

Alexander Calder and Marcel Duchamp: A Four-dimensional Friendship

1. See *Le Mouvement*, exh. cat. (Paris: Galerie Denise René, 1955). The exhibition was celebrated on its twentieth anniversary in the publication *Le Mouvement / The Movement Paris 1955* (Paris; New York; Düsseldorf: Denise René, 1975).

2. Hultén's chronology in the *Le Mouvement* catalogue begins "Circa 1911: Cubists and futurists atomized the Renaissance notions of fixed space and time." Hultén dates the invention of the mobiles and Duchamp's naming of them to 1932, as was long the case.

3. Hultén [sic], "Mouvement-Temps ou les quatre dimensions de la plastique cinétique," in *Le Mouvement*.

4. See *Rörelse i konsten*, exh. cat., ed. K. G. Hultén (Stockholm: Moderna Museet, 1961). For the Calder and Duchamp works, see cats. 32–63 (Calder) and 70–79 (Duchamp). For Swedish translations of multiple texts by Calder, see pp. 6–9. For photographs of the exhibition and catalogue as well as discussion of Hultén's organizing activities, see Paul B. Franklin, "Exposing Duchamp in Sweden," in *Étant donné Marcel Duchamp*, no. 11 (2016), pp. 94–141.

5. See, for example, Alexander Calder, *Calder: An Autobiography with Pictures*, ed. Jean Davidson (New York: Pantheon Books, 1966), pp. 126–127. For the precise chronology, see Alexander S. C. Rower, "Chronology," in Joan Simon and Brigitte Leal, *Alexander Calder: The Paris Years, 1926–1933*, exh. cat. (New Haven: Yale University Press, 2008), p. 275.

6. See Paul B. Franklin, "Thanks to Mary, Sandy Met Marcel," *Étant donné [Marcel Duchamp & Mary Reynolds]*, no. 8 (2007), pp. 206–222.

7. For a sampling of the intersections of the two artists, see the chronology by Jennifer Gough-Cooper and Jacques Caumont, "Ephemerides on and about Marcel Duchamp and Rose Sélavy, 1887–1968," in *Marcel Duchamp: Work and Life*, ed. Pontus Hultén (Cambridge, Massachusetts: MIT Press, 1993). The relevant entries begin with Duchamp calling on the Calders on August 2, 1936, while he was working on the repair of the *Large Glass* at Katherine Dreier's Milford, Connecticut, home.

8. Duchamp quoted in Alain Jouffroy, "Marcel Duchamp: L'Idée du jugement devrait disparaître," *Arts-Spectacles*, no. 491 (November 24–30, 1954), p. 13.

9. For this history, see Linda Dalrymple Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art* (1983; rev. ed., Cambridge, Massachusetts: MIT Press, 2013); see also L. D. Henderson, "The Image and Imagination of the Fourth Dimension in Twentieth-century Art and Culture," *Configurations: A Journal of Literature, Science, and Technology*, vol. 17, no. 1 (Winter 2009), pp. 131–160.

The 1955 exhibition *Le Mouvement* (118) at the Galerie Denise René in Paris juxtaposed works by Alexander Calder and Marcel Duchamp with those of younger artists who represented the growing trend of kinetic art, including Yaacov Agam, Pol Bury, Robert Jacobsen, Jesús-Raphael Soto, Jean Tinguely and Victor Vasarely.¹ Calder and Duchamp were the senior exhibitors there and figured prominently in Swedish curator Pontus Hultén's chronology in the exhibition's catalogue. Although Calder's role in the history of moving sculpture is well established, "kinetic artist" has not been a primary descriptor for Duchamp since the 1950s. Hultén's chronology cites Calder's initial performances of his *Cirque Calder* in 1926 and creation of his first moving sculptures in the early 1930s, noting Duchamp naming them "mobiles." He also highlights Duchamp's *Bicycle Wheel* of 1913 as well as each of his subsequent works involving motion: the *Rotary Glass Plates* (1920), his *Anemic Cinema* project (1926), the *Rotary Demisphere* (1925) and the *Rotoreliefs* of 1935 (119).²

The *Le Mouvement* show was accompanied by a folded yellow sheet/catalogue with several texts, including a brief essay by Hultén, "Movement-Time or the Four Dimensions of Kinetic Plastics." In his text Hultén praises kinetic art as a manifestation of a temporal fourth dimension: "One of the outstanding innovations of our century has been art's appropriation and exploitation of the time factor (notably the fourth dimension)." Hultén's enthusiastic celebration of kinetic art continues: "Motion is that spark of life that turns art into something human and at the same time deeply realistic. A work of art imbued with a non-repeating kinetic rhythm is one of the freest things imaginable, a creation unhampered by systems, which subsists on beauty alone."³

Six years later, in 1961, Hultén included Calder and Duchamp in the first major international show of kinetic art, *Rörelse i konsten* [Movement in Art], which included eighty artists from twenty countries.⁴ Such regular pairings of the two artists may seem surprising today, when the standard link noted between the two is limited to Duchamp's christening of Calder's moving constructions as "mobiles" in fall 1931.⁵ Yet from the 1930s to the 1960s the two artists were, in fact, close friends, whose individual art practices were marked by their rich interchanges. Born eleven years apart, they had met in late May 1931, when their mutual friend Mary Reynolds, Duchamp's close companion in Paris, took him to visit Calder's studio.⁶ There were extensive personal and intellectual interactions between the two in the years that followed.⁷ In 1954, when critic Alain Jouffroy asked Duchamp to name his friends, the artist listed "Breton, Max Ernst, Matta, Tanguy, Brancusi, Calder, Donati, Cornell," adding, "What I like about them is their intelligence, which I detect through their work."⁸

This essay explores the interconnections between Duchamp and Calder, specifically around the theme of the "fourth dimension," a multivalent concept whose meaning changed over the decades of the twentieth century. In addition, the essay recovers the central significance of the term *mobile* for Duchamp,⁹ which has been absent from previous scholarship.

THE "FOURTH DIMENSION" AND ITS INTERPRETATIONS IN ART

Calder was twenty-one in 1919, the year that Einstein became a world celebrity when one of the postulates of his 1915 general theory of



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relativity was confirmed as a result of an expedition to measure the curvature of light during an eclipse.¹⁰ An artist since childhood who trained as a mechanical engineer (1915–19), Calder was primed to embrace the new physics of relativity that came to dominate science as of the 1920s.¹¹ The new watchword was “space-time,” based on the continuum of three spatial dimensions and a fourth dimension of time, which Hermann Minkowski had proposed in 1908 as a geometrical framework for Einstein’s 1905 special theory of relativity. For young artists in the 1920s, such as László Moholy-Nagy, the new understanding of time as a fourth dimension had encouraged the incorporation of motion into art, inaugurating the mode of kinetic art. Hultén and others were celebrating at mid-century.¹² And Moholy-Nagy himself became a primary spokesman for the new “space-time” aesthetic, in books such as *Von Material zu Architektur*, published in translation as *The New Vision* in New York in 1930, which Calder likely would have known. Moholy-Nagy included both Calder and Duchamp in his influential 1947 book *Vision in Motion*, in which he argued that the fusion of space and time in physics signalled a fundamental revolution in perception to which the arts must respond.¹³

But from the 1880s to the early 1920s there had been a widely popular signification of the term fourth dimension as a higher spatial dimension, perpendicular to the three familiar dimensions we know. This was the fourth dimension that would attract a wide variety of modern artists, beginning with Cubism, the context in which Duchamp encountered the idea in pre-World War I Paris.¹⁴ Although only in his teens in the 1910s, Calder may have been aware of this earlier tradition as well, although it would be largely overshadowed by Einstein’s temporal dimension from the 1920s through the 1980s.

The idea that space might have an extra, fourth dimension in addition to height, width and depth, making our familiar three-dimensional world simply a shadow or section of a truer reality, was ubiquitous before 1920. Anyone with an interest in mathematics, like the young Calder, would have encountered it in popular literature—from its earliest promulgation in E. A. Abbott’s *Flatland: A Romance of Many Dimensions by a Square of 1884* to the science fiction of H. G. Wells and others.¹⁵ Claude Bragdon in his *A Primer of Higher Space (The Fourth Dimension)* of 1913 had codified a variety of ways to grapple with a higher geometrical dimension, including



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10. On Einstein’s theories, see, for example, Helge Kragh, *Quantum Generations: A History of Atomic Physics in the Twentieth Century* (Princeton: Princeton University Press, 1999), pp. 90–104.

11. See Vanja Malloy’s essay herein. See also Joan M. Marter, *Alexander Calder* (Cambridge: Cambridge University Press, 1991).

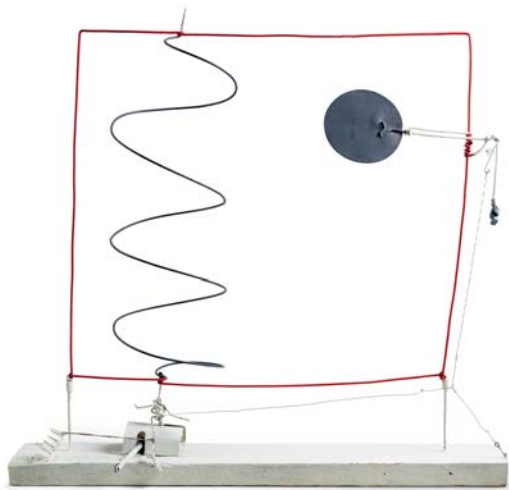
12. On artistic responses to Einstein and the theory of relativity, see Linda Dalrymple Henderson, “Einstein and Twentieth-century Art: A Romance of Many Dimensions,” in *Einstein for the Twenty-first Century*, ed. Peter L. Galison, Gerald Holton and Silvan S. Schweber (Princeton: Princeton University Press, 2007), pp. 101–129.

13. See László Moholy-Nagy, *Vision in Motion* (Chicago: Paul Theobald, 1947); Moholy-Nagy illustrated a Herbert Matter photograph of a Calder mobile (p. 240) and Duchamp’s *Nude Descending the Stairway* [sic] (p. 249). On the tendency to subsume earlier modern art under the sign of “space-time,” see Linda Dalrymple Henderson, “Four-dimensional Space or Space-Time: The Emergence of the Cubism-Relativity Myth in New York in the 1940s,” in *The Visual Mind II*, ed. Michele Emmer (Cambridge, Massachusetts: MIT Press, 2005), pp. 349–397.

14. On Duchamp and the spatial fourth dimension, see, for example, L. D. Henderson, *Fourth Dimension*, chap. 3.

15. On the emergence of interest in higher spatial dimensions in the 1870s and subsequent popularizations, see L. D. Henderson, *Fourth Dimension*, chap. 1.

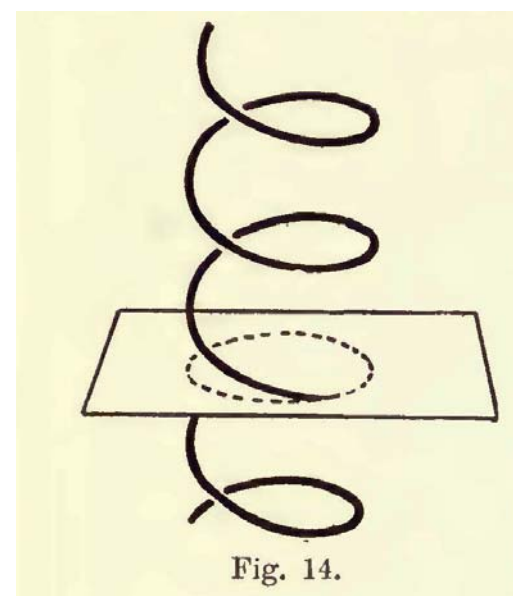
16. See Claude Bragdon, *A Primer of Higher Space (The Fourth Dimension)* (Rochester, New York: The Manas Press, 1913); for Bragdon’s spiral illustration, see pl. 16. Bragdon was drawing many of his ideas from the influential texts of Charles Howard Hinton, *A New Era of Thought* (1888) and *The Fourth Dimension* (1904).



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17. On Cubism and the fourth dimension, see L. D. Henderson, *Fourth Dimension*, chap. 2.

18. On Duchamp's early career, see Henderson, *Fourth Dimension*, chap. 3; and Linda Dalrymple Henderson, *Duchamp in Context: Science and Technology in the Large Glass and Related Works* (Princeton, New Jersey: Princeton University Press, 1998), chap. 1.

19. Calder, 1933 catalogue statement for *Modern Painting and Sculpture* (Berkshire Museum, Pittsfield, Massachusetts), quoted in Marter, *Calder*, pp. 139–140.

20. See Henderson, *Fourth Dimension*, chap. 3.

21. On Duchamp's project, see Henderson, *Duchamp in Context*; and Linda Dalrymple Henderson, "The *Large Glass* Seen Anew: Reflections of Contemporary Science and Technology in Marcel Duchamp's 'Hilarious Picture,'" *Leonardo*, vol. 32, no. 2 (April 1999), pp. 113–126.

22. See Calder, *An Autobiography with Pictures*, pp. 126–127.

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Installation view of the exhibition *Le Mouvement*, at galerie Denise René in Paris 1955

119
Marcel Duchamp
Rotoreliefs
1953

120
Mobile
1931

121
Marcel Duchamp
The Green Box (The Bride Stripped Bare by Her Bachelors, Even) (detail)
1934

122
Illustration of a spiral experienced on film as a time series, in Charles Howard Hinton's *The Fourth Dimension*, 1912

the idea of shadows as a means of signifying dimensional change. Shadows would become important for both Duchamp and Calder, as discussed below. Bragdon also addressed the relevance of the spiral for thinking about dimensional relationships: the passage of a spiral through a plane illustrates how denizens of a plane would mistake a three-dimensional object as a dot moving in a circle (122).¹⁶ Spirals would likewise come to figure importantly in the works of both Duchamp and Calder, and the young American demonstrated early on his understanding of the form's ability to project out from a plane into space. That was the technique he used once he began making his wire sculptures in the 1920s, to cleverly create, for example, the breasts and belly of *Josephine Baker III* (about 1927) (40).

As a young man, Duchamp had responded directly to the spatial fourth dimension at the height of its cultural prominence in pre-World War I Paris.¹⁷ In dialogue with the Cubists, he adopted their palette and technique of fragmenting objects, but quickly asserted his own interest in chronophotography and its dissection of motion in works such as *Nude Descending a Staircase, No. 2* (1912).¹⁸ Calder cited this work in his statement for a 1933 exhibition, which included *Double Arc and*

Sphere (117) and *Dancing Torpedo Shape* (both of 1932) (The Berkshire Museum, Pittsfield, Massachusetts). "Marcel Duchamp's 'Nude descending the stairs' is the result of the desire for motion," he asserted, noting that "the sense of motion in painting and sculpture has long been considered as one of the primary elements of the composition."¹⁹ Duchamp's major concern in the painting was, in fact, not with time itself, but rather with the motion of geometric elements through space as a means to generate the next, higher spatial dimension.²⁰ Duchamp would continue his pursuit of the spatial fourth dimension in his *Large Glass* project (1915–23) (126), for which he made hundreds of preparatory notes between 1912 and 1915 and which he executed using unconventional materials such as lead wire to outline the forms.²¹ That seminal project was the context for Duchamp's original usage of the term *mobile*.

When Calder wrote about the *Nude Descending a Staircase* in 1933, it was after having met Duchamp in winter 1930–31 and accepting his suggestion of "mobile" as a name for his crank- or motor-driven constructions in the fall of 1931.²² The intersection of the two artists' careers at this time and their interchanges deserve closer consideration, particularly

against the backdrop of Duchamp's *Large Glass*. Far more than has been realized, Duchamp would have felt a real appreciation both for *who* Calder was (the type of trained engineer he had emulated in his execution of the *Large Glass*) and for *what* the sculptor was doing at that time—both drawing with wire in space and creating constructions such as the one Calder later captioned “The motorized mobile that Duchamp liked” (151).²³ Offering Calder the name *mobile* was a significant gift on Duchamp's part, because the word came from his own “Mobile,” a never-executed component of the *Large Glass*, which was then still unknown to the world; Duchamp's first major collection of notes, which brought it to public attention for the first time, would appear only in 1934.²⁴

DUCHAMP'S LARGE GLASS PROJECT AND ITS “MOBILE” COMPONENT

Duchamp's nearly three-metre-tall *Large Glass* was a double-edged attack on contemporary painting in the wake of his brief Cubist phase. His goal was to create a style he termed “painting of precision” (an alternative to the touch-oriented medium of oil on canvas) and, at the same time, to re-establish intellectual content in art, “put[ting] painting once again at the service of the mind.”²⁵ Duchamp was seeking impersonal techniques of execution, and he found an ideal model in mechanical drawing—as well as in the use of heavy thread/string or wire to “draw.” The lead fuse wire Duchamp used for the *Large Glass* is complemented by other unusual materials, such as lead foil, mirror silver and dust, all of which are more characteristic of a laboratory than a painter's studio.²⁶ When Duchamp met Calder, he encountered an artist who had likewise replaced an earlier pursuit of painting by drawing with wire (23, 82, 89). And the principles of mechanics behind Calder's constructions—such as “Volumes—Vectors—Densities,” words contained in the title of his 1931 exhibition—paralleled those Duchamp himself had explored humorously in the “Playful Physics” of the *Large Glass*, including in the functioning of the Mobile.²⁷

In terms of the content of *The Bride Stripped Bare by Her Bachelors, Even*, or *Large Glass*, Duchamp established a complex narrative for his techno-scientific allegory of quest, drawing on contemporary science as well as four-dimensional geometry to create the insuperable divide between the realm of the Bride above and the Bachelors below.²⁸ Thus, Duchamp's notes define the world of the biomechanical Bride (126, at upper left) as four-dimensional, unmeasurable, free of gravity and characterized by ethereal, vibrating, wave-borne communication; by contrast, that of the Bachelors/Nine Malic

Moulds and the central Chocolate Grinder is three-dimensional, measured, gravity-bound and ruled by laws of “playful” mechanics. Since the Bride and the Bachelors never connect directly, the only communication between them would have been by means of the activities of the Juggler/Handler of Gravity and the chance falls of the Mobile, which was to splash the “erotic liquid”²⁹ of the Bachelors into the Bride's realm, if it fell correctly and hit its target.

Duchamp's Juggler/Handler of Gravity embodied exactly those aspects of mechanical engineering central to Calder's constructions—weight, centre of gravity, equilibrium—and, moreover, as a Juggler, he actually had roots in the popular culture of fairs and circuses that Calder also explored. At the base of his spiral, the Juggler/Handler (121) holds a pole like a circus tightrope walker, and the challenge of maintaining equilibrium while standing on a moving base had precedents in fairground entertainments.³⁰ Although Duchamp never executed the Juggler of the Centre of Gravity or Handler of Gravity, as the artist variously named him, he was to have been positioned at the upper right, opposite the Bride, as shown in Jean Suquet's diagram of the *Large Glass*, which depicts the components missing from the work (125, upper right). By shifting the position of the ball on his upper plate, the Juggler/Handler was to maintain his balance when the geared Boxing Match of the Bachelor Apparatus (125, just below his feet) tugged on the Bride's garment on which he stood; from his frantic motions the Bride would then detect the ardour of the Bachelors below.³¹ Duchamp would surely have sensed the resonances between the Juggler/Handler and Calder's constructions when he visited his studio. With his “ball in black metal” and spiral, the Juggler/Handler of Gravity looks like he might have stepped right out of one of Calder's works, which are replete with spirals, for example, *Mobile* (120).³² Indeed, Calder's *Little Ball with Counterweight* (about 1931) (Whitney Museum of American Art, New York) actually demonstrates how to “handle” the centre of gravity by lowering it with a hanging counterweight.

Likewise, Duchamp may well have sensed analogies between Calder's constructions and one of the key moving parts of the *Large Glass* he had designated the Mobile in his notes of two decades earlier. Giving Calder that term when asked to suggest a name was extremely generous on Duchamp's part, since he had never actually added his suspended Mobile to the two tips of the Horizontal Scissors of the Bachelor Apparatus of the *Large Glass* (125, where it was to hang just to the right of the Chocolate Grinder). Thus, even after Duchamp included one of his multiple notes

23. Calder illustrated the mobile and captioned it as such in *An Autobiography with Pictures*, p. 127.

24. For these notes, see Marcel Duchamp, *Salt Seller: The Writings of Marcel Duchamp*, ed. Michel Sanouillet and Elmer Peterson (New York: Oxford University Press, 1973); reprinted as *The Writings of Marcel Duchamp* (New York: Da Capo Press, 1989) and hereafter cited as *Writings*.

25. Duchamp made his “service of the mind” statement in a 1946 interview with James Johnson Sweeney, reprinted in Duchamp, *Writings*, p. 125; for “painting of precision,” see *Green Box*, in *ibid.*, p. 30.

26. For the laboratory-like quality of the *Large Glass*, see, for example, Henderson, “The *Large Glass* Seen Anew”; and Henderson, *Duchamp in Context*, chap. 8.

27. For “Playful Physics,” see Duchamp, *Green Box*, in *Writings*, p. 49. Calder titled his 1931 exhibition at the Galerie Percier “Volumes—Vecteurs—Densités / Dessins—Portraits” (see Calder, *An Autobiography with Pictures*, p. 118).

28. On the science of the *Large Glass*, including electromagnetism, see Henderson, *Duchamp in Context*; and Henderson, “The *Large Glass* Seen Anew.”

29. For “erotic liquid,” see Duchamp, *Marcel Duchamp, Notes*, ed. and trans. Paul Matisse (Paris: Centre National d'Art et de Culture Georges Pompidou, 1980; Boston: G. K. Hall, 1983), note 98, for full citation.

30. On the Juggler/Handler in the context of science and popular entertainment, see Henderson, *Duchamp in Context*, pp. 155–158, 163–165. For Duchamp's fullest discussion of the Juggler/Handler in his unpublished notes, see note 152 in *Marcel Duchamp, Notes*.

31. Duchamp included only one drawing of the Juggler/Handler in the *Green Box* (see *Writings*, p. 65). For the never-executed Boxing Match, see *ibid.*, pp. 66–67.

32. For “ball in black metal,” see Duchamp, *Marcel Duchamp, Notes*, notes 137 and 152 (p. 2).



on the Mobile in the 1934 *Green Box*, its role remained rather obscure. Without a physical presence in the *Large Glass*, his conception was virtually lost on the public and scholars alike until after his death in 1968, when a cache of unpublished notes was found and first published in 1980.³³

Yet the Mobile meant a great deal to Duchamp, because it was critical to the role of chance underlying the *Large Glass* narrative. It was the chance falls of the Mobile, successfully plunging—or not—“into the pool of liquid below” that determined whether the Bachelors’ liquefied Illuminating Gas [semen] would be splashed into the Bride’s realm above (125, lower right). This event was the final stage of a left-to-right process of liquefaction that would begin in the Nine Malic Moulds and conclude with the splash. The Mobile’s chance falls were produced by the jerky, back-and-forth movement of the Chariot that opened and closed the Scissors from which it hung (125, lower left), an irregular motion caused by the “oscillating density” of a falling weight.³⁴ This was a prime example of Duchamp’s humorous play with mechanics and incorporation of chance, and the Mobile was a central part of it.

Chance had not been a concern for Calder with his motorized mobiles, but once he adopted wind power, his constructions came to embrace and exemplify chance and indeterminacy, a theme that would stimulate subsequent critics and musicians alike.³⁵ By contrast, experiments in chance, which were so important in his early career and in his *Large Glass*, would come to occupy Duchamp less as he pursued his motorized mechanisms during the 1920s and 1930s. Yet, although chance was no longer a shared theme, two aforementioned fourth-dimension-related ideas—spirals and shadows—would continue to play key roles for the two artists.

SPIRALS AND SHADOWS IN THE ART OF DUCHAMP AND CALDER

Spirals had pervaded the *Large Glass* project, and, as noted earlier, the form bore strong associations with the dimensional change that became central to Duchamp’s motorized works.³⁶ By the time he met Calder in winter 1930–31, he had already made the film *Anémic Cinéma* (1926), with its alternating spiral puns and circular spiralling designs, and his *Rotary Demisphere* a year earlier, in which the spiralling forms on a three-dimensional hemisphere suggested a possible move into the fourth dimension.³⁷ Duchamp continued this preoccupation in his *Rotoreliefs* (1935) (119), consisting of cardboard disks that were to turn on a turntable to produce dramatic illusions of spirals, eccentric circles and various

objects rising up into space from the plane. Both Calder and Duchamp would have been well aware of the similar illusion of upward motion by spirals, viewed laterally in Calder’s mobiles. As the sculptor wrote of a “Mobile” reproduced in *Abstraction-Création* in 1933, “The black helix turns less rapidly and seems to always climb”; the same effect occurs with the white spiral in *Black Frame* (1934) (115).³⁸

It was Duchamp’s *Rotoreliefs* that attracted the attention of Hungarian poet Charles Sirato as he organized the project that would bring Calder and Duchamp together in spring 1936, the publication of the *Manifeste Dimensioniste*. The two artists were among twenty-six signatories from Paris and abroad who agreed with Sirato’s argument that each medium should increase by a dimension: poetry would become planar and painting three dimensional, with sculpture progressing from “closed, immobile forms” to incorporate movement and even to “vaporize” and utilize “gaseous materials” to create a “Cosmic Art.”³⁹ Sirato commenced the manifesto by citing Einstein’s new physics, and he thus found Calder’s kinetic works exemplary; he was drawn to Duchamp’s *Rotoreliefs* for the same reason. But the *Manifeste Dimensioniste* project also gave Duchamp an opportunity to reassert his devotion to the spatial fourth dimension versus the space-time world of Einstein.⁴⁰ Thus, although Duchamp signed the manifesto, he added a crucial statement in the “Mosaic” section appended to the manifesto, “Use of movement in the plane for the creation of forms in space: Rotoreliefs,” clarifying that motion was for him only a means to create space, not an end in itself.⁴¹

Sirato’s reference to “Cosmic Art” in the future reflected another of the ways the fourth dimension had functioned in twentieth-century culture: as a sign for mystical “cosmic consciousness” of a higher, four-dimensional reality.⁴² Although that idea was not of specific interest to either Duchamp or Calder, it was a central concern for the poet Eugene Jolas, the editor of the journal *transition* (1927–38), which their mutual friend James Johnson Sweeney coedited from 1936 to 1938.⁴³ Works by Calder appeared in four issues of *transition*, and Duchamp designed the cover for the Winter 1937 issue.⁴⁴ Jolas’ commitment to the mystical tradition was evident throughout the journal, but the connection of the fourth dimension to mysticism was most prominent in his 1941 album, *Vertical: A Yearbook for Romantic-Mystic Ascensions*, for which Calder designed the cover (124). In this collection of poems and texts by Jolas and others, Jolas defined the “FOURTH SPATIAL DIMENSION” as “a working hypothesis for cosmological thinking,” writing elsewhere in the volume, “Man’s hope to elude the

33. On the functioning of the Mobile, see Henderson, *Duchamp in Context*, pp. 150–152. See also Jean Suquet, “Possible,” in *The Definitively Unfinished Marcel Duchamp*, ed. Thierry de Duve (Cambridge, Massachusetts: MIT Press, 1991), pp. 85–110, 114–115. Suquet’s drawing (125) is based on Duchamp’s unpublished note 153; see Duchamp, *Marcel Duchamp, Notes*, note 153 (1).

34. For “oscillating density,” see Duchamp, *Green Box*, in *Writings*, p. 62.

35. For example, in composer Earle Brown’s 1963–66 “open form” composition, “Calder Piece,” percussionists respond only to the movements of a mobile.

36. For the various spirals in the *Large Glass*, see Henderson, *Duchamp in Context*, index entry on “Duchamp, and spirals.”

37. For all of these works, see Arturo Schwarz, *The Complete Works of Marcel Duchamp*, 3rd. rev. ed. (New York: Delano Greenidge, 1997), vol. 2, nos. 379, 405, 407, 409, 415–424, 441.

38. See Calder, “Un ‘Mobile,’” in *Abstraction-Création, Art non figuratif*, no. 2 (1933), p. 7.

39. All quotations here come from the text of the *Manifeste Dimensioniste*. For a reprint of the manifesto flyer, see *Dimensionism: Modern Art in the Age of Einstein*, exh. cat., ed. Vanja Malloy (Cambridge: MIT Press, 2018). For Sirato’s ambitious plans for group exhibitions and a periodical to be titled *Revue N + 1*, see the essay by Oliver Botar in *Dimensionism*, ed. Malloy. Sirato’s efforts were cut short by his ill health and return to Hungary later in 1936.

40. On Duchamp and the *Manifeste Dimensioniste*, see Henderson, “The *Manifeste Dimensioniste* and the Multivalent Fourth Dimension: Sirato, Delaunay, Duchamp, Kandinsky, and Prampolini,” in *Dimensionism*.

41. See Duchamp, statement under “Mosaic,” *Manifeste Dimensioniste*, back of flyer; reprinted in Malloy, ed., *Dimensionism*.

42. This interpretation of the fourth dimension was developed most fully by Russian mystical philosopher Petr Demianovich Ouspensky in books such as his 1911 *Tertium Organum: The Third Canon of Thought, a Key to the Enigmas of the World* (2nd American ed., rev., New York: Alfred A. Knopf, 1922). See, for example, Henderson, *Fourth Dimension*, chap. 5.

43. For Jolas’ career and philosophy, see Eugene Jolas, *Man from Babel*, ed. Andreas Kramer and Rainer Rumold (New Haven: Yale University Press, 1998).

44. The Calder works appeared in issues no. 7 (October 1927), no. 16/17 (June 1929), no. 24 (June 1936) and no. 26 (Winter 1937). Duchamp’s cover for *transition*, no. 26 featured an image of his 1916 Ready-made Comb; see Schwarz, *Complete Works*, vol. 2, no. 457.

45. See Eugene Jolas, ed., *Vertical: A Yearbook for Romantic-Mystic Ascensions* (New York: Gotham Bookmart Press, 1941), p. 13; for “FOURTH SPATIAL DIMENSION,” see Jolas, “Suggestions for a Verticalist Vocabulary,” in *ibid.*, p. 96. In the same “glossary,” he defines “SPIRAL” as a “Sacred symbol of many primitive races indicating ascent” (p. 95).

46. Calder statement, in “What Abstract Art Means to Me,” *The Bulletin of the Museum of Modern Art*, vol. 18, no. 3 (Spring 1951), p. 8. On Calder and astronomy, see Vanja Malloy’s essay herein.

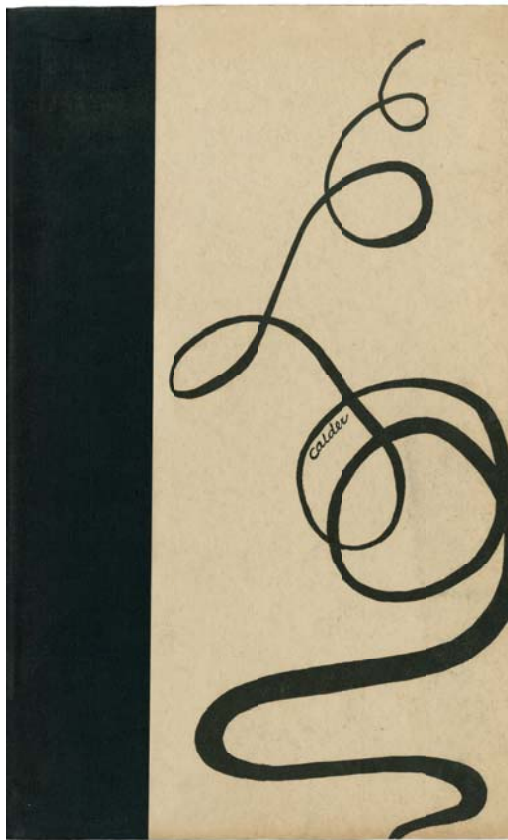
47. See Duchamp, *À l’infinifit*, in Duchamp, *Writings*, p. 89 (and related notes on p. 88).

48. See Robert Lebel, *Marcel Duchamp* (New York: Grove Press, 1959), pp. 27–28. See also Pierre Cabanne, *Dialogues with Marcel Duchamp* (New York: Viking Press, 1971), p. 40, for this explanation. On Duchamp and the issue of shadows more generally, see Henderson, *Duchamp in Context*, pp. 80–81; and Henderson, *Fourth Dimension*, chap. 3.

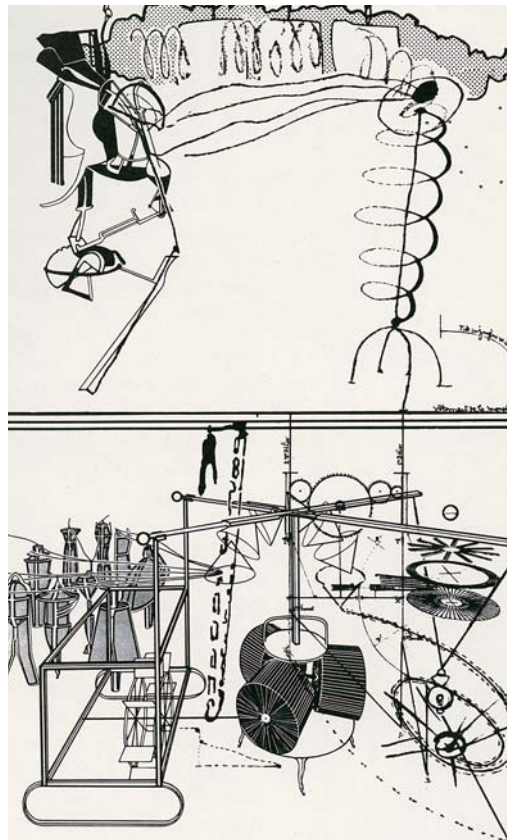
49. For the publication, see *À l’infinifit (The White Box)* (New York: Cordier and Ekstrom, 1966); see also Duchamp, *Writings*, pp. 74–101; for the notes on the fourth dimension, see pp. 84–101.

50. Duchamp, as quoted in Calvin Tomkins: *Marcel Duchamp: The Afternoon Interviews* (New York: Badlands Unlimited, 2013), p. 92.

51. For Marter’s suggestion, see Calder, p. 119. See Arnauld Pierre, *Calder: Mouvement et réalité* (Paris: Editions Hazan, 2009), pp. 243–249, where he also notes parallels to Moholy-Nagy.



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three-dimensional prison and search for the four-dimensional universe through the conquest of Time emancipates the creative personality by making him look at the stars again and develops a living nexus with the cosmos.⁴⁵ Calder could certainly identify with gazing at the heavens, and his irregular spiral on the cover climbs upwards, tunneling into space, just as spirals had done in works such as *Space Tunnel* (98) or, even more closely, *Movement in Space* (both of 1932). Spiral galaxies had been part of the discussion of astronomical discoveries in the 1920s, and Calder's belief that "the system of the Universe, or part thereof" underlay the forms in his works meant that he was keenly aware of spirals and spiralling movement at the cosmic scale in the four-dimensional space-time world of Einstein.⁴⁶

Just as Duchamp and Calder shared an interest in spirals, the matter of shadows and their dimensional implications was another important theme for each man. Duchamp had written on shadows in his notes for the *Large Glass*, and, having explored a variety of means to create a four-dimensional realm for the Bride, he had come back to an explanation he had found in a 1903 geometry book: "The shadow cast by a 4-dim'l figure on our space is a 3-dim'l shadow."⁴⁷ As he had told Robert Lebel, when the critic was preparing his

1959 monograph, the Bride was meant to be a two-dimensional compression on glass of a three-dimensional Bride, who was the shadow of the ultimate four-dimensional Bride.⁴⁸ Although he included one reference to "shadows cast by Readymades" in the notes he published in 1934 as the *Green Box*, Duchamp released his extensive notes on the fourth dimension, including shadows, only in his 1966 collection *À l'infinifit* (*The White Box*).⁴⁹ With the release of those notes in 1966, Duchamp deliberately pointed to his interest in a spatial fourth dimension—as he had done when he signed the statement appended to the *Manifeste Dimensioniste*—in a period when his work at times continued to be interpreted in temporal terms, along with Calder's kinetic art. As Duchamp explained to Calvin Tomkins in a 1964 interview, "My contention is that the fourth dimension is not the temporal one."⁵⁰

What about Calder and his growing interest in shadows during his career—and might they also have had dimensional implications for him? Joan Marter has suggested that the sculptor's interest in the shadows cast by his mobiles may well have been inspired initially by Moholy-Nagy's *Light-Space Modulator* (1922–30) (Busch-Reisinger Museum, Harvard University), which was exhibited in Paris in 1930.⁵¹ And, if Calder had not yet encountered Moholy-Nagy's rhetoric about space-time

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Calder's cover for *Vertical: A Yearbook for Romantic Mystic Ascension*, edited by Eugene Jolas, 1941

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Jean Suquet
Large Glass Diagram with Missing Components, 1988
Ill. in *The Definitely Unfinished Marcel Duchamp*, 1991

126
Marcel Duchamp
The Bride Stripped Bare by Her Bachelors, Even (The Large Glass)

art, he may have first heard his own work referred to as “four-dimensional” in Waverly Root’s review of his 1932 exhibition at the Galerie Vignon: “Calder’s *mobiles* may very well be the beginning of four-dimensional sculpture.”⁵² Here, the primary meaning would have been the temporal fourth dimension, but Calder had also begun his conversations with Duchamp, which may well have included the subject of shadows. From the moment he hung a wire portrait on a wall at his 1931 Galerie Percier show, for example, shadows reducing the three-dimensional objects to two-dimensional planes would have been part of Calder’s experience. That effect would have been particularly appropriate for his portrait of [Edgard] Varèse (about 1930) (32), a close friend of the artist’s, whom Duchamp knew in New York in the 1910s and who was exploring dimensionality in music, ultimately creating works such as *Hyperprism* (1922–23).⁵³

As Arnauld Pierre and others have suggested, shadows became a subject of intense interest for Calder once he was working with photographer Herbert Matter, beginning in 1936.⁵⁴ Made with professional lighting equipment, Matter’s 1936 photograph of Calder in his storefront studio with the unfinished *Devil Fish* of 1937 (128, 129), transforms the sculpture into a looming two-dimensional creature—almost a prototype for the planar elements of the *stables* he would produce later, such as his 1940 *Black Beast* (134).⁵⁵ Matter’s dramatic lighting strongly suggests contemporary effects in Hollywood films in the 1930s, such as *The Thin Man* (1934).⁵⁶ The shadows in Matter’s photographs of Calder and his works also bring to mind Duchamp’s painting *Tu m’* of 1918 (Yale University Art Gallery), which was actually a painting of cast shadows of Readymades, including a three-dimensional bottle brush intended to stand as the shadow of its four-dimensional counterpart. *Tu m’* was owned, along with the *Large Glass*, by the Calders’ fellow Connecticut resident Katherine Dreier, and would become Calder’s favourite Duchamp work.⁵⁷ Indeed, Duchamp’s first visit to the Calders in Roxbury had actually occurred in late 1936, while he was staying with Dreier in Milford, working on repairs on the cracked *Large Glass*.⁵⁸ It is hard to imagine that the dimensional associations of shadows did not come up in the two artists’ conversations.

Pierre documents how Calder’s growing interest in the lighting of his exhibitions is apparent in his correspondence, beginning with his proposal to A. E. Gallatin for his New York exhibition of 1934, which notes that he now considers himself a kind of “illuminating engineer.”⁵⁹ In such exhibitions, the shadows projected were also *moving* shadows that combined planar shadows and time to suggest

yet another kind of dimensional change: two-dimensional planes moving through space generate three-dimensional forms. Indeed, shadows became such a central part of Calder’s installations that he had to take extreme measures when the electrical power was off for his 1946 Galerie Louis Carré exhibition in Paris. This was the show Duchamp had arranged with Carré and for which Reynolds provided considerable help with the sculptures Calder shipped in small boxes to Paris. Many difficulties attended the show’s preparation, but, in the end, a candle on the floor produced the now-critical shadows.⁶⁰ Appropriately, a review of that exhibition, featuring a photo of Calder and Duchamp, was titled “Un Fabricant d’espace” and suggested that Calder’s humour was “à la N^{me} dimension,” evoking the *n*-dimensional geometry that had given rise to interest in the spatial fourth dimension in the first place.⁶¹

Calder and Duchamp’s friendship was indeed a special one, with much vital interchange and multiple musings on the shifting identities of the “fourth dimension” over many years. Their relationship went far beyond the simple occurrence of Duchamp’s oft-cited naming of the *mobile*, a term we can now recognize as being far more resonant than had previously been realized. Behind that name and the two artists who shared it is a multi-faceted history rich with dimensional implications.

52. See Waverly Lewis Root, “Calder Makes Some New Gadgets, Puts ‘Em on Exhibit,” *Chicago Tribune* (European Edition), February 13, 1932, p. 6.

53. On Duchamp and Varèse, see, for example, Henderson, *Fourth Dimension*, chap. 4, which draws on the pioneering 1992 dissertation of Olivia Mattis on Varèse.

54. See Pierre, *Calder*, pp. 243–249.

55. I am grateful for conversations with Elizabeth Turner Hutton, in which she suggested this reading of the planar *stables* as materializations of shadows. For Matter’s photographs, see *Calder by Matter*, ed. Alexander S. C. Rower (Paris: Cahiers d’art, 2013).

56. On the director’s purposeful introduction of shadows in *The Thin Man*, see Patrick Keating, *Hollywood Lighting from the Silent Era to Film Noir* (New York: Columbia University Press, 2010), p. 163. The 1936 film *After the Thin Man*, released in December 1936, featured an even more remarkable shadow-dominated stairway sequence.

57. Robert Osborn, “A Conversation with Alexander Calder,” *Art in America*, vol. 57, no. 4 (July–August 1969), p. 31. On *Tu m’*, see, for example, Henderson, *Fourth Dimension*, chap. 3, and fig. 3.11.

58. See again the chronology by Gough-Cooper and Caumont cited in note 7.

59. Calder letter to A. E. Gallatin, November 4, 1934, Calder Foundation archives.

60. See Calder, *An Autobiography with Pictures*, pp. 188–194. For the exhibition and Reynolds’ role, see again Franklin, “Thanks to Mary, Sandy Met Marcel,” pp. 211–216.

61. See Charles Estienne, “Un Fabricant d’espace,” *Combat*, October 30, 1946, p. 2; the clipping (Calder Foundation archives) is reproduced in Franklin, “Thanks to Mary,” p. 214.

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Herbert Matter
Installation View Showing Calder’s White Panel (1936) and Tighrope (1936), at the Exhibition Calder: Stables and Mobiles, at Pierre Matisse Gallery, New York, 1937

128
Devil Fish
1937

129
Herbert Matter
Calder with White Panel (1936) and Devil Fish (1937, before completion) at His New York City Storefront Studio, Winter 1936

