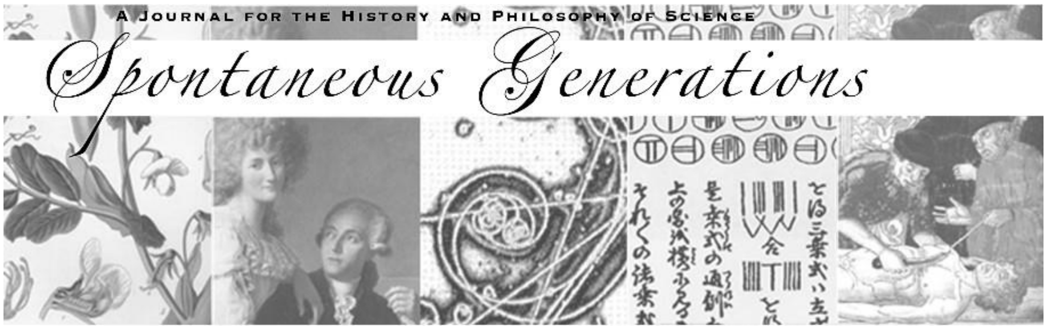

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Space-Time and Utopia: Notes on artistic engagement with physics from Cubism to Laszlo Moholy-Nagy

Brittany Myburgh

Abstract Throughout the twentieth and twenty-first centuries, artists and scholars have pursued connections between modern art movements and scientific exploration and expertise. Particularly in discussions of Cubism and Futurism, artists and historians have employed the terms 'fourth dimension', 'simultaneity', and 'space-time' in their artistic theories. Select scholars have connected the use of these terms with Albert Einstein's theories of relativity. This paper presents brief notes on this perceived intersection between Western science and art during the early to mid-twentieth century. It focuses on the Bauhaus master Laszlo Moholy-Nagy, for whom ideas of "space-time" offered new and dynamic possibilities for art and perception. Rather than solely trying to interpret or represent Einstein's theories in art, Moholy-Nagy considered the artistic implications of a theory that challenged the notion of absolute time and space. His writing on technology and the use of projected light to produce spatial modulation greatly impacted subsequent generations of artists. Moholy-Nagy also viewed greater collaboration within the disciplines of science and art as necessary. He argued that in order to best respond to the twentieth century a new generation of artists must be equipped with both technical and scientific expertise.

In the early twentieth century the science of light and the consideration of higher dimensions became more significant. Engaged in popular interpretations of physics that questioned the underlying structures of the world and cosmos, artists were concurrently questioning the underlying structures of forms and subjects in art. Bauhaus master Laszlo Moholy-Nagy (1895-1946) advocated for a movement away from the traditional forms of painting and towards projected light as a medium that could realize a new vision. Moholy-Nagy believed strongly in the social obligation of the artist, who he argued must also be trained as a technician in order to best respond to the consequences of the industrial revolution, capitalism, and modern spectacle. As a result, his artistic pedagogy emphasized interdisciplinary expertise that could be achieved through a new unity between art, technology, and science. This paper presents brief notes on intersections between Western science and art during the period of Moholy-Nagy's artistic career, commenting on artists' interpretations of Albert Einstein's theory of relativity. It considers Laszlo Moholy-Nagy's argument that interdisciplinary experimentation and expertise were crucial for the formation of a new and modern society.

Art historians have argued that the move towards abstraction that occurred in Western art of the late nineteenth and early twentieth century resulted from various factors. These include the increasing pace of modernity, the impact of technology and politics, and the desire in art to uncover universal visual truths and, problematically, a more 'primitive' approach to form.[1] Artists had previously emphasized the representation of naturalistic

[1] The use of the term 'primitivism' in Art History is indicative of how the Western world viewed non-Western cultures. In the early to mid-twentieth century, forms from African and Oceanic art in particular were employed by Western artists to announce a break with formal traditions of

depth through linear perspective and tonal modelling, and this interest shifted towards an investigation of the picture plane and the essence of forms. Particularly within artistic movements such as Cubism and Futurism, painters began to explore the possibility of representing simultaneous perspectives or the infinite movement of form.

Georges Braque, *Still Life with Metronome*, late 1909, oil on canvas, 81 x 54.1 cm, image © 2020 Artists Rights Society (ARS), New York, Metropolitan Museum of Art

modelling and perspective. Western artists claimed a kinship with, and appropriated forms from, what they termed 'primitive' cultures who were understood as closer to the essence of human creativity. Due to the implicit assertion of the superiority and originality of the West, and despite the appropriation of their own artistic traditions, non-western artists were not seen as having equal artistic and intellectual expertise. The question of influence, only addressed briefly in this paper in relation to the disciplines of art and science, has been part of the asymmetrical and uneven valuations of cultural exchanges between non-western and Western art. For more on the legacy of Primitivism see: Thomas McEvilley, William Rubin, Kirk Varnedoe, "Doctor, Lawyer, Indian Chief: Primitivism in Twentieth Century Art at the Museum of Modern Art in 1984," *Artforum* 23 no. 3 (November 1984): 54-61.

Artists of the Cubist movement such as Guillame Apollinaire (1880 – 1918) employed the term ‘simultaneity’ in their descriptions of Cubist work and referred to the fourth dimension and non-Euclidean geometry in their theorization of art. Scholars have since pursued connections between Cubism and scientific exploration and expertise. In 1945 Paul M. Laporte wrote “Cubism and the Theory of Relativity,” an essay that sought to demonstrate parallel ideas and analogies between the disciplines of physics and modern art. He found that “the principle of integrating visual and kinesthetic experiences in painting implies some concept of a space-time continuum…This happened in physics at exactly the same time as the change to cubism happened in painting.”[2] The essay prompted a reply from Albert Einstein in 1946. Science, wrote Einstein, has practical value, and its similarity to artistic activity might only be found in its pursuit of unity and order.[3] For Einstein, the evaluation of artistic expertise was not wholly based on the same principles as it was in science; it could only be undertaken by those who appreciated the way in which forms articulated such clarity or unity according to artistic antecedents. Picasso and Cubism’s ability to achieve artistic unity were understood by Einstein as only able to be evaluated intuitively by the individual viewer. Regardless, Einstein argued that the theory of relativity described a whole system mathematically and therefore had nothing to do with an artistic language that sought to represent specific objects from a multiplicity of coordinates. He found Laporte’s comparison “rather unsatisfactory.”[4]

Despite Einstein’s argument to the contrary, scholars have argued for a relationship between Einstein’s theory of relativity and the development of Cubism based on artists’ ideas of ‘space-time’ and ‘simultaneity.’[5] An argument has similarly been made in the other direction that new visual relationships presented in Cubism impacted scientific thought. Scholars have asserted that Niels Bohr, the physicist who in 1912 began working on a theory of how atoms absorb and emit light, was impacted by analytic cubism due to his ownership of the work of Jean Metzinger.[6] This desire to uncover the direction of influence is perhaps indicative of how historians have traditionally pursued narratives of originality and primacy, as well as the tension between the disciplines of art and science regarding definitions and perceptions of expertise.

[2] Paul Laporte. “Cubism and Relativity” [1948]. *Art Journal* 25 (1966): 246.

[3] Laporte. “Cubism and relativity,” 246.

[4] Ibid.

[5] For more on the correlation between Einstein and Cubism see: Paul Laporte. “Cubism and Relativity.” *Art Journal* 25 (1966): 246–48 where a reply from Einstein is included and Fry, E. “Picasso, Cubism and Reflexivity.” *Art Journal* 47 (1988): 296–310.

[6] See: A. Miller, *Einstein, Picasso: Space, Time and the Beauty that Causes Havoc* (London: Basic Books, 2001); A Pais, *Niels Bohr’s Times, in Physics, Philosophy, and Polity* (Oxford: Oxford University Press, 1991); C. Schinckus, “From Cubist Simultaneity to Quantum Complementarity,” *Foundations of Science* 22 (2017): 709–716.

Jean Metzinger, *La Femme au Cheval (Woman with a Horse*), 1911-12, oil on canvas, 162 cm × 130.5 cm (63.8 in × 51.2 in), Statens Museum for Kunst. Purchased by Bohr in 1932.

Linda Henderson's seminal publication *The Fourth Dimension and Non-Euclidean Geometry in Modern Art,* rather than discounting artistic understandings of scientific expertise, has demonstrated that these arguments for a direct correlation between Einstein's theory of relativity and Cubism are misguided based on the dates of publication of scientific discovery.[7] A series of scientific developments related to light, space, and time had already begun in the mid-1800s and would culminate in later discoveries by scientists such as Einstein and Hermann Minkowski. In 1864 James Clerk Maxwell delivered his paper "A

[7] See: Linda Henderson, "Appendix A: The Question of Cubism and Relativity" in *The Fourth Dimension and Non-Euclidean Geometry in Modern Art* (Cambridge, MA : MIT Press, 2013): 511-521. The study also demonstrates that artists maintained an interest in expressing a higher spatial dimension even after the introduction of Einstein's General theory of relativity. A popular conception of the fourth dimension as time would ultimately displace popular interest in higher spaces, following the introduction of Minkowski's space-time, but in the early 20th century time merely played a role in visualizing a higher dimension of space.

Dynamical Theory of the Electromagnetic Field" that would identify light as an electrical phenomenon.[8] In 1879, Albert Michelson measured the speed of light (*c*), within 0.0002 percent, and in 1887 he and his partner Edward Morley conducted an experiment that would help to disprove the existence of the luminiferous ether. In 1895 Einstein performed a thought experiment that considered how the world would appear if a person could travel at the speed of light, and he concluded in 1905 that if light is constant then the experience of time must be relative to the position of an observer.[9]

Henderson's study has demonstrated how radically the Western understanding of the physical world shifted in the early years of the twentieth century as a result of these broader events. Discussing developments in art, science, and technology, she has highlighted the general artistic interest in invisible realities beyond the limits of human perception. Henderson has marked the x-ray in particular as a technology that established "the limited nature of human perception: the eye sees only a narrow band of visible light in the much larger electromagnetic spectrum."[10] It is within this broader cultural context that Henderson has identified how avant-garde artists explored new ways to engage with visible light and three-dimensional form.[11] A preoccupation with higher realms of space and the role that light plays in the perception of space and time also characterized the work of many early twentieth century artists.[12]

While developments in physics did not, therefore, happen "at exactly the same time as the change to cubism happened in painting," it would be remiss to argue that artists did not understand or consider the implications of this research when it became available. Already in the early twentieth century Einstein had been featured on the cover of the first mass-marketed German illustrated news magazine *Berliner Illustrirte Zeitung*, entering the popular imagination as a scientist with insights equal to that of "Copernicus, Kepler and Newton," who had challenged the notion of absolute space and time and therefore of absolute truth.[13]

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[8] In the late 1880s James Clerk Maxwell's electromagnetic theory of light would be confirmed by Heinrich Hertz.

[9] Einstein proposes that "light is always propagated in empty space with a definite velocity *c* which is independent of the state of motion of the emitting body" and uses calculated lengths of time to demonstrate that "two events which, viewed from a system of coordinates, are simultaneous, can no longer be looked upon as simultaneous events when envisaged from a system which is in motion relatively to that system." See Albert Einstein, "On the Electrodynamics of Moving Bodies," *Annalen der Physik* 17 (1905): 891-921 in *The Collected Papers of Albert Einstein: Volume 2, The Swiss Years: Writings* 1900-1909 trans. Anna Beck (Princeton: Princeton University Press, 1989).

[10] Henderson, *The Fourth Dimension*, 18.

[11] Ibid: 15-18.

[12] Another key interest for artists at this time, linked to curiosity about invisible worlds, was the study of synesthesia. As synaesthesia was not a phenomenon perceivable to all, it was also considered representative of higher consciousness and enlightenment or was considered to take place within an astral or higher realm similar to that of the fourth dimension. Synesthetic perception was therefore particularly of interest to those artists who held beliefs in Theosophy, such as painter Wassily Kandinsky, who discusses the effect of light and color on the different senses in *Concerning the Spiritual in Art* (1911). The term synaesthesia was first employed in reference to cross sensory metaphors, but by the mid-20th century it was extended in literary scholarship to refer to the relationship between the sensory experiences of sight and sound. For more on synesthesia see Kevin Dann, *Bright Colors Falsely Seen: Synaesthesia and the Search for Transcendental Knowledge* (New Haven: Yale University Press, 1998).

[13] To demonstrate the broader context of Einstein's theories, Peter Galison has presented a cultural and intellectual history of the emergence of relativity theory and ideas of simultaneity in

References to light rays were also frequently employed by physicists and astronomers to illustrate Einstein's theory of relativity to the general public.[14] The relationship between light and his theories was repeatedly communicated in the printing of a diagram of the eclipse that demonstrated a light ray bending around the sun. While it is incorrect to assume a direct correlation between his theory of relativity and the development of Cubism, artists were engaged in these forms of popular and generalized scientific theory, and this impacted artistic conceptions of light and space. This is particularly evident in the artistic practice of Laszlo Moholy-Nagy (1895-1946), a master of the Bauhaus who theorized projected light as an artistic medium.

Although he corresponded and met with Einstein to discuss possible collaboration, Moholy-Nagy did not argue for a direct correlation between Einstein's theories and art; rather, he understood the implications of a theory that challenged object relations and absolute space.[15] In *Vision in Motion* (1947) he argued that various ideas about 'simultaneity' and 'relativity' being presented by scientists and artists alike were making their way into the popular imagination and designating "a new dynamic and kinetic existence."[16] Projected light, for Moholy-Nagy, was the medium *par excellence* for achieving dynamic and kinetic displays that would modulate space. In the *New Vision* he solidified this argument, writing that "we must 'paint' with flowing, oscillating, prismatic light, in lieu of pigments" so as to better approach the new conception of space-time.[17] Moholy-Nagy further theorized surfaces, particularly the photogram or the projection screen, as spaces modulated by light. Screens, whether photographic or cinematic, became spaces in which to experiment with new ways of rendering three dimensions and the new spatial relations that were necessary to achieve a new vision.

In various publications Laszlo Moholy-Nagy emphasized interdisciplinary inquiry and the need for an engagement with science and technology in art education. As early as 1923 Moholy-Nagy noted that:

> "It is a surprising fact that today's painter of 'genius' possesses very little scientific knowledge in comparison with the 'unimaginative' technician. The technician has already long worked with this knowledge. Thus from the field of optics he uses, for example, phenomena of interference and polarisation, subtractive and additive blends of light, etc. But that these should be used as much as a matter of course in creating coloured displays seems at present a Utopian

relation to Einstein's work at a patent office. Diagrams of electromechanical networks for the synchronization of time in the railway system made time visible, and its implementation brought to the fore considerations of time as relative rather than absolute. Galison positions considerations of simultaneity and time as popular and of consequence prior to relativity. See: Peter Galison, *Einstein's Clocks, Poincaré's Maps: Empires of Time* (New York: W.W. Norton, 2004).

[14] Keely Orgeman, Thomas Wilfred, James Turrell, and Maibritt Borgen. *Lumia: Thomas Wilfred and the Art of Light* (Yale University Art Gallery, 2017): 29.

[15] Although he was not always in favor of modern design, Einstein served on the Governing Board and the Circle of Friends at the Bauhaus and supported the effort to keep the Bauhaus in Weimar despite political pressure to have it moved. In a letter to Theo van Doesburg, Moholy-Nagy recounts discussing the potential collaboration between artists and scientists with Einstein, who had to be fully convinced of the benefit of the endeavors of Bauhaus artists. Letter reprinted in: Theo van Doesburg, *Grondbegrippen van de Nieuewe Beeldende Kunst* (Nijmegan: Sun, 1983): 109.

[16] Laszlo Moholy-Nagy, *Vision in Motion* (Chicago: Paul Theobald & Co., 1947): 266.

[17] Ibid: 40.

idea…"[18]

For Moholy-Nagy, the modern age demanded the education of artist-technicians who could respond to new creative sectors and scientific developments. In the 1937 *International Survey of Constructive Thought* he would argue that art education might systematically bridge "the scattered forces of thought and technics," and that this education may enable society "to find the balance between our psychophysical limitations and the uncontrolled achievements which proceed without any ordered limits from the machine which we ourselves have created."[19] In the context of World War II, his arguments regarding art education were also undoubtedly politicized.

Moholy-Nagy was concerned about specialization and expertise in increasingly siloed disciplines. In the mid-twentieth century, he viewed specialized vocation and industry as lessening the sense of obligation to collaborate and cooperate, and as subdividing moral and social responsibility "to the evasiveness of the microscopic."[20] He proposed a parliament of social design, the purpose of which would be to remove intellectual experts from a life of metaphysical haze and to focus on "biological justice to develop all creative capacities for individual and social fulfillment."[21] Moholy-Nagy was also optimistic regarding transnational collaboration, writing that "such experts are already working in different parts of the world. If earnest efforts were made to relate their findings and if a suitable environment could be found for their work, a deeper insight into urgent problems would result."[22]

Just as Moholy-Nagy acknowledged that in his time the technical training of artists in projected light seemed a utopian idea, he acknowledged the utopian aspirations of this parliament of social design. For Moholy-Nagy, the ultimate aim of such an agency would mirror his aim for interdisciplinary artistic education. Collaboration would enable experts to help all achieve a life of balance through the free use of liberated creative energies. Writing in the immediate post-war period, he sought a new charter for human life, one developed through collaborative expertise that ensured "the right to and the capacity of self-expression without censorship or economic pressure."[23]

Moholy-Nagy's vision for utopian manipulations of light had a sinister counterpoint in Germany where the search light was being turned to another purpose. Already between 1934 and 1938 displays such as the *Lichtdom*, by Albert Speer, were becoming a feature of Nazi Party rallies at Nuremberg. Born to a Jewish family in Hungary, Moholy-Nagy's own works were included in the 1937 exhibition of *Degenerate Art,* by which time he had relocated to Chicago where he founded the New Bauhaus, now the IIT Institute of Design. The original Bauhaus director Walter Gropius had forged a new direction for the school in Weimar with his often quoted phrase "Art and Technology: A New Unity," and at the New Bauhaus Moholy-Nagy added an equal emphasis on offering scientific courses that would provide training in both the chemistry of new materials and physics.[24] Moholy-Nagy's arguments against division and for interdisciplinary collaboration towards a shared goal were

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[18] László Moholy-Nagy, *Painting, Photography, Film* (London: Lund Humphries, 1969): 26.
[19] Martin, Leslie, Ben Nicholson, and Naum Gabo. *Circle: International Survey of Constructive Art* (London: Faber and Faber, Limited, 1937): 344.
[20] Moholy-Nagy, *Vision in Motion*, 16.
[21] Ibid: 361.
[22] Ibid: 360.
[23] Ibid: 361.
[24] For more on Moholy-Nagy's pedagogy and emphasis on scientific and technical training see: Alain Findeli, "Moholy-Nagy's Design Pedagogy in Chicago (1937-46)." *Design Issues* 7, no. 1 (1990): 4-19.

influenced by his own positionality and the context of the Second World War, but they also indicate a wide reaching new vision for a future. This future, Moholy-Nagy hoped, would have seen collaborations between experts that would translate "utopia into action."[25]

[25] Ibid.

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