát nem szilárd, hanem légnemű halmazállapotban kerül művészi hatáskeltésre. Nyilvánvaló, hogy ebbe az irányba, vagyis a négydimenziós téridő-kontinuum meghódítására a művészet csakis az euklideszi világkép egyetlen tér-művészetéből, a háromdimenziós szobrászatból haladhat szervesen. Ezt az új művészi hatást tehát most már nem tudtam másképpen néven nevezni, mint eredetére utalva így: **A SZOBRÁSZAT VAPORIZÁLÁSA**.⁹⁹ (Obviously, by space I did not mean some kind of void but real, earthly space saturated with matter, radiation, and force fields. If we talk about such space being moved, or more accurately being set into motion, and varying

the German Werkbund's exhibit at the *Exposition des Arts décoratifs* in Paris in 1930 or through photographs taken by Kertész, who attended and met with Moholy-Nagy.

⁹⁸ Johann Wolfgang von Goethe, *Goethe's Theory of Colours*, trans. Charles Lock Eastlake, originally published 1810 as *Zur Farbenlehre*.

⁹⁹ Károly Tamkó Sirató (Charles Sirató), *Az első Dimenzionista Album*, (1966), paragraph 7. Available online at artpool.hu/TamkoSirato/, last accessed on September 5, 2018.

it with the help of our sensory organs, we can call it "matter-music," where matter is used to create an artistic effect not in its solid but aeriform state. It was obvious that the only path in art that could organically lead in this direction, namely to the conquering of the four-dimensional space-time continuum, was through three-dimensional sculpture, which was the only "Space-art" among the Euclidean arts. I could not think of a better way to denote this new artistic effect than by referring to its origin, calling it "the vaporization of sculpture.")¹⁰⁰

In other words, Sirató was not proposing abstract explorations, merely hypothetically addressing the idea of the four-dimension of space, but rather an art that engaged with the terrestrial reality, suggesting that electrical vibrations or other invisible forces would produce material paths toward new space-time experiments. Whereas previous dimensional categories imposed upon art, isolated art from the real, from multi-sensory, multi-dimensional experiences of space-time, Sirató called for crossing boundaries with non-Euclidean, realizing complexity by multiplying not dividing. It is in this syno-sense that Sirató wrote:

A művészetek életét, ugyanúgy, mint az emberiség szellemi fejlődésének folyamatát, a maga „sokszerűségében”, rétegeztségében és szövevényességében kell felfognunk. Talán egy delta-szerű, többsíkú tér-idomban kialakuló, egymásba át-átmenő jelenségek sorozatának (hogyan egy speciálisan a nemeuklideszi művészetek világából vett kifejezést használjunk), lüktető felületmozgásainak képzelhetjük el leginkább, ahol az egyes részmozgások nem zárják ki vagy nem semmisítik meg a többi részmozgásokat, hanem ellenkezőleg, egymással felületi és mély-feszültségi kapcsolatban lévén, magasabb egyensúlyt

¹⁰⁰ Charles Sirató, "The History of the Dimensionist Manifesto, and Related Texts," translated by Oliver A. I. Botar in Vanja Malloy, ed., *Dimensionism: Modern Art in the Age of Einstein*, 214.

teremtve – együtt adják ki a többsíkú delta-tömb teljes életritmusát.¹⁰¹ (The arts must be seen through their own diversity, in their layeredness and intricate nature – in the same way as the intellectual/spiritual development of humankind. Perhaps this whole thing can be best imagined as a series of phenomena metamorphosing into one another in a delta-like multiplanar solid (to use a term from the world of specifically non-Euclidean arts); as pulsating surface movements of the individual parts neither exclude, nor extinguish, other partial movements; on the contrary, a higher-level balance is created among the parts through their being linked by surface and deep tension, and the entire biorhythm of this multiplanar block is produced jointly by the partial movements.)¹⁰²

Another term that may be substituted for sokszerűségében is multitudes, recognizing space as the crossing over, under, and through of phenomena engaging the senses and the body through vibrations that are able to be interpreted and re-interpreted in many different ways, co-existing as Euclidean and non-Euclidean at the same time. In *Vision in Motion*, Moholy-Nagy described Joyce as containing multitudes, demonstrating through language the possibility of interpretation and re-interpretation of language and across languages. Moholy-Nagy claimed that Joyce's use of language was akin to Cubist collage fusing disparate elements into a new unity, which he characterized as follows:

The peculiarity of Joyce's language is its multiple meaning, achieved through the fusion of the external reality with the subconscious state in the form of the interior monologue—"stream of consciousness"—and the day dreams of an introvert, centripetally condensed. In this way situations—old and new—words and

¹⁰¹ Károly Tamkó Sirató (Charles Sirató), *Az első Dimenzionista Album*, (1966), paragraph 7. Available online at artpool.hu/TamkoSirato/, last accessed on September 5, 2018.

¹⁰² Charles Sirató, "The History of the Dimensionist Manifesto, and Related Texts," translated by Oliver A. I. Botar in Vanja Malloy, ed., *Dimensionism: Modern Art in the Age of Einstein*, 243.

sentences are recast and shifted to unexpected connotation, cunning, intricate, pouring out humor and satire. Flashing sparks from the subconscious, mixed with trivialities of routine talk, sharp-tongued gossip illuminate hidden meanings. Puns are of deep significance touching off liberating explosions.¹⁰³

Relating Joyce's intentions to the interpretation of ancient Roman law, necessitated by its terseness, Moholy-Nagy applied the Latin expression, "Glossas glossarum glossant" ("Interpretations of interpretations interpreted").¹⁰⁴ This intellectual process was required of the reader, engaging his audience in his revelations, which, according to Moholy-Nagy, would chart a path to see more, to develop the capacity in the audience for space-time thinking.¹⁰⁵ As such, Moholy-Nagy stated that "Joyce contained multitudes,"¹⁰⁶ invoking the words of Walt Whitman, who, in his poem, *Song to Myself*, included in the first edition of *Leaves of Grass* (1855), interrogated himself thusly: "Do I contradict myself? Very well then I contradict myself, (I am large, I contain multitudes.)."¹⁰⁷

¹⁰³ Moholy-Nagy, *Vision in Motion*, 1947, 341–342.

¹⁰⁴ *Ibid.*, 344.

¹⁰⁵ *Ibid.*, 346.

¹⁰⁶ *Ibid.*

¹⁰⁷ Walt Whitman, *Song of Myself* (East Aurora, NY: Roycroft Press, 1904), 69. Iván Hevesy's Hungarian translation of a selection from Walt Whitman's poem, "I Sing the Body Electric," appeared in *MA* (June 1918): 74–75.

IV. SPACE

Planar Rotation into the Fourth Dimension:
Revelations in the Shadows of the
Menschmechanik in the *Partiturskizze zu
einer mechanischen Exzentrik* [Act IV]

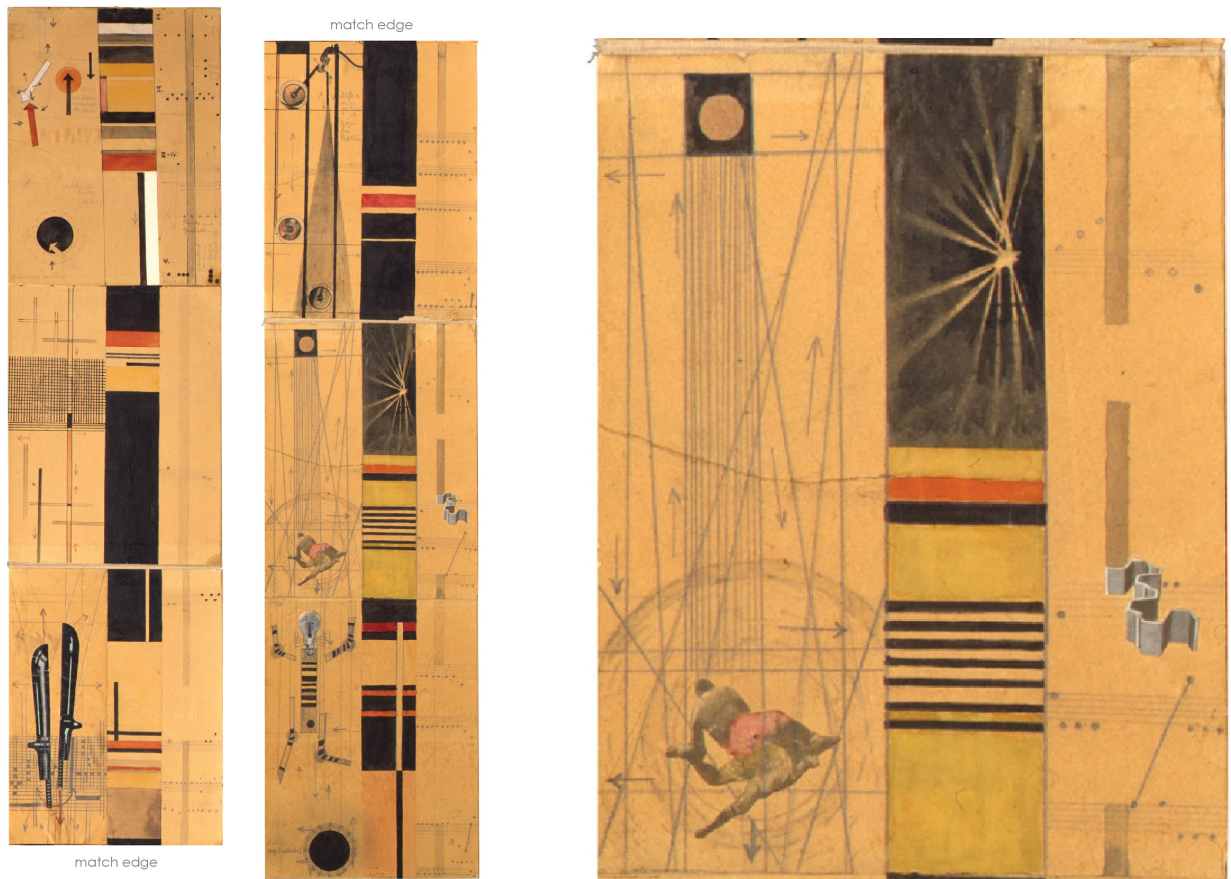


Figure 4.1: László Moholy-Nagy, Untitled, c. 1924, for complete caption see Figure 0.1 + Act IV Detail.

Following the sensory climax of the third act of the hybrid drawing of the *Exzentrik*, an openness toward new interpretations of the nature of space is especially important in the fourth act, featuring two men apparently in a wrestling position. **(Figure 4.1)** One man is clearly pinned down by the other, who is sitting on his back and holding onto his foot. There are ten small arrows drawn in graphite on the sheet revealing that there would be a lot of movement during this scene along the horizontal, vertical, and diagonal lines, as well as circular rotations. Six lines appear to form the spill of three spotlights originating from above: two are focused on the pair of wrestlers while one is just to the left of the couple. Another similar, yet wider, cone of light emerges from the bottom of the sheet completely encompassing the two men. In the second column, depicting the lighting effects, Moholy-Nagy had painted a burst of light rays emanating from the darkness of the black ink. Halfway down the panel, the darkness would have been interrupted by alternating colors of house lights, depicted with bands of yellow, one stripe of red, and black, producing something like a strobe effect. This spray of spotlights was the only deviation from horizontal and vertical bands in this column and alters the diagrammatic nature of these designations with a single illustrative image. In combination, the directions suggest an alternation of spotlights directed randomly around the stage and theater creating a strobe effect.

Also in the first column, describing the *Form + Bewegung* (Form + Movement), far over the head of the wrestler with the upper hand, Moholy-Nagy drew tightly spaced vertical lines projecting down from the bottom of a black square with a slightly off-center, rose-colored circle. These vertical lines are not diverging from a point as the other diagonal lines previously described as depicting the light from spotlights, suggesting that the black box might be different in type or intensity. In the printed version of the *Exzentrik*, Moholy-Nagy incorporated a "Kino auf Tageswand" (film-of-the-day wall) and slightly altered the depiction of this element. In the printed version, the black square was placed in the second column of the two columns describing forms and movements. **(Figure 0.16)** Within the square, there is a colorless circle that is

ringed by two offset circles creating two red arcs at the top and bottom edges. Four diagonal lines were drawn from the four corners of the black square to the edges of the column approximately at the horizontal position of the wrestlers in the first column. Under the black square and between the two centermost lines is a pale blue gradient emanating down but fading away before it reaches the wrestlers. This translation of images from the *Photoplastik* to the printed version combined with the note about a changing film-of-the-day, suggests that this square is denoting a film projector. If so, the film would project onto the upper torso of the man with the advantage in the wrestling match.

These two figures are positioned in the center of radiating circles with both solid and dashed lines like the lines painted to designating the boundary of a wrestling ring or a circus ring and recalling the circles surrounding the black circle in the prelude and similar radiating circles placed under the grid in the first act. However, in this fourth act, these circles demarcate the space of the action indicated by both the wrestlers frozen in position and three arrows pointing away from the figures and perhaps suggesting a pinwheel, spinning movement. In fact, wrestlers often pivoting in circles when repositioning themselves on their opponents. The printed version of the *Partiturskizze* includes two long arrows that present both clockwise and counterclockwise rotations.

With these indications, the column representing *Form + Bewegung*, and especially the movements of the wrestlers, exemplify Moholy-Nagy's ideas about *Raumgestaltung* (space formation). In *Von Material zu Architektur*, Moholy-Nagy not only listed the types of spaces inspired by his reading of Rudolf Carnap's *Der Raum*, he also began to articulate the shift of spatial experience from a static understanding to a dynamic positional relationship of bodies, volumes comprised of biotechnical elements described by Raoul Francé in his *Die Pflanze als*

Erfinder (Plants as Inventors, 1920).¹ Moholy-Nagy proposed adopting the definition of space found in physics, that “raum ist lagebeziehung von körpern” (space is the relationship of the positions of bodies), to develop a universal definition of space formation, “raumgestaltung ist die gestaltung von lagebeziehungen der körper (volumen)” (space formation is the formation of relationships of the positions of bodies [volumes]).² It is important to recognize in these definitions that Moholy-Nagy did not refer to the relationships of the positions of bodies *in space*, but rather these relationships are space. As such, space formation is not the creation of an envelope in which to place bodies, but rather space is the forming and reforming of these relationships.

Moholy-Nagy then elaborated on the role of senses in the experience of space or, in other words, in the experience of these relationships:

dem menschen wird der raum — die lagebeziehungen der körper — zuerst mittels seines gesichtssinnes bewußt, dieses erlebnis der sichtbaren lagebeziehungen kann durch bewegung: Veränderung der eigenen läge — und mittels des tastsinnes parallel erlebt, kontrolliert werden. ... von der Seite des Subjekts aus ist also raum am unmittelbarsten erlebbar durch bewegung, auf einer höheren stufe durch den tanz, der tanz ist gleichzeitig ein elementares mittel zur erfüllung raumgestalterischer wünsche. er kann den raum verdichten, ihn gliedern: der raum dehnt sich, sinkt und schwebt — fluktuierend in allen richtungen.³ (To the human being, space shall become known — by the relationships of the positions of bodies — first by the medium of his sense of sight, this experience of the visible relationships of the positions can be controlled through movement: change of one's own position — and by the parallel medium of the tactile sense. ... From

¹ Moholy-Nagy, *Von Material zu Architektur*, 1929, 195.

² Ibid.

³ Ibid., 195 footnote.

the side of the subject, space can be experienced most immediately through movement, on a higher level through dance, simultaneously dance is an elementary medium fulfilling a desire for the formation of space. It can intensify space, subdivide it: space lengthens itself, sinks and floats — fluctuating in all directions.)⁴

To the expanded English translation, Moholy-Nagy added the statement, "Variety, circus stage, cinema, light display can be of the same order of space creation,"⁵ after this passage, linking his ideas about the experience of space through the movement of the positions of bodies to his insights related in *Die Bühne im Bauhaus*. Further encompassing the senses of hearing and balance and alluding to other sensory experiences mentioned earlier, telepathic and atmospheric, Moholy-Nagy declared that "die bewußtmachung dieser bereiche wird u. a. auch der architektur große dienste leisten." (The formulation of the consciousness in these areas will perform great services, among others, also for architecture.) Recognizing a historic shift in architecture from the static forms of the past toward kinetic "raumgestaltung" (space formation), Moholy-Nagy proposed that the "organische raumerlebnis" (organic spatial experience) of space will become:

die tatsache einer kinetischen plastischen ausdrucksform führt zu der anerkennung eines raumzustandes, der nicht das ergebnis der lagebeziehungen von starren volumen ist, sondern von sichtbaren und unsichtbaren Wirksamkeiten der bewegungstatsachen und bewegungsformationen, unter umständen also aus beziehungen von kraftfeldern besteht.⁶ (The fact of a kinetic, plastic form of expression leads

⁴ Translated by author.

⁵ Moholy-Nagy, *The New Vision*, 2005, 163.

⁶ Moholy-Nagy, *Von Material zu Architektur*, 1929, 202.

to the recognition of a spatial condition that is not the result of the positional relationships of stationary volumes, but rather of the visible and invisible effects of the facts of movement and formations of movement, existing in between an understanding of the relationships of force fields.)

This definition of space, spatial formation, and spatial experience permeates the performance proposed in the hybrid drawing of the *Exzentrik*, in the simultaneity of movements of forms, showers of aromas, and vibrations of light and music, in addition to the design of the stage itself as it was developed in the printed version of the *Exzentrik*. In a small isometric diagram at the top of the fold-out, Moholy-Nagy depicted three stages. **(Figure 4.2)** The first and largest stage is shown at the lowest level with a large black rectangle. In the accompanying text, Moholy-Nagy designated that forms and movements would take place on this stage, corresponding to the first column of the performance entitled “Form + Bewegung” (Form + Movement).

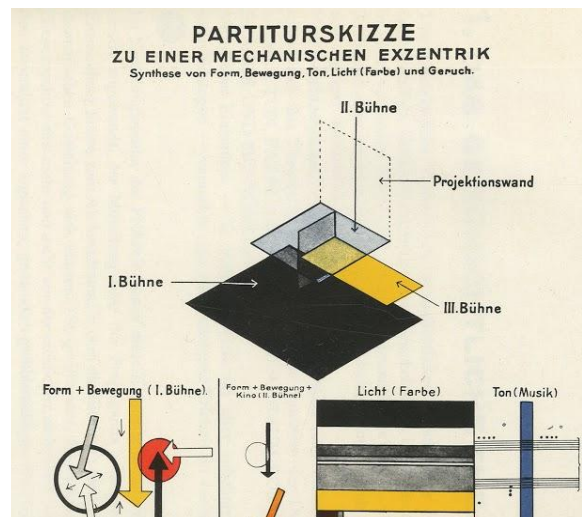


Figure 4.2: László Moholy-Nagy, *Partiturskizze zu einer mechanischen Exzentrik* (Score-Sketch for a mechanical Eccentric), 1925, for complete caption see note to Figure 0.2.

The second column of the performance, also under the title, "Form + Bewegung," was proposed for the second stage, which was at the highest level. The second stage was rendered as a translucent square in a pale shade of blue, corresponding to the pale blue of the projector and hinged on the far edge allowing it to rotate to a vertical position as a projection wall, shown with a dashed outline. There is one vertical plane supporting the second stage, whenever the stage would be in the horizontal position, and also supporting one end of the third stage, shown as a long yellow rectangle positioned in between the first and second stages. Moholy-Nagy designated that mechanical musical instruments would be on this stage; presumably, the induction coil would sit on this level.

In light of his definition of space and in keeping with his sentiments on the sensual experience of space, Moholy-Nagy did not propose an envelope for this stage/ theater design. In the notes to the printed version of the *Exzentrik*, Moholy-Nagy also described vertical canvas panels, through which colored lights would be projected. Using the notations and images, it is clear that Moholy-Nagy intended to employ moving spotlights and/ or moving light images or colored lights to define the space of action through the changing the relationships of the wrestlers' bodies, rotating in the center of the radiating circles. In *Von Material zu Architektur*, Moholy-Nagy summarized his spatial conception in the following passage:

diese auslegung von „lagebeziehungen der körper“ (gleich raum) für die Schaffung neuer raumrelationen ist durch die heutigen wissenschaftlichen erkenntnisse wie „Stoff gleich kraft“ durchaus gegeben, ihre bedeutung für reale architektur: beziehung statt masse — wird sich voraussichtlich erst bei der kommenden generation auswirken. von hier aus bahnt sich auch ein weg für die zukünftige architektur: das innen und das außen, das oben und das unten verschmelzen zu einer einheit. ... Öffnungen und begrenzungen, durchlöcherungen und bewegliche flächen reißen die periferie zur mitte und stoßen die mitte nach außen, ein stetes fluktuieren, seitwärts und aufwärts,

strahlenhaft, allseitig, meldet dem menschen, daß er den unwägbareren, unsichtbaren und doch allgegenwärtigen raum — soweit seine menschlichen beziehungen und heutigen Vorstellungen reichen — in besitz genommen hat.⁷ (This interpretation of the "relationship of the positions of bodies" (equal space) for the creation of new spatial relations was given definitively through contemporary scientific knowledge like "mass equals energy," its meaning for real architecture: relationship instead of mass — will probably only be worked out by the coming generation. From here is also carved out a way for future architecture: the inside and the outside, the over and the under merge into a single unity. ... Openings and boundaries, perforations and moving planes, the periphery is pulled to the center and the center is pushed outward, a continuous fluctuation, sideways and upwards, held radiant, all-around, tells the human being that he is the imponderable, invisible and yet existing-universe space — as far as his human relationships and current ideas range — have taken in possession.)

To this statement, he referred the reader to the final image of the book, a photomontage by Jan Kamman entitled "Architektur" (Architecture). **(Figure 4.3)** In this photomontage, the caption explained that the simultaneous image was produced by overlaying two negatives (meaning that the lights and darks were inverted), but, more importantly, Moholy-Nagy proposed that architecture would achieve this result, akin to an x-ray image, using planes of transparent glass panels.⁸

⁷ Moholy-Nagy, *Von Material zu Architektur*, 1947, 222.

⁸ Moholy-Nagy, *Von Material zu Architektur*, 1929, 236.

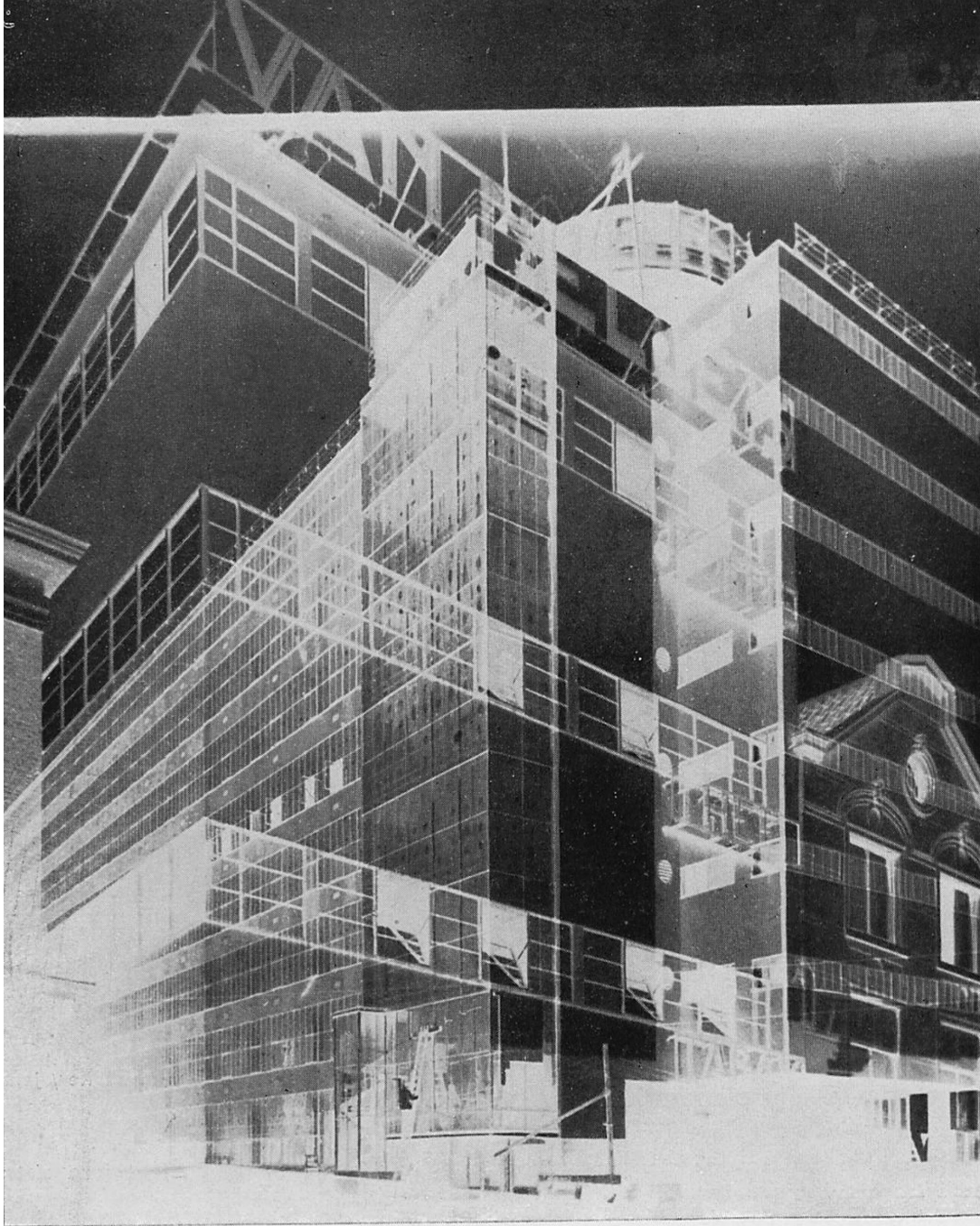


Figure 4.3: Jan Kamman, "Architektur," in László Moholy-Nagy, *Von Material zu Architektur*, München, Albert Langen Verlag, 1929.

SHADOW

When describing the origin of the photogram in *Vision in Motion*, Moholy-Nagy included a drawing of a man tracing the silhouette of a seated woman projected onto a scrim by candlelight.⁹ (**Figure 4.4**) The image was first published in the second volume of *Essai sur la physiognomie* (Essays on Physiognomy) in 1781, a French translation that expanded on the *Physiognomische Fragmente zur Beförderung der Menschenkenntnis und Menschenliebe* (Physiognomic Fragments for the Promotion of Knowledge and Love of Humankind, 1775–1778) by Johann Kaspar Lavater.¹⁰ In his “Onzieme Fragment des Silhouette” (Eleventh Fragment on the Silhouette), Lavater praised the tracing of the profile shadow for its purity, as a direct copy of nature, touching briefly upon the storied history of the tracing of a corporeal shadow as the origin of painting: “On peut supposer avec assez de vraisemblance que l'ombre des corps a

⁹ Moholy-Nagy, *Vision in Motion*, 1947, 187. This engraving was originally published in Jean Gaspard Lavater, *Essai sur la physiognomie: destiné a faire connoître l'homme & à le faire aimer* (Zürich: Imprimé à La Haye, 1783), 2: unpaginated between 160–161, while only an empty chair was featured in the English translation, John Caspar Lavater, *Essays on Physiognomy*, trans. Thomas Holcroft (London: Ward Lock & Company, 1875), unpaginated between 190–191.

¹⁰ Jean Gaspard Lavater [Johann Kaspar Lavater], *Essai sur la physiognomie: destiné a faire connoître l'homme & à le faire aimer* (Zürich: Imprimé à La Haye and Imprimé chez Jaques Van Karnebeek, 1783), 2: between 160–161 expanded edition of *Physiognomische Fragmente zur Beförderung der Menschenkenntnis und Menschenliebe*, 3rd ed. (Winterthur, Switzerland: Verlag Heinrich Steiners und Compagnie, 1787). The caption accompanying the image provides a glimpse of Lavater's reading of a profile: “Voici le caractère que j'assignerois à la Silhouette de cettejeune personne. J'y trouve de la bonté. Sans beaucoup de finesse, de la clarte dans les idees & le talent de les conceroir avec facilité, un esprit fort industrieux mais qui n'est point dominé par une imagination bien vive, & qui ne s'attache quère à une exactitude scrupuleuse. On ne retrouve point dans la copie le caractère de gaieté qu'annonce l'Original, mais le nez a gagné dans la silhouette – il y exprime plus de finesse.” (Here is the character that I would assign to the Silhouette of this young person. I find there goodness. Without a great deal of subtlety, clarity in ideas, and the ability to conceal them with ease, a very industrious spirit, but one which is not dominated by a lively imagination, and which attaches itself to a scrupulous exactitude. We do not find in the copy the character of gaiety announced by the Original, but the nose has won in the silhouette – it expresses more finesse.)

donné la première idée de l'art de Dessin & de la Peinture."¹¹ (It may be assumed with sufficient probability that the shadow of the body gave the first idea of the art of Drawing & Painting.)

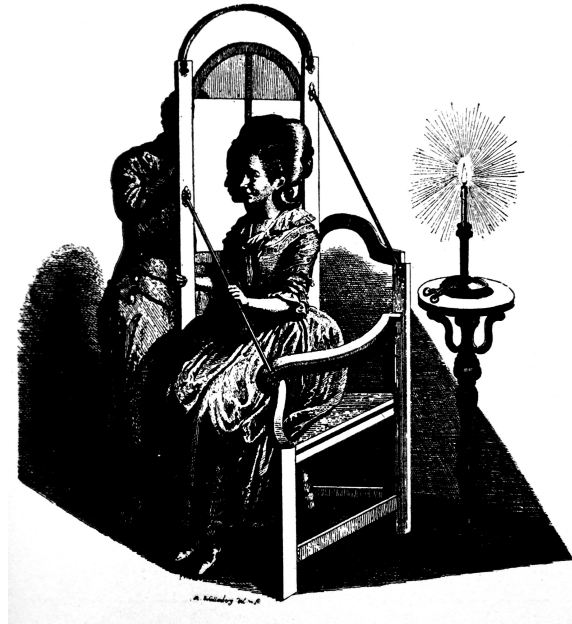


Figure 4.4" Illustration adapted from original by Henry Fuseli in Johann Kaspar Lavater, *Essai sur la physiognomonie: destiné a faire connoître l'homme & à le faire aimer*, Zürich, Imprimé à La Haye and Imprimé chez Jaques Van Karnebeek, 1783, reproduced in László Moholy-Nagy, *Vision in Motion*, Chicago, Paul Theobald, 1947.

According to Victor Stoichita in his text on *A Short History of the Shadow*, the oldest known account of the origin of painting was the act of tracing of a shadow and was recorded by Pliny

¹¹ Jean Gaspard Lavater, *Essai sur la physiognomonie: destiné a faire connoître l'homme & à le faire aimer* (Zürich: Imprimé à La Haye and Imprimé chez Jaques van Karnebeek, 1783), 2: unpaginated between 160–161. The English translation took some liberties with the text, shortening the sentence significantly on page 188 of John Caspar Lavater, *Essays on Physiognomy*, trans. Thomas Holcroft (London: Ward Lock & Company, 1875): "Drawing and painting, it is probable, originated in shades."

the Elder in his *Naturalis Historia* (Natural History, c. 77 C.E.),¹² in which he related:

De picturae initiis incerta nec instituti operis quaestio est. Aegyptii sex milibus annorum apud ipsos inventam, priusquam in Graeciam transiret, adfirmant, vana praedicatione, ut palam est; Graeci autem alii Sicyone, alii apud Corinthios repertam, omnes umbra hominis lineis circumducta, itaque primam talem, secundam singulis coloribus et monochromaton dictam, postquam operosior inventa erat, duratque talis etiam nunc. (The question as to the origin of the art of painting is uncertain and it does not belong to the plan of this work. The Egyptians declare that it was passed over into Greece – which is clearly an idle assertion. As to the Greeks, some of them say it was discovered at Sicyon, others in Corinth, but all agree that it began with tracing an outline around a man's shadow and consequently that pictures were originally done in this way, but the second stage when a more elaborate method had been invented was done in a single colour and called monochrome, a method still in use at the present day.)¹³

In this passage, Pliny acknowledged that the history of painting, as well as its origin, was much disputed. However, the image of the Corinthian maid tracing the shadow of her lover by the light of a candle was perhaps the most compelling of the various histories.

In a later account, *Institutio oratoria* (The Orator's Education, c. 95), Quintilian described the origin of painting with the tracing of a shadow cast by the light of the sun. In this passage, Quintilian argued in favor of invention over imitation, since the latter placed limits on artistic achievement, when he wrote:

¹² Victor I. Stoichita, *A Short History of the Shadow*, trans. Anne-Marie Glasheen (1997; repr., London, 2011: Reaktion Books), 7.

¹³ Pliny the Elder, *Natural History*, Loeb Classical Library, trans. H. Rackman, (Cambridge, MA: Harvard University Press, 1952), XXXV, 15–16 (270–271).

Nam rursus quid erat futurum si nemo plus effecisset eo quem sequebatur? Nihil in poetis supra Livium Andronicum, nihil in historiis supra pontificum annales haberemus; ratibus adhuc navigaremus, non esset pictura nisi quae lineas modo extremas umbrae quam corpora in sole fecissent circumscriberet. (Once again, what would have happened if no one had achieved more than the man he was following? We should have nothing in poetry better than Livius Andronicus, nothing in history better than the Annals of the pontifices; we should still be going to sea on rafts, and the only painting would consist in drawing outlines round the shadows cast by objects in the sun.)¹⁴

In his *Essai sur l'origine des langues* (Essay on the Origin of Languages, 1781), Rousseau related the origin of drawing/ painting to the origin of language, particularly as the invention of a language of love, which otherwise has little use for the rationality of words.¹⁵ The etymological connection between drawing/ painting and language was further developed by Henry Fuseli (née Johann Heinrich Füssli), who was Lavater's collaborator and illustrator, in his 1801 lecture at Royal Academy of London:

Greek art had her infancy, but the Graces rocked the cradle, and Love taught her to speak. If ever legend deserved our belief, the amorous tale of the Corinthian maid, who traced the shade of her departing lover by the secret lamp, appeals to our sympathy, to grant it ... The etymology of the word used by

¹⁴ Quintilian, *The Orator's Education*, trans. Donald E. Russell (Cambridge, MA: Harvard University Press, 2001), 4: x, ii, 7–8 (324–325), originally published c. 95 C.E. as *Institutio oratoria*.

¹⁵ Jean-Jacques Rousseau and Johann Gottfried Herder, *On the Origin of Language*, trans. John H. Moran and Alexander Gode (New York: F. Unwin, 1966; Chicago: University of Chicago Press, 1986), 6: "Love, it is said, was the inventor of drawing. It might also have invented speech, though less happily. Not being very well pleased with it, it disdains it; it has livelier ways of expressing itself. How she could say things to her beloved, who traced his shadow with such pleasure!"

the Greeks to express *Painting* being the same with that which they employ for *Writings* makes the similarity of tool, materials, method, almost certain. The tool was a style or pen of wood or metal; the materials a board, or a levigated plane of wood, metal, stone, or some prepared compound; the method, letters or lines. The first essays of the art were skiagrams, simple outlines of a shade, similar to those which have been introduced to vulgar use by the students and parasites of Physiognomy, under the name of Silhouettes.¹⁶

Skiagraphia in Greek was derived from the roots *skia*, meaning shadow, and *graphē*, meaning drawing with lines or writing. According to Plutarch in *De gloria Atheniensium* (On the Glory of Athens) collected in his *Moralia* (Morals), the Athenian Apollodorus was known to be the inventor of *skiagraphia* during the fifth century before the common era.¹⁷ While none of his paintings have survived, references to his invention abound. It is thought that Apollodorus developed his shading technique using both cross-hatching and the strategic thickening of contour lines possibly with the addition of a range of tones, which earned him the name, Apollodorus Skiagraphos (Shadow-writer) recorded in Homer's *Illiad*.¹⁸ In *Naturalis Historia*, Pliny the Elder described Apollodorus of Athens as the first painter to depict things as they truly appeared.¹⁹

From this understanding of a skiagraphic language, Lavater developed his science of reading the human silhouette, suggesting that the shadow is both a record of itself and an icon/index of

¹⁶ J. H. Füssli, *The Life and Writings of Henry Fuseli, Esq.*, John Knowles, ed., 25–26; Stoichita, *A Short History of the Shadow*, 2011, 155.

¹⁷ Plutarch, "Whether the Athenians Were More Renowned for Their Warlike Achievements or Their Learning," trans. R. Smith, in *Plutarch's Morals*, ed. William W. Goodwin, trans. Multiple (Boston: Little, Brown, and Company, 1878), 5: 400, originally published c. 100 as *Moralia*.

¹⁸ Homer, *Illiad*, ...

¹⁹ Pliny the Elder, *Natural History*, trans. H. Rackman, 1952, XXXV, 36.

the profile of the person whose form created the shadow.²⁰ Fuseli's criticism of physiognomy, seemingly paradoxical since he extensively illustrated Lavater's principle work on the subject, was actually directed at the "parasites" identified with Étienne de Silhouette, Controller-General of Finances for Louis XV, who popularized the tracing of the human shadow for aristocratic amusement in eighteenth-century French salons.²¹ In contrast to these triflings, Lavater believed that the shadow expressed the essence of the soul, without the disguise of social rank, feigned expression, or made-up features. In this sense, it was an emanation of the soul, a written testament revealing the strength and weakness of its character.²²

SYMMETRY

In this tradition, for Moholy-Nagy to refer to Fuseli's illustration and, in turn, to invoke Lavater's thesis on the physiognomy, he was positioning the photogram, writing with light, within a line of succession as the inverse of the skiagram, writing with shadow. If the skiagram was the origin of painting, then the photogram would be the rebirth of painting. Unlike his contemporaries who simultaneously named their own skiagraphic processes after themselves, Man Ray's *Rayograph* and Christian Schad's *Schadograph*, Moholy-Nagy may have recognized the import of the development in the tradition of painting opting for the non-autobiographical term, photogram.²³ **(Figure 4.5)**

²⁰ Stoichita, *A Short History of the Shadow*, 2011, 113.

²¹ Barbara Maria Stafford, *Body Criticism: Imaging the Unseen in Enlightenment Art and Medicine* (Cambridge, MA: MIT Press, 1991), 96.

²² Stoichita, *A Short History of the Shadow*, 2011, 156–164.

²³ Moholy-Nagy, *Vision in Motion*, 1947, 187–188. In a footnote, Moholy-Nagy clarified that "[t]hat around 1920 Man Ray and I, independent of each other, re-invented the photogram," attributing the first photogram using a piece of lace on paper treated with light sensitive chemicals to Henry Fox Talbot in 1835.



Figure 4.5: (left) Man Ray (Emmanuel Radinsky), Rayograph, 1922, Gelatin silver print: 22.2 x 16.9 cm (8 3/4 x 6 5/8"), Museum of Modern Art, New York, 253.1935.2 + (right) Christian Schad, Schadograph no. 4, 1919.

The chiastic nature of the terms is also reflected in the process of making a photogram, which reverses the optical effects of light into the negative, creating a double in which light and shadow are reversed through resulting from the chemicals of the emulsion into an inverted mirror image. On this procedure, Moholy-Nagy wrote in *Vision in Motion*: "By this reversal of customary observation a new hidden world arises out of night scenes, settings in contrasts, glowing with sublime magnificence, a play of radiating light sources enveloping the objects with an aura and giving them fresh potentialities for lyric or dramatic quality."²⁴

Recognizing the potential to record space-time as "light-tracks," important for the industries of both architecture and film, space-time industries charged with designing forms in and with light, Moholy-Nagy described the inversion of light and shadow in the photogram as revealing new worlds, especially in recording night scenes with inverted highlights and shadows in *Vision in Motion*:²⁵

The photogram understood as a diagrammatic record of the motion of light

²⁴ Moholy-Nagy, *Vision in Motion*, 1947, 197.

²⁵ Moholy-Nagy, *Vision in Motion*, 1947, 188–197.

translated into black and white and gray values can lead to a grasp of new types of spatial relationships and spatial rendering. The receding and advancing values of the gradations, which are projections of the 'light tracks', can be used for space—that is, space-time—articulation.²⁶

The photogram not only records light as shadow and shadow as light, it also flattens the object in a similar manner as in a mirror, collapsing the foreground and background. In this case, the foreground face would be the far side of the objects arranged on the chemically-treated surface, the invisible side. In his chapter on "Mirrors" in *The Ambidextrous Universe* (1964), Martin Gardner explained that mirror reflections are inversions of near and far, which are typically apperceived as a reversal of left and right.²⁷ According to Gardner, Immanuel Kant was the first to seriously examine mirror symmetry in his *Prolegomena zu einer jeden künftigen Metaphysik*:

Was kann wol meiner Hand oder meinem Ohr ähnlicher und in allen Stücken gleicher sein als ihr Bild im Spiegel? Und dennoch kann ich eine solche Hand, als im Spiegel gesehen wird, nicht an die Stelle ihres Urbildes setzen; denn, wenn dieses eine rechte Hand war, so ist jene im Spiegel eine linke, und das Bild des rechten Ohres ist ein linkes, das nimmermehr die Stelle des ersteren vertreten kann. Nun sind hier keine inneren Unterschiede, die irgend ein Verstand nur denken könnte; und dennoch sind die Unterschiede innerlich, so weit die Sinne lehren, denn die linke Hand kann mit der rechten unerachtet aller beiderseitigen Gleichheit und Aehnlichkeit doch nicht zwischen denselben Grenzen eingeschlossen sein (sie können nicht congruiren), der Handschuh der einen

²⁶ Moholy-Nagy, *Vision in Motion*, 1947, 188–189.

²⁷ Martin Gardner, *The New Ambidextrous Universe: Symmetry and Asymmetry from Mirror Reflections to Superstrings*, 3rd rev. ed. (New York: W. H. Freeman and Company, 1990), 1–6, originally published 1964 as *The Ambidextrous Universe*, 11–16.

Hand kann nicht auf der anderen gebraucht werden.²⁸ (What indeed can be more similar to, and in all parts more equal to, my hand or my ear than its image in the mirror? And yet I cannot put such a hand as is seen in the mirror in the place of its original; for if the one was a right hand, then the other in the mirror is a left, and the image of the right ear is left one, which can never take the place of the former. Now there are no inner differences here that any understanding could merely think; and yet the differences are inner as far as the senses teach, for the left hand cannot, after all, be enclosed within the same boundaries as the right (they cannot be made congruent), despite all reciprocal equality and similarity; one hand's glove cannot be used on the other).²⁹

Similar to the chiral symmetry of left and right hands, the photograph presents the chiral image of the object recorded with the addition of inverting light and shadow. The effect thwarts the ability of the intellect to quickly determine the nature of the source object, leaving a person with a vague feeling of confused recognition described by Ernst Jentsch as the uncanny in his 1906 article, "'Zur Psychologie des Unheimlichen" (On the Psychology of the Uncanny).³⁰ Exploring several examples, including the unsettling experience of encountering life-like wax figures, Jentsch determined that feelings of uncertainty often produce an uncanny sensation. More than coincidentally, Jentsch also mentioned the uncanny sensation developed in *Der*

²⁸ Immanuel Kant, *Prolegomena zu einer jeden künftigen Metaphysik, , die als Wissenschaft wird auftreten können*, ed. Benno Erdmann (Leipzig: Verlag von Leopold Voss, 1878), 37.

²⁹ Immanuel Kant, *Prolegomena to Any Future Metaphysics That Will Be Able to Come Forward as Science*, trans. Gary Hatfield (Cambridge, UK: Cambridge University Press, 1997), 36–37, originally published 1783 as *Prolegomena zu einer jeden künftigen Metaphysik...*

³⁰ Ernst Jentsch, "Zur Psychologie des Unheimlichen (Teile 1)" [On the Psychology of the Uncanny], *Psychiatrisch-Neurologische Wochenschrift* 8, no. 22 (August 25, 1906): 195–198 and "Zur Psychologie des Unheimlichen (Teile 2)" [On the Psychology of the Uncanny], *Psychiatrisch-Neurologische Wochenschrift* 8, no. 23 (September 1, 1906): 203–205.

Sandmann (The Sandman, 1817) by E. T. A. Hoffman in which the main character, Nathaniel, was tricked into falling in love with Olympia, a life-sized automaton, perfectly poised, ever attentive, and flawlessly symmetrical, whom he viewed through a small telescope provided by the evil alchemist, Coppelius, producing a deception equal only to the deception of Nathaniel's own eyes, blinded by love.³¹

Premiering in 1881, Jacques Offenbach combined elements of the plot of *Der Sandmann* and two other tales of Hoffman in a popular opera under the title *Les contes d'Hoffmann* (Hoffmans Erzählung, Tales of Hoffman, 1881). Several key details of the story had been altered, in an apparent effort to shorten the length of the story and to limit the number and type of stage sets required. In the first act of the operatic version, Nathaniel, while wearing special eye glasses provided by Coppola, was unable to recognize that his beloved Olympia was an automaton. Since, according to his own sensual experiences, she appeared to be a real woman, he could not be persuaded by the obvious incongruencies that were so clear to his friends and to the audience. Once his glasses were broken, Olympia's true nature was revealed just as her creators tore her to pieces. Moholy-Nagy produced the *Gesamtausstattung* (total decor) for the 1929 Berlin premiere of *Hoffmans Erzählung* (Tales of Hoffman) at the Krolloper (Kroll Opera). The stage sets relied heavily on the changing effects of the shadows cast by the scenery.³² **(Figure 4.6)**

³¹ Ernst Theodor Amadeus Hoffmann et al., *Tales from the German Comprising Specimens of the Most Celebrated Authors*, trans. John Oxenford and C. A. Feiling (New York: Harper & Brothers, 1844), 140–165.

³² Hans Curjel, *Experiment Krolloper 1927–1931* (München: Prestel-Verlag, 1975), 259–260. The Berlin premiere of *Hoffmans Erzählung* at the Krolloper took place on February 12, 1929.

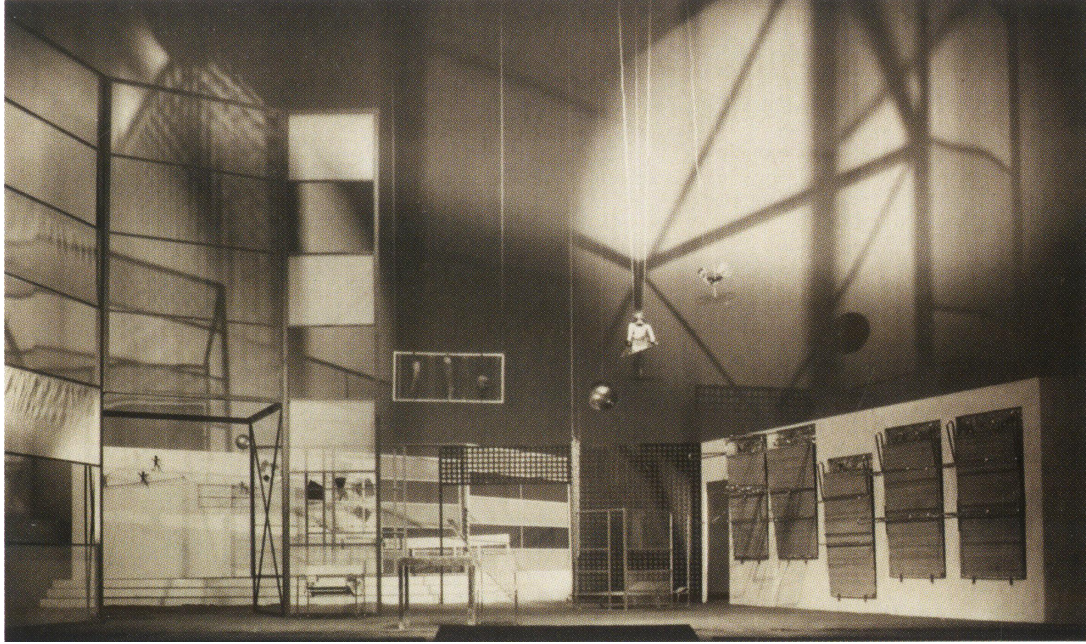


Figure 4.6. László Moholy-Nagy, Scenery for *Hoffsmanns Erzählung*, Krolloper, Berlin, 1929.

In the playbill for *Hoffmans Erzählung*, Moholy-Nagy reproduced his essay on the total theater, “Theater, Zirkus, Varieté,” vastly increasing the audience for his work previously published in the *Bauhausbücher* series in 1925.³³ More importantly, by connecting the ideas behind this operatic production of Hoffman’s uncanny story with his own ideas about the role of perception and apperception in the total sensory experience of the total theater, Moholy-Nagy retrospectively deepened the potential of his observations on the experience of the uncanny; for another way to define the uncanny is a feeling of uncertainty derived from an oscillation between perception (what is) and apperception (what is believed to be) followed by a shedding of old habits for an new openness toward an objective understanding of the world.

Recalling Moholy-Nagy’s definition of apperception in “Theater, Zirkus, Variete” is a reminder of the productive function of the oscillation between these two interpretive states. Moholy-Nagy

³³ Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 263.

related apperception to association alluding to the conceptual role of the intellect in the psychophysical experience. Giving the example of the interpretation of complimentary color perceptions, Moholy-Nagy connected instinctual response with the recollection of past experiences.³⁴

In this fourth Act, Moholy-Nagy employed light, shadow, and color to enhance the audience's sense of uncertainty proposing the projection of both spotlights and, proposed in the projection of images onto the two wrestlers with twelve closely spaced vertical lines extending from the lowest edge of the black square to the torso of the wrestler with the upper hand perhaps hinting at the intensity of the light. Stage lights typically use a black metallic square frame to hold interchangeable colored gels; this interpretation is supported by the replacement of the twelve vertical lines with a pale blue gradient tone in the printed version of the *Exzentrik*. **(Figure 0.16)** Inspired by a photograph in *Von Material zu Architektur*, another interpretation of the black square as a light cannon is suggested by a similar dark metal square featured in a photograph of a "riesiger amerikanischer reklame-scheinwerfer, in new york, auf dem dach des capitolteaters" (giant American advertising-floodlight, in New York, on the roof of the Capitol Theater) as the frame holding the transparent image to be projected onto a building or into the air materializing in the droplets of a cloud.³⁵ **(Figure 4.7)** Such beam projectors used intense carbon-arc lamps producing an ultraviolet (bluish) light. The tightness of the twelve vertical lines may suggest the increased intensity of the light and, therefore, the increased intensity of the shadows. Since the two outermost vertical lines extend to the bottom of the panel, well below the two wrestlers, these lines may depict a frame for the light to move up and down on a track system, similar to the wheels in the third Act.

³⁴ Moholy-Nagy, "Theater, Zirkus, Varieté," in *Die Bühne im Bauhaus*, 1925, 48.

³⁵ Moholy-Nagy, *Von Material zu Architektur*, 1929, 173–174.

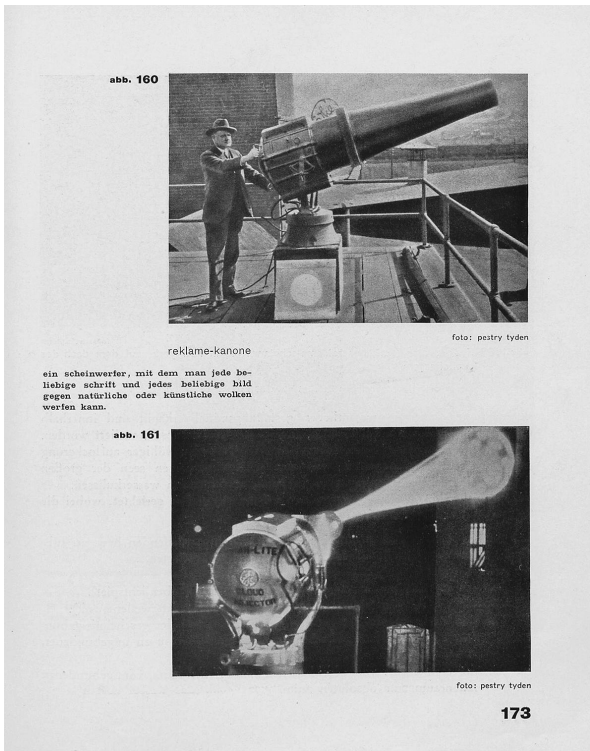


Figure 4.7: Advertising cannons, reproduced in László Moholy-Nagy, *Vision in Motion*, Chicago, Paul Theobald, 1947, 173–174.

Further attesting to this theory requires an examination of the shadows and the use of complementary colors on the wrestlers. The wrestler with the upper hand has a red tone added to his trousers, while the man pinned underneath has a very faint green tone just below the red trousers, radiating from the point of contact. This green shading produces the impression of a complimentary shadow effect perhaps produced by the colors mingled in the film projection. Moholy-Nagy appears to have slightly rotated the orientation of the two figures so that the dividing line between the two men is horizontal at the center of the radiating circles, rather than below the lower wrestler. In the printed version of the *Exzentrik*, this horizontal division was emphasized by two horizontal arrows pointing away from the wrestlers. The effect of the green shadow and the rotation of the figures creates the impression that the second man is merely a

shadow.³⁶ **(Figure 0.16)**

This impression is reinforced in the printed version of the *Exzentrik*, in which Moholy-Nagy loosely rendered the form of the lower wrestler by blackening only the shadows created by the upper wrestler. **(Figure 0.16)** If the lower wrestler is merely a shadow of the upper wrestler, a man wrestling with his double, the shadow appears to have been rotated as it was projected, perhaps rotated by the spinning radiating circles projected onto and around these figures indicated by the directions of the arrows.

In Adelbert von Chamisso's very popular novella, *Peter Schlemihls wundersame Geschichte* (Peter Schlemihl's Miraculous Story, 1814), a poor young man named Peter Schlemihl sold his shadow to an old man dressed in gray for a satchel perpetually filled with gold, Fortunatus' purse, but his lack of shadow quickly became a curse, when people constantly remarked on his missing double with some viewing its absence as a sign of moral failure.³⁷ In an illustration by George Cruikshank for an English translation of Chamisso's book, the man in gray was portrayed in the act of pulling Peter's shadow off of his body at the foot and away from the ground, as if the shadow had substance.³⁸ **(Figure 4.8)** In this ominous scene, the old man was rendered in a

³⁶ In *Vision in Motion* (1947, 157), Moholy-Nagy discussed conservator Helmut Ruhemann's thesis that Michelangelo used of red and green pigments in creating flesh tones and shadows on flesh: "Ironically, the illusion of flesh coloring has been attained in this picture by abstract means. He used a green undercoating. The shadows of the green clothes, however, he painted first in red, then varnished with light transparent green, the whole being apprehended by the eyes as green fabric with dark folds. ... Tiepolo painted shadows on a face not with gray or brown but with vermilion red." In a corresponding footnote, Moholy-Nagy related these observations to Goethe's theory of turbidity, atmospheric effects that produce the apparent blue of the sky and the deepening of the red light of the setting sun.

³⁷ Adelbert von Chamisso, *Peter Schlemihls wundersame Geschichte*, ed. Friedrich Baron de la Motte Fouqué (Nürnberg: Johann Leonhard Schrag, 1814), 1–24.

³⁸ Adelbert von Chamisso, *Peter Schlemihl*, trans. Unknown, illus. George Cruickshank (London: G. and W. B. Whittaker, 1824), unpaginated frontispiece, originally published 1814 as *Peter Schlemihls wundersame Geschichte*.

monochrome manner similar to a silhouette, not only wearing all gray but being gray, unlike Peter who was depicted with both shade and shadow as he was shown facing the setting sun. Although the gray man appears as if he is a shadow, he also cast his shadow onto the ground. Furthering the idea of the severability of a man and his shadow, the gray man was pulling at the leg of Peter's shadow, while the gray man's shadow looks as if he was simultaneously working on the arm of Peter's shadow, demonstrating what Stoichita called shadow *en abyme*.³⁹

A later scene further alluded to the interplay between substantiality and insubstantiality of the shadow double, when Peter pursued what he had thought was a soulless shadow, a twin of his own shadow, chasing it into the forest and wrestling with it.⁴⁰ The enduring popularity of *Peter Schlemihls Wundersame Geschichte* was attested to in an entry in the 1920 edition of the *Encyclopedia Americana*, in which it was reported that the term *schlemihl* had become a euphemism in Yiddish designating a person who was unable to succeed in the world.⁴¹ In this case, Schlemihl sought out his shadow in order to regain the outward expression of his honor, even attempting to capture someone else's shadow, a surrogate for his own missing double. However, when faced with the opportunity to regain his shadow from the gray man, Schlemihl was unwilling to pay the high price, his everlasting soul.

³⁹ Victor I. Stoichita, *A Short History of the Shadow*, trans. Anne-Marie Glasgeen (1997; repr., London, 2011: Reaktion Books), 168–169.

⁴⁰ Adelbert von Chamisso, *Peter Schlemihl*, 1824, 92–94.

⁴¹ Ewald Eiserhardt, "Peter Schlemihls wundersame Geschichte," in *Encyclopedia Americana: A Library of Universal Knowledge*, ed. George Edwin Rines (New York and Chicago: Encyclopedia Americana, 1920), 11.



Figure 4.8: George Cruikshank, Illustration, Adelbert von Chamisso, *Peter Schlemihl*, trans. Unknown, London, G. and W. B. Whittaker, 1824, originally published 1814 as *Peter Schlemihls wundersame Geschichte*.

Chamisso's popular story elaborates on the idea that a shadow is self and other at the same time, capable of both mirroring and wrestling as in Moholy-Nagy's mechanical *Exzentrik*. Also producing a sense of the extraordinary in the fourth act, the siren that has been a near constant presence with varying intensities in the *Exzentrik* performance becomes three-dimensional. In the hybrid drawing, Moholy-Nagy attached undulating segmented pieces, perhaps a study for a bent plywood panel system like those designed by Charles and Rae Eames. The transformation of the thick, gray, two-dimensional line of the siren into an equally thick, gray, three-dimensional shape in the hybrid drawing is translated into a perpendicular rotation of the sound followed by a zig-zag folding of the line from red to yellow in the printed version of the *Exzentrik*. While the experience of sound is three-dimensional, as it reverberates off of hard surfaces within a room,

the heretofore monotony of the siren is broken, rotated, three-dimensional, spatial, capable of casting its own shadow.⁴² The folded structure is reminiscent of Moholy-Nagy's student exercises to produce light modulators: curved surfaces which, unlike flat surfaces, create gradation effects of light with cut and bent paper or other pliable materials to create endless varieties.⁴³

According to Moholy-Nagy, "[b]lack-and-white photography revealed for the first time light and shadow in their interdependence. The development of reliable artificial illumination, like electricity, brought an increasing adoption of flowing light effects and richly graduated shadow."⁴⁴ In other words, photography, representing three-dimensional form with light and shadow, could be enhanced by artificial lighting, perhaps further, the representation of three-dimensional space could be manipulated by electricity, producing uncanny effects as in the representation of the invisible within the language of the visible. The three-dimensionality of the line of the photographic siren casting its own uncanny shadows may relate to Moholy-Nagy's direction to place speakers in unusual locations such as under the audience which would surround them in sound and also produce surprise.⁴⁵

Sigmund Freud recognized that dreams about shadows often involved a pursuit.⁴⁶ In his essay, "Das Unheimliche" ("The Uncanny," 1919), Freud attempted to ground Jentsch's work on the uncanny, which he defined as the uneasy sensation produced by intellectual uncertainty, with his own thesis on the source of such psychophysical sensations stemming from childhood experiences, especially those related to a trauma. Following a lengthy discussion of the various

⁴² See also Einstein, *Relativity: The Special and the General Theory*, trans. Robert W. Lawson, 139–140, in which he described Minkowski's "point-event" or "world-point" as essentially Euclidean in nature with time represented as an imaginary fourth point and constituted by a "rotation" in the fourth dimension.

⁴³ Moholy-Nagy, *Vision in Motion*, 1947, 198.

⁴⁴ Moholy-Nagy, *Vision in Motion*, 1947, 178.

⁴⁵ Moholy-Nagy, "Theater, Circus, Variety," *The Theater of the Bauhaus*, trans. Arthur S. Wensinger, 1961, 64.

⁴⁶ Stoichita, *A Short History of the Shadow*, 2011, 142–148.

etymologies, translations, and definitions of *heimlich* (canny) and, more briefly, of *unheimlich* (uncanny), Freud concluded:

Wenn wir jetzt an die Musterung der Personen und Dinge, Eindrücke, Vorgänge und · Situationen herangehen, die das Gefühl des Unheimlichen in besonderer Stärke und Deutlichkeit in uns zu erwecken vermögen, so ist die Wahl eines glücklichen ersten Beispiels offenbar das nächste Erfordernis. E. Jentsch hat als ausgezeichneten Fall den »Zweifel an der Beseelung eines anscheinend lebendigen Wesens und umgekehrt darüber, ob ein lebloser Gegenstand nicht etwa beseelt sei« hervorgehoben und sich dabei auf den Eindruck von Wachsfiguren, kunstvollen Puppen und Automaten berufen.⁴⁷ (When we proceed to review the things, persons, impressions, events and situations which are able to arouse in us a feeling of the uncanny in a particular forcible and definite form, the first requirement is obviously to select a suitable example to start on. Jentsch [in an article of 1906] has taken a very good instance 'doubts whether an apparently animate being is really alive; or conversely, whether a lifeless object might not be in fact animate'; and refers this connection to the impression made by waxwork figures, ingeniously constructed dolls and automata.)⁴⁸

Freud also recognized the sensation of the uncanny found in seemingly automatic responses such as epileptic seizures and "manifestations of insanity,"⁴⁹ presumably that produce certain

⁴⁷ Sigmund Freud, "Das Unheimliche" [The Uncanny], *Imago: Zeitschrift für Anwendung der Psychoanalyse auf die Geisteswissenschaften* 5/6 (1919): 303.

⁴⁸ Sigmund Freud, "The Uncanny," in *An Infantile Neurosis and Other Works (1917–1919)*, ed. James Strachey, et al., trans. Alix Strachey, vol. XVII, *The Standard Edition of the Complete Psychological Works of Sigmund Freud* (London: Hogarth Press and Institute of Psycho-Analysis, 1974), 226, originally published 1919 as "Das Unheimliche."

⁴⁹ *Ibid.*

automatic effects, such as facial ticks, muscle twitches, repetitive actions, as well as the double, which, genetically speaking, could also be considered a mechanical process of duplication. For Freud, the duplication of the self was a visible manifestation of the invisible experienced as the uncanny.⁵⁰

As mentioned previously, in the printed version, Moholy-Nagy provided a separate list of terms that corresponded to the four columns of the *Exzentrik*. Many of these terms were included as handwritten notations in the Prelude section of the hybrid drawing of the *Exzentrik*, making a comparison useful and enlightening. However, causing some confusion, Moholy-Nagy removed elements related to the fifth act, notably the large marionette, yet he kept the terms related to the fifth act, specifically *Menschmechanik* (mechanical human) and *Explosionen* (explosions), suggesting that the former would relate to the wrestlers and the latter to the sneezing audience, strobing lights, and bursting of sounds. In this version, the sneezing powders have two sprays: one falling on the wrestlers and the other directed outside of the center ring, likely toward the audience. The change in description to *Menschmechanik*, the sneezing powders, and the emphasis on the second wrestler as merely a shadow, all suggest that Moholy-Nagy altered his conception of the wrestler after creating the hybrid drawing building up to the climax of the uncanny performance: a mechanical man comically wrestling his own shadow.

ROTATION

Among his arguments for the existence of the fourth dimension, Charles Howard Hinton claimed that one way of finding evidence of the fourth dimension would be to search for occurrences that suggest unexplainable movements or rotations in the third dimension, such as an object turning into, or rotating into, its mirror image. Hinton remarked that right-handed or left-handed

⁵⁰ Stoichita, *A Short History of the Shadow*, 2011, 138–141.

symmetry, which suggests symmetry about a plane, exists only in living forms, not in inorganic matter, which is limited to axial symmetry. By analogy, he claimed that two-dimensional surfaces may be activated symmetrically only with three-dimensional intervention, such as when a pebble dropped into water. Planar symmetry that is not superimposable, such as a pair of hands, exhibits chirality. As such, Hinton surmised that planar symmetry in the third dimension must denote a movement in the fourth dimension; however, it may only be perceptible to us in the most minute bodies. For instance, the movement of a vortex in air or in a fluid may reveal the manner of movement in the fourth dimension, since the particles of water or air rotate both individually and collectively transforming the shape of the vortex, turning it inside out and back again. The behavior of an electrical current may also point to the fourth dimension. The current does not move in one direction along a wire but is a closed circuit, moving back and forth not unlike a vortex within the wire. Since light is also an electromagnetic action, we experience light superficially without perceiving these minute forces at work, where an electric current requires a beginning and an end in this closed circuit and the vortex continues to the boundaries of a medium.⁵¹

His first example of right and left handed symmetry found in nature was also discovered in the polarization of light. The second example was in the formation of living beings, where a fourth dimensional movement created right and left handedness during formation. Hinton's explanation would require that two axes of the plane would remain fixed while two other would interchange without destroying the integrity of the object.⁵² As such, Hinton subscribed to the Theosophical belief that it is possible that a soul is a four-dimensional being coordinating with

⁵¹ Charles Howard Hinton, *The Fourth Dimension* (London: Sonnenschein, 1904; Kila, MT: Kessinger Publishing, 1996), 76–84. See also Claude Bragdon, *A Primer of Higher Space* (Rochester, NY: Manas Press, 1913; Tuscon, AZ: Omen Press, 1972), Plate 8.

⁵² *Ibid.*, 211–219.

and animating a three dimensional body.⁵³ For Hinton, in the fourth dimension, objects capable of rotation about a plane would physically create a mirror image of a mirror image, conceived of conceptually as *mise en abyme*, or, as Stoichita nominated, shadow *en abyme*.

Focusing on both the phenomenon itself and its cultural interpretation, Hinton was fascinated by the explanatory mysteries of higher dimensional symmetries formed by rotation, chirality, or handedness. In an earlier essay entitled, "A Plane World" (1884), Hinton described an alternate world with some similarities to Edwin Abbott's contemporaneous *Flatland*; however, Hinton's world was on the surface of a sphere that he characterized as a vast, hardened, and opaque bubble. Hinton proposed that, in this planar world, triangular men and women were mirror images of each other. The two main characters, Homo (vir) and Mulier (femina), were surprised to find that Mulier had turned into a man, although she was still herself on the inside. After refusing to reveal what had happened to her, and after much grief, Mulier disappeared from sight. When she returned, she was a woman again. The implication is that Mulier was able to lift herself out of the limitations of her two dimensional world and flip herself over, in other words, to rotate herself along a linear axis.⁵⁴ Hinton likened this type of mysterious rotation to electricity and polarized light, claiming that the forces behind these phenomena could be explained through planar rotation in the fourth dimension.

Recalling that Moholy-Nagy described a similar type of planar rotation as the promising future of architecture in *Von Material zu Architektur*, in which, "die periferie [reißen] zur mitte und stoßen die mitte nach außen" (the periphery is pulled to the center and the center is pushed outward).⁵⁵ Meanwhile, in previous observations about the relationship between movement and

⁵³ Hinton, *The Fourth Dimension*, 1904, 20–22.

⁵⁴ Charles Howard Hinton, "A Plane World," in *Scientific Romances: First and Second Series* (New York: Arno Press, 1976), 135–153, original published in 1884.

⁵⁵ Moholy-Nagy, *Von Material zu Architektur*, 1929, 222.

space, Moholy-Nagy expressed his belief that space, as “lagebeziehung von körpern” (relationship of the positions of bodies), would reach its fulfilment in dance:⁵⁶

von der Seite des Subjekts aus ist also raum am unmittelbarsten erlebbar durch bewegung, auf einer höheren stufe durch den tanz, der tanz ist gleichzeitig ein elementares mittel zur erfüllung raumgestalterischer wünsche. er kann den raum verdichten, ihn gliedern: der raum dehnt sich, sinkt und schwebt — fluktuierend in allen richtungen.⁵⁷ (From the side of the subject, space can be experienced most immediately through movement, on a higher level through dance, simultaneously dance is an elementary medium fulfilling a desire for the formation of space. It can intensify space, subdivide it: space lengthens itself, sinks and floats — fluctuating in all directions.)

Moholy-Nagy's ideas about spatial relationships and dance, especially related to circles and circular rotations, may have been influenced by his experiences at Monte Verità in Ascona, Switzerland, a favorite retreat for the Bauhaus faculty, where Rudolf von Laban first established his summer Tanzschule, 1912–1914, returning periodically for conferences and performances.⁵⁸ Another opportunity to Berlin *Tanzbühne Laban* and *Kammertanzbühne Laban* from 1921–1929. As a trained architect and experienced dancer and choreographer, Rudolf Laban articulated dance positions in space as a series of kinetic traces of invisible geometries. In his *Choreutics*, he defined these traces as “living architecture:”

Space is a hidden feature of movement and movement is a visible aspect of space. ... Movement is, so to speak, living architecture—living in the sense of

⁵⁶ Ibid., 195.

⁵⁷ Ibid.

⁵⁸ Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, 285–286.

changing emplacements and as well as changing cohesion. This architecture is created by human movements and is made up of pathways tracing shapes in space, and these we may call 'trace-forms.'⁵⁹

While a "living architecture" is defined by movements (trace-forms) in a dynamic equilibrium, dream architecture can be out of balance, or out of sequence. Laban believed that primitive man experiences the world as a unity through a tactile, "bodily perspective."⁶⁰ Laban developed his dance movements as a form of choreosophy, stemming from the Greek words *choros* meaning circles and *sophia* meaning wisdom, based on the *choreosophia* developed by Pythagoras and his followers. However, Laban quipped that "the wisdom of circles is as old as the hills" retaining powerful magical roots.⁶¹ Other combinations of terms building upon the root of *choros* include choreography, choreology, and choreutics, the "practical study of the various forms of (more or less) harmonised movement."⁶² Similar to the coining of photography, as writing with light, Laban called his notation system, "kinetography," meaning writing with movement.⁶³

In this summation of his theory of dance as "living architecture," Laban was connected to the idea of a bodily perspective placing the human body at the center and radiating an infinite number of extensions to infinity. **(Figure 4.9)** Lying horizontally or standing vertically, the body is simply extended, one-dimensional. The second extension is the body's bilateral symmetry. Similar to leaves, people are flat with only a small extension in the third dimension. The third dimension is experienced through movement in space. Bodily movements are in lines, capable of both

⁵⁹ Rudolf Laban, *Choreutics*, ed. Lisa Ullman (London: MacDonald and Evans, 1966), 4–5.

⁶⁰ Laban, *Choreutics*, 1966, 5–6.

⁶¹ Laban, *Choreutics*, 1966, vii.

⁶² Laban, *Choreutics*, 1966, viii.

⁶³ Laban, *Choreutics*, 1966, viii.

monolinear and polylinear movements. A sequence of lines creates pathways; a closed pathway is a circuit or ring. Laban defined the space of the body in movement as the kinesphere, which has distinct zones, one for each limb.⁶⁴ (Figure 4.10)

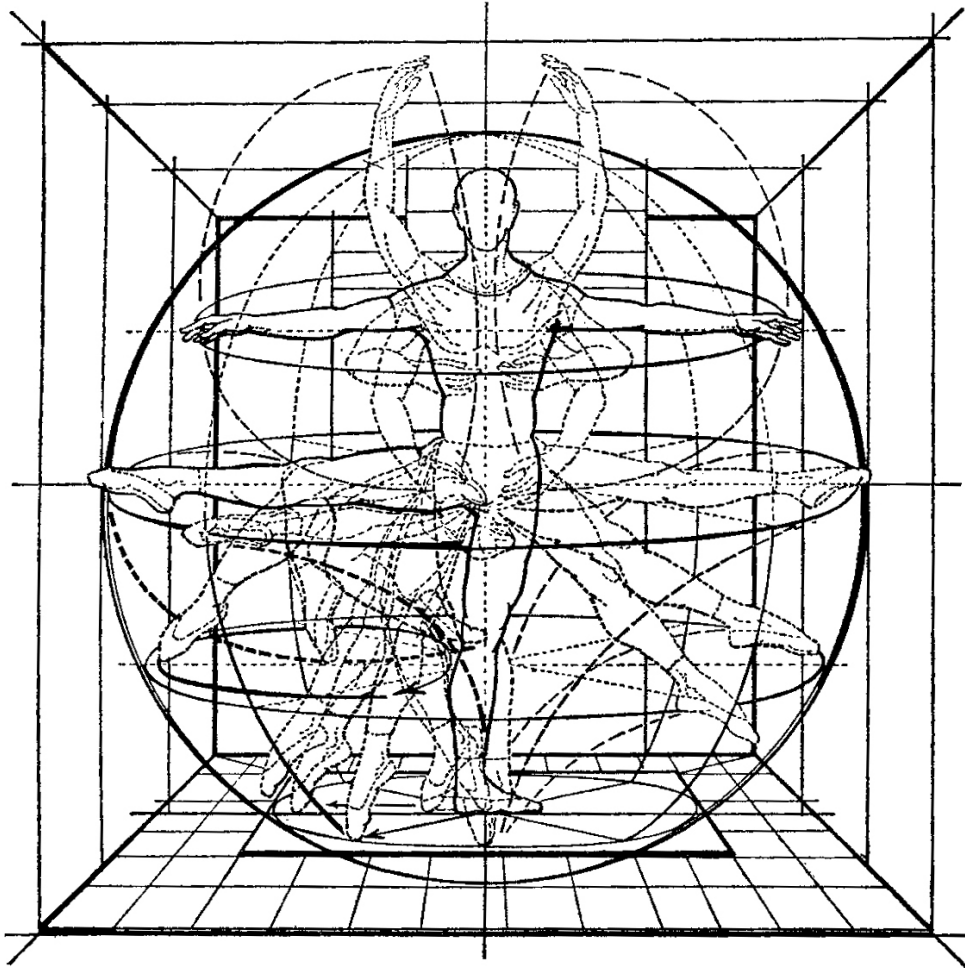


Figure 4.10: Rudolf von Laban, *Kinesphere*, *Choreutics*, 1966.

Laban's conception of space-movement identified the body itself as a mirror of the circular movements of the entire universe in which all changes in position produce new tactile impressions, able to project inner emotion outside of the body and to generate harmonic

⁶⁴ Laban, *Choreutics*, 1966, 17–19.

interrelations between the twelve points of the kinesphere.⁶⁵ At the same time, conversely, space-movements mirror the inside to the outside.⁶⁶ To maintain a distinction with the body's kinesphere, Laban called the universe, the dynamosphere, the space in which "dynamic actions take place." Laban identified eight directions and eight actions, which create "secondary trace-forms," that generate movement in the dynamosphere. **(Figure 4.9)** He further elaborated on the shadows of trace-forms:

Trace-forms have both an obvious and a hidden content. There are trace-forms within the body and outside it, and they are, both closely interrelated, completing each other, as shadow and light. Hidden trace-forms are the "shadow-forms." They act in the dynamosphere as both the source and the producer of dynamic phenomena in the nerves, limbs and muscles of the body. All bending, turning and elevation of the body, the instrument of motion, is filled with dynamism, integrating the two elements, shadow and light. These primitive activities of dynamism lead to the most complex emotions we can feel and to the thoughts with which we try to grasp the essence of existence. The role of the bodily perspective is especially important in all investigations into movement and space.⁶⁷

Building upon his fascination with geometric solids, Laban conceived of movement as deformations of crystalline geometric forms, recognizing the magic foundations of which reach back to Plato's discussion of the regular solids in *Timaeus*. Laban recorded the angles of a variety of ranges of motion in both living and dead subjects and found that these angles correspond with the icosahedron in that any one limb can reach any point in the kinespheric

⁶⁵ Laban, *Choreutics*, 1966, 86–91.

⁶⁶ Laban, *Choreutics*, 1966, 100.

⁶⁷ Laban, *Choreutics*, 1966, 91.

shape. As such, Laban concluded that the kinesphere is geometric in that it is a dynamic crystalline morphing form of harmonic relationships (spectral-analysis, acoustics).⁶⁸ Laban built life-size wireframe geometric shapes in which his dancers would demonstrate the geometry of their moves. **(Figure 4.10)**

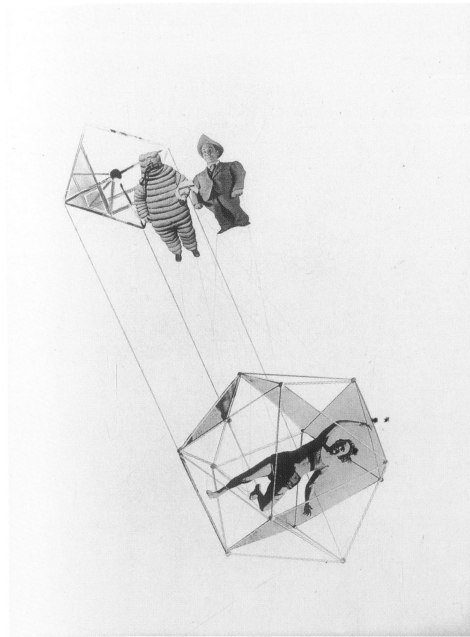


Figure 4.10: Rudolf von Laban, "Icosaeder Tanz" ("Dance of the Icosahedron"), 1925, Kunsthau Zürich, Library of the Estate of Suzanne Perrottet + László Moholy-Nagy, *Das Korsett* (The Corset), 1927, Gelatin Silver Print of a photomontage: 28 x 18 cm (9.4375" x 7.0625"), Stattsgalerie, Stuttgart, Sammlung Mayer, F 1989/68.

In his *Photoplastik* entitled *Das Korsett* (The Corset, 1927), Moholy-Nagy included a photograph of one of Laban's dancers posing with the framework of a large-scale icosahedron. **(Figure 4.10)** While the female figure was left intact, the background was removed from many of the faces of the geometric shape playing producing multiple visual interpretations. On the one hand, the photograph as a representation of a three-dimensional setting is recognizable; at the same time,

⁶⁸ Laban, *Choreutics*, 1966, 105–110.

the selected removal of the photograph between some of the poles oscillates between registering the poles, as one-dimensional lines, and the faces, as two-dimensional planes. Of course, in reality, the faces would not have been included in the figure, merely implied by the coplanarity of three poles.

In addition to this explicit reference to Laban's *Tanzschule*, Moholy-Nagy also reproduced the geometric wireframe shapes from his *Photogram* mentioned earlier and included in another of his *Photoplastiks*, *Untersehboot*. In this collage, the geometric shapes were selectively removed to suggest a viewing apparatus. However, in *Das Korsett*, the shape is more complete and Moholy-Nagy has not included the circular segments lending to its increased legibility. As such, this wireframe shape is reminiscent of one of Laban's didactic constructions. **(Figure 4.11)** In this photograph, Laban is touching a large mural of his unique language for dance notation with his left hand; meanwhile, he is holding one of these geometric constructions in his right hand. While these two geometric shapes are not quite the same, they share several similar features. The most obvious are the center ball from which the poles extend to describe complex solid geometries. These similarities are sufficient to suggest a connection between the two apparati. Using a technique from *Untersehboot*, Moholy-Nagy made the visual connection from the photograph of the large scale geometric figure to the smaller geometric figure shown in his *Photogram* using three single lines, joining point to point with Laban's construction, in *Das Korsett*. While these lines do not converge to suggest a cone of vision representing the under-seeing-boat, these lines may be interpreted in light of this title, as the laces of a corset strung between reinforced eyelets. Joining two sides of a single piece of fabric, or a curved planar surface, a corset is a two-dimensional construction that creates a three-dimensional figure, the inverse of the flattening procedures of the photograph and photogram.

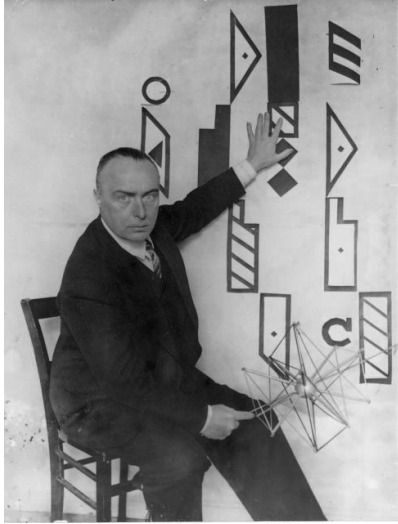


Figure 4.11: (left) Rudolf von Laban, Dance Notation Mural + (right) Michelin Man, Tires Advertisement, c. 1900.

Another similarity between these two *Photoplastiks* is the number and placement of the figures. A single female dancer, not wearing a corset, is below in this case, and figures, presumably male, are a costume above, one dwarf male clown and one person in a contemporary Michelin man costume with puffy rings from head to ankles. **(Figure 4.11)** Faint lines extend from the dancer's hands and feet to the clown and his advertising companion suggesting again another corset or, alternatively, the linkages of a bizarre marionette-like relationship between the figures. Since these lines are not as substantial as the three lines connecting the figures, Moholy-Nagy may be referencing the trace-forms central to Laban's philosophy of dance.

Positioning architecture and dance as the two most "basic arts from which the others derive," Laban described the similarity between the first "inner visions" of the two, their trace-forms, similar to that of a snail-shell. Laban then unfolded or unraveled a three-dimensional dance trace-form onto a two-dimensional plane, projecting its distinctive axial geometry. From these continuous geometric movements, Laban developed the concept of the "diaformic chain"

linking the point projections and also moving with the body.⁶⁹ In keeping with the notion of space as continuously fluctuating, Laban wrote:

Space-time configurations unfold in a flower-like manner; they swallow and engender formations; they wither and die and are reborn often filled with entirely unexpected inner and outer potentialities. Together with the dynamic rhythm with which the flowing energy drives along their tracks they constitute the vehicle of the language of movement. ... We therefore distinguish in our considerations of harmony of movement between "central" spatial lines meaning those which intersect in the centre of the kinesphere and the body, and "non-central" lines, meaning those which avoid the centre.⁷⁰

Thus, Laban conceived of dance as a language of movement traced by the body in motion in space and time. In Laban's analogy, trace-form of dance movements not only unfold in space-time, but they also evolve from birth, to life, to death, to be born again, encompassing the multitude senses of the term animate, alive and moving, as a living architecture in motion. Extending this notion to fighting, which Laban considered to be more purposeful than dance,⁷¹ the movements of the wrestlers in Moholy-Nagy's hybrid drawing of the *Exzentrik* trace out positions of dominance and submission in this epic struggle, defined by gravity in terms of ever-changing relationships of bodily position, strength, and weight. The circles surrounding the wrestlers articulate the ring and, as Moholy-Nagy had articulated elsewhere, trace their movements in: "ein stetes fluktuieren, seitwärts und aufwärts, strahlenhaft, allseitig, meldet dem menschen, daß er den unwägbaren, unsichtbaren und doch allgegenwärtigen raum — soweit seine menschlichen beziehungen und heutigen Vorstellungen reichen — in besitz genommen

⁶⁹ Laban, *Choreutics*, 1966, 115–119.

⁷⁰ Laban, *Choreutics*, 1966, 136, 147.

⁷¹ Laban, *Choreutics*, 1966, 26–45.

hat"⁷² (a continuous fluctuation, sideways and upwards, held radiant, all-around, tells the human being that he is the imponderable, invisible and yet existing-universe space — as far as his human relationships and current ideas range — have taken in possession). Likewise, Laban related his trace-forms created by spatial movements to the invisible of space-time, that which is unknown and unknowable, infinite, eternal, akin to clairvoyance.⁷³

In his "Mensch und Kunstfigur" (Man and Art Figure), the second chapter in *Die Bühne im Bauhaus*, immediately preceding the printed version of the *Exzentrik*, Oskar Schlemmer, Moholy-Nagy's Bauhaus colleague, elevated the cultural role of theater, by equating its history with the history of the physical and spiritual relationship of man in relation to nature, reflected in the degree of artifice. Modern man reflected nature through abstraction and mechanization. Schlemmer proceeded to describe and to diagram the range of theatrical experiences from religious ceremony to circus sideshows, including the effect physical form of the theater.⁷⁴ In this vein, Schlemmer composed his definition of the theatrical stage, that echoed strongly in Moholy-Nagy's writings:

"Bühne," allgemein genommen, ist der Gesamtbereich zu nennen, der zwischen religiösem Kult und der naiven Volksbelustigung liegt, die beide nicht sind, was die Bühne ist: zwecks Wirkung auf den Menschen vom Natürlichen abstrahierte Darstellung. Dieses Gegenüber von passivem Zuschauer und aktivem Darsteller bestimmt auch die Form der Bühne, deren monumentalste die antike Arena und

⁷² Moholy-Nagy, *Von Material zu Architektur*, 1947, 222.

⁷³ Laban, *Choreutics*, 1966, 53–54.

⁷⁴ Oskar Schlemmer, "Man and Art Figure," in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *The Theater of the Bauhaus*, trans. and ed. Arthur S. Wensinger, 4th ed. (Middletown, CT: Wesleyan University Press, 1987), 17–19, originally published as *Die Bühne im Bauhaus* (München: Albert Langen Verlag, 1925). See also Marcia Fae Feuerstein, "Oskar Schlemmer's Vordruck: The Making of an Architectural Body for the Bauhaus" (PhD diss., University of Pennsylvania, 1998).

deren primitivste das Brettergerüst auf dem Marktplatz ist.⁷⁵ (Stage, taken generally, is to be called the total area, that which lies between religious cult and naive folk amusement, both of which are not what the stage is: for the purpose of the effect on people of the abstract representation of the natural. This confrontation of the passive spectator and active performer also determines the form of the stage, of which the most monumental is the antique arena and the most primitive is the wooden scaffold in the marketplace.)⁷⁶

Additionally, Moholy-Nagy shared similar views on the importance of the mechanical reproduction of musical instruments, including the human voice. Likely inspired directly by Schlemmer's theatrical productions with their Bauhaus students and faculty, Moholy-Nagy translated these ideas directly into his notions about the need to aggrandize the actors through both costume and mechanical amplification and to, thereby, increase the impact on the audience. Foreshadowing the sentiment of Sirató's *Manifeste dimensioniste*, Schlemmer wrote that the mechanical amplification of sounds would "diese über ihre Maß- und Zeitbedingtheit hinaus zu steigern"⁷⁷ (raise these out of and above their space- and time-limitations).⁷⁸ With the human being at the center as both organism and number, as the measure of all things, the stage was dynamic. Unlike painting, sculpture, and architecture, the stage should be, according to Schlemmer, "kaleidoskopisches Spiel" (kaleidoscopic play), "als Stätte zeitlichen Geschehens bietet hingegen die Bewegung von Form und Farbe; zunächst in ihrer primären Gestalt als bewegliche, farbige oder unfarbige, lineare, flächige oder plastische Einzelformen, desgleichen

⁷⁵ Oskar Schlemmer, "Mensch und Kunstfigur," in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *Die Bühne im Bauhaus*, ed. Walter Gropius and László Moholy-Nagy, Bauhausbücher 4 (München: Albert Langen Verlag, 1925), 7–8.

⁷⁶ Translated by author.

⁷⁷ Oskar Schlemmer, "Mensch und Kunstfigur," in *Die Bühne im Bauhaus*, 20–21.

⁷⁸ Translated by author.

veränderlicher beweglicher Raum und verwandelbare architektonische Gebilde"⁷⁹ (as a place of temporal events [it] offers, on the other hand, the movement of form and colors; first of all, in its primary formation as the movable, colorful or uncolorful, linear, planar, or sculptural singularity of forms, likewise changeable, movable space and transformable, architectonic constructions).

In other words, a fluctuating space of transformation with the human being positioned "in dem kubischen, abstrakten Raum der Bühne"⁸⁰ (in the cubical, abstract space of the stage). **(Figure 4.12)** This centric position radiating out to infinity resulted in invisible relational lines, in Laban's terminology, primary and secondary trace-forms:

Die Gesetze des kubischen Raums sind das unsichtbare Liniennetz der planimetrischen und stereometrischen Beziehungen. Dieser Mathematik entspricht die dem menschlichen Körper innewohnende Mathematik und schafft den Ausgleich durch Bewegungen, die ihrem Wesen nach mechanisch und vom Verstand bestimmt sind.⁸¹ (The laws of cubical space are the invisible lineage of planimetric and stereometric relationships. These mathematics correspond to that of the inherent mathematics of the human body and create balance through movements, that have been determined to be human according to their nature and by the intellect.)⁸²

Schlemmer maintained that organic laws also govern the invisible, internal functions of people, such as pulse, breath, and electrical impulses, understood by the *Tänzermensch* (dancer) as both within himself/ herself and without, determining his/ her relationship to space. In order to magnifying the outward expression of the internal, a metamorphosis could be achieved by using

⁷⁹ Ibid., 22.

⁸⁰ Ibid., 13.

⁸¹ Ibid.

⁸² Translated by author.

costume according to four laws: "[d]ie Gesetze des umgebenden kubischen Raums... Wandelnde Architektur" (laws of the surrounding cubic space... ambulant architecture); "[d]ie Funktionsgesetze des menschlichen Körpers in Beziehung zum Raum... Gliederpuppe" (functional laws of the human body in relationship to space... mannequins); "[d]ie Bewegungsgesetze des menschlichen Körpers im Raum... [e]in technischer Organismus" (laws of motion of the human body in space... a technical organism); and "[d]ie metaphysischen Ausdrucksformen... Entmaterialisierung" (metaphysical forms of expression... dematerialization).⁸³ (Figure 4.13)

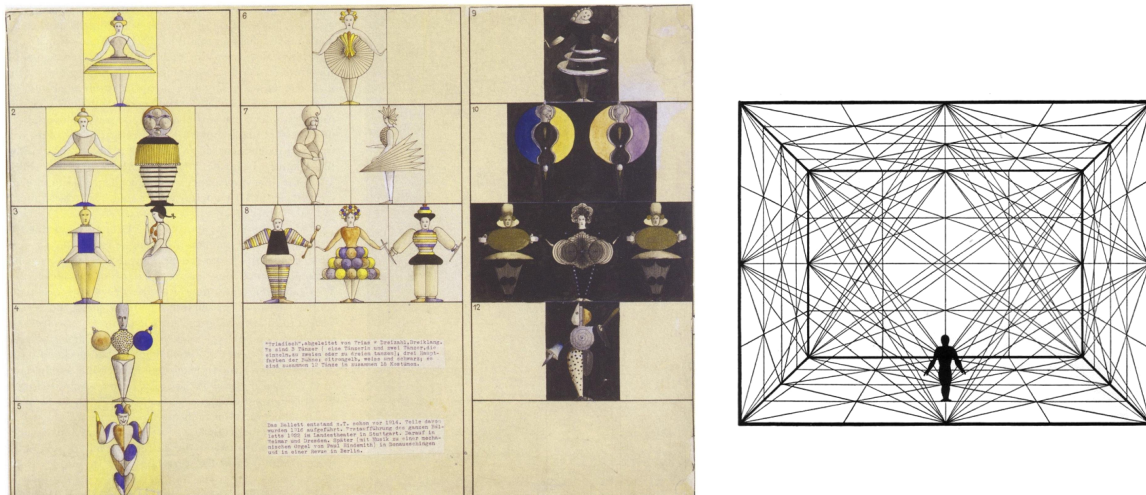


Figure 4.12: (left) Oskar Schlemmer, Costume Designs + "Mensch und Kunstfigur" in *Die Bühne im Bauhaus*, 1925.

These ideas blend seamlessly into Moholy-Nagy's notion of the "mechanischen Exzentrik" (mechanical eccentric) centered on the perception and apperception of the wrestling

⁸³ *Ibid.*, 16–17.

“Menschmechanik” (mechanical human),⁸⁴ when he wrote:

Die Wirkung dieser Körpermechanik (bei Artisten z. B.) besteht im wesentlichen darin, daß der Zuschauer über die ihm von andern vorgeführten Möglichkeiten seines eigenen Organismus erstaunt oder erschrocken ist. Es entsteht also eine subjektive Wirkung. Hier ist der menschliche Körper allein das Mittel der Gestaltung. Für eine objektive Bewegungsgestaltung ist dieses Mittel begrenzt, um so mehr als es zudem noch mit » gefühlsmäßigen« (literarischen) Elementen vermischt wird. Die Unzulänglichkeit »menschlicher« Exzentrik führte zu der Forderung einer bis ins Letzte beherrschbaren, exakten Form- und Bewegungsorganisation, welche die Synthese der dynamisch kontrastierenden Erscheinungen (von Raum, Form, Bewegung, Ton und Licht) sein sollte.

Mechanische Exzentrik.⁸⁵ (The effect of this mechanical body (with artists, for example) exists essentially therein, that the spectator was amazed or frightened by the possibilities of his own organism presented to him by others. It originates a subjective effect. Here is the human body alone the medium of formation. For an objective formation of movement was confined to this medium, more so as it will be mixed, moreover, with “emotional” (literary) elements. The inadequacy of the “human” eccentric leads to the requirement of an ultimate, controlling, precise organization of form and movement, which should be the synthesis of dynamic, contrasting phenomena (of space, form, movement, tone, and light).

Mechanical Eccentric.)⁸⁶

⁸⁴ László Moholy-Nagy, “Folge” in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *Die Bühne im Bauhaus*, ed. Walter Gropius and László Moholy-Nagy, Bauhausbücher 4 (München: Albert Langen Verlag, 1925), 44.

⁸⁵ Moholy-Nagy, “Theater, Zirkus, Varieté,” *Die Bühne im Bauhaus*, 1925, 47–48.

⁸⁶ Translated by author.

In the fifth and final Act, Moholy-Nagy introduced a marionette that appears to be larger-than-life, if compared to the size of the two wrestlers. **(Figure 0.15)** While this puppet may well represent the “Menschmechanik” in this production, the two wrestlers may first establish and project the inner struggle of a man with himself, with shadow in substantial form and as a psychophysical surrogate. With this relationship established, with the the human body and its shadow, whose positional relationships in their chirality are reflected and raised to the next higher dimension, at this point, may successfully be transferred to the “Menschmechanik,” as the out-sized, amplified, automaton.

V. ECCENTRIC

Exploding Center: Extra-Sensory
Awareness in the Experience of Higher
Spatial Dimensions in the *Partiturskizze zu
einer mechanischen Exzentrik* [Act V]

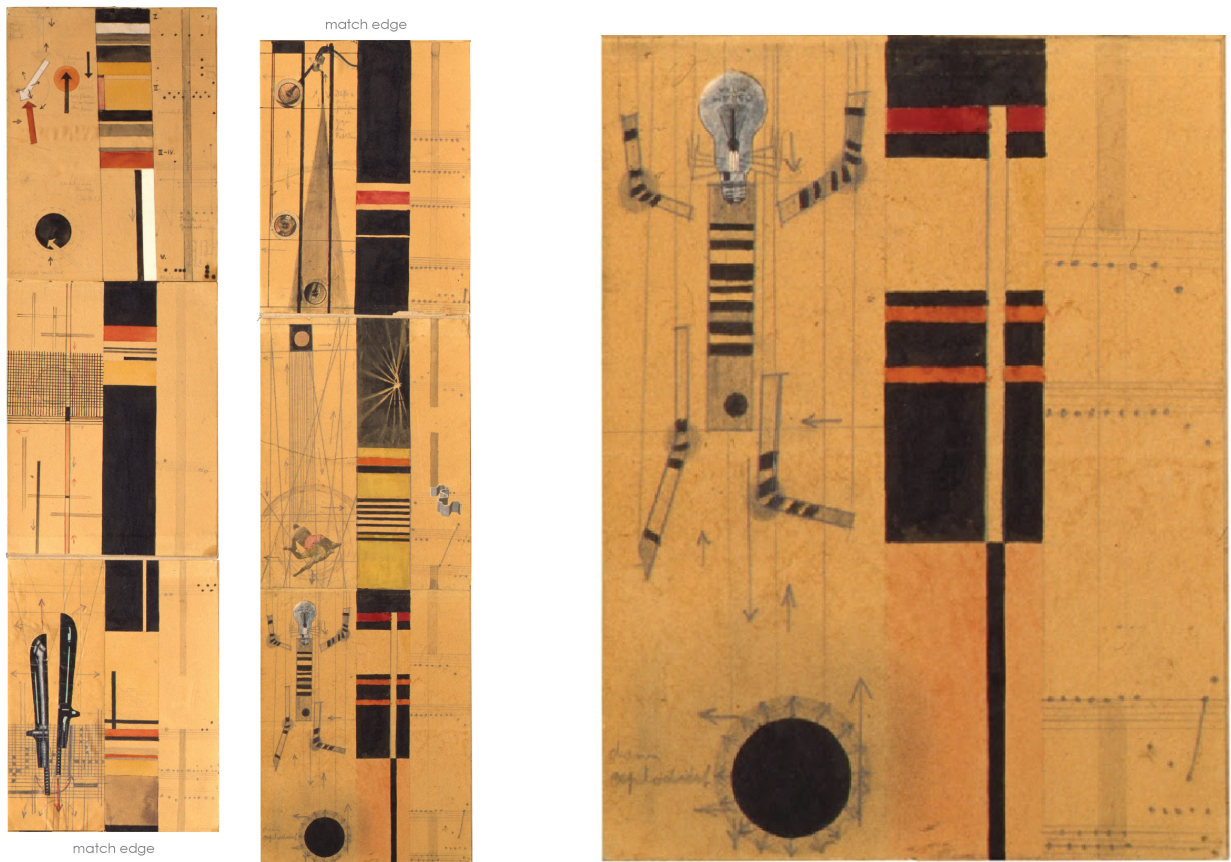


Figure 5.1: László Moholy-Nagy, (left) Untitled, c. 1924, for complete caption see note to Figure 0.1. + Act V Detail.

In his *Das Unheimliche* (The Uncanny, 1919), Sigmund Freud claimed that, after the prolonged suffering experienced during World War I, it would take some effort on his part to place himself in the proper frame of mind to recognize and appreciate the uncanny sensation of wit, as it would often be found in the humorous, amusing, and laughter-inducing.¹ In other words, Freud needed to put himself into a state of emotional openness. The final act of the *Exzentrik* was designed to achieve a receptive state of consciousness, an openness, that Moholy-Nagy achieved in his own work and sought to extend to his audience through their physical interaction and psychological investment in the performance. In a manner similar to the films of Charlie Chaplin, Moholy-Nagy employed the comedic facade combined with an electromagnetic vibratory penetration of their bodies, synaesthetic bombardment of the senses and laughter-inducing automaton to penetrate the consciousness of the audience, shaking loose their preconceptions about space and time. In the fifth act of the *Exzentrik*, Moholy-Nagy would use a marionette to pantomime the final destruction of the old understanding of space-time to be replaced by the dawn of a new openness to the experience of life, the *Gesamtwerk*, leaving the audience stripped bare of psychophysical preconceptions and ready to perceive the world anew. **(Figure 5.1)**

An *Exzentrik* (eccentric) is a theatrical performance employing an exaggerated form of comedy, similar to vaudeville or vaudeville, more than capable of lowering the audience's psychophysical barriers with uproarious laughter, opening them to new ideas. According to a contemporary Russian manifesto on ЭКЦЕНТРИЗМ (Eccentrism, 1922) containing four provocative texts by Soviet film and stage directors, Leonid Trauberg, Grigorii Kozintsev, Sergei Yutkevich, and Georgii Kryzhitskii, a Theater of Eccentrism would be capable of awakening the

¹ Sigmund Freud, "The Uncanny," in *An Infantile Neurosis and Other Works* (1917–1919), ed. James Strachey, et al., trans. Alix Strachey, vol. XVII, *The Standard Edition of the Complete Psychological Works of Sigmund Freud* (London: Hogarth Press and Institute of Psycho-Analysis, 1974), 220, originally published 1919 as *Das Unheimliche*.

public by employing tactics akin to a variety performance or a circus show. (Figure 5.2) With Vladimir Tatlin and others, these four were faculty of the Фабрика эксцентрического актёра (ФЭКС, FEKS, Factory of the Eccentric Actor) in Petrograd, where artists were trained in the attitudes and techniques of Eccentrism.²



Figure 5.2: Leonid Trauberg, Grigorii Kozintsev, Sergei Yutkevich, and Georgii Kryzhitskii, ЭКСЦЕНТРИЗМ (Petrograd, 1922).

In “СПАСЕНИЕ В ШТАНАХ ЭКСЦЕНТРИКА” (Salvation in the Trousers of the Eccentric), the first manifesto in ЭКСЦЕНТРИЗМ, Kozintsev tersely formulated the new roles of the actor, director, dramatist, artist, and audience with five “ПОДАЕМ ... СВИСТКА” (blasts on the whistle).³ Starting

² Leonid Trauberg, Grigorii Kozintsev, Sergei Yutkevich, and Georgii Kryzhitskii, *Eccentrism 1922*, trans. Marek Pytel and Giovanni Dadomo (London: Eccentric Press, 1992), 1–21, originally published as ЭКСЦЕНТРИЗМ (Petrograd, 1922).

³ Ibid.

with the actor (first blast), his/ her role would be transformative moving themselves and the audience from emotion, sadness, fear, anguish, presumably from melodrama (embodied in the performances of Eleonora Duse) to mechanized movement through a topsy-turvy circus prank, akin to Chaplin's psychological inversions using the tramp character. To achieve greater transformations, the director (second blast) would employ myriad inventions with the ability to generate a rhythm of their own. The dramatist (third blast) would join together these pranks into a whirling climax, while the artist (fourth blast) would create a kinetic architecture that would also participate in the performance. Lastly, "К СВИСТКУ ПЯТОМУ" (for the fifth whistle blast), the audience would become as much a part of the spectacle, which "should beat rhythmically upon the nerves ... using sirens, shots, typewriters—eccentric music."⁴

In another text included in the manifesto, "Eccentrism, Painting, Advertising," in the ЭКЦЕНТРИЗМ, Yutkevich exclaimed, "LIFE CONCEIVED AS A SKILLFUL GAG ... Out of the maze of the Intellect towards the full perception of the real!"⁵ Calling for the transformation of painting into an advertising poster for "actuality," Yutkevich equated "actuality" with life and life with a "skillful gag," which may also be translated as a witty prank. Therefore, the eccentric performance would have been designed to jostle the audience, pulling them out of their traditional assumptions: "WE CONSIDER ART AS A TIRELESS RAM SHATTERING THE HIGH WALLS OF HABIT AND DOGMA."⁶

Modeled, in part, after "Il Teatro Futurista Sintetico" (The Futurist Synthetic Theater) by Filippo Tommaso Marinetti, Emilio Settimelli, and Bruno Corra, Kryzhitskii outlined a "Theater of Chance" in which he advocated for similar witty pranks on the audience such as sprinkling their seats with itching and sneezing powders as a way to instigate sounds and movements bringing the

⁴ Ibid., 1–4.

⁵ Ibid., 13.

⁶ Ibid., 14.

audience into the performance. While there are many similarities between the Synthetic Theater and the Eccentric Theater, the third conclusion of the "Il Teatro Futurista Syntetico" appears to be the most relevant for Eccentrism:

SINFONIZZARE LA SENSIBILITÀ DEL PUBBLICO ESPLORANDONE, RISVEGLIANDONE,
CON OGNI MEZZO, LE PROPAGGINI PIÙ' PIGRE: ELIMINARE IL PRECONCETTO DELLA
RIBALTA LANCIANDO DELLE RETI DI SENSAZIONI TRA PALCOSCENICO E PUBBLICO;
L'AZIONE SCENICA INVADERÀ PLATEA E SPETTATORI.⁷ (SYMPHONIZE THE
AUDIENCE'S SENSIBILITY BY EXPLORING IT, STIRRING UP ITS LAZIEST LAYERS WITH
EVERY MEANS POSSIBLE; ELIMINATE THE PRECONCEPTION OF THE FOOTLIGHTS BY
THROWING NETS OF SENSATION BETWEEN STAGE AND AUDIENCE; THE STAGE
ACTION WILL INVADE THE ORCHESTRA SEATS, THE AUDIENCE.)⁸

Both the Eccentric Theater and its precursor the Futurist Synthetic Theater sought to penetrate and activate the audience in the performance, goals mirrored in the mechanical *Exzentrik*.⁹ After penetrating the audience with electromagnetic vibrations, both optical and phonetic, spraying them with scented and sneezing powders, bombarding them with sirens and rhythmic tones and flashing colored lights, in the fifth act, Moholy-Nagy featured a marionette as a human surrogate, a mechanical man in the hybrid drawing of the *Exzentrik*. In his chapter for *Die Bühne im Bauhaus*, Moholy-Nagy declared that:

Der Mensch, dem es nicht mehr gestattet sein sollte, sich als geistiges Phänomen
in seinen geistigen (logisch-gedanklichen) Fähigkeiten, zu repräsentieren, hat in

⁷ Filippo Tommaso Marinetti, Emilio Settimelli, and Bruno Corro, *Il Teatro futurista sintetico* (Piacenza: G. Constantino, 1921), 19.

⁸ F. T. Marinetti, *Critical Writings*, ed. Günter Berghaus, trans. Doug Thompson (New York: Farrar, Straus, and Giroux, 2006).

⁹ Moholy-Nagy, "Theater Circus Variety," *The Theater of the Bauhaus*, 1925, 52.

dieser Aktionskonzentration keinen Platz mehr; denn er kann — wenn auch noch so kultiviert — mit seinem Organismus höchstens eine gewisse auf seinen natürlichen Körpermechanismus bezogene Bewegungsorganisation durchführen."¹⁰ (Man, who no longer should be permitted to represent himself as a phenomenon of spirit and mind through his intellectual and spiritual capacities, no longer has any place in this concentration of action. For, no matter how cultured he may be, his organism permits him at best only a certain range of action, dependent entirely on his natural body mechanism.)¹¹

Following this argument, Moholy-Nagy advocated for the *Menschmechanik* to build upon the greater range of actions to expand upon the "subjektive Wirkung" (subjective effect) developed in the audience.¹²

However, even with this importance placed upon the amplification of the subjective effect of *Menschmechanik* in the mechanical *Exzentrik*, Moholy-Nagy excluded the marionette in the final act in the printed version of the mechanical *Exzentrik*. At the same time, he retained several notations that seem to relate to this part of the performance with one note nearly duplicating the last stage direction: namely, next to the black circle on the hybrid drawing of the *Exzentrik*, Moholy-Nagy wrote, "dann explodiert" (then it explodes) and, in the notes to the printed version, he listed "EXPLOSIONEN" (EXPLOSIONS), although there is no black circle in the forms and movements columns.¹³ The printed version ends with the fourth act, with the wrestlers engaged in an epic struggle. After "EXPLOSIONEN," Moholy-Nagy included three more notes with the printed version: "GERÜCHE" (ODORS), which relate to the third act in the hybrid drawing but

¹⁰ Moholy-Nagy, "Theater, Zirkus, Varieté," *Die Bühne im Bauhaus*, 1925, 47.

¹¹ Moholy-Nagy, "Theater, Circus, Variety," *The Theater of the Bauhaus*, Janet Seligman, trans., 54.

¹² Moholy-Nagy, "Theater, Zirkus, Varieté," *Die Bühne im Bauhaus*, 1925, 47.

¹³ Moholy-Nagy, *Die Bühne im Bauhaus*, 1925, 44.

were shown showering the wrestlers in the printed version, "CLOWNERIE" (CLOWNERY, BUFOONERY), possibly relating to the antics of the wrestlers, and "MENSCHMECHANIK" (MECHANICAL HUMAN), very likely describing the marionette that is no longer depicted in the printed version, but possibly transferred to the actions of the wrestlers.¹⁴ Without the black circle in the printed version, "EXPLOSIONEN" might be merely referring to an auditory blast, since the siren, previously depicted in yellow or red, becomes a black bar with a small band of red, suggesting an increased intensity and modulation of the sound. Additionally, the musical notes are placed closer together and more frequently jump between high notes and low notes amid the rhythmic phrase, an explosion of sounds.

In the printed version of the *Exzentrik*, "MENSCHMECHANIK" might relate to the wrestlers, perhaps this pair was meant to be replaced by automatons. Alternatively, the notation might suggest the insertion of an automaton, not depicted in the forms and movements columns, just as the mechanical musical instruments were not shown in the hybrid drawing nor the printed version.

In *Die Bühne im Bauhaus*, Moholy-Nagy included three of his *Photoplastiks* among many other images without specifically referencing them in his text. **(Figure 5.3)** However, their titles and imagery seem to relate to the *Exzentrik*. One *Photoplastik* entitled, "Bühnenszene Lautsprecher" (Stage Scene Loud Speaker), depicted what might be the mechanical musical instruments, shown hanging on wires and sliding along tracks, which also recall the notation on the prelude panel of the hybrid drawing of the *Exzentrik*: "Musiker | schwebend | (an einem | Gürtel | angeschnallt)" (musicians floating (on a belt fixed)). A second *Photoplastik* portrayed three acrobats, two on tightropes, while another knelt on an elevated platform. This *Photoplastik* was titled, "Der wohlwollende Herr (Zirkusszene)" (The Benevolent Gentleman (Circus Scene)), while actually showing two gentlemen, or perhaps it is one gentleman in two poses. Adding another layer of obfuscation, the last of his *Photoplastiks* was named "Menschmechanik (Variété)"

¹⁴ Moholy-Nagy, *Die Bühne im Bauhaus*, 1925, 44.

(Mechanical Human (Variety)). In this *Photoplastik*, Moholy-Nagy doubled the image of a leaping gymnast above a small child dancing with three legs and holding rings over her head. These figures were intertwined with intersecting, transparent lines, planes, and solid shapes.

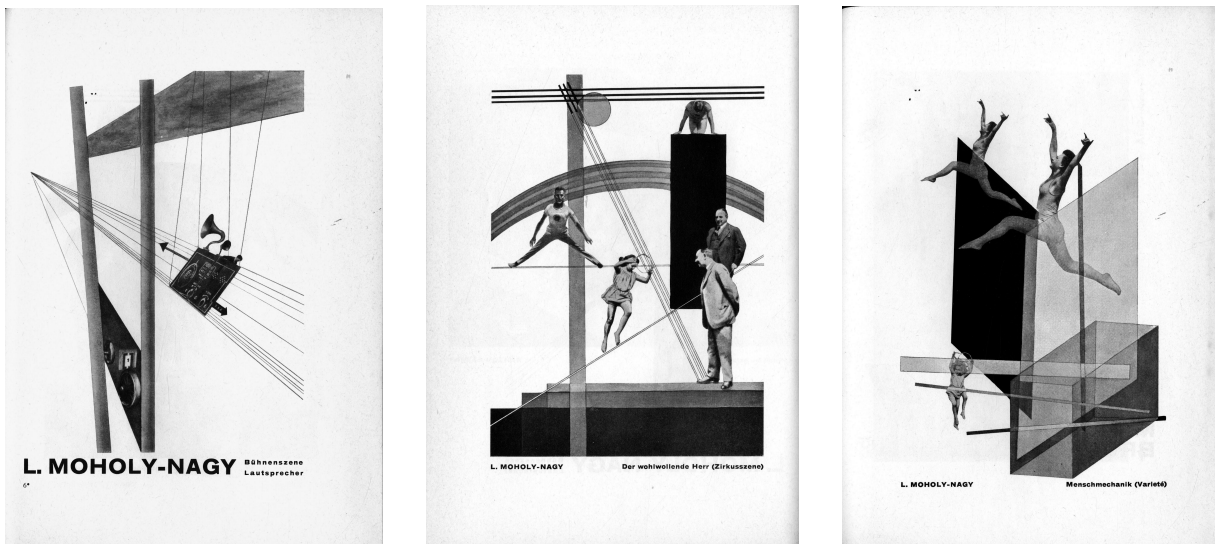


Figure 5.3: László Moholy-Nagy, (left) *Bühnenszene Lautsprecher* (Stage-scene Loudspeaker) + (middle) *Der wohlwollende Herr* (The Benevolent Gentleman) + (right) *Menschmechanik (Variété)* (Mechanical-Human [Variety]) in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *Die Bühne im Bauhaus*, Edited by Walter Gropius and László Moholy-Nagy, München, Albert Langen Verlag, 1925, Black and white print on paper.

Additionally, the sense of perspective created by the sizes and placements of the gymnasts, the spatial relationships of their forms, is thwarted by the orthographic and isometric planes, akin to the intersecting dimensional planes of the *Gelber Kreis und schwarzes Quadrat*, *Konstruktion All*, and *Untersehboot*, that weave between the two gymnasts and the child. As with *Untersehboot*, the twinned gymnasts and the twinned leg, as well as the twinned gentlemen of *Der wohlwollende Herr (Zirkusszene)*, may suggest two moments in time occupying two positions in space. The concurrent use of axonometric planes and perspective diminishment, as well as the

uncanny body and body part doubles, creates a space-time ambiguity necessary for the viewer to enter into the work to examine, but more importantly, muse about the possibilities inherent in the portrayal of these spatial-temporal relationships. Even more than *Untersehboot*, *Menschmechanik (Variété)* brings human form into relationships with the transparent planes and intersections recurring in Moholy-Nagy's paintings, revealing these compositions as space-time constructions.

Another image in *Die Bühne im Bauhaus* is relevant to the final act of the *Exzentrik*: the photograph of three marionettes created by Kurt Schmidt as the characters in a Bauhaus production of *Die Abendteuer des kleinen Buckliger (Adventures of the Hunchback)*.¹⁵ One of the featured marionettes, *Der Schneider* (the tailor) nearly identical to the marionette in the fifth act of the hybrid drawing of the *Exzentrik*. **(Figure 5.4)**

“The Adventures of the Hunchback” is one of the stories collected into *ألف ليلة وليلة* (Alf layla wa-layla, One Thousand and One Nights, c. 1100) in which the tailor's wife accidentally kills the drunken hunchback by forcing him to swallow a mouthful of fish. Three more times various people believe that they have killed the already-dead hunchback. Then, in reverse order of their crimes, the four men publicly confess to their actions, just as in time, because each man cannot bear to see another hanged for their sins. In the end, all four men were saved from the gallows because their story is so marvelous.¹⁶

¹⁵ For accurate reconstructions of the *Die Abendteuer des kleinen Buckliger* marionettes, see Christian Fuchs, *The Adventures of the Little Hunchback: A Bauhaus Puppet Play*, accessed March 27, 2019, <https://buckliger.wordpress.com/>. In an email on March 27, 2019, Fuchs stated that the marionettes were set aside, without even being strung, after they were created and that, for unknown reasons, the play was never performed at the Bauhaus. The “strings” depicted in the photographs were drawn on the print in the approximate locations, yet lacking the connections.

¹⁶ Richard F. Burton, trans., *The Book of the Thousand Nights and a Night: A Plain and Literal Translation of the Arabian Nights Entertainments* (London: Burton Club, 1888), 1: 255–262.

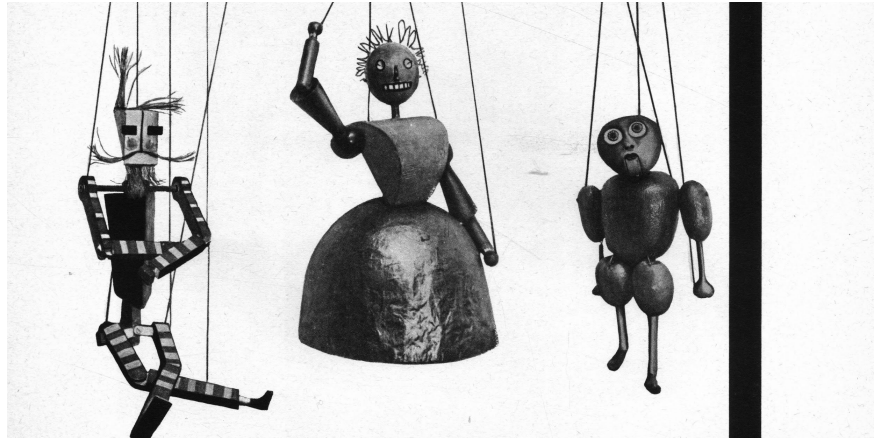


Figure 5.4: Kurt Schmidt, *Figurinen aus dem Marionettenspiel: „Die Abendteuer des kleinen Buckliger“* (Figures from the Marionette-play: “The Adventure of the Small Hunchback”) in Oskar Schlemmer, László Moholy-Nagy, and Farkas Molnar, *Die Bühne im Bauhaus*, Edited by Walter Gropius and László Moholy-Nagy, München, Albert Langen Verlag, 1925, Black and white print on paper.

The Scheider-like marionette in the *Exzentrik* appears to be identical to Schmidt's character except that the head has been replaced by a light bulb. The copper wire hair, moustache, and beard of Schneider appear to be attached to the base of the light bulb in the hybrid drawing of the *Exzentrik*, perhaps alluding to its function to receive the electromagnetic vibrations from the induction coil and, therefore, to become illuminated, wirelessly, in sync with the musical impulses. One can imagine that the larger than life marionette looms over the audience, his head blinking on and off as the electrical sounds simultaneously ignite its filaments and stimulate the eyes/ears/intellects of the audience.

In his *Der Witz*, Freud was critical of Bergson's hypothesis from *Le rire* that the comedic stemmed entirely from the recognition of the mechanical claiming that no author had satisfactorily addressed its psychophysical origins. Freud wrote that “Es ist nicht leicht, hiefür eine befriedigende Aufklärung zu geben, wenn man sich nicht der Ansicht von Bergson anschließen will, durch welche die Komik der Nachahmung nahe an die durch Aufdeckung des psychischen

Automatismus herangerückt wird."¹⁷ ("Bergson believes that everything gives a comic impression, which manifests itself in the shape of a machine-like inanimate movement in the human being.")¹⁸ In his own theory of laughter, Freud examined the comic effect of mismatched levels of exertion.¹⁹ In analyzing what he called the most primitive stage performance, the pantomime, Freud concluded that people laugh at the movements of clowns because their actions are immoderate, at times inappropriate, in their proportion and intensity,²⁰ which may or may not relate to their mechanical nature. As such, in *Der Witz*, Freud claimed that:

Das Lachen gehört zu den im hohen Grade ansteckenden Äußerungen psychischer Zustände; wenn ich den Anderen durch die Mitteilung meines Witzes zum Lachen bringe, bediene ich mich seiner eigentlich, um mein eigenes Lachen zu erwecken, und man kann wirklich beobachten, daß, wer zuerst mit ernster Miene den Witz erzählt hat, dann in das Gelächter des Anderen mit einer gemäßigten Lache einstimmt. Die Mitteilung meines Witzes an den Anderen dürfte also mehreren Absichten dienen, erstens mir die objektive Gewißheit von dem Gelingen der Witzarbeit zu geben, zweitens meine eigene Lust durch die Rückwirkung von diesem Anderen auf mich zu ergänzen, drittens — bei der Wiederholung eines nicht selbstproduzierten Witzes — der Lusteinbuße durch

¹⁷ Freud, *Der Witz und seine Beziehung zum Unbewussten*, 1905, 180. A closer translation of this statement would be: [i]t is not easy to give a satisfactory explanation for this, if one does not want to join Bergson's view, through which the comedy of imitation would approach close to that through uncovering of psychic automatism.

¹⁸ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 337.

¹⁹ Sigmund Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill (London: Kegan Paul, Trench, Trubner & Company, 1916), 302, originally published as *Der Witz und seine Beziehung zum Unbewussten* (Leipzig und Wein: Franz Deuticke, 1905).

²⁰ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 304.

Wegfall der Neuheit abzuhelfen.²¹ (Laughter belongs to those manifestations of psychic states which are highly infectious; if I make someone else laugh by imparting my wit to him, I am really using him as a tool in order to arouse my own laughter. One can really notice that the person who at first recites the witticism with a serious mien later joins the hearer with a moderate amount of laughter. Imparting my witticisms to others may thus serve several purposes. First, it serves to give me the objective certainty of the success of the wit-work; secondly, it serves to enhance my own pleasure through the reaction of the hearer upon myself; thirdly, in the case of repeating a not original joke, it serves to remedy the loss of pleasure due to the lack of novelty.)²²

Furthering his argument, Freud maintained that the inclination to mimic, imitate, pantomime, or caricature produces reciprocal expenditures between the clown/comic and the audience, especially seen in an impulse to imitate perceived motions without actually physically following through on the mirroring. As such, the audience compares the expenditure of energy of the clown/comic who has outsized movements, large gestures, with their own imagined investment rooted in "Apperzeption" (apperception).²³ Freud alleged that, when perceiving movements,

²¹ Sigmund Freud, *Der Witz und seine Beziehung zum Unbewussten* (Leipzig and Vienna: Franz Deuticke, 1905), 132–133.

²² Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 242.

²³ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 307–308. In the corresponding passage in *Der Witz und seine Beziehung zum Unbewussten* (Leipzig, 1905, 164–165), Freud wrote: "Wenn ich nun eine ähnliche, mehr oder minder große Bewegung bei einem Anderen wahrnehme, wird der sicherste Weg zum Verständnis — zur Apperzeption — derselben sein, daß ich sie nachahmend ausführe, und dann kann ich durch den Vergleich entscheiden, bei welcher Bewegung mein Aufwand größer war. Ein solcher Drang zur Nachahmung tritt gewiß beim Wahrnehmen von Bewegungen auf. In Wirklichkeit aber führe ich die Nachahmung nicht durch, sowenig wie ich noch buchstabiere, wenn ich durch das Buchstabieren das Lesen erlernt habe. An Stelle der Nachahmung der Bewegung durch meine Muskeln setze ich das Verstellen derselben vermittels meiner Erinnerungsspuren an die Aufwände bei ähnlichen Bewegungen." For more on the promulgation of laughter, see also Joseph S. Roucek and Elias Cannetti, "Crowds and

the brain sends weakened impulses to the corresponding muscles in a sort of pantomime. He described these ideational mimicries taking place in the gestures of the face, hands, arms, etc. with examples of reciprocal facial expressions and hand gestures made while talking. According to Freud, this mimicry explains laughter that is elicited in response to immodest or inappropriate (comic) movements.²⁴

Moholy-Nagy acknowledged a similar intention in his "Theater, Zirkus, Varieté," when he wrote: "Die Wirkung dieser Körpermechanik (bei Artisten z. B.) besteht im wesentlichen darin, daß der Zuschauer über die ihm von andern vorgeführten Möglichkeiten seines eigenen Organismus erstaunt oder erschrocken ist. Es entsteht also eine subjektive Wirkung."²⁵ (The effect of this mechanical body (for artists, for example) consists, essentially, therein, that the spectator himself, against a predetermined preference for his own organism from others, is astonished or frightened by it. It, therefore, develops a subjective effect.) In other words, the audience will psychologically and physically recognize and react to the bodily movements of other bodies, whether human or mechanical. However, Moholy-Nagy continued to appreciate the mechanical *Exentrik* over the human *Exzentrik* for the reason that the form and movements of the human body are confined to a limited range, while the mechanical body defies these physical limitations, such as size, gravity, strength, and so forth.²⁶

Within his thesis of expenditure, Freud compared the comedic and wit in their formation, reception, and interpretation, ultimately, identifying an inverse relationship between the expenditure of physical or psychical energy: the comedic requires an excess and wit prefers an economy. Freud determined that the sense of pleasure, aroused by each, stems from a feeling

Power," *American Sociological Review* 31, no. 3 (1966): 420.

²⁴ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 307–311.

²⁵ Moholy-Nagy, "Theater, Zirkus, Varieté," in *Die Bühne im Bauhaus*, 1925, 47.

²⁶ *Ibid.*

of superiority generated by imagining a more appropriate gesture, a movement in proportion to what would be required.²⁷ This feeling of superiority within the notion of comparative expenditures is reminiscent of Bergson's argument that laughter is a social gesture. However, with Freud, it was more specifically the perception of these expenditures that would trigger a reciprocal psychophysical impulse in the audience. Elaborating on this point, Freud wrote:

An Stelle der Nachahmung der Bewegung durch meine Muskeln setze ich das Verstellen derselben vermittelt meiner Erinnerungsspuren an die Aufwände bei ähnlichen Bewegungen. Das Vorstellen oder 'Denken' unterscheidet sich vom Handeln oder Ausführen vor allem dadurch, daß es sehr viel geringere Besetzungsenergien in Verschiebung bringt und den Hauptaufwand vom Abfluß zurückhält. ²⁸ (Instead of imitating the movement by my muscles I substitute the idea of the same through my memory traces of the expenditures necessary for similar motions. Perceiving, or "thinking," differs above all from acting or carrying out things by the fact that it entails a very much smaller displacement of energy and keeps the main expenditure from being discharged.)²⁹

As such, in the clown/ comedic/ circus act, the audience would have been pulled into such an investment. While watching the outsized movements of clowns and other circus performers. For example, when viewing the abnormal expenditure of acrobats swinging overhead on a trapeze, risking life and limb, as they soar through the air, the audience would participate in the movements, even producing twitches in their own muscles as if they are attempting to grab the trapeze bar or avoid the pail of water. This reciprocation is the phenomena of a physical

²⁷ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 313–314.

²⁸ Sigmund Freud, *Der Witz und seine Beziehung zum Unbewussten* (Leipzig and Vienna: Franz Deuticke, 1905), 165.

²⁹ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 307–308.

reaction in the audience, when invested in the drama can be seen jumping in unison with the actor, when the actor is startled.

In *The Circus*, Chaplin portrayed the hilarity of this type of psychophysical investment, when he contrasted the starkly different audience reactions to watching the clowns performing uninspiring comedy routines with the highly engaged cheering for the tramp as he was chased by the policeman or a donkey. The former left them yawning as their expectations were set and met, while the latter pulled them into the plight of Chaplin who inadvertently made the policeman look foolish, thereby inverting the respective social standings of the two men. This scene provides an example of what Freud identified as the role of the comic facade in wit-work, enabling the audience to release their inhibitions through laughter before sliding in an irreverent, degrading remark meant to undermine preconceptions. Chaplin created a comic facade with the accidental chase scene, arriving at the center ring of the circus, where a ready-made audience awaited, operating also a surrogate for the audience in the movie theater. Through this somewhat plausible comic premise, a witty scenario unfolded using all of the physical comedy of the circus. Running on the spinning merry-go-round, the two men do not appear to be going anywhere until gradually the policeman slows down from exhaustion, falls behind and in so doing finds himself in front of Chaplin, switching from the role of the pursuer to the pursued.

Such inversions are equally present in wit and in dreams. Freud determined that there are significant and meaningful similarities between *Traumarbeit* (dream-work) and *Witarbeit* (wit-work), as both include identical techniques of interpretation.³⁰ Finding its roots in Pascal's assumption that two identical faces suggest that one is unnatural, or inhuman, when they are placed next to one another, Freud demonstrated that Bergson's thesis was based on a comedy of expectation, in other words, on the subversion of an expectation of individuality.³¹

³⁰ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 126 and 249.

³¹ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 337–338.

Connecting wit-work and dream-work through the similar acts of formation and interpretation, Freud wrote in *Der Witz*:

Die interessanten Vorgänge der Verdichtung mit Ersatzbildung, die wir als den Kern der Technik des Wortwitzes erkannt haben, wiesen uns auf die Traumbildung hin, in deren Mechanismus die nämlichen psychischen Vorgänge aufgedeckt worden sind. Eben dahin weisen aber auch die Techniken des Gedankenwitzes, die Verschiebung, die Denkfehler, der Widersinn, die indirekte Darstellung, die Darstellung durch's Gegenteil, die samt und sonders in der Technik der Traumarbeit wiederkehren. Der Verschiebung verdankt der Traum das befremde Ansehen, das uns abhält, in ihm die Fortsetzung unserer Wachgedanken zu erkennen; die Verwendung von Widersinn und Absurdität im Traum hat ihn die Würde eines psychischen Produkts gekostet und hat die Autoren verleitet, Zerfall der geistiger Tätigkeiten, Sistierung von Kritik, Moral und Logik als Bedingungen der Traumbildung anzunehmen.³² (The interesting processes of condensation with substitutive formation, which we have recognized as the nucleus of the technique of word-wit, directed our attention to the dream-formation in whose mechanism the identical psychic processes were discovered. Thither also we are directed by the technique of the thought-wit, namely displacement, faulty thinking, absurdity, indirect expression, and representation through the opposite—each and all are also found in the technique of dreams. The dream is indebted to the displacement for its strange appearance, which hinders us from recognizing in it the continuation of our waking thoughts; the dream's use of absurdity and contradiction has cost it the dignity of a psychic product, and has misled the

³² Sigmund Freud, *Der Witz und seine Beziehung zum Unbewussten* (Leipzig and Vienna: Franz Deuticke, 1905), 72.

authors to assume that the determinants of dream-formation are: collapse of mental activity, cessation of criticism, morality, and logic.)³³

Expounding upon his claim that the subconscious determines conscious action, especially neuroses and anxieties, bolstered by evidence of such a connection in post-hypnotic suggestions and psychoanalysis, Freud asserted that regression in *Traumarbeit* can elucidate the transition from thought-formation to sensory perception through the stages of transference (from conscious to subconscious), *Traumarbeit* (dream interpretation using condensation, displacement, etc.), and regression (from thought to sense). While a witty expression has the sense of being spontaneous, Freud surmised that, like a dream, a witticism would form, when a stream of thought would drop momentarily into the subconscious, where it would be transformed by these techniques of condensation and displacement found in both *Traumarbeit* and *Witzarbeit*, in part, explaining the mechanism behind his theory of economy of psychophysical expenditure in both dreams and wit.³⁴

In dreams, displacement signals an avoidance of the psychological process of self-censorship; similarly, certain techniques of wit, especially in the case of tendency-wit in which the witticism is meant to attack an authority (for instance, a tramp chasing and knocking down a policeman, or, in the case of the mechanical *Exzentrik*, inverting a prevailing understanding of space and time), use displacement to render the witticism as seemingly innocuous. However, such associations become the veil used to slip by the censor, or, in other words, a more powerful figure of authority.³⁵ While both wit and dreams deal with repression and inhibition, sharing in

³³ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 125–126.

³⁴ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 254–268.

³⁵ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 271–273.

objects and sources of pleasure found in displacement and allusions, wit must make “Sinn im Unsinn” (sense in nonsense).³⁶ On this topic, Freud wrote:

In welchem Falle wird nun der Witz vor der Kritik als Unsinn erscheinen?
Besonders dann, wenn er sich jener Denkweisen bedient, die im Unbewußten üblich, im bewußten Denken verpönt sind, also der Denkfehler. Gewisse der Denkweisen des Unbewußten sind nämlich auch für das Bewußte erhalten geblieben, z. B. manche Arten der indirekten Darstellung, die Anspielung usw., wenngleich deren bewußter Gebrauch größeren Beschränkungen unterliegt.³⁷ (Now in what case will wit appear to the critic as nonsense? Particularly when it makes use of those modes of thought, which are common in the unconscious, but forbidden in conscious thought; that is, when it resorts to faulty thinking. Some of the modes of thinking, of the unconscious, have also been retained in conscious thinking, for example, many forms of indirect expression, allusions, etc., even though their conscious use has to be much restricted.)³⁸

In addition to “sense in nonsense,” wit has also been defined similarly as a “contrast of ideas” and “confusion and clearness.”³⁹ Psychologically, wit places a person in a position to change, to question preconceptions, and to be convinced of alternative ways of conceiving of the world. In a longer list, Freud showed that previous authors were looking at the expression and comic effect of wit without examining its psychological source:

³⁶ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 274–275.

³⁷ Freud, *Der Witz und seine Beziehung zum Unbewussten*, 1905, 176.

³⁸ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 329.

³⁹ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 7.

die Beziehung zum Inhalt unseres Denkens, der Charakter des spielenden Urteils, die Paarung des Unähnlichen, der Vorstellungskontrast, der „Sinn im Unsinn“, die Aufeinanderfolge von Verblüffung und Erleuchtung, das Hervorholen des Versteckten und die besondere Art von Kürze des Witzes.⁴⁰ (the relation of the content of wit to our thoughts, the character of the playful judgment, the union of dissimilarities, contrasting ideas, 'sense in nonsense,' the succession of confusion and clearness, the sudden emergence of the hidden, and the peculiar brevity of wit).⁴¹

According to Freud, wit is a powerful psychic force that vanquishes shame and critical judgment through pleasure, since wit is skeptical of all authority and thwarts reason.⁴² Moholy-Nagy employed more than one type of *Witzarbeit/Traumarbeit*, as discussed previously, such as the double meaning produced by a play on words in his *Photoplastik* titles and discussion of Joyce's writings in *Vision in Motion* and the photographic (visual) jokes in *Malerei, Fotografie, Film*. In such cases, Freud maintained that double meanings found in the significance of a name, oscillate between literal and metaphoric senses of a word:⁴³

Es gibt im Deutschen auch Worte, die in anderem Sinne voll und leer genommen werden können, und zwar in mehr als nur einem. Es können nämlich zwei verschiedene. Abkömmlinge desselben Stammes, das eine sich zu einem Worte mit voller Bedeutung, das andere sich zu einer abgeblaßten End- oder Anhängesilbe entwickelt haben, und beide doch vollkommen gleich lauten.⁴⁴

⁴⁰ Freud, *Der Witz und seine Beziehung zum Unbewussten*, 1905, 6.

⁴¹ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 12.

⁴² Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 204.

⁴³ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 41–47.

⁴⁴ Freud, *Der Witz und seine Beziehung zum Unbewussten*, 1905, 23.

(Language is replete with words which taken in one sense are full of meaning and in another are colorless. There may be two different derivatives from the same root, one of which may develop into a word with a full meaning while the other may become a colorless suffix or prefix, and yet both may have the same sound.)⁴⁵

In the case of Moholy-Nagy's use of double meanings in the titles of his *Photoplastiks*, *Untersehboot* (submarine and under-seeing-boat), also *Die Lichter der Stadt* (the lights of the city and Chaplin's *City Lights*) and Chaplin's *The Circus*, as well as *Da stehst du machtlos vis-a-vis* (There you stand powerless face to face), all of these titles and their play on words, on misidentifications, and with transferences, hint at the hidden meanings within the images, forms, and structure in the *Photoplastik*. Similarly, the use of the word *Exzentrik* in the title of the *Partiturskizze zu einer mechanischen Exzentrik* uncovers the multiple meanings or allusions present in the term itself. In turn, the performance appears to not only have a relationship to each of those meanings, but also the overlapping of Eccentricism (circus comedy) and eccentric sensation (Marcus) reveals to potential power of the synaesthetic experience to use the involuntary psychophysical mechanisms of the human body and intellect to its fullest effect.

This penetrative aspect of comedy was further described by Freud as:

Als eigentlicher, noch tendenzloser, Witz leiht er dann Gedanken seine Hilfe und stärkt sie gegen die Anfechtung des kritischen Urteils, wobei ihm das Prinzip der Verwechslung der Lustquellen dienlich ist, und endlich tritt er großen, mit der Unterdrückung kämpfenden Tendenzen bei, um nach dem Prinzip der Vorlust innere Hemmungen aufzuheben.⁴⁶ (Wit carries out its purpose in advancing the

⁴⁵ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 39.

⁴⁶ Freud, *Der Witz und seine Beziehung zum Unbewussten*, 1905, 116.

thought by magnifying it and by guarding it against reason. Here again it reveals its original nature in that it sets itself up against an inhibiting and restrictive power, or against the critical judgment.)⁴⁷

The wit-maker is compelled to release inhibited energies through a single avenue, consideration of alternatives would awaken reason and attention in the audience. Similar to the dream-state, wit-makers build facades, syllogistic or comic, in order to distract, by consuming intellectual attention, in the wit-process.⁴⁸ Tracing a representation by the opposite is the most reliable path to find a witticism. With this path in mind, Freud purported that *Traumarbeit* delights in this form of representation, inversions and subversions, in their ability to confound and destabilize an interpretation.⁴⁹ According to Moholy-Nagy, this operation was the unique ability of the mechanical *Exzentrik*: "Forderung einer bis ins Letzte beherrschbaren, exakten Form- und Bewegungsorganisation, welche die Synthese der dynamisch kontrastierenden Erscheinungen (von Raum, Form, Bewegung, Ton und Licht) sein sollte. Mechanische Exzentrik."⁵⁰ (Demand for it, in the end, became prevalent, [an] exact organization of form and movement, which should be the synthesis of the dynamic contrasting appearances (of space, form, movement, tone and light). Mechanical Eccentric.)⁵¹ This summary statement further reveals Moholy-Nagy's intention to use the mechanical *Exzentrik* to explore perception and apperception through contrasts in dynamic forms, flashing lights, and staccato sounds.

⁴⁷ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 203.

⁴⁸ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 235–239.

⁴⁹ Freud, *Wit and Its Relation to the Unconscious*, trans. A. A. Brill, 1916, 276–278.

⁵⁰ Moholy-Nagy, "Theater, Zirkus, Varieté," in *Die Bühne im Bauhaus*, 1925, 47.

⁵¹ Translated by author.

DIMENSION

The *Exzentrik* not only employed the comic facade to psychophysically lure the audience into the performance, but it also presented the actors as marionettes, rather than human figures. These mechanical figures enhanced the comic effect and also were free from the gravitational forces of the earth-bound dimensional coordinate system established earlier in the *Exzentrik* performance. In this way, the marionette, Schneider (tailor), functions to draw the audience into the performance, with psychophysical investment, and, in the final act, allows the audience to experience the explosion through a surrogate, a double of themselves, unlike with the sneezing powders when the audience was immediately bound to the performance.

According to Heinrich von Kleist in his essay, *Über das Marionettentheater* (On the Marionette Theater, 1810), the marionette was superior to the human actor because the marionette reacted to but ultimately was not bound by gravitational forces.⁵² This key aspect of the marionette allowed it too defy gravity and hover above the dimensional plane, lifting itself out of the *Flatland* and enter the next higher dimension of space. Moholy-Nagy's Bauhaus colleague and co-author of *Die Bühne im Bauhaus*, Oskar Schlemmer, mentioned the importance of Kleist's essay in the lead essay, "Mensch und Kunstfigur" (Man and Art Figure). Conceiving of and directing the fantastical performances at the Bauhaus, Schlemmer would have served as Moholy-Nagy's most immediate source of inspiration for his ideas about performance. In the same text, Schlemmer also referred to the marionettes in E. T. A. Hoffmann's *Der Sandmann*,⁵³ Gordon Craig's *Übermarionette*, and Valery Bryusov's call to replace the actor with dolls, as

⁵² Heinrich von Kleist, "Über das Marionettentheater" [On the Marionette Theater], 1810.

⁵³ In 1929, Moholy-Nagy designed the stage sets for *Hoffmannserzählungen*, which included *Der Sandmann* in the trilogy.

examples of mechanical human figures.⁵⁴ On the necessity to involve and transform the audience in theatrical performance, Schlemmer wrote:

Sie beginnt aber auch mit der inneren Verwandlung des Zuschauers Mensch als dem A und O der Voraussetzung jeder künstlerischen Tat, die selbst bei ihrer Verwirklichung verurteilt ist, Utopie zu bleiben, solange sie nicht die geistige Bereitschaft vorfindet.⁵⁵ ("It depends well upon the inner transformation of the spectator — Man as alpha and omega of every artistic creation which, even in its realization, is doomed to remain Utopia so long as it does not find intellectual and spiritual receptivity and response.")⁵⁶

Not only did Schlemmer mention Hoffmann's *Der Sandmann* in this text, he also included one of Hoffmann's main characters, Spalanzani, in his production of *Das figurale Kabinett I* (The Figural Cabinet I), first performed in 1922 and again during the Bauhaus' Weimar Ausstellung in 1923, the first which Moholy-Nagy attended, as a newly hired Bauhaus Master, and, as editor, featured drawings of the cabinets in *Die Bühne im Bauhaus*. **(Figure 5.5)** Schlemmer described this production as "[h]alb Schießbude halb Meta-Physikum abstractum, Gemisch, das ist Variiertes aus Sinn und Unsinn, methodisiert durch Farbe, Form, Natur und Kunst, Mensch und Maschine, Akustik und Mechanik. Organisation ist alles, das Heterogenste zu organisieren das Schwerste." ([h]alf shooting gallery, half metaphysical abstract, mixture, that is varies between sense and nonsense, made methodical through color, form, nature and art, human and machine, acoustics and mechanics.)⁵⁷ In these notes to his illustrations, Schlemmer also mentioned one of the familiar characters in *Das figurale Kabinett I* as: "Dazwischen geistert, dirigierend,

⁵⁴ Schlemmer, "Man and Art Figure," in *The Theater of the Bauhaus*, 1925/ 1961, 28.

⁵⁵ Schlemmer, "Mensch und Kunstfigur," in *Die Bühne im Bauhaus*, 1925, 20.

⁵⁶ Schlemmer, "Man and Art Figure," in *The Theater of the Bauhaus*, 1925/ 1961, 32.

⁵⁷ Translated by author.

gestikulierend, telephonierend der Magister, E. T. A. Hoffmanns Spallanzani, tausend Tode sterbend durch Selbstschuß und aus Sorge um die Funktion des Funktionellen."⁵⁸ ("In the midst, the Master E. T. A. Hoffmann's Spalazani, spooking around, directing, gesticulating, telephoning, shooting himself in the head, and dying a thousand deaths from worry about the function of the functional.")⁵⁹

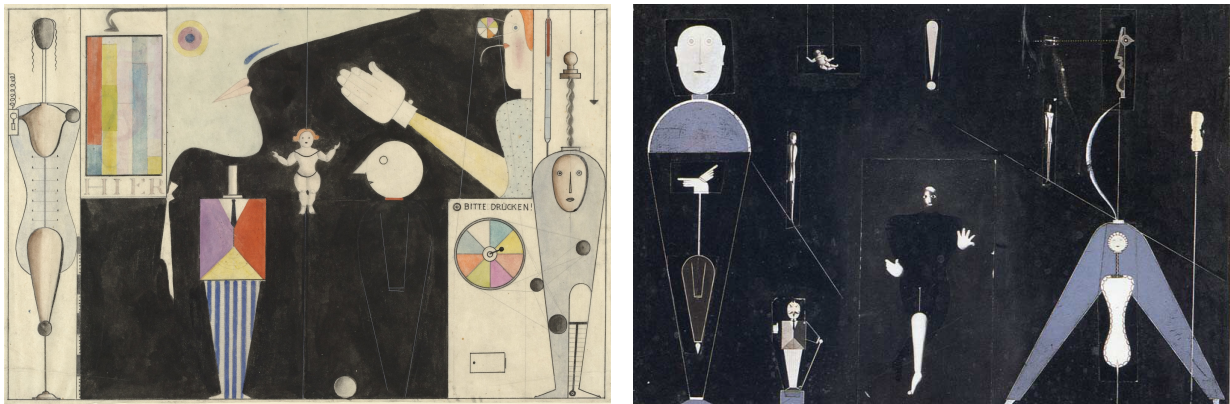


Figure 5.5: Oskar Schlemmer, Figural Cabinets I (left) + II (right), 1922.

In his own essay in *Die Bühne im Bauhaus*, Moholy-Nagy determined that the audience is not only amused by the mechanical figure, the marionette, but also frightened by the mechanical body; it is in this combination of sympathy and fear that Moholy-Nagy aimed to startle, shake, shock, and, ultimately, awaken the audience of the *Exzentrik*.⁶⁰ In the fifth act, as the siren becomes more faint with a long pause in the middle of the action, the music returns to rhythmic low notes punctuated by even lower notes. The large marionette, Schneider, is suspended on

⁵⁸ Schlemmer, Note to "Siete 38: Das Figurale Kabinett I," in *Die Bühne im Bauhaus*, 1925, 22–23, translated by author.

⁵⁹ Schlemmer, "Man and Art Figure," in *The Theater of the Bauhaus*, 1925/ 1961, 40.

⁶⁰ Moholy-Nagy, "Theater, Zirkus, Varieté," in *Die Bühne im Bauhaus*, 1925, 47.

wires above a black circle. The head of the marionette is a photograph of an incandescent lightbulb that has been colored in with silver pencil. Presumably, the wires would allow this bulb to be illuminated remotely by the induction coil mentioned in the note to the prelude, “elektrische Funken (Tesla?)” (electric Sparks [Tesla?]), performing the rhythmic sounds running vertically in the fourth column (Klänge [noises]), penetrating the audience with electromagnetic waves in the second act, and powering the La Cour wheels in the third. Capable of receiving the electrical pulses through the air, eight bent lines extend from inside of the bulb and form a collar near its base. Meanwhile, these wires are also reminiscent of the copper wires that created the hair, moustache, and beard of the *Schneider* marionette, in which the marionette strings would reportedly get tangled for further comic effect.

Other than the light bulb head, Moholy-Nagy appears to copy the striped torso and articulated limbs of the *Schneider* marionette. These joints were designed to easily allow the marionette to sit cross-legged, meaning that they would have been loose joints. However, at the bent elbows and knees of Moholy-Nagy's drawing of the body of the marionette are light gray graphite circles, disarticulating the arms and the legs of this puppet and, in keeping with the exploding black circle with gray radiating rings designating the force of the explosion, could indicate smaller explosions at each joint. Each limb would be, therefore, held in space only by the marionette's strings approximately near their correct anatomical locations, ready to be pulled apart in order to heighten the audience's feeling of terror.

Five arrows pointing up, down, and to the left suggest that the marionette would move around in the air. A longer arrow beneath the torso points downward. Perhaps this arrow denotes the entrance of the marionette into the scene from above, or perhaps it indicates that the puppet will crash to the ground after exploding at the end of the show, leaving its limbs to sway back and forth in the dimensional space above the stage. There is also one black circle approximately in the genital area, perhaps denoting a more intense explosion disturbing the very existence of humanity as the audience realized that they existed within a constructed

conception of space-time, heretofore incapable of lifting themselves out of the third dimension, imprisoned by the perceptual capabilities of their own bodies, now exposed.

The form of the body, articulation of the joints, and positions of the strings of the marionette prescribe the mechanical nature of the movements of the figure. These mechanical movements, according to Freud and Bergson would incite laughter in the audience developing the comic facade, similar to the funny stride of Chaplin's tramp character relying on the too-thin cane, exaggerated by the oversized shoes, pointing outwards, and producing a mechanical waddle. Resembling the geometric trace-forms of Rudolf Laban in which the laws of cubical space, in other words, three-dimensional space, are over-articulated, the marionette is limited also by the spatial relationships of its form and mechanisms in three dimensions. Its gravitational freedom only serves to lift it out of three dimensions to view the limitations of its own world. The explosion, the dismemberment of its own form in space, is necessary for the audience to realize the prison in which they exist, their own psychophysical prison. In this context, even Schlemmer's costumes, producing similar geometric trace-forms in space, capable of audience transference are yet incapable of this final realization: one must shed the sensory assumptions, the apperceptions, made through the filter of the human body and mind.

Using the marionette as a mechanical surrogate for this realization, in keeping with Bergson's and Freud's writings on laughter, the comic and wit-induced, is also a synthesis of the eccentric, as a comic performance, and eccentric sensation as described by Ernst Marcus in his 1918 book published by *Der Sturm*, *Das Problem der excentrischen Empfindung und seine Lösung*.⁶¹ In this

⁶¹ Ernst Marcus, *Das Problem der excentrischen Empfindung und Lösung* (Berlin: Sturmverlag, 1918). If Moholy-Nagy read Marcus, which it stands to reason that he would have, since the central points were so important to Eggeling and Hausmann, who Moholy-Nagy referred to, in some way, repeatedly in every one of his books throughout his entire career, then he would have encountered Marcus' characterization of central theories of perception of Immanuel Kant, Sigmund Freud, Ernst Mach, and Richard Avenarius; see Arndt Niebisch, "Ether Machines: Raoul Hausmann's Optophonetic Media," in *Vibratory Modernism*, Anthony Enns and Shelley Trower, eds. (London: Palgrave MacMillan, 2013). It also appears that Moholy-

text, Marcus discussed his concept of eccentric sensation, which he developed as he sought to understand the phenomena of the phantom limb, residual, at times, intense sensations felt after a limb has been amputated. Published toward the end of World War I, this condition had become widespread throughout Germany and Europe. This idea of dismemberment intensifying sensations outside of the body deepens the use of the term Exzentrik. Moholy-Nagy, a former soldier witness to bodies being torn apart on the battlefield and himself nearly losing a finger in the war, would have felt great sympathy for Marcus' theory, perhaps observing soldiers having these eccentric sensations as he recovered in a military hospital in Hungary. He may have wondered how, while the limb is gone, it is still experienced as real, invisible yet present and, perhaps taking it another step further, what else is invisible to humans, real and unreal simultaneously.

In their "Zweite präsentistische Deklaration: Gerichtet an die internationalen Konstruktivisten" (Second Presentist Declaration: Directed to the International Constructivists, 1923), published in the international journal *MA (Today)* for which Moholy-Nagy served as the Berlin emissary,⁶² Viking Eggeling and Raoul Hausmann clearly stated their incorporation of space-time, synaesthetic perception, based on Ernst Marcus' eccentric sensation:

Der General- nenner aller unserer Sinne ist der Zeit-Raum-Sinn. Die Sprache, der Tanz und die Musik waren Höchst- leistungen der intuitiven Zeit-Raum- Funktionalität, und die Optik, Haptik etc. müssen auf einem neuen Wege nachfolgen, für den Ernst Marcus im Problem der exzentrischen Empfindung wichtige Vorarbeit geleistet hat. Das Zentralorgan Gehirn ergänzt ge-wissermaßen einen Sinn durch den andern, es vervoll- kommt jeden durch

Nagy's notion of the synaesthetic theater relies in large part on Hausmann's research on *Optophonetiks*, which he must have followed closely.

⁶² Botar, *Technical Detours: The Early Moholy-Nagy Reconsidered*, 115.

gegenseitige Schwingungs- steigerung unter Zeitübereinstimmung der Größe von Frequenz und Amplitude. Die dynamische Natur- anschauung kennt hierfür nur ein Funktionalitäts- prinzip der Zeit, die als kinetische Energie Raum und Materie bildet.⁶³ (The general name of all of our senses is time-space-sense. The language of dance and music had been the most powerful of the intuitive functionality of time-space, and optics, haptics, etc. must follow a new path, for which Ernst Marcus has achieved important preliminary work in the problem of eccentric sensation. The central organ of the brain expands, in a certain manner, one sense through another, it becomes full every one through mutually increasing vibrations under the temporal-coincidence of the magnitude of the frequency and amplitude. The dynamic perception of nature recognizes heretofore only a principle of functionality that forms as a kinetic energy of space and matter.)⁶⁴

Moholy-Nagy praised the work of both of these artists in the same section, "Die statische und kinetsche optische Gestaltung" (Static and Kinetic Optical Formation) in his *Malerei, Photographie, Film* originally published concurrently with *Die Bühne im Bauhaus* in 1925. Of Eggeling, Moholy-Nagy wrote that "Am wichtigsten aber waren die Arbeiten des früh verstorbenen VIKING EGGELING (Schweden), der die alle bisherige Ästhetik umstürzende Wichtigkeit des Zeitproblems — nach den Futuristen als erster — weiterentwickelt und dessen wissenschaftlich strenge Problematik aufgestellt hat."⁶⁵ (Eggeling – the first after the Futurists to do so – further developed the importance of the time problem, which revolutionised the whole existing aesthetic and formulated a scientifically precise set of movements built up from the simplest linear element and, by correctly estimating developmental relationships in size, tempo,

⁶³ Viking Eggeling and Raoul Hausmann, "Zweite präsentistische Deklaration: Gerichtet an die internationalen Konstruktivisten," *MA* 8, no. 5/6 (1923): 5.

⁶⁴ Translated by author.

⁶⁵ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 18–19.

repetition, discontinuity, etc., tried to render the complexity which grows out of simplicity.)⁶⁶

Moholy-Nagy then marvelled at Eggeling's ability to estimate changes in space to approximate changes in time, before moving to the work of Raoul Hausmann in Optophonetics, including the long footnote quoting the research of Moholy-Nagy's student, Walter Brinkmann, on Hausmann's understanding of vibrations in air and ether.⁶⁷

Marcus claimed that these vibrations penetrate the human body stimulating a sixth spatial sense in the brain, which he called the central organ, that sense would in turn project the image of the object out into space, thereby locating its position and understanding its form.⁶⁸ In this manner, eccentric sensation externalizes perception as a process of gathering and, more importantly for Marcus, sending forth perception outside of the body. In other words, the brain as the *central* organ sends forth its own vibrations, eccentric to itself, into the ether in order to perceive an object in space, an eccentric sensation, taking place outside of the center.⁶⁹ Another key aspect of Marcus' theory of eccentric sensation was that all types of sensory perception participated in the other types, giving the example that the eyes of bees can also hear by registering sound vibrations. Marcus' stated that every human sense had the capability of touching and being touch, the originary human sense with the most direct experience of this phenomenon.⁷⁰ In this vein, the discovery of the spectrum concept of electromagnetic radiation, only a portion of which is visible to the human eye, capable of penetrating the human body and convertible into the sensations of light, heat, and sound, proved Marcus' hypothesis.

⁶⁶ Moholy-Nagy, *Painting, Photography, Film*, 1987, 20–21.

⁶⁷ *Ibid.*, 22–23.

⁶⁸ Niebisch, "Ether Machines: Raoul Hausmann's Optophonetic Media," 163–166.

⁶⁹ *Ibid.*, 165.

⁷⁰ Marcus, *Das Problem der excentrischen Empfindung und Lösung*, 1918.

Hausmann expounded upon his experiments with light and sound in his later essay entitled "Optofonetik" (Optophonetics, 1922):

Energikus léptekkel közeledünk a szintézishez, sikerülni fog nekünk a fény és hang vibrációinak összekapcsoló formát adni. Félredobjuk a tudományos optika siralmas tanait és mindenki előtt fel fogjuk tárni a fény és hang megegyezését. Ellipszoid szemünk világítása a mi számunkra nem bir többé teremtőerővel, de a vibrációkból, melyeket most már felismerünk, egy új szoláris optika fog megszületni, mely nem mechanikus s nem magának s fénymozgásnak lényege.⁷¹ (With energetic approaches to the synthesis, we will be able to give a link to the vibrations of light and sound. We curse the pernicious tenets of scientific optics and we will explore the light and the voice of each other beforehand. The lightness of our ellipse eyes is no more creative than us, but the vibrations we now recognize will create a new solar optics that is not mechanical and it is not the essence of itself and the movement of light.)⁷²

In his last book, *Vision in Motion*, testifying to his enduring admiration for Raoul Hausmann's work on optophonetics, Moholy-Nagy described Hausmann's thesis as leading to the ability "to see music and hear pictures simultaneously: a startling articulation of space-time."⁷³ In his *Exzentrik*, Moholy-Nagy appears to take up this charge using electromagnetic vibrations to penetrate the audience's sensorium, putting into a theatrical performance what many artists and scientists were discovering around him.

⁷¹ Raoul Hausmann, "Optofonetika" [Optophonetics], *MA* 7, no. 1 (1922): 3–4.

⁷² Translated by author.

⁷³ Moholy-Nagy, *Vision in Motion*, 1947, 168.

For instance, another indication that Moholy-Nagy may have been aware of the space-time implications of opto-phonetics, is the development of this link between sensory perception related to optophonetic performance and understanding the sensation of space-time in the work of prominent physician and physicist Hermann von Helmholtz. In his lecture, "Über die physiologischen Ursachen der musikalischen Harmonie" (On the Physiological Causes of Harmony in Music), delivered during the winter 1857 in Bonn, the birthplace of Beethoven, as he pointed out in his introduction, Hermann von Helmholtz asked his musically sophisticated audience:

Zuerst, was ist ein Ton? Schon die gemeine Erfahrung lehrt uns, dass alle tönenden Körper in Zitterungen begriffen sind. Wir sehen und fühlen dieses Zittern, und bei starken Tönen fühlen wir, selbst ohne den tönenden Körper zu berühren, das Schwirren der uns umgebenden Luft. Specieller zeigt die Physik, dass jede Reihe von hinreichend schnell sich wiederholenden Stößen, welche die Luft in Schwingung versetzt, in dieser einen Ton erzeugt.⁷⁴ (First of all, what is a musical tone? Common experience teaches us that all sounding bodies are in a state of vibration. This vibration can be seen and felt; and in the case of loud sounds we feel the trembling of the air even without touching the sounding bodies. Physical science has ascertained that any series of impulses which produce a vibration of the air will, if repeated with sufficient rapidity, generate sound.)⁷⁵

⁷⁴ Hermann von Helmholtz, "Ueber die physiologischen Ursachen der musikalischen Harmonie," in *Vorträge und Reden von Hermann von Helmholtz*, 5th ed. (1862; repr., Wiesbaden: Verlag von Friedrich Vieweg und Sohn, 1903), 1: 120.

⁷⁵ Hermann von Helmholtz, *Popular Lectures on Scientific Subjects*, trans. Pye Smith (New York: D. Appleton and Company, 1885), 63. Originally "Die Lehre von den Tonempfindung als physiologische Grundlage für die Theorie der Musik," 1857.

Looking at the optophonetics described in the second and third columns of the hybrid drawing of the *Exzentrik*, Moholy-Nagy described the vertical dimension progressing in time from top to bottom and the horizontal as happening simultaneously. The width of the stripes in the light column indicates duration. Given the large bars of black, Moholy-Nagy intended for the audience to be in darkness for the majority of the performance, entirely focused on the forms and movements, that would be interrupted in burst of yellow and red colored lights. Similarly, the darkness of the sound column may be found in the long stretches of a droning siren punctuated periodically with rhythmic sounds. If Moholy-Nagy was thinking of Hausmann's Optophone, which transformed light into sound and vice versa, the lights themselves could have instigated the electrical current to the induction coil using a selenium cell or conversely the sounds from the coil could have been transformed into the light effects.⁷⁶ However, given the directions that the horizontal dimension is simultaneous, it appears unlikely that the light and sound phenomena are linked in this way.

In addition to the insights into the meaning of his mechanical *Exzentrik* provided by the connection to comedic circus performance with Russian Eccentrism and Marcus' eccentric sensation, the sixth sense described by Eggeling and Hausmann as the time-space-sense, Moholy-Nagy exhibited a painting at Der Sturm Gallery in Berlin in 1921 entitled, *Exzentrische Konstruktion* (Eccentric Construction). **(Figure 5.6)** In the same year, a similar linoleum-cut print appeared on the cover of *Der Sturm*, an issue that documented the work of the exhibit.⁷⁷ **(Figure 5.6)** In both images, but more so in the cover image, Moholy-Nagy crosses two thick lines in a

⁷⁶ Raoul Hausmann published a description of the optophone in 1922 in El Lissitzky's *Wjescht, Gegenstand, Objet* and in *MA* including sketches of his optophone. In 1926, Moholy-Nagy sent his student, Walter Brinkmann, to show Hausmann a letter from Albert Einstein praising the importance of the optophone, prompting Hausmann to pursue a patent for his invention granted on April 27, 1936. See Jacques Donguy, "Machine Head: Raoul Hausmann and the Optophone," *Leonardo*, v. 34, n. 3 (2001), 217–220.

⁷⁷ Engelbrecht, *Moholy-Nagy: Mentor to Modernism*, figure 113.

circle or fragment of a circle, shifted slightly off-center. These lines are accompanied by others apparently weaving in front of and behind each other and creating a sense of depth on the flat plane of the picture, not the depth of perspective construction, rather that described by Lissitzky in his *K. und Pangeometry*, where overlapping figures may represent depth in space or sequence in time.⁷⁸

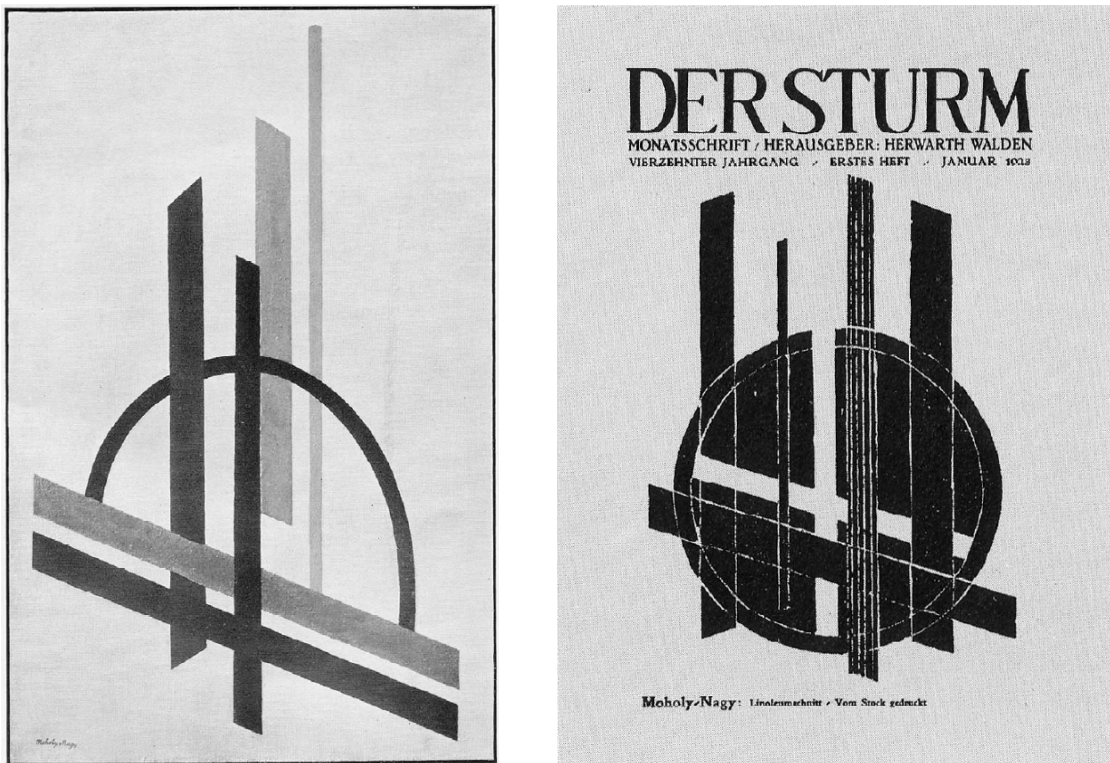


Figure 5.6: László Moholy-Nagy, (left) *Exzentrik Konstruktion* (Eccentric Construction), 1921 + (right) Cover Design for *Der Sturm*, 1921.

This painting and cover design were exhibited and published during the same year that Moholy-Nagy signed on to Raoul Hausmann's manifesto, *Aufruf zur elementaren Kunst* (Call for

⁷⁸ Lissitzky, "A. and Pangeometry," in *El Lissitzky: Life, Letters, Texts*, 349.

Elemental Art, published in 1921 in *De Stijl*) with Hans Arp and Ivan Puni being the other signatories.⁷⁹ In fact, this motif is found in many of his painting of this period, one that he also referred to as *Glasarchitektur*.⁸⁰ In different paintings over the years, Moholy-Nagy experiments with this image of eccentrically intersecting elements: lines, planes, circles, straight, curvy and amorphous. Given the coincidence of his encounter with Hausmann in Berlin and his enduring respect for Hausmann's optophonetics, Moholy-Nagy was likely referring to eccentric sensation when conceiving of this and similar paintings, refining and revising his understanding over time.

CATHARSIS

Analogous to the doubles found in his other *Photoplastiks*, the third and fifth acts of the hybrid drawing of the *Exzentrik* produce a double catharsis, a psychological and physical catharsis, in the audience. In the third act, the climax of the performance, the tension that had been developed in the audience through optophonetic sensations of forms, movements, lights, and sounds is released with the inducement of sneezing fits. In such a state, the sneeze forces the audience's eyes to close, faces to contort, and lungs to fill to capacity with the invigorating mixture of ozone in the air, in order to expel air violently, pushing out all impediments in the lungs and nasal passages and producing the ability to breathe more freely and deeply. Opening their "entirely different eyes"⁸¹ and ears, this release is followed by the revelation of the wrestlers, engaged in a battle between man and his fourth-dimensional projection into the third-dimension, his own rotated shadow. In the fifth act, the audience is brought to a second climax, building upon their projection of eccentric sensation, their own psychophysical engagement in the wrestlers' struggle transferred onto the larger-than-life-size marionette with a blinking

⁷⁹ Passuth, "Manifesto of Elemental Art," *Moholy-Nagy*, 286.

⁸⁰ Botar, *Technical Detours: Early Moholy-Nagy Reconsidered*, 136.

⁸¹ Moholy-Nagy, *Painting, Photography, Film*, Janet Seligman, trans., [1925] 1987, 29.

illuminating head casting its gigantic shadow radially onto the surrounding audience below, creating a blackened circle.

In the hybrid drawing of the *Exzentrik*, three vertical lines extend off-center to a black circle below and to the right of the puppet. This circle is ringed by seventeen arrows pointing out and two arrows pointing to the left, one down, and one longer arrow pointing up. The radiating arrows are within a band of gray creating a large circle, while the four other arrows project beyond the edge of the gray. There is graphite smudging projecting beyond the gray circle and even into the second column. The audience would be reminded of the black circle in the prelude that “dreht sich vertikal” [turns itself vertical] with the corresponding note in the music of the prelude, “Blechsturzen” [metal falling]. This metal falling may be just the sound of metal falling, since the note is in the music column and not in the form and movements column. Although, as mentioned earlier, there is also some overlap between the columns. Next to this black circle in the final scene are the words, “dann explodiert” (then [it] explodes). Perhaps the explosion produces the disarticulation of the marionette, since this gray smudging encircling the black circle is also found at the joints of the marionette. Entranced by their own eccentric investment in the *Menschmechanik*, the audience is emotionally released by the explosion, startled as the marionette's limbs disarticulate and are free to float away from its torso and crash to the ground perhaps producing the sounds of “falling metal.”

In *Malerei, Fotografie, Film*, after praising Raoul Hausmann's work on optophonetics and describing La Cour's light-powered wheels, Moholy-Nagy described a tension that would build up in an observer while viewing kinetic light displays:

Hier schaffen das neu auftretende Zeitmoment und seine immer weiter laufende Gliederung einen gesteigerten aktiven Zustand des Zuschauers, der — statt einer Meditation über ein statisches Bild und statt eines Hineinsinkens, woraus seine Aktivität sich erst aufbaut — gezwungen wird, sich gewissermaßen sofort zu

verdoppeln, um eine Kontrolle und ein gleichzeitiges Mittun der optischen Ereignisse ausführen zu können. Die kinetische Gestaltung gibt dem Aktivitätsdrang sozusagen eine Erleichterung zu einem sofortigen Erfassen neuer Lebens sicut Momente, während das statische Bild solche langsam keimen läßt.⁸² (The newly emergent impulse of time and its ever expanding articulation here produce a state of increased activity in the observer, who – instead of *meditating* upon a static image and instead of immersing himself in it and only then becoming active – is forced almost to double his efforts immediately in order to be able simultaneously to comprehend and to participate in optical events. Kinetic composition so to speak enables the observer's desire to participate to seize instantly upon new moments of vital insight, whereas the static image generates these reactions slowly.)⁸³

In the *Exzentrik*, Moholy-Nagy would have demonstrated this notion of an “expanding articulation” of time, engaging the audience through a quickening of their desire to participate in the performance through their psychophysical, eccentric projection onto the *Menschmechanik* marionette. Surrounded on all sides by optophonetic stimuli, colored lights and rhythmic sounds, the *Exzentrik* audience would experience the second crescendo perhaps as Moholy-Nagy had further described as the ultimate invention of the “Haus-Pinakotheke” (Domestic Pinacotheca) in *Malerei, Fotografie, Film*:

Es ist wahrscheinlich, daß die künftige Entwicklung den größten Wert auf die kinetische projektorische Gestaltung legen wird, sogar wahrscheinlich mit im Räume freischwebenden, einander durchdringenden Farbgarben und -massen **ohne direkte Projektionsfläche**; sie wird durch die ständige

⁸² Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 21–22.

⁸³ Moholy-Nagy, *Painting, Photography, Film*, Janet Seligman, trans., [1925] 1987, 24.

Vervollkommnung ihrer Instrumente viel größere Spannungsbereiche umfassen als das entwickeltste statische Bild.⁸⁴ (It is probably that future development will attach the greatest importance to kinetic, projected composition, probably even with interpenetrating beams and masses of light floating freely in the room **without a direct plane of projection**; the instruments will continually be improved so that it will be able to embrace far larger fields of tension than the most highly developed static picture.)⁸⁵

Within the theater of totality, Moholy-Nagy sought to create a total "organism" from the synthesis of forms, movement, light, and sounds into which he proposed several opportunities for man to integrate including the use of repetitive, simultaneous voices amplified by loudspeakers, audible doubles similar to his uncanny use of visual doubles, and mirrors and projections to mechanically enlarge an actor's face and gestures. These mechanizations of the human actor combined with the mechanized automaton, or marionette, would produce the "SIMULTANE, SYNOPTISCHE, SYNAKUSTISCHE (optisch- oder phonetisch-mechanische) Wiedergabe von Gedanken"⁸⁶ (SIMULTANEOUS, SYNOPTICAL, and SYNACOUSTICAL reproduction of thought), which he related to the action of meshing gears, able to transfer and amplify torque forces from one gear to the next.⁸⁷ In other words, relating this statement to the *Exzentrik*, the synaesthetic experience would amplify the audience's desires, building their tension, in order to bring them "auf der höchsten Stufe einer erlösenden Ekstase"⁸⁸ (to the peak of cathartic ecstasy),⁸⁹ when

⁸⁴ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 24.

⁸⁵ Moholy-Nagy, *Painting, Photography, Film*, Janet Seligman, trans., [1925] 1987, 26.

⁸⁶ Moholy-Nagy, "Theater, Zirkus, Varieté," *Die Bühne im Bauhaus*, 52.

⁸⁷ Moholy-Nagy, "Theater, Circus, Variety," *The Theater of the Bauhaus*, 62.

⁸⁸ Moholy-Nagy, "Theater, Zirkus, Varieté," *Die Bühne im Bauhaus*, 55.

⁸⁹ Moholy-Nagy, "Theater, Circus, Variety," *The Theater of the Bauhaus*, 68.

Moholy-Nagy would reveal his intentions: "Geöffnete Augen und Ohren werden in jedem Augenblick mit dem Reichtum optischen und fonetischen Wunders erfüllt ... zum Anfang neuen Lebens."⁹⁰ (Eyes and ears have opened and are filled at every moment with a wealth of optical and phonetic wonders ... [with more work will lead to] the dawn of a new life.)⁹¹

VAPORIZATION

While the fifth act of the hybrid drawing of the *Exzentrik* begins with rhythmic notes and alternations of darkness and red lights pierced by a thick colorless line running vertically and turning into a vertical black line of equal thickness, suggesting an inversion of a figure ground relationship. Black and white vertical lines also complete the Prelude, without the rosy tone and in a side-by-side relationship, suggesting simultaneity, rather than one running up to the other, unfolding over time. In the explanatory text to the printed version of the *Exzentrik*, Moholy-Nagy wrote that "Schwarz = Finsternis."⁹² (Black = Darkness.)⁹³ Presumably, in such an inversion, *nicht Schwarz* (not black) would equal *nicht Finsternis* (not darkness), or, in other words, colorless/white line is equivalent to lightness. Running behind the vertical lines are alternating black bars with horizontal red bars, the latter becoming gradually lighter until, in the final moments, the last red bar is shown as a sustained rose tone. This chiastic transition in the fifth act begins with a vertical lightness passing through horizontal darkness and ends with a horizontal lightness pierced by a vertical darkness. Moholy-Nagy explored inverting chiaroscuro relationships in his photographs and photograms, in which light becomes shadow and shadow becomes light. The inversion of light and dark in the vertical and horizontal also suggests a spatial rotation, a synaesthetic

⁹⁰ Moholy-Nagy, *Malerei, Fotografie, Film*, [1925] 1927, 43.

⁹¹ Moholy-Nagy, *Painting, Photography, Film*, Janet Seligman, trans., [1925] 1987, 45.

⁹² Moholy-Nagy, "Partiturskizze zu einer mechanischen Exzentrik," *Die Bühne im Bauhaus*, 44.

⁹³ Moholy-Nagy, "MOHOLY-NAGY," *The Theater of the Bauhaus*, trans. Arthur S. Wensinger, 1961, 48.

reorientation through rotation as the eyes and ears of the audience are opened, seeing a new dawn in the vaporization of the *Gesamtkunstwerk*.

Accompanying the visual inversion phonetically, the musical notes in the fifth act move from high to low and back again as they plunge into the bass scale and ascend again, with the return of the siren, quickly alternating mid-tone notes, and ending with a final stretch of very high repetitive notes over one last alternation of mid-scale notes.⁹⁴ The phonetic activity at the very end of the hybrid drawing of the mechanical *Exzentrik* would have corresponded to the build-up of tension with the eccentric explosion, echoing the explosion of sneezing in the third act, the ultimate vaporization, thereby releasing the audience to construct a “new vision”⁹⁵ with “entirely different eyes”⁹⁶ and ears and noses and skins that have been cleared of psychophysical preconceptions, specifically preconceptions related to three-dimensional space and time.

Such a shift in perception and understanding was later named by Sirató in his *Manifeste dimensioniste* (1936) as a vaporization and described in more detail in his *Az első Dimensionista Album* (1966) as “anyag-zenének” (matter-music, including movement and multiple senses), simultaneities as “sokszersőségében” (multitudes), opening up a path to explore the “négydimenziós téridő-kontinuum” (fourth-dimensional space-time continuum),⁹⁷ an artistic practice capable of encompassing Euclidean and non-Euclidean conceptions of space and embracing a plurality of spatial understandings as expressed in Bólyai's *Scientiam spatii absolute veram* (The Science of Absolute Space) and in keeping with Moholy-Nagy's later reference to

⁹⁴ While the printed version of the *Exzentrik* does not contain the forms, movements, and lights of the hybrid drawing, it appears to reproduce the frenetic tones of the fifth act using different combinations of high and low notes.

⁹⁵ Moholy-Nagy, *The New Vision and Vision in Motion*.

⁹⁶ Moholy-Nagy, *Painting, Photography, Film*, 29.

⁹⁷ Sirató, *Az első Dimensionista Album*, paragraph 7.

Carnap's *Der Raum* (Space) in *Von Material zu Architektur*.⁹⁸ This notion of space incorporating time and, vice versa, time incorporating space is yet another chiasmic structure important to releasing perception from psychophysical interference, otherwise known as apperception.

In the *Manifeste dimensioniste*, Charles Sirató linked the vaporization of sculpture with the examples of “L’Art Cosmique. (Vaporisation de la Sculpture, Théâtre Synos-Sens dénominations provisoires). La conquête totale par l’art de l’espace à quatre dimensions un « Vacuum Artis » jusqu’ici. La matière rigide est abolie et remplacée par les matériaux gazéifiés.”⁹⁹ (“Cosmic Art [The Vaporization of Sculpture, Synos-Sense Theater, provisional denominations.] The artistic conquest of four-dimensional space [is] to date an artistic vacuum. Rigid matter is abolished and replaced by vaporized materials.”).¹⁰⁰ In *Dimensionism*, Oliver Botar identifies Sirató’s concept of vaporization deriving from Arpád Mezei’s embrace of both Bergson’s characterization of duration as “extensionless motion,” in contrast to the human tendency to spatialize time, and Minkowski’s world points as “stationary extension” in his article, “Forma” (*Form, Is*, 1924).¹⁰¹ Akin to the previously mentioned inversions, the possibility of each echoes within the other producing either a type of mutual embrace or destruction; however, the echo is reminiscent of the temporal implications surrounding the *Photogram* and chronophotography, as the double, in Moholy-Nagy’s work. While the *Photogram* is somehow the embodiment of “extensionless motion,” chronophotography captures its inverse, “stationary extension.”

⁹⁸ Sirató admitted that he had admired Moholy-Nagy’s work from a very young age making it unsurprising that his ideas about higher dimensions correspond with this inspiration. See Sirató, “The History of the Dimensionist Manifesto, and Related Texts,” in *Dimensionism: Modern Art in the Age of Einstein*, ed. Vanja Malloy, 227–228.

⁹⁹ Sirató, “Manifeste Dimensioniste,” insert.

¹⁰⁰ Sirató, “The Dimensionist Manifesto,” in *Dimensionism: Modern Art in the Age of Einstein*, ed. Vanja Malloy, 171.

¹⁰¹ Botar, “Charles Sirató and the Dimensionist Manifesto,” *Dimensionism: Modern Art in the Age of Einstein*, ed. Vanja Malloy, 25–26.

The results of the chronophotographic experiments of Marey and Muybridge were widely publicized in Europe.¹⁰² Their provocative images captured the imaginations of artists and scientists and sought to achieve the results of Bergson's counter-argument of experiencing time as a succession of moments in space.

Cette différence est d'ailleurs la condition même de cette identité. Quand on prend diverses photographies d'un objet en tournant autour de lui, la variabilité des détails ne fait que traduire l'invariabilité des relations que les détails ont entre eux, c'est-à-dire la permanence de l'objet.¹⁰³ (That difference is, moreover, the very condition of this identity. When we take different photographs of an object while walking around it, the variability of the details only expresses the invariability of their interrelations, in other words, the permanence of the object. Here we are, then, brought round again to multiple times, to simultaneities, to lengths that must be measured differently according to whether they are ruled stationary or moving. But this time we are before the definitive form of the theory of relativity.)¹⁰⁴

¹⁰² Eadweard Muybridge reproduced snippets of praise for his lectures published in many newspapers in the United States and Europe in his "Appendix: Abbreviated Criticisms," in *Descriptive Zoopraxography, or the Science of Animal Locomotion Made Popular* ([Philadelphia]: [University of Pennsylvania], c. 1893), 4–34, including high praise from at least three Berlin periodicals: *Berliner Tageblatt*, *Berliner Post*, "'Noted artists, such as Menzel, Knaus, Begas; eminent scientists, such as von Helmholtz, Siemens and Förster and even the imperturbable field-marshal, Count von Moltke, were enthusiastic in their applause.' ... 'So great an interest did the demonstrations excite that Mr. Muybridge was unanimously requested to repeat them. Two days afterward this distinguished company, including the venerable Field-Marshal (Count von Moltke) himself, attended a repetition of the lecture.'—*Illustrierte [sic] Zeitung*."

¹⁰³ Bergson, *Durée et Simultanéité: a propos de la théorie d'Einstein*, 95.

¹⁰⁴ Henri Bergson, *Duration and Simultaneity with Reference to Einstein's Theory*, trans. Leon Jacobson (Indianapolis, New York, Kansas City: Bobbs-Merrill Company, Howard W. Sams & Company, 1965), 70, originally published 1922 as *Durée et Simultanéité*.

In his most extensive study of the implications of time in Einstein's Special and General Theories of Relativity, *Durée et Simultanéité: a propos de la théorie d'Einstein* (Duration and Simultaneity, 1922), recognizing that our perception of reality must account for the consciousness that exists in reality, Bergson characterized the different types of investigators looking at time as follows:

Le métaphysicien fera intervenir directement une conscience universelle. Le sens commun y pensera vaguement. Le mathématicien, il est vrai, n'aura pas à s'occuper d'elle, puisqu'il s'intéresse à la mesure des choses et non pas à leur nature. Mais s'il se demandait ce qu'il mesure, s'il fixait son attention sur le temps lui-même, nécessairement il se représenterait de la succession, et par conséquent de l'avant et de l'après, et par conséquent un pont entre les deux (sinon, il n'y aurait que l'un des deux, pur instantané): or, encore une fois, impossible d'imaginer ou de concevoir un trait d'union entre l'avant et l'après sans un élément de mémoire, et par conséquent de conscience.¹⁰⁵ (The metaphysician will have a universal consciousness intervene directly. Common sense will vaguely ponder it. The mathematician, it is true, will not have to occupy himself with it, since he is concerned with the measurement of things, not their nature. But if he were to wonder what he was measuring, if he were to fix his attention upon time itself, he would necessarily picture succession, and therefore a before and after and consequently a bridge between the two [otherwise, there would be only one of the two, a mere snapshot]; but, once again, it is impossible to imagine or conceive a connecting link between the before and after without an element of memory and, consequently, of consciousness.)¹⁰⁶

¹⁰⁵ Henri Bergson, *Durée et Simultanéité: a propos de la théorie d'Einstein* (Paris: Librairie Félix Alcan, 1922), 60–61.

¹⁰⁶ Henri Bergson, *Duration and Simultaneity with Reference to Einstein's Theory*, trans. Leon Jacobson (Indianapolis, New York, Kansas City: Bobbs-Merrill Company, Howard W. Sams & Company, 1965), 48,

Bergson analyzed in more depth the implications of Einstein's two lightning strikes viewed from the railroad tracks or from the train running along the tracks, summarizing or quoting liberally from Einstein's exposition. Bergson pointed out an experiential assumption underlying Einstein's and Minkowski's relativity theories. With two coordinate systems and two observers, neither can confirm the results of the other, meaning that their differing results are inconclusive due to this fact. Similarly, with Minkowski's diagram of the past, present, and future, no person could confirm the results of another, since the results are in the past, the person is in the present, and the future has yet to be.¹⁰⁷ Bergson further exposed the importance of Einstein's underlying assumptions:

Nous nous demanderons s'ils perçoivent ou non le même Temps. Or, il est généralement difficile au philosophe d'affirmer avec certitude que deux personnes vivent le même rythme de durée. Il ne saurait même donner à cette affirmation un sens rigoureux et précis. Et pourtant il le peut dans l'hypothèse de la Relativité.¹⁰⁸ (We shall ask ourselves whether or not they perceive the same time. Now, it is in general difficult for the philosopher to declare with certainty that two people live the same rhythm of duration. He cannot give the statement a rigorous, precise meaning. Yet he can do so in the hypothesis of relativity.)¹⁰⁹

In order to experience time more directly, Bergson attempted to shed his spatial and visual terminologies to experience time as duration without apperceptions produced by spatial analogies. To illustrate his point, Bergson described three identical images of sheep to express spatialized time, similar to chronophotography, Minkowski's "stationary extension," and Lissitzky's example of overlapping cows in *K. und Pangeometrie*, in which the viewer can shift between

originally published 1922 as *Durée et Simultanéité*.

¹⁰⁷ Bergson, *Duration and Simultaneity with Reference to Einstein's Theory*, 1965, 93–100.

¹⁰⁸ Bergson, *Durée et Simultanéité: a propos de la théorie d'Einstein*, 164.

¹⁰⁹ Bergson, *Duration and Simultaneity with Reference to Einstein's Theory*, 1965, 112.

apperceptions of depth in space and movement over time. All of these examples had the potential to influence Moholy-Nagy's preoccupation with doubles. When Bergson asked, "le temps est-il de l'espace?"¹¹⁰ (Is time space?),¹¹¹ he concluded: "Il résulte de cette analyse que l'espace seul est homogène, que les choses situées dans l'espace constituent une multiplicité distincte, et que toute multiplicité distincte s'obtient par un déroulement dans l'espace."¹¹² ("It follows from this analysis that space alone is homogeneous, that objects in space form a discrete multiplicity, and that every discrete multiplicity is got by a process of unfolding.")¹¹³

Comparing Bergson's multiplicity through an unfolding, in other words, the experience of time as duration and Minkowski's *Weltpunkte* as changes in position over time along *Weltlinie* to Moholy-Nagy's formulation of "vision in motion" reveals the his later conception of times is similar to his earlier conception of spaces – inspired by Carnap – the possibilities of both being plural rather than singular. Moholy-Nagy described "vision in motion" as:

seeing while moving ... seeing moving objects either in reality or in forms of visual representation ... recreat[ing] mentally and emotionally the original motion ... simultaneous grasp ... [as a] creative performance—seeing, feeling and thinking in relationship not as a series of isolated phenomena ... transmut[ing] single elements into a coherent whole ... a synonym for simultaneity and space-time; a means to comprehend the new dimension ... signifies planning, the projective dynamics of our visionary faculties.¹¹⁴

¹¹⁰ Bergson, *Essai sur les données immédiates de la conscience*, 1889, 138.

¹¹¹ Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, trans. F. L. Pogson, 181.

¹¹² Bergson, *Essai sur les données immédiates de la conscience*, 1889, 90.

¹¹³ Bergson, *Time and Free Will: An Essay on the Immediate Data of Consciousness*, trans. F. L. Pogson, 120.

¹¹⁴ Moholy-Nagy, *Vision in Motion*, 1947, 153.

Apparently in favor of both Bergson and Minkowski, "extensionless motion" and "stationary extension," in his mature conception of "vision in motion," Moholy-Nagy articulated his intentions and intuitions found in his earlier works across all media: to construct vision through psychophysical experiences of space-time in order to see the world with "entirely different eyes," which would be capable of perceiving higher dimensions and, thereby, vaporizing previous apperceptions of the world as illusions. Through their synaesthetic participation in the mechanical *Exzentrik*, with their rationality suspended by the comedic facade, the apperceptions of the audience would be vaporized by their centric (sneezing) and eccentric (exploding) cathartic experiences, leaving them in the rosy, gassified light of a new dawn, like the prisoners in Plato's allegory of the cave, emerging from the darkness and seeing objects, once familiar, differently for the first time, in the uncanny light of the sun.¹¹⁵

¹¹⁵ This red dawn may also refer to Moholy-Nagy's affinity for Communist ideals and his hope for a better future after witnessing the futility of war.

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