Kenneth Snelson and the Science of Sculpture in 1960s America

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ABSTRACT

In this dissertation, I examine the work of the American sculptor Kenneth Snelson in the context of 1960s art and cultural history. Snelson became well known in the mid-sixties for his large-scale metal sculptures that achieve stability through a physical principle he had discovered, which Buckminster Fuller later called "tensegrity," based on the balance of tension and compression. Snelson has also devoted much of the past half century to research on atomic structure, resulting in an on-going multi-media project called *Portrait of an Atom* that includes both a scientific treatise and works of art. The concepts of physics and engineering that make Snelson's tensegrity sculptures possible, and the nuclear science that inspired his atom, are essential to his artistic process and to the meaning of his work. To explore the apparent tension of an artist who works in the techno-scientific domain, I look at how Snelson conceived of his own work and how it was discussed by art writers and critics of the sixties. I further this discussion by exploring Snelson's work in the context of his artistic peers who shared his interests and strategies. Drawings on interviews with Snelson and period sources, I place Snelson, an artist who has been seen as an outsider and is largely absent from current literature about 1960s sculpture, within popular currents of artistic thought from the period. In addition, I contribute to the body of knowledge about 1960s American sculpture by demonstrating the manifestations and cultural implications of the techno-scientific in art.

To my mom and dad.

ACKNOWLEDGEMENTS

This project would not have been possible without the guidance and friendship of many people. I am profoundly grateful for the intellectual and emotional support I received from my Bard Graduate Center dissertation committee—Jeffrey Collins, Pat Kirkham, Amy Ogata, and Catherine Whalen. They reviewed drafts, offered valuable insights, patrolled for the use of the passive voice, and, perhaps most importantly, did a great deal of handholding. I want to particularly thank Jeffrey Collins, who has been my mentor and advisor at the BGC since I was a Masters student, and inspired and motivated me to press on. I also want to give special thanks to Amy Ogata who went above and beyond in the handholding department and whose insight was invaluable in shaping this project. I also appreciate Ann Butler's patience and time at the Center for Curatorial Studies at Bard College where I consulted the Dwan Gallery Archive. In addition, I would like to thank Tom Wolf, Professor of Art History at Bard College, who supplied advice and glasses of wine—both of which were essential. I am also grateful to have had the support of my fellow BGC PhD students without whom I would never had been able to complete this program, particularly Sonya Abrego, Donna Bilak, Amy Bogansky, Erin Eisenbarth, Caroline Hannah, Jessica Lanier, Laura Microulis, Maria Perers, Shax Riegler, Jonathan Tavares, and Tom Tredway. I was lucky to have found such a supportive academic community for my graduate work. Finally, a special thank you to Ken Snelson who opened up his studio, his archives, and his mind for my research. I am so lucky to have been able to spend time with someone as wise, funny, kind, interesting, creative, and talented as Ken, and I am honored to be entrusted with the creation of the first chapter of his historical record.

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LIST OF ILLUSTRATIONS

SELECT CHRONOLOGY

1927	Born June 29, Pendleton, Oregon
1934	His father, Jack Snelson, opened The Snelson Camera Shoppe
1945-6	U.S. Navy, stationed in Washington, D.C.
1946-8	Attended University of Oregon, Eugene
1948	Attended Black Mountain College summer session, North Carolina
1948	Discovered principle of "tensegrity"
1949	Attended Black Mountain College summer session, North Carolina
1949	Attended Oregon State College at Corvallis, Engineering Program
1949-50	Attended The Institute of Design in Chicago, Illinois
1950-68	Worked as cameraman based in New York City
1951	Attendeded Fernand Léger's Académie Montmartre, Paris
1956-9	Resumed painting
1959	First public recognition of his contribution to tensegrity in *Three Structures by Buckminster Fuller*, The Museum of Modern Art, New York
1960	Began large-scale tensegrity sculptures and moved to 148 Spring Street, New York
1963	Married Audrey Goldenstein (she died 1966)
1964	Sculpture included in the New York World's Fair
1964	Bought house in Sagaponack, Long Island
1964	*Twentieth-Century Engineering*, The Museum of Modern Art, New York (group show)
1966	First gallery show, Dwan Gallery, New York City

1966-70	Represented by Dwan Gallery, New York and Los Angeles (New York solo shows in 1966, 1968, and 1970; Los Angeles solo show in 1967)
1966	*Annual Exhibition*, Whitney Museum of American Art, New York (group show)
1967	*American Sculpture of the Sixties*, Los Angeles County Museum of Art (group show)
1967	*Sculpture: A Generation of Innovation*, Art Institute of Chicago (group show)
1968	Solo show of sculpture in Bryant Park, New York
1968	*Plus by Minus: Today's Half Century*, Albright-Knox Art Gallery, Buffalo (group show)
1968-9	*The Pure & Clear: American Innovations*, Philadelphia Museum of Art (group show)
1969	*Twentieth Century Art from the Nelson Aldrich Rockefeller Collection*, The Museum of Modern Art, New York (group show)
1969	*Kenneth Snelson: Five Monumental Sculptures*, Fort Worth Art Center
1969	*Kenneth Snelson*, at Krefeld Gallery, Düsseldorf, Germany
1969	*Kenneth Snelson: Stress Structures*, Kröller-Müller Museum, Hoge Veluwe National Park, Otterlo, The Netherlands
1970-1	*Annual Exhibition*, Whitney Museum of American Art, New York (group show)
1971	*Structur und Spannung*, Kunstverein, Hanover, West Germany (group show)
1971	*Easy-K* installed in Sonsbeek Park, Arnhem, Holland
1972	Married Katherine Kaufmann; had daughter, Andrea
1972	*Seventieth American Exhibition*, Art Institute of Chicago (group show)
1973	*Art in Space: Some Turning Points*, Detroit Institute of Arts (group show)
1974	Reynolds Metal Sculpture Award

1974	*Sculpture in the Park*, Art Institute of Chicago, Grant Park (two person show)
1975-6	Deutscher Akademischer Austauschdienst (DAAD) Fellow, Berliner Kunstlerprogramm
1977	*Kenneth Snelson: Skulpturen*, Nationalgalerie, Berlin and Wilhelm Lehmbruck Museum, Duisburg, Germany
1979	*Portrait of the Atom*, Maryland Science Center, Baltimore (solo atom show)
1980	*Kenneth Snelson: Structures*, Birmingham Museum of Art and The Tampa Museum of Art
1981	American Institute of Architects Medal
1981-2	*Kenneth Snelson*, Hirschhorn Museum and Sculpture Garden, Smithsonian Institutions, Washington, D.C., Albright-Knox Art Gallery, Buffalo, and Sarah Campbell Blaffer Gallery, University of Houston
1981-94	Represented by Zabriskie Gallery, New York and Paris (solo shows in 1981, 1986, and 1990)
1983	*Big Pictures*, The Museum of Modern Art, New York (group show)
1985	*Kenneth Snelson: Panoramic Photographs*, De Cordova and Dana Museum and Park, Lincoln, Massachusetts
1985	Honorary Doctorate of Arts and Humane Letters, Rensselaer Polytechnic Institute, Troy
1987	American Academy of Arts and Letters, Art Award
1989-90	*Kenneth Snelson: The Nature of Structure*, The New York Academy of Sciences, California Museum of Science and Industry, and The National Academy of Sciences, Washington, D.C. (solo atom show)
1990	*Full Circle: Panoramas of France, Italy, and Japan* by Snelson and Laurence Wieder
1991	American Institute of Architects, Biennial Artist's Award
1991, 1993	Solo shows at Yoh Art Gallery, Osaka

1992, 1995	Solo shows at Contemporary Sculpture Center, Toyko
1994	Admitted to the American Academy of Arts and Letters
1994-9	Represented by Maxwell Davidson Gallery, New York (solo shows in 1994 and 1998)
1994-2003	Represented by Laurence Miller Gallery, New York (solo shows in 1994 and photography in 2003 photography)
1999	International Sculpture Center, Lifetime Achievement Award
1999-present	Represented by Marlborough Gallery, New York (solo sculpture shows in 1999, 2003, and 2009; 2011 with George Rickey)
2002	The Elizabeth N. Watrous Prize, National Academy of Design, New York
2006	*Deux Américains à Paris: Sculptures de George Rickey et Kenneth Snelson,* Jardins du Palais Royal, Paris
2008	*Digital Stone*, Today Art Museum, Beijing (group show)
2008	Design selected for top of Freedom Tower, 1 World Trade Center, New York
2009	*Kenneth Snelson: Forces Made Visible* by Snelson and Eleanor Heartney

INTRODUCTION

Kenneth Snelson (b. 1927) is an American sculptor who became well known in the 1960s for his large-scale metal sculptures that achieve stability through tension and compression, a principle Buckminster Fuller called "tensegrity." Snelson's sculptures retain their structure through the opposing forces of outward pushing rods and inward pulling cables. Using this system of construction, Snelson has created a variety of forms, including soaring towers reaching sixty feet toward the sky and dramatic cantilevers that thrust into the distance. Viewed from afar, it appears as if dozens of steel bars have been thrown in the air and defy gravity to remain frozen, suspended. Although Snelson usually defines himself as an artist, his main interests are also scientific and philosophical. He is driven by the desire to understand what gives objects their structural integrity and also by grand ideas about physical forces and the composition of the universe. He has explored such questions not only through his tensegrity sculptures, but also through a half century of work on a model of the atom—the essence of all substances in the universe. Snelson's desire to create visual representations of things that cannot be seen also motivates both of these projects. The natural forces of tension and compression are made visible in his tensegrity sculptures, while his atomic model gives physical form to something too small to be seen with the strongest microscope.

Snelson has been the subject of twenty-four solo exhibitions and, at the height of his fame, in the 1960s and 70s, his sculptures were included in important shows at institutions such as the Museum of Modern Art (MoMA), New York, the Whitney Museum of American Art, New York, the Los Angeles County Museum of Art (LACMA), the Art Institute of Chicago, and the Philadelphia Museum of Art. He is currently represented by the Marlborough Gallery in Manhattan and has pieces in museum collections around the world. Despite these professional successes, art historians and writers have addressed his work only in a handful of brief catalogue essays and popular press articles, and he is almost never mentioned in the general literature on 1960s art. This study is the first large-scale examination of Snelson's body of work, and it is, therefore, a project of recovery. By presenting and analyzing Snelson's artistic development and practice in the context of sixties sculpture, I aim to establish his place in the history of art. Beyond this, I also present a broader understanding of his work as both art and science within the context of artistic interest in the techno-scientific domain in the 1960s in the United States.

The origin of Snelson's relative absence from the art historical record can perhaps be found in his own presentation of his work. The artist statement Snelson provided in 1967 for the LACMA *American Sculpture of the Sixties* catalogue said simply, "My concern is with nature in its most fundamental aspect: the patterns of physical forces in space."[1] Although he has since been the subject of interviews, written essays, and published an illustrated book on his own work, he does not expand significantly on this

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[1] Maurice Tuchman, ed., *American Sculpture of the Sixties* (Los Angeles: Los Angeles County Museum of Art, 1967), 52.

definition. The problem of Snelson's unbending orthodoxy in defining his own work was compounded for me by the fact that he is a living subject. Snelson is now in his mid-eighties, residing and working in the West Village in New York City. I met with him many times, during the course of my research, but in the interviews that I conducted for this study, I frequently came up against the fact that he sees his work only as an exploration of structural possibilities and a demonstration of physical forces and does not accept the possibility of additional intellectual content. Moreover, he insists for the most part that he cannot be associated with other artists, stating, for example, that he is a "one man movement with no following."[2] Snelson denies any connection between his sculpture and artistic and cultural trends of the 1960s that could provide a historical context for his work. For example, he resists being labeled as a Minimalist sculptor and sees no relationship between his atomic research and the pervasive nuclear anxiety historians of the postwar period describe.[3] Snelson presents himself as an outsider and locates the cause of this status in his melding of art with science and engineering. He believes that his art work has faced rejection for not being "art," and his scientific

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[2] Snelson, in discussion with the author, October 30, 2008.

[3] Snelson, in discussion with the author, April 16, 2008; Snelson, in discussion with the author, December 10, 2011; regarding postwar atomic culture, see: Brooke Kamin Rappaport and Kevin L. Stayton, *Vital Forms: American Art and Design in the Atomic Age, 1940-1960* (New York: Brooklyn Museum and Harry N. Abrams, 2002), 24; Carroll W. Pursell, *Technology in Postwar America: A History* (New York: Columbia University Press, 2007), 1-2, 59; Paul Boyer, *By the Bomb's Early Light: American Thought and Culture at the Dawn of the Atomic Age* (Chapel Hill: The University of North Carolina Press, 1994), Linda Sargent Wood, *A More Perfect Union: Holistic Worldviews and the Transformation of American Culture after World War II* (New York: Oxford University Press, 2010); Margot Henriksen, *Dr. Strangelove's America: Society and Culture in the Atomic Age* (Berkeley: University of California, 1997).

pursuits for not being "science."[4] Although there is a great deal of truth in the latter, Snelson has found considerable success in the art world, despite the continual ambiguity around his identity as an artist who works in structural science. The more I learned more about Snelson's work, however, the more I discovered he was not the outsider that he describes himself to be. In fact, he has much in common with his artistic contemporaries who shared his interest in creating art with qualities such as impersonal objectivity and experimental innovation that are associated with modern science. Therefore, it is the context of 1960s art in which I aim to situate Snelson, rejecting the idea that he is an isolated figure, working against the grain and unappreciated.

The concepts of physics and engineering that make Snelson's tensegrity sculptures possible, and the science that inspired his model of the atom are essential to his artistic process and the meaning of his work. Therefore, a major theme of this dissertation is the tension in the career of an artist whose primary interests reside outside of the traditional domain of art. To explore this apparent conflict, I look at how Snelson conceived of his own work and how art writers and critics of the time discussed it. Although certain aspects of Snelson's artistic philosophy and work are unique, it is my contention that he shared strategies and goals with other sculptors of the period. Therefore, I consider his art in the context of three trends within 1960s sculpture in the United States. First, I demonstrate that during the years in which Minimalism was at its height, Snelson was engaged with the ideas and aesthetic associated with that movement and that his work was presented and received as "Minimalist." Second, I look beyond the established genre of Minimalism to define a group of abstract geometric sculptors who, in

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[4] Snelson, in discussion with the author, May 13, 2009 and December 8, 2009.

the 1960s, shared Snelson's interest in the techno-scientific and relied on a common set of intellectual and artistic sources. I explore the themes of truth and visibility in the work of these sculptors, linking them to twentieth-century developments in atomic science. Third, I establish that Snelson was part of a group of twentieth-century artists and thinkers who believed that technology and science could be humanized and improved through artistic contributions. By establishing Snelson's place in the context of Minimalism and among artists who shared his concerns with science and technology, I achieve two goals. First, I situate Snelson, an artist who has been seen as an outsider by himself and others and is not discussed in current literature about 1960s sculpture, within popular currents of artistic thought from the period. This allows Snelson's contribution to be appreciated in a way it has not been previously. Second, I contribute to our understanding of 1960s sculpture by demonstrating the manifestations and cultural implications of the techno-scientific in art.

Scope

The primary focus of my study of Snelson's work is limited chronologically to the 1960s. During the ten or so years that roughly correspond with this decade, Snelson laid the groundwork for the major artistic projects, the tensegrity sculptures and *Portrait of an Atom*, that would define his career. This was the period in which Snelson first made large-scale sculptural works and during which these pieces were initially exhibited and received by the public. Although there was a significant shift in Snelson's aesthetic in 1969, by the close of the decade he had established the basic parameters of his visual vocabulary and the production techniques and methodology that he would use for the rest of his career. Concurrent with these developments in his tensegrity sculptures, Snelson began working on his atomic theory and first atomic projects that constitute his second major focus. I also limit my study by not addressing Snelson's photography, other than the brief discussion that appears in this introduction. I justify this exclusion in several ways. First, this is a study of three-dimensional work, and as such, his non-sculptural projects are omitted. Second, and more importantly, there is a close relationship between Snelson's tensegrity sculptures and his atomic project that is not evident in his photography. Both the tensegrity sculptures and the atomic model address issues of structure and natural forces; they also both relate his art work to science, and they were both initiated with the idea of making a real-world contribution beyond aesthetics.

I have limited my comparisons between Snelson and his artistic peers to sculpture, and mostly to abstract geometric work, although related themes can be found in two-dimensional art and in representational sculpture from the period. For example, abstract geometric painters, such as Frank Stella and Kenneth Noland, were informed by ideas closely related to those held by the Minimalist sculptors discussed in this study. The use of industrially produced or readymade elements relates the abstract sculptors I focus on here to their peers whose work was not divorced from representation. Robert Rauschenberg, who incorporated found objects, including taxidermal animals and household furnishings, into his "Combine" paintings is just one example. In addition, Josef Albers's primary influence in the 1960s was on two-dimensional OpArt that elicits a physical response in viewers as they attempt to stabilize their vision of a shifting or vibrating image. In fact, some 1960s practitioners, including Stella, Richard

Auszkiewicz, and Gene Davis, drew directly on Albers's scientific techniques to explore different optical affects.[5]

Focusing on sculpture, however, has allowed me to pay thorough attention to an area of art history that is often neglected, and this limitation is also justified by period considerations. Many Minimalists were drawn to three dimensions in effort to create objects that could be appreciated in their own right rather than as representations of something else.[6] More generally, sculpture played a major role in the fine art of the 1960s. Many young artists turned away from work on canvas and paper toward the less restricted possibilities in form and materials that three-dimensional art suggested. The idea of what sculpture could look like and what it could be made of expanded rapidly in the post-war period, creating enormous variety among three-dimensional art objects.

I also limit my examination to artists showing in the United States. Although Snelson exhibited in Europe frequently in the late 1960s and 70s, the reception of his work there was subject to different social and artistic conditions that necessitate separate examination.[7] While many aspects of the cultural milieu in the United States that I discuss in this study were mirrored around the Western world during this period, exploring the implications of techno-scientific art as a global phenomenon of the sixties would have created too broad a field, and taken me away from Snelson, the primary focus

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[5] Jeanne Patricia Moynihan, "The Influence of the Bauhaus on Art and Art Education in the United States," Ph.D. Dissertation (Evanston, Illinois: Northwestern University, 1980), 208.

[6] Michael Fried, "Art and Objecthood," in *The New Art: A Critical Anthology*, ed. Battcock (New York: E. P. Dutton, 1973), 117-8; Clement Greenberg, "Recentness of Sculpture," in *The New Art: A Critical Anthology*, ed. Battcock, 183.

[7] James Meyer introduces this subject at the close of *Minimalism: Art and Polemics in the Sixties* (New Haven: Yale University Press, 2001), 255-270.

of my study. It should be noted that there is also a bias toward New York City-based artists and exhibitions. Although sculptors, such as Robert Irwin and John McCracken, worked in a similar genre in California, as Kenneth Baker noted in his work on Minimalism, New York was the center of the movement.[8]

Finally, since this work is not a study of the history of tension and compression sculpture, I do not address artists beyond my geographic and chronological parameters who shared this aspect of Snelson's practice.[9] For example, a Japanese sculptor named Morio Shinoda, who was also working in the 1960s, used a principle related to tensegrity to float steel balloons in sculptural work.[10] Additionally, Bruce Altshuler claims that Isamu Noguchi used something like tensegrity in his *Monument for Heroes*—a model he built in 1943 that was never executed on a large scale.[11] My interest is not on tensegrity sculpture, per se, but rather on how Snelson's work can be understood in the context of 1960s art and culture in the United States.

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[8] Kenneth Baker, *Minimalism: Art of Circumstance* (New York, Abbeville, 1988), 9.

Artists associated with the 1960s Light and Space movement, based in Southern California and working in both two and three dimensions, shared Snelson's interest in technological advances and perceptual experiences. If I were to expand this study, comparisons could be drawn between Snelson's work and that of artists such as James Turrell, Doug Wheeler, Mary Corse, and Larry Bell. See, for example, Jan Butterfield, *The Art of Light and Space* (New York: Abbeville Press, 1993).

[9] Similarly, this is not an examination of specifically atomic-themed works of art. For such a study see, for example, Rapaport and Stayton, *Vital Forms*, and Peter Bexte, "Henry Moores Atom Piece / Nuclear Energy," in *Atombilder: Ikonographien des Atoms in Wissenschaft und Öffentlichkeit des 20. Jahrhunderts*, eds. Bigg and Hennig (Göttingen: Wallstein, 2009).

[10] Jack Burnham, *Beyond Modern Sculpture: The Effects of Science and Technology on the Sculpture of This Century* (New York: George Braziller, 1968), 44-5.

[11] Bruce Altshuler and Isamu Noguchi, *Isamu Noguchi* (New York: Abbeville Press, 1995), 39.

Approach

For much of this study, I use an art historical approach, drawing on visual information and texts written by art writers and artists to compare and contrast Snelson's sculptures with those of his contemporaries. However, Buckminster Fuller, an architect who would become famous in the 1950s for his innovative engineering and develop a cult-like following for his visionary philosophies about the conservation of global resources, had a more profound effect on Snelson's life and work than any other artist. The theory of tensegrity emerged from their complicated student-mentor relationship, and Snelson's interest in subjects such as the atom and structural engineering was inspired by Fuller's lectures. The biographical story of Snelson's relationship with Fuller is therefore essential to understanding the trajectory of how he has viewed and presented his work. The art historian Thomas Crow's 1996 *The Rise of the Sixties* provided a model for how to combine personal motivations with cultural and artistic ones. Crow used the details of biography, what he calls "the lived experiences and conscious decisions of individuals," to explain the draw of certain subjects and modes of expression.[12] Similarly, in the 1996 *Machine in the Studio*, when Caroline Jones described an artist's development, she included factors such as neuroses, personal relationships, and religious beliefs.[13] Scholars like Crow and Jones paint a picture that goes beyond the work of individual artist, blending personal narratives into a broader cultural analysis. It is my intent, as

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[12] Thomas Crow, *The Rise of the Sixties* (New Haven: Yale University Press, 1996), 12.

[13] Caroline A. Jones, *Machine in the Studio: Constructing the Postwar American Artist* (Chicago: University of Chicago Press, 1996).

well, to combine the particular story of Snelson's life with a more general examination of 1960s scientific art.

I also draw on the tradition of scholarship that examines art in light of the cultural history of scientific development. In 1956, Erwin Panofsky published a now seminal art historical essay on aesthetics and scientific thought in which he examined Galileo's art criticism, drawing parallels between his opinions about art and his more well-known astronomical theories.[14] Panofsky suggested that Galileo's adherence to a Copernican circular model of planetary movement, rather than adoption of Johannes Kepler's elliptical model, related to Galileo's preference for Renaissance regularity over Mannerist distortion. Panofsky set an important precedent because he demonstrated a mutual influence between art and science owing to a shared cultural milieu. There are numerous more recent examples, including Thomas DaCosta Kaufmann's 1993 *The Master of Nature* that examines the scholarly and social roles that practitioners of art and science filled during the Renaissance and how their fields of knowledge were delineated.[15] He relates these developments in natural sciences and art to the establishment of the modern political state, humanist scholarship, and ethical beliefs. Another example, more closely related to this study, is Margot Henriksen's 1997 *Dr. Strangelove's America: Society and Culture in the Atomic Age*. She examines literature, television, and film to discuss how

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[14] Erwin Panofsky, "Galileo as a Critic of the Arts: Aesthetic Attitude and Scientific Thought," *Isis* 47, no. 1 (March 1956): 3-15.

[15] Thomas DaCosta Kaufmann, *The Master of Nature: Aspects of Art, Science, and Humanism in the Renaissance* (Princeton, NJ: Princeton University Press, 1993).

atomic science and politics related to the cultural changes of the 1960s.[16] Following the example of scholars like DaCosta Kaufman and Henriksen, I combine visual analysis with cultural history to confront the social and political meaning of an artist working in the scientific mode in this period.

Sources and Scholarship

Although Snelson has been a major figure in the art world for nearly half a century, little has been written about his contribution to twentieth-century art. Given this lack of secondary literature that directly addresses Snelson's work, I was fortunate to be able to supplement my research with personal correspondence and other unpublished documents from Snelson's studio. These include an unpublished and unfinished memoir, entitled *Not In My Lifetime*, that Snelson began writing in 1984. In addition, I conducted a series of interviews with Snelson, some formal and some more casual, between 2008 and 2011. Transcripts of some of these sessions appear in Appendix E. These material not only helped me to tell the story of Snelson's artistic life, but also provided insight into his experiences and his development as an artist. An essay entitled "How Primary is Structure" that Snelson published in *Art Voices* in 1966 also provided important evidence about how Snelson's views his art.[17] When possible, I have substantiated the story Snelson tells with published sources. In other instances, I have had to rely on Snelson's

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[16] Henriksen addresses painting and sculpture just briefly, mentioning only Wayne Thiebaud, Andy Warhol, and Claus Oldenburg: *Dr. Strangelove's America*, 297-8.

[17] Kenneth Snelson, "How Primary is Structure," *Art Voices* 5, no. 3 (Summer 1966): 82-3.

account. The most contentious subject I address relates to Snelson's relationship with Fuller and the discovery of tensegrity. To balance Snelson's account, I draw on not only Fuller's published record, but also a letter he wrote to Snelson in 1949 and a series of lectures Fuller gave in 1975.[18]

Snelson's atom was the subject of two science center exhibitions, the first in 1981 at the Maryland Science Center and the second at The New York Academy of Sciences in 1989.[19] Catalogues were produced for both of these shows with texts by Snelson, who explained his theory, and essays by scientists on the history of atomic models and the validity of Snelson's. In addition the latter publication includes an essay by the art historian Barbara Maria Stafford that I address below. Only the Maryland exhibition catalogue was reviewed, and the focus of that discussion, like the scientists' essays, is the success of Snelson's model.[20] In addition to the catalogues, Snelson also explained his atomic theory in two articles published in 1963 and 1994.[21]

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[18] R. Buckminster Fuller, "Tensegrity," *Portfolio and Art News Annual*, no. 4 (1961): 112-27, 144, 148. http://www.rwgrayprojects.com/rbfnotes/fpapers/tensegrity/tenseg01.html (accessed May 26, 2010); Buckminster Fuller to Kenneth Snelson, December 22, 1949, Snelson Archive; R. Buckminster Fuller, "Everything I Know," Session 8, Part 5, lecture transcription, The Buckminster Fuller Institute, January 1975. http://www.bfi.org/about-bucky/resources/everything-i-know (accessed August 5, 2011)

[19] Joelle Burrows, ed., *Kenneth Snelson: The Nature of Structure* (New York: The New York Academy of Sciences, 1989; Kenneth Snelson, *Portrait of an Atom: Artist-Sculptor Kenneth Snelson's Visualization of the Atom's Electronic Sculpture* (Maryland: Maryland Science Center, 1981).

[20] Dietrich Schroeer and Lawrence Slifkin, "Portrait of an Atom: Artist-Sculptor Kenneth Snelson's Visualization of the Atom's Electronic Structure" *Leonardo* 15, no. 3 (Summer 1982): 240.

[21] Kenneth Snelson, "A Design for the Atom," *Industrial Design* 10 (February 1963): 48-57; Kenneth Snelson, "An Artist's Atom," *Leonardo* 27, no. 3, Art and Science Similarities, Differences and Interactions: Special Issue (1994): 231-236.

Snelson's tensegrity sculptures have been the subject of several brief exhibition catalogue essays including those produced by Marlborough Gallery in New York, the Hirshhorn Museum and Sculpture Garden in Washington, D.C., and the Jardins du Palais Royal in Paris.[22] Snelson's work was also discussed in about two dozen popular press articles and reviews, the earliest from 1962. In addition, two illustrated books have been published about Snelson's art. The first, in 1990, *Full Circle*, addressed his panoramic photography exclusively, with short essays by Snelson and Laurence Wieder.[23] His entire body of work—sculpture, photography, and the atom studies—is discussed in *Forces Made Visible*, which Snelson published in 2009.[24] This volume contains chapters by Snelson about his work and career and a twenty-page essay by the art critic Eleanor Heartney. The short biography she provides closely follows the narrative Snelson tells in his unpublished memoir and her interpretation of his work is in keeping with his own, aligning the tensegrity sculptures with the Modernist edict that "form follows function" and arguing against an association with Minimalism.[25] Howard Fox, in a 1981 exhibition

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[22] Snelson exhibition catalogues include: Eleanor Heartney, *Kenneth Snelson: Selected Works, 1948*-2009 (New York: Marlborough Gallery, 2009); Robert Hobbs, *Deux Américains à Paris: Sculptures de George Rickey et Kenneth Snelson* (Paris: Jardins due Palais Royal, 2006); Mark Daniel Cohen, *Kenneth Snelson Sculpture* (New York: Marlborough Gallery, 2003); Douglas G. Schultz, ed., *Kenneth Snelson* (Buffalo: Albright-Knox Art Gallery, 1981); Edward F. Weeks, *Kenneth Snelson: Structures* (Birmingham, Alabama: Birmingham Museum of Art, 1980); Karl Ruhrberg and Angela Schneider, *Kenneth Snelson Skulpturen* (Berlin: Nationalgalerie, 1977); Peter Struyken, *Kenneth Snelson: Stress Structures* (Otterlo, The Netherlands: Kröller-Müller Museum, 1969).

[23] Laurence Wieder and Kenneth Snelson, *Full Circle: Panoramas of France, Italy, and Japan* (New York: Aperture Books, 1990).

[24] Eleanor Heartney and Kenneth Snelson, "Forces Made Visible," (Lenox, Mass: Hard Press Editions, 2009).

[25] Eleanor Heartney, "Forces Made Visible," *Kenneth Snelson: Forces Made Visible*, 14-6, 24-5.

catalogue essay, agreed with the latter assessment.[26] Heartney argued that Snelson's interest in structural properties distinguished his work from that of Minimalist sculptors, an argument Snelson himself makes repeatedly.[27] Both Heartney and Fox found Snelson's "highly expressive" side and "romantic ethos" to be in opposition to the objectivity and reduction of meaning advocated by Minimalists.[28] However, as I argue in Chapter Two, further analysis reveals a close relationship between Snelson's work and that associated with Minimalism. Moreover, by looking at Snelson's work chronologically, I have identified a distinct period of production during the 1960s when Snelson was first making large-scale work and the Minimalist style was at its height. During this time, Snelson favored symmetrical compositions with modular repetition and a static appearance that relates closely to Minimalist projects both visually and conceptually. Heartney, in contrast, examined Snelson's work typologically, based on form rather than date of production or manner of execution. For example, she grouped *Cantilever*, 1967 (Figure 1-2) with *Dragon*, 2000-3 (Figure 3) and *Sleeping Dragon*, 2002-3 (Figure 4) created over thirty years later. Although all three of these sculptures have a long unsupported arm, the earlier piece employs Snelson's 1960s "symmetrical" style, while the latter works present an energetic and seemingly disorganized composition. These differences in appearance represent distinct manners of artistic

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[26] Howard N. Fox, "Kenneth Snelson: Portrait of an Atomist," in *Kenneth Snelson* (Buffalo: Albright-Knox Art Gallery, 1981), 13.

[27] Kenneth Snelson, "How Primary is Structure," *Art Voices* 5, 82-3; Deborah Perlberg, "Snelson and Structure," *Artforum* XV, no. 9 (May 1977): 46-9.

[28] Fox, "Kenneth Snelson: Portrait of an Atomist," *Kenneth Snelson*, 13; Heartney, "Forces Made Visible," in *Kenneth Snelson: Forces Made Visible*, 24.

development and execution that are ultimately more important in an understanding of Snelson's work than the shared aspect of a cantilevered element.

Almost everyone who has written about Snelson's work mentions the seeming anomaly of an artist whose concerns relate so closely to those more generally associated with science or engineering. In Chapter One, I look at most of the 1960s reviews and articles about Snelson's work and observe a shift both in how he presented himself and how he is described, although his work itself did not change. In 1962, for example, he was called a "structural designer" in *Time* magazine, but as his reputation in the art world became established in the late sixties, he is almost always identified as an artist.[29] Like many of the critics who discussed Snelson's sculpture after 1966, Heartney argued that, despite the role of engineering in his work, Snelson was an artist because he took an aesthetic rather than practical interest in his materials.[30]

Stafford also examined the issue of Snelson's identity as an artist in a 1989 essay published in a catalogue that accompanied a science center exhibition about the *Portrait of an Atom*. This text is one of the only scholarly art historical examinations of Snelson's work. In it, she related him to Scientific Revolution and Enlightenment philosophers who were interested in what could be learned through visual observation.[31] The critic Howard Fox similarly compared Snelson to an alchemist, a natural philosopher who "embraced both physics and metaphysics, before the pragmatism of modern thought

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[29] "Sculpture to Build With," *Fortune* 66, no. 5 (November 1962), 121.

[30] Heartney, "Forces Made Visible," in *Kenneth Snelson: Forces Made Visible*, 30.

[31] Barbara Maria Stafford, "Kenneth Snelson Imagines the Atom," in *Kenneth Snelson: The Nature of Structure Exhibition Catalogue* (New York: The New York Academy of Sciences, 1989), 51-7.

cleaved them into separate disciplines."[32] I agree that the apparent ambiguities of Snelson's career are instructive about our modern understanding of the fields of art and science. I find these comparisons, however, somewhat lacking because, unlike the natural philosophers of Early Modern Europe, Snelson primarily expresses his scientific and philosophical ideas through the creation of objects, rather than with the written word. Rather than using such historical comparisons to understand Snelson's interest in nature and structure, I find it more fruitful to look at his work in the context in which it was produced—the1960s in the United States.

The only scholars who have examined Snelson's work extensively are engineers and architects, and they have focused on his relevance to their own field. In 2004, in a Master's thesis written in Ireland, Valentín Gómez Jáuregui, for example, addressed the contested origin of tensegrity by comparing the technical aspects of work by Snelson, Fuller, and the French architect David George Emmerich (who autonomously and concurrently developed and patented a structure similar to the one discovered by Snelson and Fuller).[33] Jáuregui also thoroughly reviewed what could be seen as the pre-history of tensegrity—earlier structures, such as bridges and suspended ceilings that depend on tension wires—and he explored possible applications of tensegrity beyond architecture, including research in cell structure.

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[32] Fox, "Kenneth Snelson: Portrait of an Atomist," *Kenneth Snelson*, 23.

[33] Valentín Gómez Jáuregui, "Tensegrity Structures and their Application to Architecture," Master's Thesis (Queen's University, School of Architecture, Ireland, 2004).

Beyond Snelson as a specific subject, there is a small body of literature that addresses the importance of science and technology to art in the 1960s.[34] Most closely related to my study is Marga Bijvoet's 1997 book that relates light, sound, and video pieces and earthworks, made between 1968 and 1972, to systems analysis and cybernetics.[35] Her broader aim is to demonstrate how art in the late sixties and early seventies set the stage for the trends of "Art in Public Places" and "Media Art" that have been among the dominant forms since this time. Although she addresses a different body

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[34] There is a broader literature on the general topic of the relationship between art and the techno-scientific that does not relate directly to my study of this subject in the 1960s. This includes the history of artists who were engaged with science and the mutual cultural influence between art and science. Sources addressing these topics include: Erwin Panofsky, "Galileo as a Critic of the Arts: Aesthetic Attitude and Scientific Thought," *Isis* 47, no. 1 (March 1956): 3-15; Kenneth Clark, "The Blot and the Diagram," in *Moments of Vision* (London: Murray, 1981), 18-29; Pierre Francastel, *Art and Technology in the Nineteenth and Twentieth Centuries,* trans. Randall Cherry (New York: Zone Books, 2000); Jacques Mandelbrojt, Giorgio Careri, and L. Alcopley, eds. *Leonardo* 27, no. 3, Art and Science Similarities, Differences and Interactions: Special Issue (1994); Michele Emmer, ed. *The Visual Mind: Art and Mathematics* (Cambridge: MIT Press, 1994); Robert Root-Bernstein, "ArtScience: The Essential Connection," *Leonardo* 37, no. 2 (2004): 94; Stephen Wilson, *Art and Science Now* (New York: Thames and Hudson, 2010); Elaine Strosberg, *Art and Science* (Paris: UNESCO, 1999); Leonard Shlain, *Art and Physics: Parallel Visions in Space, Time, and Light* (New York: William Morrow and Company, 1991).

There is also body of literature, to which contributions have been made not only by art historians but also by anthropologists and cultural historians, that addresses how images contribute to knowledge by examining scientific illustrations and diagrams. The art historical texts among these look, for example, at visual elements of depictions and relate them to cultural conditions challenging the idea of the objectivity of the scientific image. Art historical texts relating to this field include the *Bildenwelten des Wissens*, Humboldt University; Caroline A. Jones and Peter Galison, eds. *Picturing Science Producing Art* (New York: Routledge, 1998); Bruce Clarke and Linda Dalrymple Henderson, eds. *From Energy to Information: Representation in Science and Technology, Art and Literature* (Stanford: Stanford University Press, 2002); Martin Kemp, "Seeing and Picturing: Visual Representation in Twentieth-Century Science," in *Science in the Twentieth Century*, eds. John Krige and Dominique Pestre (Australia: Harwood Acaemic Publishers, 1997).

[35] Marga Bijvoet, *Art as Inquiry: Toward New Collaborations Between Art, Science, and Technology* (New York: Peter Lang, 1997). Lynn Gamwell takes a similar approach, presenting the relationships between developments in art and in science over two centuries but only addresses sixties sculpture briefly in *Exploring the Invisible: Art, Science, and the Spiritual.* (Princeton: Princeton University Press, 2002).

of art work made during a slightly later period, her strategy of connecting artistic production to scientific knowledge is similar to the one I employ when comparing the techno-scientific art of the sixties to quantum physics in Chapter Four. In addition, Bijvoet defines an "Art and Technology Movement" for this period addressing some of the same organizations that I address in Chapter Five, including Art and Technology at LACMA and Experiments in Art and Technology (E.A.T.), and György Kepes's project at the Massachusetts Institute of Technology (MIT). Although our discussions begin from a similar point, we do not discuss the same artists or time period, and our conclusions and focus are different.

Jones has also written about the importance of industry and technology to artists working in the United States in the 1960s, but her subject is a comparison of artistic production in the sixties with earlier periods.[36] Jones writes that in the postwar era, the idea of the artist as producer shifted from Romantic visions of a reclusive genius working in isolation to a manager who directed a team of technicians and laborers. This shift, according to Jones, related to dominant cultural views of industry and technology as the source of solutions to the world's problems.[37] She describes how earlier art movements had drawn on technology either visually or by mimicking industrial processes, 1960s artists, however, represented a new level of technological sympathy by employing both a look and methodology mined from the world of industrial technology.[38] Jones uses Stella, Warhol, and Robert Smithson as case studies, and only briefly addresses abstract

[36] Jones, *Machine in the Studio.*

[37] *Ibid.*, 54-5.

[38] *Ibid.*, 54, 345.

geometric sculpture.[39] Jones concludes her discussion by explaining that the appeal of the machine in this period was related to the "speed and power" it represented.[40] Although she does not explore the work of abstract geometric artists in any depth, her argument can be applied in many ways to the artists I look at here. In addition, Jones's approach provided a model for incorporating biographical information along with art and cultural history. She weaves the psychological issues that emerge from the unique circumstances of an artist's life into her discussion of their artistic development. I found this method particularly helpful when addressing the role of Fuller in Snelson's development as an artist.

Art historians have broached the subject of atomic imagery and culture in the late 1940s and 1950s in the United States. For example, The Brooklyn Museum's 2002 show *Vital Forms* related art and design to the Cold War fervor surrounding atomic science and technology during this period.[41] This exhibition included now iconic objects, such as George Nelson's *Ball Wall Clock*, c. 1948-69, and also organic forms, such as Eva Zeisel's ceramic *Town and Country* salt and pepper shakers, c.1946, that were seen by the *Vital Forms* curators, Kevin Stayton and Brooke Kamin Rapaport, as a reference to atomic mutation.[42] Kamin Rapaport's essay in this volume discussed paintings and sculpture that allude to atomic weaponry and science with both ominous imagery and

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[39] *Ibid.*, 269.

[40] *Ibid.*, 358.

[41] Kamin Rapaport and Stayton, *Vital Forms*; see also Charlotte Bigg and Jochen Hennig, eds., *Atombilder: Ikonographien des Atoms in Wissenschaft und Öffentlichkeit des 20. Jahrhunderts* (Göttingen: Wallstein, 2009).

[42] Kamin Rapaport and Stayton, *Vital Forms*, 65, 155.

references to the non-visible world.[43] Similarly, in Lynn Gamwell's study of two centuries of scientific discovery and artistic development, she explores 1950s Abstract Expressionism and later genres, such as Post Modernism in relation to nuclear science.[44] Her treatment of 1960s sculpture, however, is limited to a single paragraph in which she compares the "content-less" art of Minimalism to what she describes as the postwar emphasis on scientific objectivity in the United States.[45] It is my hope that this study contributes to the existing literature on the relationship between the techno-scientific and sixties art by introducing the subject of abstract geometric sculpture into the established art historical literature that focuses primarily on painting. In addition, I aim to expand on the existing literature on the role of nuclear science in postwar art by addressing specifically the 1960s.

In addition to these texts on science and art in the 1960s, the art historical literature that pertains most closely to Snelson's sculpture is that which addresses Minimalism. The first generation of scholarship on Minimalist art was written during the mid-sixties when the movement was at its height. Such texts, notably by art writer Barbara Rose, art historians Clement Greenberg and Michael Fried, and curators Kynaston McShine and Maurice Tuchman, struggled to identify and define the new

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[43] Brooke Kamin Rapaport, "The Greater Mystery of Things: Aspects of Vital Forms in American Art," in *Vital Forms*, 78-121. On this topic see also Stephen Porcari, *From Omaha to Abstract Expressionism: American Artists' Responses to World War II* (Potsdam, NY: Roland Gibson Gallery, Potsdam College of the State University of New York, 1992).

[44] Gamwell, *Exploring the Invisible.*

[45] *Ibid.*, 289.

movement.[46] As I discuss in Chapter Two, they described how practitioners of the new sculpture, in contrast with their Abstract Expressionist predecessors, minimized their presence and the emotional content of their work through highly regular, often modular, compositions that appeared dispassionate and neutral. Minimalist sculpture, installed without the traditional art pedestal, was meant to enter the space of the viewer and be confronted immediately in its complete form. These tactics were intended to force the viewer to engage with the work as they would a non-art object. Such sculptures were supposed to exist as a discrete entity—an object—rather than a representation or stand-in for something else. These concepts relate closely to Snelson's artistic practice during the 1960s, making this primary literature essential for understanding how his work was initially received.

When scholars took up the subject of Minimalism in the late 1980s, for the first time with a critical distance, one of the focuses was the political nature of the movement. For example, in 1988 the art historian Kenneth Baker equated the Minimalist blurring of the line between art and non-art with the 1960s disruption of traditional social structures, such as those that defined gender, family, and the division between public and private.[47] He argued that by embracing the appearances, materials, and means of production traditionally associated science and industry, Minimalists, including Snelson, insisted on their own definitions and parameters of artistic expression. Baker wrote that this sense of

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[46] Barbara Rose, "A B C Art," *Art in America* 53, no. 5 (October/November 1965): 57-69; Clement Greenberg, "Recentness of Sculpture," in *American Sculpture of the Sixties*, 24-6; Michael Fried, "Art and Objecthood," in *Minimal Art: A Critical Anthology*, 125-8; Kynaston McShine, *Primary Structures: Younger American and British Sculptors* (New York: The Jewish Museum, 1968)' Tuchman, *American Sculpture of the Sixties*.

[47] Baker, *Minimalism: Art of Circumstance*, 16.

individualism was at odds with a consumer culture based on homogeneous mass-produced goods and a government that disregarded the ideals of equality and freedom at home in the battle over civil rights and in Southeast Asia in the Vietnam War.[48]

Crow has taken up this argument more recently, proposing in 1996 that during the time of widespread protest against the war in Vietnam, art work was necessarily judged on its moral and political implications and on "fundamental questions of honesty and falsehood in representation."[49] In a time when young and forward-thinking Americans were experiencing a deeply felt distrust in traditional sources of power, the idea of truth took on a new importance. Crow looked at sixties sculpture in this context, stating that the Minimalists rejection of the look of fine art, including the use of non-art materials, like fluorescent light bulbs and bricks, was a form of critique and dissent against the ruling order, which included the elite gallery world where their work was shown. Furthermore, Crow saw the use of "anonymity, repetition, and equality of parts" in Minimalist sculpture as a metaphor "for altruism and egalitarianism in politics."[50] In Crow's view the use of factory production and readymade elements in modular and serial compositions to downplay the role of the artist was a statement against hierarchical power structures.

In the conservative publication *New Criterion*, Eric Gibson took the opposite perspective, denying political content in Minimalist art, in a scathing review of a 1987

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[48] *Ibid.*, 13-5.

[49] Crow, *The Rise of the Sixties*, 11.

[50] *Ibid.*, 142-3.

symposium organized by the art historian Brian Wallis at the School of Visual Arts in New York.[51] Wallis's aim was to reinterpret Minimalism in the context of the 1960s political unrest and social activism, including the protests against the Vietnam War, Civil Rights violations, and bourgeois capitalism. Gibson's main objection to Wallis's argument was that he focused on radical elements to the exclusion of aesthetic concerns. Gibson believed there was a subversive element to Minimalism, but that it was a purely visual statement divorced from the historical moment. He wrote, "It was art that was made to criticize art, not anything else."[52] In contrast with Baker, Gibson's argument creates a world in which artists operate in a vacuum. Although Snelson denies any political content in his work, it is tempting to see the relationship Baker describes between artistic production and the 1960s crossing of traditional boundaries in Snelson's artistic trespass into the domains of science and engineering.[53] These fields are generally considered the exclusive territory of professionals with a specific academic background, and whether or not there was political motivation that would relate Snelson's work to Crow's larger subject of the 1960s disruption of power structures, by undertaking projects that addressed questions of physics and nuclear science as an artist, Snelson ignored the established demarcation of scientific knowledge.

In a 1990 essay, Anna Chave also commented on the political content in Minimalism. Using a feminist lens, she pointed to the Minimalist use of "strong" and

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[51] Eric Gibson, "Was Minimalist art a political movement?" *The New Criterion* 5, no. 9 (May 1987), 59-64.

[52] *Ibid.*, 64.

[53] Snelson, in discussion with the author, December 10, 2011.

"virile" industrial materials that she believed allowed these artists to take on "the cultural authority of the markers of industry and technology."[54] Chave saw Minimalist artists as representative of the governmental and industrial establishment Baker and Crow believe they opposed. She related their "domineering" and "brutal" aesthetic to growing corporate power and to the force used by the United States military in Vietnam and the police against student demonstrators. Chave supports her point visually by referencing phallic forms—representative of virile power—in pieces by Flavin and Andre.[55] Snelson also used long phallic projections in several of his 1960s pieces, and he even described *Cantilever*, 1966 (Figures 1-2), as an erection. It seems unlikely that Snelson, a liberal who opposed the Vietnam War, would consciously create art work representative of political oppression. There is, however, an aspect of virility and masculinity to his work that recalls Chave's analysis. I believe in Snelson's case, that such aspects related to his perception of his embattled and often thwarted existence. He bragged in his memoir about the construction of *Cantilever*, writing "I meant for it merely to hold itself out there; a sturdy big erection, curving up gently at its end; just a grace note to show that the feat was effortless."[56] I contend that this comment, made about a sculpture completed during the year when Snelson received his first significant artistic recognition, was directed at Fuller. There is a self-recognized Oedipal nature to Snelson's conflict with his one-time mentor and father figure, and finding success in the art world, which was

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[54] Anna C. Chave, "Minimalism and the Rhetoric of Power," *Arts Magazine* 64, no. 5 (January 1990): 44, 55.

[55] *Ibid.*, 45-6.

[56] Kenneth Snelson, *Not in My Lifetime* (Snelson Archive), 145-6; see also John Coplans, "An Interview with Kenneth Snelson," *Artforum* V, no. 7 (March 1967): 46-9.

distant from Fuller's achievements, perhaps allowed Snelson to feel like a grown and independent man.

The most recent literature on Minimalism has begun to question some of the definitions established by earlier scholars. In fact, Linda Dalrymple Henderson and others have argued against defining Minimalism as a movement altogether, describing how ideas related to Minimalism have become so dominant in writing about sixties sculpture that other trends have been obscured.[57] I agree with her characterization, and I also look beyond Minimalism for other contexts in which to examine Snelson's work. However, the accepted parameters of Minimalism are useful in this study, as well, to understand how Snelson's art was originally received in the 1960s. Another example of the current trend of reexamination, one that I address in Chapter Two, is James Meyer's critique of the idea that Minimalist sculptors were uniformly enamored with technology and gave up executing work themselves in favor of out-sourced factory production and readymade elements.[58] Meyer, like Jones and Crow discussed above, bases his analysis in part on artists' materials and methods of production, a common approach in current scholarship.

Meyer's broader argument is that the Minimalist movement can best be understood by looking at how its practitioners engaged with one another intellectually.[59] This is a useful means of assessing Snelson's work because Fuller, who was not an artist,

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[57] Linda Dalrymple Henderson, *Reimagining Space: The Park Place Group in 1960s New York* (New York: Blanton Museum of Art, The University of Texas at Austin, 2008), 37-41.

[58] Meyer, *Minimalism: Art and Polemics in the Sixties*, 54.

[59] *Ibid.*, 4.

had the strongest effect on his career. Snelson also does not, as Gibson suggests, define himself in opposition to the artists of previous generations, but to a man who made his primary mark as a visionary thinker. The importance Snelson gives Fuller, at the expense of engaging with other artists, has contributed to his self-perceived status as outsider to the art world and his actual absence from art historical literature. However, Snelson's contribution to the world is a primarily an artistic one, and although Fuller's important role in his life must be addressed, I aim to look beyond Fuller to establish Snelson's place in the history of 1960s art.

Biography

Snelson's unpublished memoir begins with an account of his realization that he might be an artist, an extraordinary discovery, he writes, for a boy from the small town of Pendleton, Oregon.[60] For Snelson, his upbringing far from the nation's cultural centers introduces the permeating theme of his status as an outsider who looks in on the art world, often with longing. The narrative then turns to his 1948 experience at the Black Mountain College summer session and his encounters with Fuller and the German artist Josef Albers that were to shape his artistic career. Within a few pages, the memoir turns to the complicated story of Snelson's contentious relationship with Fuller and the eventual discovery of tensegrity. This story of Fuller's deceit and betrayal dominates the text. It is perhaps not surprising that Snelson began writing this memoir, which is colored throughout by bitterness, in 1984 when his career was probably at its lowest

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[60] Snelson, *Not in My Lifetime*, 1.

point, following two decades of successful exhibitions. Snelson's sense of rejection and injustice is even reflected in the work's title: *Not in My Lifetime.*

Kenneth Duane Snelson, born on June 29, 1927, grew up in Pendleton, Oregon, a northwestern town distant both geographically and culturally from the center of the mid-century American art world in New York. Pendleton is approximately two hundred miles east of Portland, in a mountainous area in northern Oregon, and while Snelson was a child in the 1930s, there were fewer than nine thousand people living there.[61] The center of town consisted of a four-block-long Main Street that ran parallel to train tracks and the Umatilla River. Pendleton is best known for woolen mills and the annual Round Up that had developed from end-of-summer ranching activities, including "rounding up" sheep and cattle.[62] During Snelson's childhood, it attracted large crowds of people, many dressed as old-fashioned cowboys and Native Americans, who would camp just outside of town. The festivities included parades and the Wild West Show rodeos.

Snelson's parents Mildred and Jack married in 1920, and the year before Snelson was born, his father purchased the Troy Laundry in Pendleton, a sizable factory with twenty employees. Although money was tight in the 1930s, during the Depression, Snelson and his older brother Everett were raised in a comfortable middle-class household. Snelson performed in school plays, played the drums in a high school dance band called the Rhythm Kids, joined the tennis and speech teams, and served as Senior Class President. His activities suggest that he was out-going, confident, and well-

[61] Riley Moffatt, *Population History of Western U.S. Cities & Towns, 1850-1990* (Lanham: Scarecrow, 1996), 214.

[62] Michael Bales and Ann Terry Hill, *Pendleton Round-Up at 100: Oregon's Legendary Rodeo* (Portland: East Oregonian Publishing Company, 2009).

rounded. When Snelson was younger, his father's laundry plant was his playground. He recalls that he loved to explore the loud, steamy facility, filled with pulleys and enormous wooden washers, to study the mechanisms that wrung, pressed, and bundled up the endless piles of laundry.

In his memoir, Snelson describes how his parents fought viciously, particularly when money was tight during the Depression. He found a refuge in an unused part of the basement that he turned into a workroom for model making. Using balsa wood and scraps of tin, wire, and fabric, he was able to create all manner of things from airplanes, the most common, to an entire jazz band, complete with musicians, instruments, and music stands (Figure 5). Snelson frequently cites his basement workshop activities as evidence of an early predilection for construction and believes that it was his primary education in meticulous craftsmanship.

In 1934, when Snelson was six, his father opened The Snelson Camera Shoppe, turning his longtime hobby into a business. To suit Depression-era budgets, the initial stock consisted only of fifty-cent small black Bakelite Norton cameras, but within a few years, they had a full line of photographic equipment, including cameras manufactured by Leica, Contax, and Rolleiflex.[63] As a teenager, Snelson worked in the store and was allowed to experiment with the new models as they arrived from Germany. He recounts being enthralled with the constant improvements in the camera equipment, the European-sounding brand names, and the rich feel of the leather cases. An avid photographer, Snelson took pictures of still-life compositions, the Oregon landscape, and what he

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[63] Wieder and Snelson, *Full Circle*, 94.

recalled to be the only sculpture in Pendleton—an bronze equestrian statue of a sheriff named Tillman Taylor who had met a heroic death in a saloon shootout.[64] Photography became an important pastime for him that would continue throughout this life. Snelson sees his fascination with the laundry machinery, assiduous model making, and childhood love of photography as harbingers of his future career as an artist.

Snelson was drafted into the Navy just before the end of World War II in 1945. His service in the military consisted of thirteen months of shore duty in Washington, D.C. that qualified him for four years of college tuition on the G.I. Bill.[65] After being discharged in 1946, he enrolled in the University of Oregon at Eugene, undecided about what career path he would follow. After trying out classes in business, law, and English, Snelson happened into the architecture school, and he had what he calls "a great awakening."[66] His introduction to art enthralled him and made him passionate about the idea of becoming a painter. Snelson recalls romantically that he abandoned sleep and food in the relentless pursuit of mastering this new domain, learning everything he could not only about making art, but about art history, as well. His earliest paintings, produced at the University of Oregon, show the influence of the rectilinear geometry of Bauhaus artists, such as Paul Klee (Figure 6).

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[64] *Ibid.*, 94.

[65] While in the navy, Snelson attended evening adult art classes at the Corcoran School of Art. Although these indicate an interest in art prior to his attendance at the University of Oregon, it was not a long-lived experience and Snelson was unable to attend many of the class sessions because of his military duties (Snelson, in discussion with the author, December 8, 2009).

[66] Snelson, *Not in My Lifetime*, 1.

Snelson had had almost no prior exposure to art, having grown up in a provincial town. He explained, "I was so uneducated at the time.... Art was not a well-defined word in my vocabulary at all. It was Michelangelo, Raphael—it was what the teacher *told* you it was. When we took out pencil and glue and such and made stuff, that wasn't art."[67] The belief that art was something average people could not attain was common among Snelson's generation in the United States.[68] So while he was filled with excitement, his new passion also aroused significant feelings of doubt and inadequacy. Artists, Snelson believed, were "born not made and that they probably glowed with a strange aura, which, if you had it, would be visible to all."[69] Since he saw art as an alien thing related to history and greatness, it seemed preposterous that anything he made could be considered art.

The introductory art class Snelson took at the University of Oregon was structured after the Bauhaus *Vorkurs*, and Snelson became enthralled with the idea of the progressive European art school. Snelson read that when the school was closed by the Nazis, Albers had come to the United States to teach at Black Mountain College in North Carolina. Attracted to the idea of studying under a former Bauhaus master, Snelson attended two summer sessions, in 1948 and 1949, at Black Mountain College. His time at Black Mountain, and instruction under Albers in particular, had a lasting affect on Snelson's work and on his ideas about production, design, and craftsmanship. While at

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[67] Snelson, in discussion with the author, December 8, 2009.

[68] Dore Ashton, *The New York School: A Cultural Reckoning* (Berkeley: University of California Press, 1972), 15.

[69] Snelson, *Not in My Lifetime*, 1.

Black Mountain, Snelson also worked closely with Fuller, and it was this relationship that most profoundly shaped Snelson's career.

Snelson and Fuller's relationship and the development of tensegrity is a complicated and contested story. Although Snelson is now often credited with the first application of tensegrity to a structure, Fuller made tensegrity well known and, for a variety of reasons, Fuller remains more famous than Snelson. Snelson's involvement with Fuller's creations is usually explained as an aside or footnote—a source of continued bitterness and anger for Snelson. Fuller's influence on Snelson, however, goes beyond tensegrity. Fuller's idea of a Dymaxion comprehensive designer—a practitioner who uses his artistic creativity to benefit the world in profound ways—seized Snelson's imagination during his first summer at Black Mountain. It would come to shape how he defined his artistic practice and, I suggest, his fifty-year obsession with the atom.

In 1951, Snelson spent four months in Paris. His intention had been to use the last of his G.I. Bill educational funding to study in Fernand Léger's Académie Montmartre. Léger's studio appealed to Snelson because he had heard from friends that attendance was not expected, and the roster was full of GIs who were enrolled only in name. When he arrived in Paris, Snelson found Léger's studio cramped and depressing, and he immediately headed to the street with his camera. Snelson wanted to experience Paris and practice photography on his own, rather than undertake more studio-art training. He dedicated himself to his photographic discoveries, roaming the streets with his camera and investing in flea-market dark room equipment that he installed in his room near Place Pigalle. During his four months in Paris, Snelson created his first body of work outside of a classroom. He favored street scenes and composed panoramic photographs by joining multiple frames together.

Snelson's interest in photography, which blossomed during this time in Paris and continued throughout his life, can be traced directly to his childhood passion. Snelson's focus on panoramic photography was inherited from his father, and he feels that photography gives him a way to be close to Jack's memory, or as he describes it, "to talk with my father as a grown-up."[70] After Paris, Snelson became serious about photography again in 1975 when he found a box camera at a flea market in Berlin. When he returned home to New York, he began to use a specially adapted turn-of-the-century Cirkut camera to take panoramic photographs of the city. He began to collect cameras at that time, rebuilding parts of them himself, and hand-built a special darkroom for the Cirkut's large-format film. Although Snelson is primarily known in the art world for his sculptures, his panoramic photographs of Paris, Venice, Rome, Siena, Kyoto, and New York City have been the subject of several exhibitions (Figure 7). In 1985, the DeCordova and Dana Museum and Park in Massachusetts, outside Boston, showed a selection of his panoramic pieces that then traveled to the Taft Museum in Cincinnati, Ohio. In addition, his photography was the subject of solo New York gallery shows in 2003 at Laurence Miller Gallery and in 1999 and 2011 at Marlborough Gallery.

In the early 1950s, Snelson settled in New York, found employment as movie-set gofer, eventually graduated to cameraman, and continued working in the film industry until 1968. Shooting documentaries as a member of the Cinematographer's Union paid

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[70] Snelson and Wieder, *Full Circle*, 94.

well and, initially, felt glamorous and exciting. Snelson's specialty became action, hand-held camera work that took him on location all over the United States and Europe, and even to the Middle East and Japan. His work varied, including subjects such as educational films on disease for the American Cancer Society, documentaries on sky diving, and reports on school integration in New Orleans. He worked on television shows for Walter Cronkite on CBS and David Brinkley's *Journal* on NBC.

The excitement of his new career faded after a few years. The commercial filming business in New York was cut off from the feature films being made in Hollywood, and for Snelson it became just a way to make a living that held little promise of a creative outlet. Snelson wrote that going to work in the film industry was, "a way out of my inner troubles—a way of avoiding a face-to-face resolution about what art was for me."[71] He also described that time in his life as "six or eight years of thrashing about. Trying to grab hold of what to do, what to be…."[72] In 1953, he married Jenny, a soprano with the New York City Center Opera, but their relationship was tumultuous and ended in divorce in 1956 when Snelson was thirty. Soon after, during an afternoon off, while filming in Los Angeles, Snelson visited a museum with gallery-owner Michael Sonnabend. Staring at a Constable landscape, Snelson commented, "I'd give anything to be painting again." Michael studied him for a moment and replied, "It isn't that you'd give anything, you have to be willing to give everything."[73]

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[71] Snelson, *Not in My Lifetime*, 68.

[72] *Ibid.*, 79.

[73] *Ibid.*, 83.

After Snelson finished filming in California, newly single and back in his fifth-floor walk-up on Eighty-Ninth Street and York Avenue, he began to paint seriously for the first time in years. He filled his three small rooms with old window shades that served as canvases and quarts of paint—house enamel in black, white, and primary colors. Thrift and a desire not to invest too much in a venture that might not work out partially inspired these inexpensive choices. However, he self-identified as an Abstract Expressionist and modeled his materials after those he had seen Willem de Kooning use at Black Mountain.[74] From 1956 to 1959, Snelson painted diligently in his free time, trying on the style of other painters to find his own voice.[75] He experimented not only with Abstract Expressionism (Figures 8-9), but also a Bauhaus-inspired style influenced by Albers and his professor at the University of Oregon, Jack Wilkinson. He also did work after the fifteenth-century Japanese master Sesshū Tōyō and in a French Impressionist taste, reminiscent of the paintings of Pierre Bonnard and Henri Matisse (Figures 10-11).

In the late 1950s, Snelson began to immerse himself in New York's Contemporary art scene. Although the West Village had long been a Bohemian center, in the late thirties, Abstract Expressionists, like de Kooning and Franz Kline, began to settle on and around East Eighth Street, and a new artistic community developed.[76] Following World War II, the second generation of Abstract Expressionists established themselves

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[74] Snelson, in discussion with the author, December 8, 2009.

[75] Snelson, in discussion with the author, December 8, 2009.

[76] Ashton, *The New York School.*

on East Tenth Street, between Second and Fourth Avenues. In the early 1950s, several storefront galleries opened on these seedy blocks, dominated by low-rise tenements.

By the time Snelson started exploring New York's art world in the late 1950s, the famous Artists Club and Cedar Tavern may have already stood for "an heroic New York School past."[77] However, they remained centers of discussion and daily life for downtown artists—particularly the Abstract Expressionists with whom Snelson identified. The Artists Club functioned as a forum, like the cafés of Paris—a place for artists to discuss art and aesthetics.[78] Not a drinker, Snelson did not frequent the Cedar Tavern, but he did attend Tenth Street gallery openings and discussions at the Artists Club in an effort "feel a part of things."[79] He found the environment at the Club intimidating and himself still an outsider, unschooled in the hip art jargon in which the discussions were held. Snelson was also in psychotherapy during this period, and he identifies it as the time during which he became not only an artist, but also an adult.

In 1959, the Museum of Modern Art held an exhibition of Fuller's work in which Snelson was publicly credited for the invention of tensegrity for the first time. Being able to feel ownership of the idea again was inspirational for Snelson, and he abandoned painting entirely, dedicating himself to the sculpture project that would occupy the rest of his life. 1960 was a watershed year for Snelson. After the move from his cramped uptown apartment to a large industrial loft downtown, he had the physical space he needed to realize his ideas, and he began work on his first large-scale tension-

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[77] Meyer, *Minimalism: Art and Polemics in the Sixties*, 33. See also Irving Sandler, "The Club," *Artforum* IV, no. 1, Special Issue: The New York School (September 1965): 27-31.

[78] Ashton, *The New York School*, 198.

[79] Snelson, in discussion with the author, September 20, 2010.

compression sculptures. Enthralled with concepts about structure, he also began his research on the atom. Also, in 1960, Snelson met Audrey Goldenstein. Audrey, like Snelson, worked in documentary film, she had a master's degree in English Literature, and was supporting herself with freelance research. At twenty-two she was eleven years younger than Snelson, and he later described her as shy and funny.[80] In September of 1963, Audrey and Snelson married. Only two months after the wedding, Audrey found a lump in her left breast that a biopsy declared malignant, and she had a radical mastectomy. Her cancer went into remission briefly, but returned, and Audrey died in the spring of 1966.

Just months after Audrey's death in 1966, Snelson had his first solo show at the Dwan Gallery on Fifty Seventh Street, which was the heart of New York's blue chip gallery world. Dwan had several subsequent shows of Snelson's work, both in New York and at their Los Angeles location, establishing Snelson's artistic career. Inclusion in group sculpture shows at museums followed, and by the close of the 1960s, Snelson was a well-known artist both in the United States and in Europe.

In 1969, he registered for MindMates, a dating service, through which he met Katherine Kaufmann. Soon after they met, Katherine left New York to spend the summer in Ibiza with her mother. Snelson was also in Europe that summer, working on an exhibition for the Krefeld Gallery near Düsseldorf, and found plenty of time to visit Katherine in Spain. In the late 1970s, Katherine trained to become a Freudian psychoanalyst; however, when the couple first met she did not have a profession and was free to travel around Europe with Snelson. In 1970, they spent time in Berlin and Paris,

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[80] Snelson, *Not in My Lifetime*, 98.

before deciding to settle down in Amsterdam. The move was practically motivated. Snelson's sculptures in Germany had to leave the country within a year, or he would be forced to pay taxes on the unsold works. Transporting the large pieces to the United States was prohibitively expensive, whereas the couple was able to purchase a historic red-shuttered warehouse along the Brouwersgracht in Amsterdam for an affordable $19,000. In late 1971, Katherine became pregnant with Andrea, their only child, and the couple moved home to New York to get married and start their family. Within a few years, they sold the Amsterdam property and purchased part of a building on Sullivan Street, just South of Houston in which there was room for an apartment and an art studio. Snelson's studio remains in this space to the present day.

Chapter Summaries

The first chapter of this study examines the development, technical aspects, construction, exhibition history, and reception of Snelson's tensegrity sculptures in the context of his relationship with Fuller and the significant role structural physics play in Snelson's artistic method. By examining period texts on Snelson's work, I demonstrate that he struggled to gain recognition as an artist and, even after he began to show regularly in a fine art context, a certain level of ambiguity continued to surround his identity. In keeping with how his work is received by others, Snelson himself questioned how he wanted to define himself professionally throughout his early career. It is my contention that by aligning himself with Fuller—an architectural engineer and inventor—rather than an artistic mentor, Snelson muddies the story of his own artistic development.

In the second chapter, I explore Snelson's emergence in the art world in the mid-1960s, during the height of Minimalism in the United States. Snelson was first represented by the Dwan Gallery, a center for the newly popular Minimalist movement that showed work by major artists of the day, including Carl Andre, Dan Flavin, Donald Judd, Sol LeWitt, and Robert Morris. Although Snelson maintains that his work should not be considered in the context of Minimalism, his tensegrity sculptures not only share a geometric, precise, austere, and industrial aesthetic with the movement, but his artistic philosophy relates to Minimalist ideas in their mutual eschewal of self-expression, as well. Through an examination of period writing, I demonstrate that art critics appreciated these commonalities in the 1960s, and that Snelson's work was initially received as Minimalist. Moreover, despite the artist's pronouncement, I also show that Snelson's artistic practice was influenced by the theories of Minimalism until 1969, when a significant shift in his production took place just as Minimalism was falling from favor. I conclude the chapter by looking more closely at the ideas that inform Snelson's sculptures—particularly those concerning means of production, in light of recent scholarship, ultimately identifying aspects that distinguish his work from that of other Minimalist sculptors.

In the third chapter, I introduce Snelson's atom, the second major focus of his career. Nineteenth-century scientists competed to formulate a visual model of the atom, but after the discovery of electron resonance, during the first quarter of the twentieth century, it was no longer thought that visualizing the atom was possible, and twentieth-century quantum physicists and chemists relied primarily on mathematical equations to describe atomic structure. As an artist, Snelson found this lack of visualization unsatisfying and was inspired to create his own atomic model. He began to develop the idea for his atomic theory in 1960, and over the next half century it grew to include a scientific treatise, two patents, sculptural pieces, models, and digital projections. Snelson calls the project as a whole *Portrait of an Atom*, and since its inception it has been a major focus of his time and energy. Although, starting in the late 1970s, he has come to see the project as a work of art, during the 1960s, Snelson believed he had made an important discovery that would change the face of scientific research. Snelson's atom, which is a product both of amateur research and imagination, rests between an artistic vision and a scientific one.

Although there are important similarities between Snelson's work and that of the 1960s Minimalist sculptors, Snelson's emphasis on the natural forces that create structures and study of the atom set his work apart from the mainstream of this movement. Therefore, in the fourth chapter, I turn to the aspects of science, technology, and engineering that are central to Snelson's artistic practice to define another period context in which to understand his work. Snelson was not unique among artists of the 1960s in his technophilic impulse, interest in science, and desire to show forces of nature. In addition, the sources that Snelson looked to for examples of scientifically influenced methodology and subject matter were shared by many of his contemporaries. By comparing Snelson with this group of sixties artists, themes relating to secret interiority and what was called at the time "the real" emerge. I suggest that these artistic themes relate to the type of science that dominated during the period—the invisible world of quantum physics. Atomic science was different from earlier techno-scientific developments because it presented a level of understanding of the natural world that was not visible and beyond the comprehension of the non-initiated. In addition, atomic science was inextricably linked with the catastrophic destruction caused by the atomic bomb. Inspired by the dominant cultural metaphor of an unknowable and threatening atom, the artists discussed in this chapter created works of art that sought define unknown interior realities.

Many of the artists discussed in this study used science and technology in their work, but unlike Snelson, they did not believe their art could be utilized by science. In Chapter Five, I present Snelson's atom and tensegrity sculptures in the context of other 1960s artistic projects that were formed with the aim of improving science and industry through the imagination and creativity of artists. To explain the cultural resonance of such projects, I look to texts on the history of technology, including the writings of Fuller, Sigfried Giedion, and Lewis Mumford, who describe a modern world that is regimented and mechanized and focused only on capitalist efficiency and devastating military strength. These writers suggest that by reuniting the arts and sciences, the emotional can be brought to bear on the logical, introducing a new emphasis on humanitarian efforts. This chapter positions Snelson's atom and tensegrity sculptures among similar 1960s projects that aimed to introduce the humanizing effect of artistic thought into techno-scientific fields and blurred the divisions between specialized fields of knowledge.

CHAPTER ONE: TENSEGRITY SCULPTURES

Snelson's artistic interest centers on what he calls "the nature of structure" or how elements combine to fill space.[81] This has led to his exploration of the natural forces of tension and compression that give objects structural integrity. Because of the importance Snelson puts on physical properties, understanding how they function in the creation of his sculpture is essential to understanding how he defines himself as an artist. Therefore, I first address both how Snelson developed his tensegrity sculptures and the technical aspects of their construction. The second half of this chapter is about the complicated relationship between Snelson and Buckminster Fuller, the figure most often associated with tensegrity. When telling his life story, Snelson has made his troubled relationship with Fuller, and what he sees as the injustice Fuller perpetrated in claiming authorship of the tensegrity principle, central. By focusing on Fuller, I believe Snelson portrayed his background, interests, and skills as distinct from other artists. This created a distance that the art writers who discussed Snelson's work perpetuated. Understanding Fuller's role in Snelson's development is essential, first, because it was through this relationship that Snelson became engaged with the structural concerns that define his artistic practice, and,

[81] Snelson, Artist Statement, *American Sculpture of the Sixties*, ed. Maurice Tuchman, 52; kennethsnelson.net/biography (accessed September 30, 2011)

second, because it has influenced how Snelson's work has been presented and received. Beyond Fuller, the broader aim of this chapter is to examine the role of structure in Snelson's sculpture, artistic philosophy, and critical reception.

Snelson's Sculptural Engineering

Tensegrity, the neologism Fuller coined—a contraction of tension and integrity—is the term most commonly used to describe the physical principle of Snelson's sculpture. Snelson prefers "floating-compression" structures, but concedes that trying to refer to it as such is a lost battle.[82] His pieces are a closed system of three or more compression units that do not touch (hence "floating") and are connected by a continuous network of tension members. Snelson registered his patent for "Continuous Tension, Discontinuous Compression Structures" in 1960, and it was granted in 1965 (Appendix B). The text states, "The present invention relates to structural framework and more particularly, to a novel and improved structure of elongate members which are separately placed either in tension or in compression to form a lattice, the compression members being separated from each other and the tension members being interconnected to form a continuous tension network."[83] In Snelson's sculptures, the "compression units" are metal struts (referred to as piping, bars, or rods) and the "tension members" are metal tendons (referred to as cables or cords). The structural integrity is achieved as the piping pushes

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[82] kennethsnelson.net/biography (accessed June 11, 2010)

[83] Kenneth Snelson, "Continuous Tension, Discontinuous Compression Structures," Patent No. 3,169,611 (United States Patent Office, February 16, 1965). (Appendix B)

outward against the joints, or nodal points, in the inward pulling wire, creating a static balance between tension and compression.

Snelson's patent includes diagrams for structures in various forms, representing some of the sculptures that he would develop during the following decades. This variety, including an arch, a tower, and many other forms, shows the possibilities for tension-compression structures that he had already envisioned in 1960 when he submitted the patent materials. The diagrams not only demonstrate that Snelson's aesthetic visions are dependent on his structural knowledge and inventions, but the inclusion of a structure that could support a roof (Appendix B: patent Figure 15) and a plan illustrating how tensegrity could be used to build a dome structure (Appendix B: patent Figures 19-20) prove that in 1960 Snelson believed there were practical applications for his research.[84] This idea had important implications for how Snelson defined himself as an artist.

The majority of Snelson's sculptures are composed of aluminum or stainless steel rods and stainless-steel cables. Although he has experimented with other materials, he returns to these for what he states are practical reasons: they are lightweight, strong, and non-corrosive.[85] It is important, as well, for the cables to be made of a type of cord that does not stretch. In 1971, Snelson had what he called "a delicious love-affair" with bamboo, using nylon rope in place of steel cables.[86] However, bamboo and nylon were

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[84] Snelson, in discussion with the author, September 9, 2011.

[85] Snelson, in discussion with the author, December 8, 2009.

[86] Angela Schneider, "Interview with Kenneth Snelson," in *Kenneth Snelson Skulpturen* (Berlin: Nationalgalerie, 1977), n.p.

ultimately not satisfying because he could only use them to create flat structures.[87] *Northwood I*, a piece Snelson constructed in 1969, is unique in its use of yellow box-shape Warren girders, such as might be used in industrial construction (Figure 12). In addition, the rods in two of his early pieces, *Audrey I* and *Audrey II*, 1966 (Figures 13-15), are coated with white, yellow, and black porcelain, and the rods in *Black E.C. Tower*, begun in 1969 and first installed in 2006, are black anodized aluminum.

Snelson uses four different types of titles for his sculptures. Most are named descriptively based on the piece's form. For example, the three 1968 *Four Module Piece* sculptures (one of which is shown in Figure 16) are each composed of a geometric unit repeated four times. Similarly, the towers are all tall columns (Figures 17-18), and the pieces titled *Cantilever*, 1967 (Figures 1-2), and *Tower (Cantilever)*, 1962 (Figure 64), are unsupported projections. The titles in the second group have personal meaning to Snelson. These include both place names, such as *Spring Street*, 1964, and *Sagg Main Street*, 1966 (Figure 19) (both of which were locations of Snelson's studios) and references to Snelson's family members. Snelson named two of his 1966 sculptures for his second wife, Audrey (Figure 13-15) and *Avenue K*, 1968 (Figure 20), and *Easy K*, 1970 (Figure 21), are both in homage to his third wife, Katherine. Snelson gave his more representative pieces titles that indicate the subject matter. These include *Forest Devil*, 1975-7 (Figure 22), *Dragon*, 1999-2000 (Figure 3), and *Sleeping Dragon*, 2002-3, (Figure 4). In the mid-1970s, Snelson began giving his sculptures, such as *Free Ride*

[87] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

Home, 1974 (Figures 23-24), *Able Charlie*, 1978, and *Coronation Day*, 1980 (Figure 25), names randomly selected from a list of registered race horses.

Snelson developed the technology for attaching the cables to the hubs (also referred to as caps, joints, or nodes) himself.[88] The original hub design utilized a nylon arcuate, or half round, lip that Snelson shaped on a lathe (shown in Appendix B: patent Figure 27). The design was included in Snelson's 1965 patent, but actually used only in some of his earliest pieces, such as the work he made for the 1964 World's Fair (Figure 26). In this hub, the cables entered a retaining well through the top of the hub, and they were all tightened simultaneously by tightening a central bolt. Snelson soon learned that he needed to be able to tighten each wire individually when constructing a piece to achieve the proper levels of tension. In a second model, which Snelson had developed on paper by 1960 as well, the wires were threaded into the retaining well through individual holes in the side of the hub (shown in Appendix B: patent Figure 28 and 29). To secure the cord, he attached a copper tube that was wider than the bored hole and used a large crimper, called a Nicopress, to flatten the end of the cord so it could not pull back through the copper tube. As in the first model, all cords were tightened at once, here by lowering the center part of the hub into the shaft of the pole. In the final model that Snelson still uses (Figures 27-29), he replaced the copper tubes with threaded plugs that he made initially by boring through the center of thick screws. Threaded stoppers make it possible to adjust each cable individually and make the cables detachable so that pieces can be neatly stored and shipped as composite parts. The fact that Snelson's two earlier

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[88] Snelson, in discussion with the author, September 20, 2010.

designs were part of his 1965 patent demonstrates that they are an intrinsic part of his work.

Although Snelson uses sketches, calculations, and, more recently, computerized modeling to some degree, for the most part he develops each sculpture intuitively using miniaturized parts to build a model or maquette (Figure 30). By playing with the small rods and cables, he creates forms that are aesthetically pleasing and structurally sound through trail-and-error experimentation.[89] The large-scale sculpture is then built based on the proportions established in the model. The diameter and length of each full-scale tube and cable are based on measurements determined by building the maquette. The model also demonstrates how many holes each hub should have and at what angle they should be placed. For example, a hub from *Easter Monday*, 1975 (Figures 28-29) is laced with five wires, indicating that the rod for that hub is connected to five other rods. In general, Snelson fabricated the tubing, cables, and hubs himself until 2000, when he met Phillip Stewart, who has since has taken over aspects of the production.[90] Stewart is a Seattle-based artisan who does machine work for artists, including Dale Chihuly. Extraordinarily large works, on the scale of *New Dimension*, 1977 (Figure 31), always required factory-produced rods and cables. In addition, Snelson sent the rods out to receive porcelain and anodized aluminum surfacing for *Audrey I* and *Audrey II*, 1966 (Figures 13-15), and *Black E.C. Tower*, 1969-2006.

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[89] Snelson, in discussion with the author, December 8, 2009; Snelson also described his process of production in Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[90] Snelson, in discussion with the author, September 20, 2010.

Snelson compares adjusting the tension wires to tuning a string instrument. When putting a piece together for the first time, he says, "I invariably need to change some of the tension members, remaking them either longer or shorter to achieve the right amount of prestressing. Every part depends on every other part, compression and tension members alike, so knowing which wire to adjust is a matter of experience. After the final adjustment, further changes over time are seldom necessary."[91] Although once-perfected composite parts will fit together after years in storage, the assembly process is always difficult.[92] "I've done this a thousand times and every time it's the same puzzle," Snelson said, assessing the pile of tubes and wire on the floor of Robert Miller Gallery in May of 2008, during the installation of *Easter Monday*, a piece he first composed in 1977 (see Figures 32-34).[93] Thirty years earlier, when discussing the installation of *New Dimension* (Figures 27 and 31) and *Forest Devil*, 1975-7 (Figure 22), for a show at the Nationalgalerie in Berlin, he reflected on the difficulties with more colorful language:

> The photographs tell the story [of how the pieces were put together], I think, but minus all the cursing. It took eight days to put together *New Dimension* and three days for *Forest Devil.* I wish I could say it went as smoothly and easily as it looks, perhaps, in the pictures. Unfortunately it is never easy with my structures, especially if they are as complex as

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[91] kennethsnelson.net/biography (accessed June 11, 2010)

[92] When possible, Snelson is on site to assemble his work to this day. When Snelson cannot be present, installation is usually directed by Phillip Stewart, Dale Lanzoni, or John Monahan. The process of installing *New Dimension* at the Nationalgalerie in 1977 is described in Heartney and Snelson, *Kenneth Snelson: Forces Made Visible*, 32-4.

[93] Snelson, in discussion with the author, May 6, 2008, during the installation of Easter Monday for *Geometry As Image* (May 8-July 30, 2008), Robert Miller Gallery, New York City.

> these.... Three of us, sometime as many as six men fought with the forces in *New Dimension* while it was going up. It is like taking on a colossal, dead-weight wrestler or an enormous mind-bending jigsaw puzzle constructed of a series of booby-traps. Sometimes we spent an hour or so just to arrange for the introduction of a single pipe. After finally overwhelming the monster with our brave determination and strength we see that we have won. Only then does someone discover that a cable is twisted over something in the wrong way and we must do the whole act again; with feeling.... Anyway, now that they are both standing, I love them and I want them to know this, despite what I may have said while the assembly was going on.[94]

The process begins by laying out the cables with their attached hubs in a pattern that resembles a flattened version of the sculpture (Figure 27). Then the hubs that are attached to the longest cables are screwed onto the appropriate tubes, creating the basic shape of the sculpture (Figures 33D-J). A ratchet must be used to bring the outward pushing rods close enough to one another to attach the final hubs (Figures 33K and 35). Because the balance of tension and compression rather than gravity defines the structural integrity, once completely assembled, the piece can be moved, tilted, or even, hypothetically, released into space, without losing its form. This also means that it does not require a base or attachment to the ground.

When designing site-specific work, the process is restricted and inspired by the location. For example, when designing *New Dimension,* Snelson considered the spatial

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[94] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

setting of the Nationalgalerie: "I conceived of the sculpture in this size to relate to the space inside of the Nationalgalerie, which I began to call Mies van der Rohe's aircraft hanger. The gallery is simply vast, with 8-meter ceilings and a space 50 meters by 50 meters. I felt challenged to do a piece that would relate to such a space."[95] The story of *Easy K*, 1970, and *Free Ride Home*, 1974, also illustrates how Snelson works with site-specific needs and aesthetic considerations. Snelson built *Easy K* to cantilever over a pond in Sonsbeek Park in Arnhem, Holland (Figures 21 and 36). His vision of how the work would look reflected in the water's surface inspired an overhanging structure. The summer after it was on view, *Easy K* was dismantled and shipped back to New York. Soon after, Snelson was asked to build a piece for a show at the Waterside Plaza on Twenty Fifth Street along the East River. Snelson wanted to reuse *Easy K*, but knew the sculpture would be inappropriate for the site because it hung low, tempting people to climb on it. This public, waterside space inspired Snelson to create something with multiple high arches that viewers could walk under, and he cannibalized the parts of *Easy K* to construct *Free Ride Home* (currently installed at Storm King Art Center in New Windsor, New York) (Figures 23-24).[96]

Although Snelson has been creating sculptures of the same type since about 1960, there is more variety within his body of work than initially might be appreciated. Snelson divides his sculpture into two categories: symmetrical and dynamic (which he also calls non-symmetrical). Snelson's preference for symmetrical or dynamic compositions has

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[95] Heartney and Snelson, *Kenneth Snelson: Forces Made Visible*, 32.

[96] Snelson, in discussion with the author, December 8, 2009.

shifted over time. He explained in 2009, "Every so often when I finish a piece I love, I think that's what I want to do forever, but then I look at pieces of the other type, and I think, well on the other hand…."[97] The categories define a difference in both artistic process and the aesthetic of the completed piece.[98]

The symmetrical sculptures are composed of repeating geometric modules and often have an appearance of static rigidity. For example, in *Vine Street*, 1968 (Figure 37), the module is made up of three poles. The first of these is tipped very slightly to the left, the second also leans left at a more extreme angle, and the third protrudes right at approximately a forty-five degree angle from floor to balance the other two. This unit is repeated three times and held steady by two additional poles placed parallel with the floor. When making a symmetrical piece, Snelson draws on a fairly limited vocabulary of forms such as towers, triangles, and pyramids. Each form supplies its own physical restrictions that define how the piece must be composed. Snelson explained, "If it's pretty much purely symmetrical geometry, I pretty much know where I'm trying to get to. It's just laborious to get to it. Because those pieces that are symmetrical are harder to do because if something is loose or too tight, I have to redo every one of them."[99] Designing such a work is a matter of figuring out the physical geometry and measurements. For

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[97] Snelson, in discussion with the author, December 8, 2009.

[98] In his 1981 essay for the Albright-Knox Museum exhibition catalogue, Howard Fox divided Snelson's works into two categories: columnar and centrically organized. This dichotomy ignores the distinction made by the artist himself that is dictated by his methods of construction. Moreover, by his own admission, Fox's categories do not account for complicated horizontal pieces such as *Free Ride Home*, 1974 and *Easy Landing*, 1977, and therefore are not ultimately that helpful in understanding Snelson's body of work (Fox, "Kenneth Snelson: Portrait of an Atomist," *Kenneth Snelson*, ed. Douglas G. Schultz, 18).

[99] Snelson, in discussion with the author, December 8, 2009.

example, to develop the formula for *Needle Tower*, 1969, (Figure 18), Snelson first tried reducing the stacked modules by seventy-five percent, but found that they tapered too quickly. Through experimentation, he discovered that a reduction of each consecutive module by a ratio of one to .93 could achieve the desired aesthetic of a tall and slivery tower that appears to extend into nothingness. He arrived at this formula not through mathematical calculation, but by testing different systems with miniaturized parts.

The dynamic works are more expressive and building them is a more free-form process. Unlike the symmetrical pieces, the dynamic works have no set pattern, rather the component rods have varying lengths and appear to spike out at random. The dynamic sculptures do not utilize repetition of forms or geometric organization. *Free Ride Home*, 1974 (Figures 23-24), for example, almost appears to be a random clustering of different length rods assembled at irregular angles. A closer examination shows that the work is a study of visual imbalance. One side is laden with a dense nest of shorter rods while the other is a simple cross, composed from two large poles. Throughout the work, the longer poles protrude, seeming to pull out against the center, which creates a feeling of movement that is typical of Snelson's dynamic work. While the forms are unstructured, Snelson starts dynamic pieces with a mental picture that defines the work's basic shape and orientation. For example, when planning *Free Ride Home*, he started with the idea that the piece would include an arch that viewers could walk under.[100] Its name indicates he had an even firmer idea when he began the composition for *Forest*

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[100] Snelson, in discussion with the author, December 8, 2009.

Devil, 1975-77 (Figure 22). Knowing that he wanted the piece to resemble a creature, he structured it to have parts that could be identified as a head, back, and legs.[101]

Snelson and Fuller

The development of, and subsequent conflict over, tensegrity is interwoven with the personal relationship between Snelson and Fuller. Fuller and Snelson first met at Black Mountain College in the summer of 1948. Snelson was there as a summer-session student, and Josef Albers invited Fuller to join the faculty as the architecture professor two weeks into the term to replace a last-minute dropout. Although Fuller had already developed some of his most well-known projects, including the Dymaxion house and car, he was not yet a well-known public figure. According to Snelson's recollection, Fuller's arrival, with a shiny Airstream trailer hitched to his car, aroused curiosity among the Black Mountain students. On the afternoon Fuller appeared on campus, Albers brought Snelson to Fuller's trailer to assist Fuller with his models. Being a professor's assistant was an honor, and Snelson could only guess that he had been chosen over the architecture students because of his talent for building structures. The crowded trailer was filled with objects that Snelson could not identify, constructed from celluloid, cardboard, aluminum, Ping-Pong balls, and marbles. The hour he spent assisting Fuller was fascinating, but the

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[101] Snelson, in discussion with the author, December 8, 2009.

architectural purpose of the unfamiliar models remained mysterious, and the objects seemed to the young Snelson more likely to belong to "a magician or an alchemist."[102]

That evening, Fuller delivered the type of lecture he would repeat throughout the term. Snelson recalls that after a protracted silence, he began to speak awkwardly in fits and starts; however, soon his words came more readily, and he continued speaking for hours, bouncing from one topic to another in a stream of uninterrupted and unplanned thoughts. That summer, Snelson heard Fuller lecture repeatedly on his ideas for the creation of an efficient, modern world—his Dymaxion World. As I discuss further in Chapter Five, Fuller explained to the Black Mountain students the essential role that artists would play in the creation of this new world by becoming "comprehensive designers" who would use their creativity to solve real-world problems. Young and idealistic, Snelson was quickly drawn in by Fuller's rhetoric. Fuller not only the way to a better, more modern world, but also explained how a twenty-one-year-old art student could be instrumental in its development. Snelson wrote, "Hearing Mr. Fuller talk made me believe that this visionary man might really be describing me."[103] The idea of a comprehensive designer resonated with Snelson and seemed to open up a world of potential in which he could contribute to something important.

Snelson recalls that the talk Fuller gave that first night at Black Mountain included a dizzying breadth of topics, such as sound and light rays and quantum effects. Fuller used the models that Snelson had seen in his trailer to demonstrate "Energetic

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[102] Snelson, *Not in My Lifetime*, 8.

[103] *Ibid.*, 11.

Geometry," a system of mathematics that Fuller claimed as his own. Snelson recalls Fuller's explanation: "Energetic Geometry held the master key to nature, from galaxies to the nucleus of the atom; the very structure of all things living or inanimate."[104] Using a model constructed of soda straws, Fuller explained how the only shape of value, because of its inherent strength, is the triangle and those shapes, such as tetrahedrons, that could be formed from triangles. It seemed to Snelson that Fuller had invented the entire discipline of science. "Here, energy is expanding and contracting,"[105] Snelson recounted Fuller explaining, near the conclusion of his talk, while dancing in imitation of an expanding and contracting cardboard model. "The audience now reached a crescendo of enthusiasm for this little man who had come to the platform unknown, humble, even a bit pathetic, as he struggled to get started," Snelson described decades later in his unpublished memoir. "He was transformed, in our eyes, into a wizard, a magician and a prophet of a triumphant, optimistic, revolutionary world view. Clearly, Black Mountain College would be his for the rest of the summer."[106]

Others who met Fuller that summer at Black Mountain have echoed Snelson's thoughts. For example, when the choreographer Merce Cunningham recalled that evening, he said, "I remember thinking it's Bucky Fuller and his magic show. ...It's like

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[104] *Ibid.*, 10.

[105] *Ibid.*, 11.

[106] *Ibid.*, 11.

some ...enormous poet who comes into your life and simply expands."[107] The film director Arthur Penn, also at Black Mountain for the summer of 1948, stated, "But he was an arresting personality, there was no question about it. There was a kind of visionary aspect to him, which was communicated out of this relatively shy man. But when he spoke about social issues and the nature of the world materials, and the prospect for the world, he was utterly captivating, utterly captivating and...quite remarkable, never met anybody like him." [108] In a 1966 profile in the *New Yorker*, Calvin Tomkins described the reaction that students had to Fuller: [Students] "pack lecture halls to hear him and often keep him talking long after the scheduled time.... After the first hour, which is usually perplexing, students find themselves tuned into the unique Fuller wave length, with its oddly necessary word coinings and its synergetic constructions. They dig his humor...."[109] Tomkins's description of young people sitting in rapt attention for marathon-length lectures, often upwards of six hours, suggests that Fuller had extraordinary charisma. In particular, he seemed to have had an ability to speak to concerns and anxieties of young people and to instill a sense of hope. Snelson and the other students at Black Mountain during the summer of 1948 were only among the first in what would become a legion of college-age people who called themselves Fullerites.

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[107] Karen Goodman and Kirk Simon, *American Masters: Buckminster Fuller, Thinking Out Loud*, documentary transcript, Channel Thirteen PBS. www.thirteen.org/bucky/merce.html (accessed May 26, 2010)

[108] *Ibid.*

[109] Calvin Tomkins, "In the Outlaw Area," in *Buckminster Fuller: Starting with the Universe*, eds. Dana Miller and K. Michael Hays (New York: Whitney Museum of American Art, 2009).

Throughout the summer of 1948, Snelson continued to believe everything he learned from Fuller to be the original thoughts of an unparalleled genius. Snelson recollected that, "we began to think of Bucky as the man who invented and owned the triangle." [110] Aggrandizing Fuller allowed Snelson an unprecedented feeling that he was part of something important: "If he was the first to make these discoveries, then surely we were next in line to learn about them and to share these insights. Just imagine!"[111] It is easy to understand how tantalizing these hopes were for a young man from a small town who had never before imagined that he could play a leading role in something significant. Nonetheless, in his memoir, Snelson's recollection of his first few months with Fuller is tinged with skepticism. For example, Snelson wrote, "But sometimes I sensed he might be using…[his nervous chuckling] to skip over a discrepancy or a claim short on evidence."[112] It is impossible to know if these moments of doubt were present at the time, or are the product of a long and bitter subsequent history.

Snelson also recounted the doubt and disappointment he experienced after he participated in Fuller's first attempt to raise a large-scale geodesic dome. The 1948 Black Mountain geodesic experiment was attempted with thirty-one strips of aluminum, of the type used for Venetian blinds, bent into crisscrossing arches to form a hemispheric dome. The finished product would have been beautiful—completed in strips of various

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[110] Snelson, *Not in My Lifetime*, 18.

[111] *Ibid.*, 18.

[112] *Ibid.*, 12.

colors—and weighed less a hundred pounds.[113] The aim of the project was to demonstrate that a sphere composed of tetrahedrons was superior to traditional enclosure shapes in strength and in economy of materials. Although Fuller had created a small model of the structure successfully, after several days of work and the students' best efforts to reinforce the limp structure, it was clear that the aluminum slates were too delicate to maintain a taut fifty-foot-long arc. According to Snelson, they were crushed with disappointment that their first full-scale experiment as Dymaxion comprehensive designers had failed.[114]

As the students stood around, looking at the yards of aluminum strips, Fuller appeared on the rooftop of a nearby building, gazing at the prone structure from above. To Snelson's surprise, Fuller looked excited and cried out, "Look! Look here…if you come up—you will see the most unexpected phenomenon. Our geodesic patterning replicates absolutely this electron-micrography image of fruit-fly chromosomes! Nature is surely trying to tell us something."[115] When describing the incident in his memoir Snelson wrote, "Kidding both ourselves and him, we all agreed that the similarity between the fruit-fly's chromosomes and the white aluminum spaghetti in the field was unmistakable."[116] Some accounts support Snelson's recollection of the failure and disappointment, and it has been noted that some scientists at the time considered Fuller to

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[113] Martin Duberman, *Black Mountain: An Exploration in Community* (New York: Dutton, 1972), 286.

[114] Snelson, *Not in My Lifetime*, 13.

[115] *Ibid.*, 14.

[116] *Ibid.*, 14.

be an untrained "quack" whose observations about nature were often incorrect.[117] Others note that Fuller jokingly called the first geodesic effort the "Supine Dome" and "flopahedron," and that he knew in advance that the slates were not strong enough to stand and that the experiment would fail.[118]

The following summer, when Fuller returned to Black Mountain, he and his students successfully erected a geodesic dome. Moreover, the geodesic dome did in fact offer tremendous potential as a new architectural form because it was lightweight, potentially portable, easy to assemble, strong, and could be made from inexpensive materials.[119] Because the dome could be built using minimal resources, the environmental movement of the 1960s and 70s adopted the form and heralded Fuller as an avant-garde ecologist.[120] Fuller patented the design in 1954, and in the decades after many were constructed around the world both for practical purposes, such as military housing, and as showy representations of futuristic architecture, including famously Fuller's United States Pavilion at the 1967 International and Universal Exposition, or Expo67, in Montreal.

Regardless of the doubts Snelson expressed over three decades later when he wrote his memoir in 1984, he was infatuated with Fuller during the summer of 1948.

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[117] Eva Diaz, "Experiment, Expression, and the Paradox of Black Mountain College," in *Starting at Zero*, ed. Mary Emma Harris (Cambridge: Kettle's Yard Gallery, 2005), 54; Sargent Wood, *A More Perfect Union*, 55.

[118] Duberman, *Black* Mountain, 286; Sargent Wood, *A More Perfect Union*, 68.

[119] "Buckminster Fuller," *Architectural Forum* 95, no. 2 (August 1951), 144-51.

[120] Sargent Wood, *A More Perfect Union*, 53-5; Sam Binkley, *Getting Loose* (London: Duke University Press, 2007), 190.

Snelson felt singled out as Fuller's protégé and looked up to his mentor as an omniscient father figure. Snelson speculated that it was probably "a fantasy…for both of us, I might turn out to be a reincarnated, young Buckminster Fuller."[121] Snelson recollected that Fuller saw aspects of a young version of himself in Snelson and hypothesized that Fuller must have found his model-making skills useful and his presence, as an eager student, gratifying. Snelson, at that time, was willing to listen endlessly to Fuller's lectures, even when the novelty had worn off for other students. In telling his own story, Snelson portrays his first summer with Fuller as a pivotal moment in his career. In his memoir, Snelson wrote, "Because I was there, not as a four year student, but only for two summers, I feel it's a stretch to say I'm a Black Mountain College alumnus yet the few months I was there set my life's direction for ever after."[122]

Fuller gives some insight to his feelings about Snelson in a 1961 publication in which he wrote, "Snelson became one of my most intimate students. His sensitivity, craftsmanship and imaginative conceptioning power were extraordinary. Though I urged him, and though he tried to undertake a graduate course in nuclear physics, Snelson found it unbearably unattractive and returned to his artist's exploration in sculptural constructs and painted canvas."[123] It is clear from this that Fuller recognized Snelson's abilities and that there was a genuine closeness between them. It is impossible to know for certain if disappointment should be heard in the final sentence, or if it rings with disdain for what Fuller saw as Snelson's failure to use his creativity for practical applications.

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[121] Snelson, *Not in My Lifetime*, 19.

[122] Snelson, *Not in My Lifetime*, 4.

[123] Fuller, "Tensegrity," *Portfolio and Art News Annual*, 112-27, 144, 148.

At the end of the summer of 1948, enthralled with the idea of becoming a Dymaxion designer, Snelson elected to stay at Black Mountain for the fall term, not to continue studying art under Albers, but to begin courses in physics and mathematics. The maintenance man was retiring before the fall term, so Albers and Fuller arranged for Snelson to take on his responsibilities. The plan did not last long. The Black Mountain science building burned down a few weeks into the fall term, leaving the science department without laboratory space or equipment.[124] Snelson had already been having trouble adapting to life at Black Mountain without Fuller, who had returned to the Institute of the Design in Chicago for the school year. In addition, Snelson did not have the skills necessary to maintain the college's physical plant. The ruin of the science department was the final straw that sent Snelson back home to Oregon.

After his life-changing summer with Fuller, the idea of returning to the University of Oregon at Eugene as a painting student felt like a regression, so Snelson enrolled in the engineering program at Oregon State College at Corvallis. From the start, it was a bad fit. Abstract mathematics and physics did not excite Snelson the way Fuller's practical applications had, and he did not have the academic background to keep up with the class. In an effort to engage with the subject, Snelson asked his engineering physics professor why gravity did what it did. The professor answered angrily, "If you're asking me what the moon cares about the earth, how the hell do I know!"[125] It was not long before Snelson dropped out of the program and returned home to Pendleton.

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[124] Josef Albers, *Black Mountain College Bulletin* 6, no. 1, Supplement: Emergency Letter (September 27, 1948). bmcproject.org (accessed May 26, 2010)

[125] Snelson, *Not in My Lifetime*, 46.

Snelson felt out of place in Pendleton with his head still lost in Fuller's Dymaxion world. He found refuge in his basement "studio," where he had spent much of his childhood building models and producing photographs while hiding from his often bickering parents. Snelson had sent home a footlocker from Black Mountain with his projects, leftover materials, and a few souvenirs. Among them were green glass marbles he had found in the burnt wreckage of the science lab and brass scraps given to him by the sculptor Richard Lippold. Using Fuller's Dymaxion geometry, Snelson suspended a cluster of marbles in the center of concentric circles of brass strips, forming the basic shape of an atom (Figure 38). He sent the small sculpture to Fuller in Chicago as a Christmas present.

Using thin dowels and soda straws, Snelson continued to experiment with Fuller's triangle-based structures, building icosahedra and octahedra. Once he had several pieces constructed, he carefully installed an "exhibition" in his parents' formal living room that was decorated with mass-produced furniture in historical styles and floral carpeting and wallpaper (Figure 39). Snelson recalled that the show was abruptly curtailed when his mother arrived home from her errands and announced, "I want that junk out of my living room this minute."[126] It was only his correspondence with Fuller that helped Snelson maintain the optimistic feeling that he was working on something important.

One day, during the early winter of 1948, Snelson, while walking on Pendleton's central shopping street, stopped to look into the window of the Pendleton Hotel's souvenir shop. His gaze went past the collection of Western and Native American paraphernalia to a toy acrobat balancing with a curved weighted bar on tip-toes on top of

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[126] *Ibid.*, 41.

a narrow pedestal (Figure 40). The toy, "Circus Sam the Balancing Man," sparked an idea for a tower of balanced, weighted objects. In his basement studio, Snelson quickly began to construct triangles from black iron wire. The completed structure, composed of five inverted triangles was about two feet high (Figure 41). A hook hung into the center of each of the four lower triangles from which arched bars, weighted with plasticine clay balls on each end, were suspended. To balance the piece, the weights were of graduated size, the lowest ones weighing ten times more than the highest pair.

Snelson's second version used thread instead of the wire hinge joints (Figure 42). In this construction, the joints were composed of downward and upward facing Vs, connected by a taut loop of cotton string, threaded through crimps in both the upper and lower sections, and balanced, again, by graduated plasticene balls. Snelson recounted that he was pleased with how the first structure swayed gently, but even more thrilled with the illusion of rigid elements floating in space created by the near-invisible taut loops.

Snelson's interest quickly shifted from weighted balance to the use of thin tension lines to create the appearance of free-floating elements. Using plywood connected by clear monofil wire, Snelson constructed his first *X-Piece* using this principle (Figure 43). The plastic wires stabilized the plywood X-forms through counter tension, creating an unmoving structure that with squinted eyes gave the appearance of levitation. As Snelson states in his memoir, "this remarkable, two-module x-column, only a foot high was the first extendable discontinuous compression structure, ever. It could grow in all directions.... One such 'X' module could take on four others, each of which could connect to three more, and on and on, indefinitely. …A whole world could be made of these solid islands, connected only by means of invisible tension lines."[127]

Snelson was concerned that Fuller would consider the experiments too artistic, and it took him several weeks to send his mentor pictures of the new work. Fuller's response, received in April of 1949, disappointed Snelson, "Thanks for the photographs of the constructions which are excellent."[128] Snelson did not know how to interpret the short reply. He wondered if Fuller had not been able to grasp how remarkable the new work was from the photographs, or if Fuller had been displeased, interpreting the structures as "arty or even counterrevolutionary."[129] Fuller's next letter to Snelson later that month announced that Fuller had been asked to serve as dean of the 1949 summer session at Black Mountain and invited Snelson to return to continue studies of structural geometry.

The environment at Black Mountain in the summer of 1949 was different from that which had prevailed during the prior summer session. Albers had resigned the winter before, and Fuller, who had brought his wife Anne with him, was now the summer director. Unlike the previous year, Fuller arrived with a retinue of engineer-design students from the Chicago Institute of Design who had come to help build the geodesic dome. The other students nicknamed Fuller's group the "Spheres," after their geodesic-

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[127] *Ibid.*, 43-4.

[128] Buckminster Fuller to Kenneth Snelson, April 1949, Snelson Archives.

[129] Snelson, *Not in My Lifetime*, 52.

dome obsession, and derisively called them "Christ's Dymaxion disciples."[130] According to Snelson, despite the addition of the Institute of Design students, he was still considered Fuller's heir apparent.

Snelson brought his plywood *X-Piece* along with him to Black Mountain and showed it immediately to Fuller, who kept it.[131] According to Snelson, the following day Fuller told him that "the problem" with the structure was that it should be composed with tetrahedral triangles (not unlike what Snelson had used in his second moving column) rather than x-forms. With wire and telescoping curtain rods acquired in Asheville, Snelson soon set about creating a tetrahedral structure built to Fuller's specifications. Fuller kept both structures and, as Snelson recounted, presented the tetrahedral model in his lecture over the course of the summer as his own design.[132]

Although he did not realize it at the time, Snelson had happened on a significant discovery that would change the course of his life. Tension-compression structures have an extraordinary weight-to-strength ratio, as the heavier and more substantial compression bars used in traditional construction techniques are replaced with lightweight tension wires. In addition, while traditional compression building materials—like stone—could not be greatly improved upon, modern technology had produced materials with extraordinary tensile strength. For example, rope made from woven hemp, a historic material, could support only 5,000 pounds per square inch,

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[130] Duberman, *Black Mountain: An Exploration in Community*, 316.

[131] Snelson tells his account of showing Fuller the *X-Piece* in *Not in My Lifetime*, 52-4, and in "From Kenneth Snelson to R. Motro," *International Journal of Space Structures* (November 1990), http://www.grunch.net/snelson/rmoto.html (accessed December 10, 2008).

[132] Snelson, *Not in My Lifetime*, 54.

whereas glass fibers that were developed in the late 1950s could support as much as 400,000 pounds per square inch.[133] Fuller immediately realized the potential architectural and engineering applications of Snelson's design.

Snelson was angry that Fuller claimed the invention as his own at Black Mountain, but despite the growing distance between mentor and student, Snelson followed Fuller back to Chicago in the fall of 1949 to study at the Institute of Design. Although Fuller was part of the faculty there, he was not teaching that semester; however, he lectured occasionally, particularly on the subject of "his" new breakthrough—the "discontinuous-compression, continuous tension mast." Snelson recalled being continuously enraged by Fuller's usurpation of what he saw as his design, and Snelson decided to leave the school after the fall term to work in the film industry in New York City.

A letter Fuller wrote to Snelson in New York begins to demonstrate how Fuller understood the rift with his student and the discovery of tension-compression structures:[134]

> In all my public lectures, I tell of your original demonstration of discontinuous-pressures (com-pressure) and continuous tensions structural advantage...which, properly incorporated in fundamental structures, may advance the spontaneous good will and understanding of mankind by

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[133] "Buckminster Fuller," *Architectural Forum* 95, no. 2 (August 1951): 149.

[134] As discussed chronologically below, Fuller's published or public references to Snelson's contribution are: Fuller, "Tensegrity," *Portfolio and Art News Annual*, 112-27, 144, 148 and Fuller, "Everything I Know," Session 8, Part 5.

> many centuries. If you had demonstrated this structure to an art audience it would not have rung the bell that it rang for me, who had been seeking structure in Energetic Geometry. That you were excited by the latter, E.G. into spontaneous articulation of the solution, also demonstrates the importance of good faith of colleagues of this frontier. The name of Ken Snelson will come to be known as a true pioneer of the realized good life and good will.[135]

Fuller believed that not only had he inspired Snelson's discovery by teaching him about Energetic Geometry, but it was only through Fuller's application of Snelson's invention that its potential worth for mankind could be realized. While Snelson may have contributed to the Dymaxion revolution with his tension-compression structures, in Fuller's mind, Snelson had only come upon the discovery because he was infused with Fuller's ideas. Fuller believed that Snelson saw the *X-Piece* experiment as a work of art, while Fuller was the one who recognized the possibility for a new construction method that could provide tremendous strength using minimal materials—a key strategy for achieving his efficient and sustainable Dymaxion world.

Although Snelson and Fuller continued to see one another on occasion in New York, Snelson's anger over Fuller's appropriation of the tension-compression structures grew each time Fuller publicly claimed the discovery as his own. For example, in 1951, Fuller was the subject of a cover story in *Architectural Forum*. Although the focus of the article was the geodesic dome, an illustrated sidebar discussed "Discontinuous

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[135] Buckminster Fuller to Kenneth Snelson, December 22, 1949, Snelson Archive.

Compression" structures without mentioning Snelson, although other contributors to aspects of Fuller's work were mentioned by name in the text (Snelson, however, is listed at the end of the article among the Fuller Research Institute Fellows).[136] As the article explained, Fuller's tensegrity domes, spheres, and towers demonstrated to the world the inherent weight-to-strength ratio of structures built using tension and compression (Figures 44-45).

During one of their occasional meetings in the mid-1950s, Fuller told Snelson, again, that he mentioned his name in all of his public lectures. Snelson responded, "But you've never managed to put it in print." According to Snelson, Fuller replied, "Ken, old man, I think you can afford to remain anonymous for a while."[137] Describing his feelings towards Fuller during this period, Snelson wrote, "I tried not to think about him. If he did turn up in my thoughts, I was usually in a murderous daydream, cutting him to pieces…."[138]

In October of 1959, Snelson received a call from Fuller's assistant John Dixon with an invitation to meet Fuller at the Museum of Modern Art (MoMA). Fuller and his team, including Edison Price and Shoji Sadao, were at work installing *Three Structures by Buckminster Fuller*, an exhibition curated by Arthur Drexler. Staged in MoMA's garden, it included the triumvirate of Fuller's inventions: a geodesic dome, an octet truss (Figures 46-48), and a tensegrity mast (Figure 49). The day Snelson went over, Fuller

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[136] "Buckminster Fuller," *Architectural Forum*, 149.

[137] "From Kenneth Snelson to R. Motro," *International Journal of Space Structures*.

[138] Snelson, *Not in My Lifetime*, 80.

and his team had nearly completed the plastic and fiberglass geodesic Radome, while the gold-colored anodized-aluminum octet truss, which would be one hundred feet long, lay in pieces waiting to be assembled, and the thirty-foot tensegrity mast had not yet been begun. Like Snelson's experiments with tensegrity structures, Fuller's tensegrity mast balanced discontinuous compression members, in the form of aluminum tubes, with tension wires. For the MoMA exhibition, Fuller had used the principle to form a tall tower that closely resembled the structure of Snelson's later *Column*, 1961-7 (Figure 17). While Fuller's project for MoMA was constructed as a demonstration, Fuller would later claim that by combining the tensegrity mast with his octet truss, he could build a bridge across the Grand Canyon.[139]

When he arrived at MoMA, Snelson summoned the courage to press his former mentor about this tensegrity mast, saying, "Bucky, I hope my name is going to be on it."[140] Snelson remembers that Fuller answered, "Oh, absolutely, Kenny, I know I've told Arthur Drexler all about you."[141] Dixon, however, interceded, correcting Fuller, and suggesting that they introduce Snelson to the curator immediately to set the matter straight. In fact, Drexler had not known of Snelson's existence before that day, but saw to it that when the show opened in September, Snelson's named appeared on the tensegrity mast label alongside Fuller's. In the accompanying exhibition leaflet, the following text preceded Drexler's discussion of the mast, "The principle involved in the tension integrity mast first discovered by Kenneth Snelson in 1949, following his studies

[139] "The Dymaxion American," *Time Magazine* 83, no. 2 (January 10, 1964): 50.

[140] Snelson, *Not in My Lifetime*, 88.

[141] *Ibid.*, 88.

at Black Mountain College with Buckminster Fuller. The mast in the exhibition was based on the same principle but employed a different configuration of parts."[142] The first printed, public recognition of his invention had tremendous significance for Snelson and initiated a new beginning in his artistic career. Although he had been experimenting with painting for several years, Snelson recalled feeling artistic exhilaration for the first time in a decade. He began to work exclusively and fanatically on sculpture, abandoning painting entirely. He wrote, "I felt I had rights and proprietorship once again; reprieved after a decade of self-imposed exile—from doing what I had loved most: building things and making discoveries in the stately realm of three-dimensions."[143]

The MoMA placard and catalogue text, crediting Snelson with the invention of tensegrity, did not have the same profound affect on Fuller. In fact, Fuller applied for a patent for Tensile-Integrity Structures the following year in 1960, coinciding with Snelson's similar patent application.[144] In addition, in his 1961 publication "Tensegrity,"

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[142] Arthur Drexler, *Three Structures by Buckminster Fuller* (New York: The Museum of Modern Art, 1959).

[143] Snelson, *Not in My Lifetime*, 89.

[144] Fuller, "Tensile-Integrity Structures," U.S. Patent No. 3,063,521 (November 13, 1962).

While Fuller and Snelson were disputing the origins of tensegrity in the United States, David Georges Emmerich was experimenting with the same method of construction in France. Inspired by Karl Ioganson's *Gleichgewichtkonstruktion* of 1920, Emmerich's research resulted in patents for "Construction de réseaux autotendants" and "*Structures* linéaires autotendants" on September 28, 1964. Emmerich, an engineer, shared neither Fuller's interest in social and political change nor Snelson's artistic aspirations. Snelson and Emmerich met once when the French engineer visited Snelson's studio around 1976. Snelson found Emmerich "pleasant enough;" however, Emmerich accused Snelson of defeatism for not pursuing architectural applications for tensegrity (Snelson, in discussion with the author, September 24, 2008). Valentín Gómez Jáuregui compared the research of Emmerich, Fuller, and Snelson in *Tensegrity Structures and their Application to Architecture*. In this thorough study, he also explored the origins and uses (both realized and potential) of tensegrity.

Fuller continued to describe the invention as his own. Although he credited Snelson in this text with "an extraordinary intuitive assist," Fuller also stated that Snelson's invention merely brought Fuller to the next level in a discovery process that had been on-going since he had begun his Dymaxion research in structural geometry in 1927.[145] In the following paragraphs Fuller expanded on the limited role that Snelson's *X-Piece* played in the development of tensegrity: "Snelson thought of this only as a unique art form and...His depolarized orientation of the Tensegrity-octahedron universal joint catalyzed *my* comprehensive integration of the whole hierarchy of mathematical inter-relationships of *my* Tensegrity Structures with my Energetic-Synergetic Geometry [emphasis added]."[146] Echoing his earlier statements, Fuller dismissed Snelson as "only" an artist incapable of seeing the potential applications of tensegrity and claimed Snelson's discovery as a small piece of the puzzle on which he, Fuller, had been long at work.

In January of 1975, eight years before his death, Fuller gave a series of lectures recounting his life story and achievements. During the course of the forty-two hour lecture series, Fuller recalled the following about Snelson, starting with their initial time together at Black Mountain:

> I...gave him my energetic geometry, and he was absolutely in love with my energetic geometry. ...Then in the second summer at Black Mountain, Ken showed me a sculpture that he had made, and, in an abstract world of sculpture, and what he had made was a tensegrity structure. And he had a

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[145] Fuller, "Tensegrity," *Portfolio and Art News Annual*, 112-27, 144, 148.

[146] *Ibid.*, 112-27, 144, 148.

> structural member out here two structural members out here, that were not touching the base, and they were being held together held they were in tension. And I explained to Ken that this was a tensegrity. Man, I had found, had [previously] only developed tensegrity structure in wire wheels and in universal joints. ...So this is the only place I found that man actually had tensegrity. So when Ken Snelson showed me this little extension thing he did it was really just an arbitrary form, he saw that you could do it, but he was just, as I say, an artistic form or something startling to look at. And I said, "Ken, that really is the tensegrity and it's what I'm looking for because what you've done I can see relates to the octahedron and this gives me a clue of how this goes together in all the energetic geometry." So Ken opened up my eyes to the way to go into the geometry.[147]

Although in this talk Fuller credited Snelson with showing him the first tensegrity structure, Fuller also emphasized again that Snelson had not realized what he had made. Fuller claimed that for Snelson the project was "abstract," "arbitrary," and merely an "artistic form or something startling to look at." According to Fuller, Snelson did not see the importance of what he had made because he did not understand the potential for its practical applications. Fuller went on to describe how Snelson's contributions to the world since the late 1940s were in the purely artistic domain, which from Fuller's point of view meant they were not important or beneficial. As discussed further in Chapter

[147] Fuller, "Everything I Know," Session 8, Part 5.

Five, Fuller believed that artists' potential in their current role was limited and marginalized by their production of non-useful work.[148] However, Fuller marginalized Snelson's contribution when he stated that Snelson's use of tension-compression structures for sculpture is exemplary of the fact that artists exploit their ideas merely for their own benefit, rather than using their creativity to benefit the world.[149] From this perspective, it was indeed Fuller, not Snelson, who made the essential connection between creative thought and practical application in the discovery of tension-compression structures, which was the mark of the Dymaxion comprehensive designer—the individual uniquely positioned to save the world through his inventions.[150]

In another session of the 1975 series, Fuller returned to the topic of Snelson's contribution to tensegrity, and again limited his student's involvement, explaining that the idea of tension-compression structures had already been at play when Fuller designed his original Dymaxion House in 1929. Fuller stated, "I had been thinking and feeling tensegrity long before I got to identify it with my energetic geometry."[151] He concluded this section, stating:

> I say this to you because I feel tremendously tender about Ken Snelson, a very extraordinarily beautiful artist. Ken...was a real catalyst, and he changed completely my realization of how I could really use that in my

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[148] R. Buckminster Fuller, *Ideas and Integrities: a Spontaneous Autobiographical Disclosure*, ed. Robert W. Marks (Englewood Cliffs, NJ: Prentice-Hall, 1963), 76-8.

[149] Fuller, "Everything I Know," Session 8, Part 5.

[150] Fuller, *Ideas and Integrities*, 173-4.

[151] Fuller, "Everything I Know," Session 9, Part 13.

> energetic geometry. I had been wanting to use tensegrity, but he gave me all the key, and so I feel very greatly indebted to him. But, I say, he's gone on as an artist, and I think there is a, I know Ken terribly well, there were times when people would say Bucky is stealing your things and so forth, he doesn't think so anymore. He really appreciates what we are doing. But I want to be sure, I've never talked tensegrity without everybody knowing what a part this boy played in this victory.[152]

Here again, while recognizing his contribution, Fuller emphasized Snelson's chosen role as an artist with no interest in the practical application of his work. In Fuller's stumbling and occasionally affectionate speech, it is tempting to identify regret over the bitter rift that was well established between the former mentor and his student by 1975. In 1975, Fuller also published a massive volume called *Synergetics* in which he explained in detail his theory of Energetic Geometry and its applications, including tensegrity.[153] No where in this text is Snelson mentioned.

For Fuller, the importance of tensegrity was that it presented an alternative construction method that improved upon traditional means. Fuller believed that with the discovery of the right metals, tensegrity could be used to create structures that could expand infinitely with an inversely proportionate relative weight to size.[154] Throughout

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[152] Fuller, "Everything I Know," Session 9, Part 13.

[153] R. Buckminster Fuller and E.J. Applewhite, *Synergetics: Explorations in the Geometry of Thinking* (New York: Macmillan, 1975), 372-434 (700 chapter); Amy C. Edmondson, *A Fuller Explanation: The Synergetic Geometry of R. Buckminster Fuller* (Boston: Birkhäuser, 1987) is excellent companion guide for understanding Fuller's theories of Energetic Geometry presented in *Synergetics* (tensegrity is discussed in this volume on pages 233-57).

[154] Fuller, *Ideas and Integrities*, 171.

his life, Fuller made numerous contributions to physics and geometry, and among them was a definition of tensegrity typologies and proposals for architectural applications of the principle.[155] In 1959, he accepted a professorship at Southern Illinois University at Carbondale and raised the profile of the institution, drawing in almost 15,000 students and a ten-million dollar space project grant.[156] In 1964, he appeared on the cover of *Time*. The article described his forward-looking Dymaxion achievements, including the geodesic dome, revolutionary housing, his space-age car, and his tensegrity mast, hailing him as a "Messiah of Ideas."[157] Fuller published almost thirty books and became famous as a visionary, respected among engineers, architects, designers, and, eventually, environmentalists.

The fact that tensegrity has not found practical application in architecture or engineering is important to Snelson because it allows him to reclaim the discovery from Fuller. Snelson wrote: "I see the richness of the floating compression principle to lie in the way I've used it from the beginning, for no other purpose than to unveil the exquisite beauty of structure itself."[158] However, Snelson's patent, which includes plans for a flat roof and dome supported by tensegrity, demonstrates that in 1960 he believed in the possibility of practical applications for his invention. This fact is essential to understanding Snelson's artistic philosophy in the 1960s. Snelson's subsequent retreat

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[155] Fuller, "Tensegrity," *Portfolio and Art News Annual*, 112-27, 144, 148); Jáuregui, *Tensegrity Structures and their Application to Architecture*, 11.

[156] "The Dymaxion American," *Time* 83, no. 2 (January 10, 1964): 48.

[157] *Ibid.*, 48.

[158] "From Kenneth Snelson to R. Motro," *International Journal of Space Structures*.

into the purely artistic was perhaps the final solution to his dispute with Fuller. Labeling his invention as "art" without practical application allowed Snelson to make his success distinct from Fuller's achievements. By embracing an artistic identity, Snelson relegated himself safely to a domain that Fuller disdained.

The Artist as Engineer: 1959-1964

After receiving public recognition for the invention of tensegrity in the 1959 MoMA exhibition of Fuller's work, Snelson was inspired to return to sculpture. He picked up where he had left off in 1949 by reconstructing his plywood *X-Piece* and then started building new forms, using eight-inch aluminum tubes with bead chain (Figure 50) and dowels connected by nylon line (Figure 51). Over the following year, his small uptown apartment filled with structural experiments and industrial tools, including a large, loud circular saw, as he learned about the limits and possibilities of the building principle that he had happened upon over a decade earlier. His constant construction eventually began to arouse complaints from his neighbors and, as his pieces grew, he could no longer get far enough away from them to take photographs. This restriction sent him up to his roof for photo shoots of completed pieces, resulting one day, in the plunge of a large sculpture and his camera over the roof's edge. Luckily there were no human casualties from the incident, but it convinced Snelson that he needed to find a more appropriate space to work.

In 1960, Snelson leased the fourth floor of 148 Spring Street near Wooster (Figure 52). Decades before the area became fashionable SoHo, it was then occupied primarily by small factories and warehouses, and the narrow cobble-stone streets were crowded with trucks. Although not residentially zoned, work/live lofts were ideal for artists because they provided lots of space for very little rent. In fact, several of the artists with whom Snelson would share the stage in the following decade, Sol LeWitt, Robert Morris, and Carl Andre, lived or worked nearby in Little Italy.[159] Snelson secured his studio for seventy-five dollars a month with an unspoken agreement, common between artists and landlords, that a blind eye would be turned to his residency in the industrial building.

The loft allowed Snelson proximity to industrial production, which meant that the tools he needed were readily available and the noises he produced would go unnoticed. His studio was 2,375 square feet with three windowed walls, providing plenty of space and light for his sculptures. The wood floor was heavily scarred and patched with sheet metal. It was pierced with openings large enough to see through to the story below and sprayed with small holes where factory machines had been bolted down. The marred floor was mirrored by an uneven tin ceiling that had been repaired by many different hands. The loft featured a ceiling-mounted gas space heater, a large round stove, a utility sink, and two small walled-off washrooms, one of which Snelson had replaced with a stall shower and hot water heater. During business hours, his floor often buzzed from the machinery the leather and textile manufacturers on the lower floors, but Snelson had the building to himself in the evening and on weekends. Most importantly, perhaps, along with the ample space, the move downtown gave Snelson the feeling that he was now living like a true New York artist.

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[159] Meyer, *Minimalism: Art and Polemics in the Sixties*, 34.

The November 1962 issue of *Fortune Magazine* featured Snelson's work in a short article with four dramatic photographs (Figure 53). The article identified Snelson as a "structural designer," saying that his architectural method could be applied to electrical transmission towers and maybe even a space station, but conceded that "some see in Snelson's frames the beauty of abstract sculpture."[160] Snelson recalls that he did not "object to that term at that time" and that his self-identification was still complicated by the remnants of his relationship with Fuller.[161] Snelson explained, "I was thinking of grander things. I knew not what that was. Was I going to be another Buckminster Fuller in some fashion? He was an extremely powerful a presence at the time."[162] For Snelson, the idea of a Dymaxion comprehensive designer who could make an important contribution to the world, beyond aesthetic creations, still had potency.

Members of the architectural team at Robinson, Capsis, and Stern, who were working on the 1964-65 New York World's Fair site, saw the article in *Fortune* and commissioned Snelson to build a piece to go in front of the Electric Power and Light Company's Pavilion (Figure 26). The piece landed Snelson his first *New York Times* mention in a short article that compared his sculpture to "a gigantic grasshopper."[163] Because of the fair's union contracts, assembling the piece on-site would have been prohibitively expensive, so Snelson gathered a team of art students who put the piece

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[160] "Sculpture to Build With," *Fortune*, 121.

[161] Snelson, in discussion with the author, September 20, 2010.

[162] Snelson, in discussion with the author, September 20, 2010.

[163] *The New York Times*, "Artist Designs 30-Legged Giant for Utility Exhibition at Fair," January 28, 1964, Arts section.

together on an abandoned dock near the Manhattan Bridge. On March 19, 1964, the finished piece was airlifted by helicopter to the fair site in Flushing Meadows, Queens (Figure 54).

The world's fair was held in honor of the three-hundredth anniversary of the founding of New York City.[164] The producers' goal was to show a vision of a near future improved through science and technology.[165] Snelson's space-age construction in front of the Tower of Light presented a magical feat of engineering with its solid members almost appearing to float in air without support. In his history of the fair, Bill Cotter described the pavilion: "By day, the Electric Companies Tower of Light reflected sunlight off hundreds of aluminum-covered prisms. By night, the panels were lighted in pastel colors, creating one of the fair's most striking visual effects. From the center shone the world's brightest searchlight: a 12-billion-candlepower beam."[166]

Installed in front of the Tower of Light Pavilion, and commissioned by fair architects, Snelson's contribution to the world's fair campus was displayed as a work of engineering. Although fine art was not a major concern of the fair's principal planners,[167] Contemporary art was included in several gallery settings, such as the Art in New York

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[164] Bill Cotter and Bill Young, *Images of America: The 1964-1965 New York World's Fair* (Chicago: Arcadia, 2004); Lawrence R. Samuel, *The End of Innocence: The 1964-1965 New York World's Fair* (Syracuse, New York: Syracuse University Press, 2007); Robert Rosenblum, ed., *Remembering the Future: The New York World's Fair from 1939 to 1964* (New York: Rizzoli and the Queens Museum, 1989).

[165] Cotter and Young, *Images of America*, 13.

[166] Cotter and Young, *Images of America*, 63.

[167] Helen A. Harrison, "Art for the Millions, or Art for the Market?" in *Remembering the Future*, ed. Robert Rosenblum (New York: Rizzoli and the Queens Museum, 1989).

State show, held in the New York State Pavilion, that included work by Edward Hopper, Frank Stella, Willem de Kooning, Jackson Pollock, and Andy Warhol.[168] The façade of the New York State pavilion was also adorned with murals and sculptures by Contemporary artists, including Roy Lichtenstein, Robert Indiana, and John Chamberlain. Although installed in an architectural context, the public understood these pieces as fine art because the group included contributions by popularly known artists.[169] In addition, there were works of contemporary sculpture that were commissioned at the suggestion of the Committee on Sculpture made up of New York museum directors.[170] Installed on pedestals, the five sculptures the committee selected were also presented to visitors as art. In addition, three of the five were fairly traditional figural works, easily identifiable to a crowd unfamiliar with abstract sculpture.[171] In contrast, Snelson's piece was installed framing the entry way to the Tower of Light, suggesting that it was an architectural element—the work of an engineer or designer, rather than an artist.

Although the *New York Times* article about Snelson's world's fair piece identified him as an artist, the discussion closed with a quotation from the artist, stating, "It is something between art and science. ...A sculptor friend of mine said that this is not finality, not art, but I simply told him he is using an extremely limited definition of the

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[168] Lawrence R. Samuel, *The End of Innocence*, 134-6.

[169] Harrison, "Art for the Millions, or Art for the Market?," *Remembering the Future*, 160.

[170] Harrison, "Art for the Millions, or Art for the Market?," *Remembering the Future*, 142.

[171] The Committee on Sculpture commissioned *The Rocket Thrower* by Donald De Lue, *The Freedom of the Human* by Marshall Fredericks, *Armillary Sphere and Sundial* by Paul Manship, *Free Form* by José de Rivera, and *Forms in Space* by Theodore Roszak (Harrison, "Art for the Millions, or Art for the Market?," *Remembering the Future*, 142-8).

word 'sculpture.' But maybe it isn't sculpture…I don't care whether it's sculpture or not; I'm interested in structure."[172] It is clear from this statement that in 1964 Snelson was still uncertain about how he wanted to define himself professionally, and, demonstrating Fuller's continued influence, that structural concerns dominated over aesthetics ones. Practically speaking, Snelson's inclusion in the fair did not help him gain entry or exposure to the art world; however, he was paid $20,000 for his piece, which allowed him to buy an old farmhouse in Sagaponack, Long Island.[173] The property included two acres of land, giving Snelson room to start building large outdoor sculptures, and a barn that he converted into a studio (Figure 55).

During the excitement of the world's fair, the MoMA curator Arthur Drexler invited Snelson to contribute a maquette of a tower piece to *Twentieth Century Engineering*, an exhibition at MoMA that opened in June of 1964.[174] The other items in the show were models and photographs of innovative engineering projects, including Fuller's geodesic dome.[175] As Snelson later wrote, "I realized when the show was installed, mine was the only impractical object there."[176] For example, the images on view included radio towers, bridges, oil refineries, power stations, and storage facilities

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[172] *The New York Times*, "Artist Designs 30-Legged Giant for Utility Exhibition at Fair," Arts section.

[173] Snelson has stated that he received $15,000 and $17,000 for his World's Fair piece. $20,000 is the figure quoted in *The New York Times*, "Artist Designs 30-Legged Giant for Utility Exhibition at Fair," Arts section.

[174] Arthur Drexler, *Twentieth-Century Engineering.*

[175] This exhibition is discussed in Felicity D. Scott, *Architecture or Techno-Utopia: Politics after Modernism* (Cambridge, MA: MIT Press, 2007), 82-3.

[176] Snelson, *Not in My Lifetime*, 124.

(Figures 56-59). However, the show did have an aesthetic goal. Drexler wanted to show off the beauty that could be found in industrial engineering. His catalogue essay for the exhibition aimed to muddy the waters between the supposed aesthetic focus of architects and the practical aims of engineers, at one point noting, "engineers do have subjective, if not actually arbitrary, preferences for certain kinds of shapes."[177] In fact, a close affinity can be found between the photographs of industrial structures selected for exhibition and the rhythmic repetition of abstract geometric forms of a type of sculpture that was just beginning to come into vogue in 1964 (compare, for example, Figures 58 with 60 and 59 with 61). That said, Drexler's intent was to demonstrate beauty in useful constructions made by engineers, not objects created with aesthetic intent by designers, architects, or artists. It is clear then, that although Snelson was showing his work at MoMA for the second time, it was not yet seen as art.

Snelson the Artist: 1965 - Today

In the fall of 1965, Snelson began showing his portfolio to gallery directors.[178] After facing several rejections, Snelson approached Virginia Dwan, owner of the newly opened Dwan Gallery at 29 West Fifty Seventh Street. Immediately after reviewing Snelson's portfolio of large metal sculptures, Dwan asked if Snelson could be ready for a

[177] Arthur Drexler, *Twentieth-Century Engineering*, n.p.

[178] Prior to the Dwan show in 1966 in March of 1963, Snelson was the subject of a solo show, *Snelson Structures*, at Pratt Institute in Brooklyn that featured twenty-five sculptures (many of them small) and his atom. Located far from New York's art scene and open during a Newspaper strike, the show received little attention and was seen primarily by family and friends of the artist, along with members of the Pratt community.

show that spring. Surprised by the simplicity of the offer that would fulfill a long-desired dream, Snelson answered, "Could I!?"[179] Fifty Seventh Street was at that time the center of the established and fashionable New York art market, and a solo show at Dwan represented a tremendous opportunity for Snelson. Little has been written about Virginia Dwan, but she is associated with the rise of Minimalism in the United States, and her stable of artists came to include LeWitt, Andre, Robert Smithson, Ad Reinhardt, Agnes Martin, Dan Flavin, Robert Ryman, and Yves Klein.[180] An heir to the 3M fortune, Dwan had galleries in Los Angeles,[181] from 1959 to 1967, and in New York, from 1965 to 1971, that showed avant-garde art, sometimes with little sales potential. She described her taste for a "spare and clean" aesthetic, "the maximum content with the minimum of art."[182] Michael Kimmelman, in a 2003 *New York Times* profile wrote, "art dealing, at its best, is not just a business, and what made her a poor businesswoman made her a legendary dealer, the grande dame of the avant garde, or a part of it, briefly."[183]

Snelson's first show at Dwan in New York was open from April 12 to May 7, 1966 (Figures 15, 19, and 62-64).[184] Relatively young and inexperienced, Snelson recalls

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[179] Snelson, *Not in My Lifetime*, 134.

[180] The Center for Curatorial Studies in Contemporary Culture at Bard College, Annandale-on-Hudson, New York, holds the Virginia Dwan Gallery Archives that include checklists, photography, invitations, press releases, and reviews for exhibitions in Los Angeles and in New York.

[181] At 10846 Lindbrook Drive.

[182] Michael Kimmelman, "Art/Architecture; The Forgotten Godmother of Dia's Artists," *The New York Times,* May 11, 2003, Arts section.

[183] Kimmelman, "Art/Architecture; The Forgotten Godmother of Dia's Artists," *The New York Times*, Arts section.

[184] Virginia Dwan Gallery Archives, Series II, Box 4, Folder 25-7, CCS Bard College.

his excitement over every detail of the exhibition down to the Formica-covered stands custom built for the table-top sculptures selected for exhibition that included four tensegrity and five atomic models. The large pieces in the show, priced between $2,500 and $4,000, were *Audrey I*, 1965, and *Audrey II*, 1966, *Sagg Main Street*, 1966, and *Tower (Cantilever)*, 1962, an eleven-foot long horizontal "tower" that cantilevered from a wall.

For Snelson, the experience of his first gallery show was exhilarating and represented a definitive shift in how he defined himself professionally. He recollected standing in the middle of the room at the opening, feeling like he had "arrived"—that he had become a part of the world of "High Art."[185] In retrospect, Snelson felt that the Dwan show was the first time he could properly claim the role of artist.[186] He reflected in an interview: "So suddenly I was what they now call hot. I had an overnight name. It was wonderful and bewildering."[187] A positive review by John Canaday, who called Snelson's work "refreshing," appeared in the *New York Times* and brought in crowds.[188] However, despite Snelson's feeling that he had finally made an impact on the world of fine art, Canaday saw both artistry and engineering in the work: "Mr. Snelson's firmly engineered structures…are sculpture only by today's elastic definition that encompasses any three-dimensional work of art. Works of art these constructions certainly are, and an

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[185] Snelson, *Not in My Lifetime*, 138.

[186] Snelson, in discussion with the author, September 20, 2010.

[187] Snelson, in discussion with the author, December 8, 2009.

[188] John Canaday, "Art Constructions on the 'Tensegrity Principle,'" *The New York Times,* April 16, 1966, Arts section.

artist Mr. Snelson certainly is. But he is at the same time an engineer and his sculptures are exercises in structural theory…."[189] Canaday used the words "work of art" to indicate the beauty he found in Snelson's pieces, but also wrote that the work is distinguished from elegant feats of engineering, like bridges and radio towers, *only* because they are without functional purpose. In addition, the first sentence of Dwan's press release for the show stated that it was "As a student of Buckminster Fuller in 1948 at Black Mountain College" that Snelson had first discovered the tensegrity principle.[190] The presence of Fuller's role in Snelson's development had followed him to the gallery world of Fifty Seventh Street.

Immediately following Snelson's New York debut, Dwan began to plan a solo exhibition of his work for her Los Angeles gallery that opened from January 9 to February 4, 1967.[191] In addition to six table-top pieces, priced between $500 and $800, the show included five large-scale sculptures with prices set between $1,000 and $5,500: *Trigonal Tower*, 1963, *Audrey I*, 1966, *Vine Street*, 1966, *Six I*, 1966, *Column*, 1961-7 (Figures 17 and 65). Snelson accompanied his work to California and stayed at Dwan's rarely-used Malibu beach house, driving her Mercedes convertible to the gallery every morning during installation. The L.A. gallery was large and run by John Weber, who would later take over Dwan's stable of artists when she closed both locations. Recalling the opening, Snelson wrote, "once again I was star of the evening, feeling I was an

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[189] *Ibid.*

[190] Virginia Dwan Gallery Archives, Press Release for "Recent Sculpture," Series II, Box 4, Folder 25, CCS Bard College.

[191] Virginia Dwan Gallery Archives, Series I, Box 3, Folder 51-3, CCS Bard College.

enormous success and surely would never die."[192] The *Los Angeles Times*, and *Art International* positively reviewed the show and praised Snelson's work as "perhaps the most determined confrontation of new materials and structural techniques."[193]

Although the *Los Angeles Times* review of the Dwan show mentioned Snelson's relationship with Fuller, it gave the artist long-awaited independence from his one-time mentor: "Though related to the theoretical and practical expressions of Buckminster Fuller, this young artist's inventions are his own, attaining their taut artistry by being entirely non-functional. Snelson managed to combine artistic sensitivity and engineering discovery...."[194] The text again raised the importance of purposelessness for defining the distinction between the work of Fuller and Snelson, although the reviewer saw Snelson's work as a combination of artistry and engineering.

Concurrent with Snelson's California exhibition, Kurt Von Meier also wrote about the tensegrity sculptures, describing how Fuller's influence had caused Snelson to abandon art for engineering and science. Von Meier continued: "one might well raise the question of whether these beautiful things are engineering models or works of art. As for the artist—or model maker—he does not claim to know which category the things fall into. ...A series of fine examples of Snelson's work in the Dwan Gallery demonstrated certain characteristics of Art objects insofar as they did suggest a process of conceptual

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[192] Snelson, *Not in My Lifetime*, 145.

[193] Henry Seldis, "Snelson's Sculptures Imaginative," *Los Angeles Times*, January 16, 1867, Part IV, 10; Kurt Von Meier, *Art International* XI, no. 4 (April 29, 1967), 54.

[194] Seldis, "Snelson's Sculptures Imaginative," *Los Angeles Times*, 10.

change, or stylistic development, permitting them to be related art historically."[195] Here the role of Fuller in Snelson's career is emphasized again, and Von Meier mused whether Snelson's work is best considered as a feat of engineering or as art. Ultimately, he found aesthetic considerations to dominate and, therefore, defined Snelson as an artist and his creations as works of art.

That March, John Coplans interviewed Snelson for *Artforum*, signifying a new level of art-world recognition for the artist.[196] However, Coplans began the conversation with the same theme of Fuller's role in Snelson's development: "It has been generally assumed that your sculpture is based upon Buckminster Fuller's principles. I understand that the reverse is true—that the original idea involved in the structure of your sculpture was invented solely by yourself. Is this true?"[197] To set the record straight, Snelson responded, "It isn't that I have to protest, but it is annoying when people come up to me and say, 'Oh, Bucky's thing, I am awfully glad that somebody is doing something with it.' I started it and am still doing it!"[198] Later in the interview, Coplans addressed the issue of Snelson's professional identity when he asked if his work was seen primarily as a form of technology or engineering. Snelson replied: "Very much so. And I don't have any clear notion why this is so. A lot of people are still perplexed as to why I am involved in art and why I am not an engineer. The point is that engineering is quite

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[195] Kurt Von Meier, *Art International*, 54.

[196] Coplans, "An Interview with Kenneth Snelson," *Artforum*, 46-49.

[197] *Ibid.*, 46.

[198] *Ibid.*, 46.

restrictively concerned with the solutions to specific problems as service for some function. I am interested in finding how far you can push structure."[199] Snelson's response indicates that by 1967 he had begun to distinguish his work from that of the practical concerns of engineering. The real-world applications for tensegrity that appear in his patent and Snelson's one-time aspirations of being a Dymaxion comprehensive designer were put aside. By this time, Snelson had reinvented the idea of structural research as an artistic concern without applied considerations and distinguished his work from that of engineers based on his disinterest in functional projects. This was a tack he continued to use; for example in 1977, he defined himself as an artist by differentiating his work from that of physicists whose methods were mathematical and "removed from direct experience" and engineers who worked on "utilitarian" "problems."[200]

Snelson had a second show at Dwan in New York from January 6 to 31, 1968, showing *Double City Boots*, 1967, *V.X.*, 1967, *Six #2*, 1967 (on view from the collection of Joseph Hirshhorn and not for sale), two untitled large-scale pieces made in 1967, and a number of small models (Figure 66).[201] Emily Wasserman's critical review of the exhibition for *Artforum* was the first significant negative press that Snelson had received. It is perhaps representative of the start of the declining taste for Minimalism, in general, and Snelson's work, in particular. Wasserman questioned the "significance" of Snelson's sculpture work, writing: "As examples of a certain kind of superficial structural 'mathematics,' or as monuments to a svelte, modern look, they show how accomplished

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[199] *Ibid.*, 49.

[200] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[201] Virginia Dwan Gallery Archives, Series I, Box 5, Folder 23-5, CCS Bard College.

craftsmanship and a stylish intellectual skin are made to appear really Important. ...Despite all the costly looking sleekness, and the real attempts at structural complexity, Snelson's work for the most part runs itself out into nothing more than a rather vapid elegance."[202] Wasserman wrote that Snelson's sculpture had a polished appearance that spoke more to fine craftsmanship than to artistic innovation. Typical of a strain of critiques of Minimalism, she found the work lacking in substance and meaning. The reception in the *The New York Times* and *New York Post*, however, was much better and the show marked another success for Snelson.[203] In addition, Snelson continued his more defined stance towards his role as an artist, stating in a quote for the *New York Post* magazine: "The sculptures come as close as anything can to show what tension and compression as a technical means can do in a total structure. The pieces, however, have to stand on their own as a formal esthetic entity."[204]

Snelson's last Dwan exhibition was open in New York from March 7 to April 2, 1970.[205] This was a smaller show with six table-top works and only three large sculptures: *Osaka II*, 1969, *Landing*, 1970, and *Northwood II*, 1970 (Figure 67). The small pieces in this show were priced between $1,000 and $4,000, and the price for *Landing*, the largest work at thirty-two feet long, was $32,000. Just four years earlier,

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[202] Emily Wasserman, "Kenneth Snelson: Dwan Gallery," *Artforum* VI, no. 7 (March 1968): 58.

[203] Hilton Kramer, "Marsden Hartley, American Yet Cosmopolitan," *The New York Times*, January 20, 1968, Arts section; Charlotte Willard, "In the Art Galleries: The Third Dimension" *The New York Post*, January 13, 1968, Magazine section, 14.

[204] Willard, "In the Art Galleries: The Third Dimension" *The New York Post*, Magazine section, 14.

[205] Virginia Dwan Gallery Archives, Series II, Box 7, Folder 1, CCS Bard College.

Dwan had set the price for large Snelson sculptures between $2,500 and $4,000. The dramatically increased prices suggest that there was a growing appreciation and demand for Snelson's work among collectors.

Concurrent with the Dwan Gallery shows, Snelson participated in a number of group shows at museums.[206] A Snelson sculpture was included in the Whitney's *Annual Exhibition* in 1966, 1968, and 1970.[207] The *Annual* featured important of-the-moment artwork and was considered a rite of passage for successful young artists. Snelson also received an invitation from the curator Maurice Tuchman to build a piece for *American Sculpture of the Sixties* that opened at the Los Angeles County Museum of Art in 1967 (Figure 1).[208] The installation spanned both indoor and outdoor exhibition space and featured 166 works by eighty well-known sculptors, such as Andre, John Chamberlain, Mark di Suvero, Dan Flavin, Donald Judd, Ellsworth Kelly, LeWitt, Morris, Louise Nevelson, Isamu Noguchi, and Claes Oldenburg. The catalogue for the show included essays by some of the most respected critics of the day, including Clement Greenberg and Lucy Lippard. Also in 1967, *Vine Street*, 1966 (Figure 37), was included in *Sculpture: A Generation of Innovation* at The Art Institute of Chicago, alongside work by twentieth-century luminaries, including Alexander Calder, Alberto Giacometti, Joan Mirò, Henry

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[206] The exhibition history for Snelson's atomic work is discussed in Chapter Three.

[207] The *Annual Exhibition* at the Whitney was held from 1959 to 1970, alternating between paintings on odd years and sculpture and prints on even years. (After 1970, the tradition was continued with the *Whitney Biennial.*)

[208] Tuchman, ed, *American Sculpture of the Sixties*.

Moore, and Pablo Picasso.[209] From October to December of 1968, five of Snelson's pieces (*Four Module Piece: Form* I, *Four Module Piece: Form II*, *Avenue K*, *Needle Tower*, and *Six #2*) were shown in Bryant Park, behind the main branch of the New York Public Library, as part of the city's Sculpture of the Month program (Figures 20 and 68).[210] In 1968 and 1969, his work was also included in group shows at the Albright-Knox Art Gallery in Buffalo, The Philadelphia Museum of Art, and the Forth Worth Art Center in Texas.[211] In 1969, *Fair Leda* was included in *Twentieth-Century Art from the Nelson Aldrich Rockefeller Collection* at MoMA (Figure 69).[212] *Fair Leda*, created in 1968, must have been one of the most recent pieces in the exhibition that showcased the Modern and Contemporary art collection of the sitting Governor of New York State. Although it was the third time Snelson's work had been displayed in New York's premier center for Modern art, it was the first time it was shown there as sculpture, rather than engineering.

After his Dwan shows of the 1960s, Snelson's work did not appear again in New York galleries until 1981. However, in the late sixties and throughout seventies, he showed at galleries and museums and in civic installations in The Netherlands, Germany,

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[209] James Speyer, *Sculpture: A Generation of Innovation*, (Chicago: The Art Institute of Chicago, 1967).

[210] Grace Glueck, "Aluminum-Pipe Sculpture Rises Amid Verdure of Bryant Park," *The New York Times*, October 3, 1968, Arts section; *The New York Times*, untitled review of Bryant Park installation, November 23, 1968, Arts section.

[211] Douglas MacAgy, *Plus by Minus: Today's Half Century* (Buffalo: Albright-Knox Art Gallery, 1968); Evan Turner, *The Pure and Clear: American Innovations* (Philadelphia: The Philadelphia Museum of Art, 1968).

[212] Dorothy C. Miller, *Twentieth-Century Art from Nelson Aldrich Rockefeller Collection* (New York: The Museum of Modern Art, 1969).

and France.[213] In addition, in 1975 he was a recipient of the Deutscher Akademischer Austauschdienst (DAAD) fellowship and lived for a year in West Berlin. During the 1970s, his work was also included in group shows in the United States at the Art Institute of Chicago and the Detroit Institute of Arts, and in an outdoor installation in Grant Park in Chicago (Figure 16).[214] In 1981, he was the subject of a major museum show, accompanied by a catalogue, at the Hirshhorn in Washington, D.C. that traveled to the Albright-Knox Art Gallery in Buffalo and Sarah Campbell Blaffer Gallery at the University of Houston.[215] In the early 1980s, his work was also shown at the Birmingham Museum of Art in Alabama, The Tampa Museum in Florida, the Museum of Modern Art in New York, and the De Cordova and Dana Museum and Park in Lincoln, Massachusetts.[216] In the 1990s, his sculpture also began to be shown in Japan.[217]

Snelson reappeared in New York's gallery scene in 1981, and, since then, both his sculpture and photography have been the subject of frequent solo exhibitions. He showed

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[213] *Kenneth Snelson*, Krefeld Gallery, Düsseldorf, Germany, 1969 (traveled to Paris); *Structur und Spannung*, Kunstverein, Hannover, Germany, 1971; *Easy-K*, Sonsbeek Park in Arnhem, Holland, 1971; *Kenneth Snelson: Skulpturen*, Nationalgalerie, Berlin and Wilhelm Lehmbruck Museum, Duisburg, Germany, 1977.

[214] *Seventieth American Exhibition* (Chicago: The Art Institute of Chicago, 1972); E. C. Goosen, *Art in Space*: *Some Turning Points* (Detroit: The Detroit Institute of Art, 1973); Max Kozloff, *Sculpture in the Park* (Chicago: Auxiliary Board of the Art Institute of Chicago Grant Park, 1974).

[215] Douglas G. Schultz, *Kenneth Snelson*, catalogue essay by Howard N. Fox (Washington, D.C: Hirschhorn Museum and Sculpture Garden, Smithsonian Institutions, 1981).

[216] Edward F. Weeks, *Kenneth Snelson: Structures* (Birmingham: Birmingham Museum of Art1980); Rachel Rosenfield Lafo, *Kenneth Snelson: Panoramic Photographs*. (Lincoln, Massachusetts: DeCordova and Dana Museum and Park, 1985).

[217] There were exhibitions of Snelson's sculptures at the Yoh Art Gallery in Osaka, Japan in 1991 and1993 and a the Contemporary Sculpture Center in Tokyo, Japan in 1992 and 1995.

at Zabriskie (in both Paris and New York) in 1981, 1986, and 1990; Maxwell Davidson in 1994 and 1998; and Laurence Miller in 1994 and 2003. He has been represented by Marlborough Gallery since 1999. Marlborough has included Snelson's work in numerous group shows and has presented four solo exhibitions in 1999 (photography), 2003 (sculpture), 2009 (sculpture), and 2011 (photography and sculpture). In 2006, Snelson and George Rickey were the subject of a two-man show in the Jardins du Palais Royal in Paris, and in 2008 his design was selected to top the Freedom Tower, commemorating those who died in the September 11, 2001, attack on the World Trade Center.[218]

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Although there is a noticeable shift in 1966, following his first gallery show at Dwan, both in how Snelson considered his own professional identify and in how his work was defined by others, the idea that his sculptures are as much technical demonstration as art continued to haunt their reception throughout the 1960s. Almost all of the reviews of Snelson's shows at Dwan describe the presence of both artistic expression and engineering achievement, and many note Fuller's important role in Snelson's development. That both Snelson himself and others who have written about his work emphasize Snelson's link to Fuller seems to confirm the idea that Snelson has skills and interests that make him distinct from other artists. Indeed, structural ideas generally

[218] Robert Hobbs, *Deux Américains à Paris: Sculptures de George Rickey et Kenneth Snelson* (Paris: Jardins due Palais Royal, 2006).

associated with engineering and natural forces studied by physicists are of primary concern to Snelson and are at the heart of his work. However, following his initial successes in the art world, Snelson began to present himself as an artist, while distancing his work from the practical concerns of engineering. Therefore, while the importance of structure does represent a clear distinction between Snelson's sculptures and those by other sixties sculptors working in an abstract geometric mode, there are also many important factors that align Snelson's work with that of his peers. With this mind, the following chapter turns to the subject of the "new sculpture" of the 1960s that has come to be known as Minimalism. As I will demonstrate, this is an important historical context for understanding Snelson's work not only because his sculptures were understood to be Minimalist during the 1960s, but also because, during the height of this movement, his artistic practice was closely aligned with Minimalist thought.

CHAPTER TWO: SNELSON AND THE NEW SCULPTURE

In the mid-1960s a new kind of sculpture was introduced to the United States, called alternatively Primary Structures, Cool Art, ABC Art, or Minimalism. The movement, which first appeared among a New York City avant-garde in 1963 and began to lose dominance after 1968, demonstrated a reduction of visual complexity through a limited palette, geometric forms, simple organization, and few parts. What has come to be known as Minimalism is often understood as a "literalist" style, without metaphorical, symbolic, expressive, or emotional content. As Frank Stella famously said in 1966, "What you see is what you see."[219] Meaning there should be nothing further to understand about Minimal art than what is immediately, visually apparent; nothing to understand or to take apart.

Snelson's emergence as an artist coincided with the rise in popularity of Minimalism. Reviews from the 1970s and 1980s—when the taste for Minimalism had waned—commented on the "cool beauty" and "chills" of Snelson's work, showing a

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[219] Bruce Glaser, "Questions to Stella and Judd," *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 158.

continued association with what was also called Cool Art.[220] Similarly, a review from 1970 described the "vapid elegance" of Snelson's work, while another from 1981, stated that in the "precision" of Snelson's sculpture there was "more elegance than soul."[221] Although Snelson claimed that he "opted out of Minimalism,"[222] and that he was a "one man movement with no following,"[223] his disavowal actually aligns him with the figures most famously associated with Minimalism. Artists such as Dan Flavin, Donald Judd, Robert Morris, and Sol LeWitt also rejected the term and claimed unique and solitary status.[224] In addition, Snelson believes that the acceptance of his sculpture as fine art in the 1960s, rather than as a structural demonstration, was related to the rise of Minimalism.[225]

Howard Fox and Eleanor Heartney, the two art writers who have addressed Snelson's work most thoroughly prior to this study, both suggested that Snelson should not be considered a Minimalist. In a 1981 museum catalogue essay, Fox wrote: "His technical methods may well be severely disciplined by his structural principle and the

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[220] Paul Richard, "Kenneth Snelson's Symphonies in Steel: The Beauty of Pure Structure at the Hirshhorn," *The Washington Post*, June 4, 1981; Perlberg, "Snelson and Structure," *Artforum*, 46-9.

[221] Emily Wasserman, "Kenneth Snelson: Dwan Gallery" *Artforum* VI, no. 7 (March 1968): 58; Richard, "Kenneth Snelson's Symphonies in Steel: The Beauty of Pure Structure at the Hirshhorn," *The Washington Post.*

[222] Snelson, in discussion with the author, April 16, 2008.

[223] Snelson, in discussion with the author, October 30, 2008.

[224] Meyer, *Minimalism: Art and Polemics in the Sixties*, 6, 30, 80, 248-9; Frances Colpitt, *Minimal Art: The Critical Perspective* (Ann Arbor, MI: UMI Research Press, 1990), 3.

[225] Snelson, in discussion with the author, September 9, 2011.

formal options proscribed to a degree unusual in twentieth-century sculpture, but there is nonetheless a highly expressive and romantic side to his work that is apparent in the challenge that Snelson sets for himself to test and stretch the structural limits of his art."[226] Fox alluded to Minimalist practices by referring to Snelson's adherence to stringent external regulation, but concludes that Snelson's compositions are equally emotive and passionate. In her 2009 essay in Snelson's monograph, Heartney is more adamant in denying a relationship between Snelson and Minimalism and, like Fox, refers to his expressive Romanticism.[227] Fox and Heartney do not differentiate among Snelson's work chronologically, and I would argue that the "highly expressive" qualities they observed are aptly applied only to Snelson's post-1969 work. I demonstrate in this chapter that during the height of Minimalism, between 1963 and 1968, Snelson's sculptures were based on rigid geometric forms and often used repeating modules that created a static and dispassionate aesthetic. In contrast, starting in 1969, breaking with the Minimalist mode, Snelson began to use his tension and compression method to compose works of art that appeared less controlled and more the product of spontaneous and creative artistic decisions. The affinity Snelson showed for a Minimalist aesthetic during the mid-1960s demonstrates that he was engaged with the ideas and visual vocabulary employed by the leading practitioners of the movement while it was at its height. Therefore, when looking at Snelson's work in the decade in which it was initially received, his reception is best be understood in light of Minimalist theory.

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[226] Howard N. Fox, "Kenneth Snelson: Portrait of an Atomist," *Kenneth Snelson*, 13.

[227] Heartney and Snelson, *Kenneth Snelson: Forces Made Visible*, 24.

The style and philosophy of the new sculpture—what is now most commonly called Minimalism—were defined at the time through a series of essays and exhibitions. In addition to the visual evidence of the works of art themselves, many of Snelson's contemporaries published texts about their artistic philosophy and practice that provide important insight into their artistic intent. In the first section of this chapter, I review Snelson's work and aesthetic ideas in the context of period sources and show that Snelson was presented and received as part of this new sixties sculpture genre. In the second section, I further develop the idea that Snelson was engaged with the aesthetic and philosophical concerns of Minimalism while the style was at its height between 1963 and 1968, demonstrating the significant shift in his sculptural aesthetic and construction method in 1969. The final section of this chapter looks at recent scholarship on 1960s Minimalist sculpture to further assess the validity of addressing Snelson's work in this context. The overall aim of this chapter is to show that—contrary to existing literature and the artist's own beliefs—Snelson was not an outsider to the artistic mainstream during the period when his work first came into the public eye.

Although a deeper understanding of Snelson's work in light of current Minimalist scholarship presents challenges to this idea, there is a place for Snelson in the study of 1960s American Minimalism. Opponents of historic periodization of art might argue that there is little to gain by establishing a relationship between Snelson and Minimalism. However, as I demonstrate, Minimalism shaped the context in which Snelson's work was first exhibited and received as fine art. Understanding how Snelson's sculpture was perceived as "Minimalist," therefore, is essential to knowing about his place in the history of the new sculpture of the sixties, a moment of high visibility for American sculpture worldwide.

The New Sculpture: Minimalism

In 1966, the same year Snelson had his first show at Dwan Gallery, Minimalism made a considerable splash in the mainstream media and came into vogue. That year The Jewish Museum had the seminal and popular exhibition *Primary Structures* that helped to establish the look, ideas, and major players of Minimalism. The media attention included a photography feature in *Harper's Bazaar*, showing Judd and other artists paired with their wives or female gallery assistants in Minimalist fashions.[228] Although Snelson's work was not included in *Primary Structures*, throughout the 1960s he showed in the same venues and exhibitions as the artists that the show established as the leading proponents of Minimalism: Judd, Morris, LeWitt, Flavin, and Carl Andre.[229]

The Dwan Gallery was a home, along with the Green Gallery and Park Place, of the newly emerging Minimalist movement.[230] Virginia Dwan has not received much scholarly attention, but it is known that she was drawn to a "contemplative" quality, a

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[228] Meyer, *Minimalism: Art and Polemics in the Sixties*, 7.

[229] Meyer, *Minimalism: Art and Polemics in the Sixties*, 250.

[230] By the end of 1960s, critics would sometimes distinguish between the more rigorous Minimalism of the Green Gallery artists and the more dynamic work presented at the Park Place Gallery and elsewhere. However, the works from the two categories continued to be shown together at museum shows and received as Minimalism. See Meyer, *Minimalism: Art and Polemics in the Sixties*, 163, 265.

"spare and clean" aesthetic, and "the maximum content with the minimum of art."[231] In 1966, Dwan presented an important exhibition entitled *10* (or, *Ten Sculptors*), featuring one piece by each of the leading practitioners of the newly famous movement: Andre, Flavin, Judd, LeWitt, Morris, Robert Smithson, Jo Baer, Agnes Martin, Ad Reinhardt, and Michael Steiner.

In the introductory essay to the 1966 *Primary Structures* catalogue, the curator, Kynaston McShine, set out a list of ten "shared stylistic tendencies" that defined the look of what has come to be known as Minimalism.[232] These characteristics distilled formal traits from the analysis of the Minimalist "sensibility" that Barbara Rose described in a 1965 *Art in America* article called "ABC Art," one of the first essays that attempted to define the new movement.[233] Maurice Tuchman then essentially repeated McShine's characteristics in the introduction to Los Angeles County Museum of Art's *American Sculpture of the Sixties* exhibition catalogue of 1967.[234] Also in 1967, Clement Greenberg and Michael Fried applied a disparaging eye to Minimalism, penning two essential essays, "Recentness in Sculpture" and "Art and Objecthood," respectively.[235] The following section uses the period definition that appeared in these texts, along with

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[231] Michael Kimmelman, "Art/Architecture; The Forgotten Godmother of Dia's Artists," *The New York Times*, May 11, 2003, Arts section.

[232] McShine, *Primary Structures*, n.p.

[233] Rose, "A B C Art," *Art in America*, 57-69.

[234] Tuchman, *American Sculpture of the Sixties*.

[235] Greenberg, "Recentness of Sculpture," *American Sculpture of the Sixties*, 24-6; Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 125-8.

others from the time, to establish that Snelson's work related closely to and was originally received in the context of the new American sculpture of the 1960s.

McShine described how the works in the new style occupied a room in a specific way that controlled how a viewer experienced a space in a manner comparable to architecture.[236] Augmenting this effect, the sculptures did not have bases or pedestals and many were attached to the walls or ceilings. Comparably, Fried described the "non-art" look of the new sculpture and how the artist's concern with the viewer's physical relationship with the work gave it a sense of "theatricality," both of which helped such works of art to achieve a sense of what Fried called "objecthood," an identity as something non-mimetic or real.[237] Similarly, Greenberg discussed the sense of "presence" enhanced by size and removal from the look of "art."[238] McShine defined the surface treatment of Minimalist art as smooth, regular, and without added color or ornament.[239] Regarding the subject matter of the new sculpture, he wrote that they are nonrepresentational and do not imitate the world visually, but that they "contain irony, paradox, mystery, ambiguity, even wit, as well as formal beauty." Finally, McShine explained how the perfected surfaces of the sculptures were the product of "modern technology and industry," and that "impersonality" was achieved through factory construction based on the artists' designs.[240] Fried added to these ideas, explaining that

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[236] McShine, *Primary Structures*, n.p.

[237] Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 125-8.

[238] Greenberg, "Recentness of Sculpture," *American Sculpture of the Sixties*, 26.

[239] McShine, *Primary Structures: Younger American and British Sculptors*, n.p.

[240] McShine, *Primary Structures: Younger American and British Sculptors*, n.p.

the new sculpture was also meant to convey a sense of "wholeness."[241] Rather than discovering the works gradually by walking around them, the new sculpture was intended to be taken in at once in its entirety.

Philosophically, this new sculpture was seen as a reaction against the "unbridled subjectivity" of Abstract Expressionism with its painterly compositions infused with emotion.[242] Rose summed up the contrast: "Today we are feeling the impact of their decisions in an art whose blank, neutral, mechanical impersonality contrasts so violently with the romantic, biographical Abstract-Expressionist style which preceded it that spectators are chilled by its apparent lack of feeling or content."[243] The gestures and forms created by the artist's movement revealed a sense of his personality and individuality. In contrast, Minimalist art employed strategies to reduce evidence of the artist's hand and the influence of emotion and spontaneity the composition.

Like other sculptors of the sixties, Snelson's work created an architectural presence that had a physical affect on the viewer's experience through scale, use of space, and manner of installation. The large scale Snelson and many of his peers employed helped to transform their works of art into "real objects"—what Fried called "non-art"—that shared an architectural environment and plane of existence with the viewer, rather than appearing as a representative work, observed from a physical and psychological

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[241] Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 118-9.

[242] Rose, "A B C Art," *Minimal Art: A Critical Anthology*, 280.

[243] *Ibid.*, 275.

distance.[244] As Greenberg explained critically, "What seems definite is that they [Minimalists] commit themselves to the third dimension because it is, among other things, a coordinate that art has to share with non-art."[245] Similarly, Fried described how makers of the new sculpture eschewed painting in their desire to avoid the "pictorial illusion."[246] Because in painting three dimensions are depicted in two, illusion is necessary for naturalistic representation. Greenberg and Fried believed that Minimalists preferred the three-dimensions of sculpture over painting as one of their strategies to align their work with objects that were not works of art.

Looking at Snelson's *Tower (Cantilever)*, 1962, which protruded eleven feet off a wall, over the heads of gallery visitors in Snelson's first show at Dwan in 1966, helps to examine how these ideas were realized (Figure 64). Looking overhead, the viewer was forced to tilt her neck back to see the work when standing beneath it. The piece is architectural both in its scale and cantilevered suspension from the wall. Many of the other pieces Snelson showed at Dwan, such as *Audrey II*, 1966, and *Vine Street*, 1966 (Figures 15 and 17) conveyed what Greenberg called "presence" and Fried "objecthood" through just their sheer size, which forced viewers to stand back to take them in or to weave around them to transverse the room.

Morris's paradigm-setting show at New York's Green Gallery in 1964 demonstrated similar characteristics with large box-like elements that filled the floor,

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[244] Martin Friedman and Jan van der Marck, *Eight Sculptors: The Ambiguous Image* (Minneapolis: Walker Art Center, 1966), 18; Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 120-8.

[245] Greenberg, "Recentness of Sculpture," *Minimal Art: A Critical Anthology*, 183.

[246] Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 117.

suspended from the ceiling, and bracketed between the walls (Figure 70). All of the works in Morris's show had unadorned, flat finishes that closely resembled the painted walls of the rooms in which they were displayed. In his "Notes on Sculpture," Morris discussed how the size of a work of art affects how viewers interact with it: "A larger object includes more of the space around itself than does a smaller one. It is necessary literally to keep one's distance from large objects in order to take the whole of any one view into one's field of vision."[247] Morris's Green Gallery installation, like Snelson's at Dwan, was composed of large pieces often installed above and below eye level that controlled how viewers took in the work by forcing them to stand at a certain distance. In Morris's installation, platforms covered large portions of the floor obstructing free flowing passage through the galleries, not unlike the experience of Snelson's room-filling sculptures at Dwan.

Many of the sculptures included in *Primary Structures* and *American Sculpture of the Sixties* were also large scale and created a similar aesthetic effect. As Irving Sandler commented in the *American Sculpture of the Sixties* LACMA catalogue that meant that these works like Morris's and Snelson's not only dominated the rooms in which they were installed, but affected how people occupied the space.[248] For example, Ronald Bladen's piece at LACMA was composed of three enormous wooden rhomboids that stood on end segmenting the room in a way that made viewers weave to pass from one end to the other (Figure 60). While Robert Grosvenor's large yellow slide, connecting

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[247] Robert Morris, "Notes on Sculpture," in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 231.

[248] Irving Sandler, "Gesture and Non-Gesture in Recent Sculpture," in *American Sculpture of the Sixties*, ed. Maurice Tuchman (Los Angeles: Los Angeles County Museum of Art, 1967), 42.

floor and ceiling, forced viewers to duck to pass under its lowest end and crane their necks to see the work at its highest point (Figure 71). Similarly, McShine wrote of the work in *Primary Structures*: "The generally large scale of the work and its architectural proportions allow the sculpture to dominate the environment. At times the sculpture intrudes aggressively on the spectator's space, or the spectator is drawn into sculptural space."[249] Not only did the artists represented in this exhibition, like Snelson, create work with a strong and architectural presence through size, they also demonstrated creative use of architectural qualities by making work that extended off walls or hung from ceilings into the viewer's space. Critics took note of such installations, often with displeasure and scorn. Rose, for example, wrote that the positioning of Morris's sculptures served "mostly to destroy the contour and space of a room."[250] In his review of the *1966 Whitney Annual* sculpture show that included a piece by Snelson, Michael Benedikt similarly described, tongue-in-cheek, how the work of John McCracken "tampers" with the wall, while Morris's "tampers with the floor…[and] Finally an assault on the ceiling occurs in George Rickey's *Four Planes, Hanging*."[251]

Like scale, the elimination of pedestals and bases also changed the relationship between viewer and work of art. Hilton Kramer described this experience in a *New York Times* review of the *1968 Whitney Annual*, which also included piece by Snelson: "Sculptors are no longer interested in producing discreet objects for esthetic

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[249] McShine, *Primary Structures*, n.p.

[250] Rose, "A B C Art," *Minimal Art: A Critical Anthology*, 284.

[251] Michael Benedikt, "Sculpture as Architecture: New York Letter, 1966-67," in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 79.

contemplation. The whole ambience suggested by that most despised esthetic fixture—the pedestal—has been repudiated. It is not an object that sculptors now want to make but—no other word seems possible—a world. They have set up as active competitors with both nature and the architect."[252] Without pedestals, the viewer co-existed with sculptures without symbolic or visual separation. Work of arts by Snelson and his contemporaries were not displayed as removed objects to be merely reflected upon. Rather, they entered the human domain physically, through their large size and manner of installation, forcing viewers to engage and interact in new ways.

While these sculptures demanded a physical response from viewers, they employed a number of strategies to reduce the emotional and personal content they conveyed. To avoid what McShine described as the "emotionalism, improvisation, and emphatic marks of individual sensibility" sculptors of the period eschewed ornament, employed an industrial aesthetic, and minimized their decision-making processes.[253] The new sculpture both had the cold, unadorned appearance of machines and was often produced with the aid of mechanical devices and factory production to reduce the trace of the artist's hand in the finished product. John Coplans explained, in his essay for *American Sculpture of the Sixties*, that artists of Snelson's generation had a new level of comfort with technology and would not hesitate to acquire a new skill or piece of machinery to create a desired effect. These artists, Coplans wrote, saw machines as a

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[252] Hilton Kramer, "An Appetite for the Absolute," *The New York Times*, December 22, 1968, Arts section.

[253] McShine, *Primary Structures*, n.p.

prosthesis—"a convenient mechanical extension of the human eye and hand."[254] In keeping with this visual sensibility, Snelson's sculptures had the clean lines, pristine surfaces, and sharp edges of machine production, and their ornament was derived from the form itself. Judd employed similar gleaming metallic surfaces in his sculpture from this period, and the power of his work is also derived from repetitive, unadorned geometric forms. As discussed below, Snelson, like Judd and other artists of the period, had a more complicated relationship with factory-aided production than was discussed at the time. It is certain, however, that the perfected surfaces and immaculate construction of their work gave what McShine called the "impersonal" *appearance* of being industrially produced.[255] In addition, as John Perrault described, it was thought that these sculptors exalted machine production for its ability to "rationalize" or perfect and replicate: "The artist is often once removed from the actual execution of the work so that the automatism of the artist's hand does not interfere with the rationalism of the readymade or manufactured units involved."[256] Factory production implied a level of remove between the artist and the work of art that enhanced the dispassionate quality associated with both the aesthetic and philosophy of Minimalism.

Repeated modules within a piece, a popular device of the new sculpture, also suggested serial production associated with the factory, and during the 1960s Snelson favored module repetition and seriality in his work. Modularity refers to the use of

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[254] John Coplans, "The New Sculpture and Technology," in *American Sculpture of the Sixties* (Los Angeles: Los Angeles County Museum of Art, 1967), 22.

[255] McShine, *Primary Structures*, n.p.

[256] John Perreault, "Minimal Abstracts" in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 257.

repeating like forms, as in Judd's gleaming cubes (Figures 72-73) and many of Andre's pieces composed of industrial brick and metal tile units (Figures 74-75). Mel Bochner, an artist who also showed at Dwan, noted that the common bricks Andre often used themselves provided a "strict, self-imposed modular system."[257] The bricks, whose size was predetermined by commercial production, created the units, leaving Andre only to select the number to use and how to arrange them. By eliminating the use of any joinery and even stacking, Andre further limited his options until he could only arrange bricks in a single layer on the floor. Although Judd's metal cubes were created specifically for his work and to his specifications, they too limited Judd's final contribution the arrangement. Judd's use of identical objects spaced at identical intervals imbues his work with mathematical precision.

Seriality describes a systematic or mathematical relationship between repeating, forms. In serial work, the artist chooses the system before beginning the piece, giving up control of the composition to a predetermined set of rules. For example, in the 1970 wall piece seen in Figure 76, Judd uses the Fibonacci Number Sequence (0 1 1 2 3 5 8 13 and so on in which each number is added to the number before to produce the next) to dictate the size of both the solid purple elements and the spaces between them. In another example, *the nominal three (to William of Ockham)*, 1963 (Figure 77), Flavin used the minimum number of objects (six) necessary to build a numerically progressive series by arranging three groups of white commercially available florescent bulbs vertically on a wall. The first group is composed of just one element, the second of two elements (1+1),

[257] Mel Bochner, "Serial Art, Systems, Solipsism," in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 94.

and the third of three elements (1+1+1). The sculpture is an homage to the fourteenth-century English thinker, William of Ockham, best known for Ockham's Razor, "It is vain [or futile] to do with more what can be done with fewer," also stated “Plurality must never be posited without necessity.”

Snelson used several different forms of modularity and seriality in his work. Like Flavin’s *the nominal three*, Snelson’s tower structures (constructed 1968, 1969, and 1960-2006) are formed using a type of seriality called “numerical progression” (Figure 18). The stacked module units decrease in size by a predetermined ratio. Simple repeating modules can be seen in many of Snelson’s other 1960s pieces, such as *Vine Street*, 1966 (Figure 37), *Avenue K*, 1968 (Figure 20), and *Double City Boots*, 1968 (Figure 78). In *Avenue K*, for example, the basic unit is composed of two rods crossed three-quarters of the way up their length. This module is repeated five times on one side of the sculpture and inverted, so that the cross is one-quarter of the length from the ground, in a second set of five units. The two sets of five are arranged side-by-side so that the outward facing rods form a row of Vs on the ground and the inner facing rods form a row of Vs in the air. By repeating a simple cross ten times, Snelson created a sculpture that is structurally simple and repetitive, but visually complex.

In addition, more broadly speaking, Snelson’s fidelity to the geometry of tension-compression structures functions as an *a priori*, external regulatory system that is mathematically calculated. Art critics in the period noted this characteristic of Snelson’s work. For example, in a 1968 *New York Times* review, Kramer described Snelson’s use of tensegrity as "a strict delimitation of means."[258] In the same year, Stephan Kurtz wrote in *Art News* that, "The invention of this principle, in Snelson's terms, is the primary creative act. It determines a range of possibilities: what may and may not happen within certain limits."[259] Unlike an artist who can add or subtract to his work according to expressive whim, physical properties of the construction principle to which he adheres restrain Snelson's work. His sculpture is not the product of an on-going, emotion-fueled decision-making process, and Snelson does not see narrative or emotional content in his completed work.[260] As Bochner explained in his 1967 essay on seriality, the use of "Systematic thinking has generally been considered the antithesis of artistic thinking. Systems are characterized by regularity, thoroughness, and repetition in execution. They are methodical."[261] Similarly Perrault wrote, "There is, therefore, an automatism of geometry and necessary efficiency rather than that of materials or direction emotion."[262] By repeating a single unit the artist was not forced to make additional visual decisions that would reflect a self-conscious subjective creativity. The artist performed like a machine, mechanically replicating a module.

The use of serial elements was also a way for Minimalists to avoid "relational compositions" in which a visual balance is formed among disparate forms that the viewer

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[258] Kramer, "Marsden Hartley, American Yet Cosmopolitan," *The New York Times*, Arts section.

[259] Stephan A. Kurtz, "Kenneth Snelson: The Elegant Solution," *Art News* 67, no. 6 (October 1968): 48-51.

[260] Snelson, in discussion with the author, September 24, 2008 and December 8, 2009.

[261] Bochner, "Serial Art, Systems, Solipsism," *Minimal Art: A Critical Anthology*, 94.

[262] Perreault, "Minimal Abstracts," *Minimal Art: A Critical Anthology*, 257.

reads sequentially. In an essay on seriality that was published in the catalogue for *American Sculpture of the Sixties*, the critic Lawrence Alloway described this effect of seriality, mentioning the work of Snelson and LeWitt: "The use of standard units, in disciplined open arrays, shifts the emphasis away from incident, so that the work becomes a form visibly and continuously structured up and out from the basic unit. Modular-based sculptures, such as LeWitt's or forms in tension, like Snelson's, have this kind of structure, in which the unit remains distinct within the aggregate. ...They are firm examples of quantitatively rigorous structure."[263] Repeated use of a module, Alloway observed, creates a cohesive work without what he calls "incidents"—areas within a work that stand out for their difference and visual drama. Seriality and modular units allowed Minimalist sculptors to expand the size of their work without adding variation to the composition.

Similarly, Fried described how Morris and Judd "assert the values of wholeness, singleness, and indivisibility" in their work.[264] The idea of a unified whole, or *Gestalt*, was a popular principle in the 1960s taken from psychological theory and applied to art, in particular the work of Judd, Flavin, and Morris. Artwork with *Gestalt* wholeness was complete in itself and nothing outside was necessary for comprehension. Morris explained the experience of viewing an object with *Gestalt* effects as follows: "One sees and immediately 'believes' that the pattern within one's mind corresponds to the

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[263] Lawrence Alloway, "Serial Forms," in *American Sculpture of the Sixties* (Los Angeles: Los Angeles County Museum of Art, 1967), 14.

[264] Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 119.

existential fact of the object."[265] A simple form was preferable because to achieve *Gestalt* a sculpture should have a unitary aesthetic—the viewer should be able understand the form in its entirety at once, rather than sequentially. Even if the whole object cannot be seen immediately, with a simple form, the viewer is able to conjure a believable image of the entire piece in his or her mind. In accord with this philosophy, Snelson stated that because viewers could see through his sculptures they were able to "relate to all aspects at once."[266] Sculptors of the period often preferred polyhedrons (three-dimensional shapes with flat faces and straight edges), which Morris called "unitary forms," because even when complex, the viewer could comprehend their geometry quickly.[267] In keeping with this idea, most of Snelson's work from this period, including pieces such as *Vine Street*, 1966 (Figure 37), *Six II*, 1967 (Figure 66), *Double City Boots*, 1968 (Figure 78), and *Avenue K*, 1968 (Figure 20), utilize flat planes and regular triangles and squares.

Judd called the new work executed in this mode "specific objects," distinguishing it from earlier three-dimensional art (i.e. "sculpture").[268] For him, specific objects signified work in which "The thing as a whole, its quality as a whole, is what is interesting. The main things are alone and are more intense, clear and powerful. They are not diluted by an inherited format, variations of a form, mild contrasts and connecting parts and area. …In the new work the shape, image, color and surface are single and not

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[265] Morris, "Notes on Sculpture," *Minimal Art: A Critical Anthology*, 226.

[266] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[267] Friedman and van der Marck, *Eight Sculptors: The Ambiguous Image*, 18.

[268] Donald Judd, "Specific Objects," in *Arts Yearbook 8: Contemporary Sculpture* (New York: Arts Digest, 1965), 74-82.

partial and scattered. There aren't any neutral or moderate areas or parts, any connections or transitional areas."[269] Judd believed that creating a work of art as a unified object, without distinguishable composite elements, gave it greater impact. The piece would have more visual power if it could be taken in by the viewer in its entirety at one time. In contrast, traditional sculpture was hierarchical. As Judd described: "Most sculpture is made part by part, by addition, composed. The main parts remain fairly discrete. They and the small parts are a collection of variations, slight through great. There are hierarchies of clarity and strength and of proximity to one or two main ideas."[270] Comparing "specific objects" with "sculpture," Judd explained how typically artists provided visual clues that directed the order in which the viewer understood the composition. For example, Alexander Calder's mobiles are composed of many separate elements of different shapes and colors arranged without symmetry. The distinctions in size, color, and shape demand that the viewer become cognizant of each element individually. In comparison, many of Judd's pieces, such as his cube series that he began in the mid-sixties, use a single unornamented element in repetition (Figures 72-73). When viewing a set of Judd cubes, such as those installed at *Primary Structures* at the Jewish Museum, the eye is confronted with the complete visual consistency of identical units. This stark uniformity allows the viewer to understand the total form of the piece quickly and without examining the individual elements.

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[269] *Ibid.*, 79.

[270] *Ibid.*, 78.

In 1971, using a slightly different interpretation of *Gestalt,* Grégoire Müller discussed Snelson's adherence to *Gestalt* principles, and identified tensegrity as playing "the unifying role" in his work: "Snelson's dealing with this issue [*Gestalt*] is a unique and original one. ...He combines elements of tension and compressed elements until he reaches a point of balance between the two opposite system of forces; thus, in the finished sculpture, each element is an indispensable one and there is no place for the esthetic game of adding or subtracting freely different parts. He balances tension and compression until it is perfect in form and nothing can be taken away or added."[271] Müller described how the balance of tension and compression in Snelson work created a restricting discipline for his compositions and the *Gestalt* of the piece through a mandated economy of form. Each element of the work was unified and understood visually through its structural necessity.

1969: Before and After

Snelson does not identify development within his own oeuvre over time, yet from a chronological examination a clear trend emerges (see Appendix A). Snelson's sculptures discussed so far in this chapter, all created before 1969, belong to the symmetrical category, defined in Chapter One, with regular and static compositions. These pieces relate closely to the work of 1960s Minimalist sculptors. In addition, almost half of the sculptures Snelson created during this period used repeating modular units of

[271] Grégoire Müller, *Structur und Spannung*, ed. Lazlo Golver (Hannover, West Germany: Kunstverein, 1971).

geometric forms, including *Vine Street*, 1966 (Figure 37), *Module Piece: Form II*, 1968 (Figure 16), and *Avenue K*, 1968 (Figure 20). Starting in 1970, however, with pieces like *Free Ride Home*, 1974 (Figures 23-24), *New Dimension*, 1977 (Figure 27), and *Easy Landing*, 1977 (Figure 79), Snelson began to favor the more expressive and irregular forms of his dynamic mode. Comparing *Vine Street*, 1968, to *Easy Landing*, 1977, for example, helps to tease out the distinctions between these two aesthetic approaches. With its repeating composition of regularly spaced Xs, *Vine Street* uses simple, organized geometry that is static and stationary, while *Easy Landing* is a jumble of rods that create a more visually complicated and energetic work. While the rods in *Vine Street* are of uniform size and spaced regularly to form a repeating composition that the viewer can quickly read, there is no perceptible regularity to the size of the rods in *Easy Landing* or in their distance and angular relationship to one another. Instead, this variety requires that the viewer to take in the different elements of the work sequentially. The organized uniformity of the elements in *Vine Street* suggest that it was the product of dispassionate planning, in contrast with the chaos of *Easy Landing* that visually implies a process of spontaneous, and perhaps even emotional, composition.

I propose that this aesthetic shift demonstrates that while Snelson had engaged with the ideas and aesthetics of Minimalism during the 1960s, his Minimalist tendencies all but disappeared as the movement fell from favor at the end of the decade. As I have described in this chapter, during the height of Minimalism, Snelson limited his artistic presence in compositional decisions and improved the *Gestalt* or unitary wholeness of his work by creating pieces with simple geometry, repeating forms, and elements that were uniform in size. Although Snelson's post-1969 work retained a shiny, machine-perfected finish, these sculptures do not have the "impersonality" of his earlier work. The thrusting lines and disorganized look suggest an intuitive and spontaneous production process and a series of artistic decisions. The drama of these works, compared to the static look and repetition of Snelson's earlier sculptures, suggests a gestural quality that reflects the artist's emotions and personal narrative. Their more complicated compositions create a weak *Gestalt*, at least in 1960s terms. There is a "hierarchical" or "relational" systems of composition in which separate elements are balanced and taken in by the viewer one by one. These visual distinctions are in fact in keeping with the differences in Snelson's process employed when working in each mode. While determining the structure of Snelson's symmetrical sculptures is a matter of "figuring…out" the geometry, the form of the dynamic pieces is "discovered" through experimentation.[272]

Snelson's most radical departure from aggressively nonrepresentational and anti-anthropomorphic Minimalism are the sculptures, including *Forest Devil*, 1975-7 (Figure 22), *Dragon*, 1999-2000 (Figure 3), and *Sleeping Dragon*, 2002-3, (Figure 4), that purposefully mimic the form of living creatures.[273] These works not only suggest the movement of living things through their dramatic lines, but lean even further from abstraction through the zoomorphism of their titles. Moreover, Snelson describes the parts of these animal-like forms using parts of the body (head, back, etc.).[274]

Snelson's post-1969 work relates to sculpture that has been understood as Abstract Expressionist. The first generation of sculptors in this group—artists who

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[272] Snelson, in discussion with the author, December 8, 2009.

[273] McShine, *Primary Structures*, n.p.

[274] Snelson, in discussion with the author, December 8, 2009.

became known in the United States following World War II—included David Smith, Ibram Lassaw, Herbert Ferber, and Seymour Lipton.[275] Sculptors from Snelson's generation, who rose to fame after the 1950s and were also understood to work in an Abstract Expressionist mode, included John Chamberlain, David Smith, and Marc di Suvero.[276] Of these expressionistic sculptors, the visual similarity between Snelson's work and di Suvero's is most clear and, in fact, the two artists shared the stage in a group show in Chicago's Grant Park in 1974.[277] For example, di Suvero's *Nova Albion*, 1964-65 (Figure 80), is a construction of tree trunks and steel bars, connected and suspended by steel cables. Like Snelson's sculptures created after the 1960s, this piece uses geometric forms along with expressive lines. As Judd described, "Di Suvero uses beams as if they were brush strokes, imitating movement, as Kline did."[278] The emotional gestures in such works, by both di Suvero and Snelson, gave these sculptures a "naturalistic and anthropomorphic image" distinct from Minimalism's calculated reduction of human emotions, decisions, and appearance.[279] Echoing Greenberg, Rose

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[275] Wayne V. Andersen, "Looking Back From The Sixties," in *American Sculpture of the Sixties* (Los Angeles: Los Angeles County Museum of Art, 1967), 15-6.

[276] Andersen, "Looking Back From The Sixties," *American Sculpture of the Sixties*, 15, 17; Barbara Rose, "Post-Cubist Sculpture," in *American Sculpture of the Sixties* (Los Angeles: Los Angeles County Museum of Art, 1967), 37.

[277] Snelson and di Suvero were members of ConStruct along with Charles Ginnever, John Raymond Henry, and Lyman Kipp. It was a short-lived organization spearheaded by Henry founded with the aim of circumventing the gallery system that took 50% of sales. It was run as a cooperative with pooled profits. Each of the member artists held stock in ConStruct Incorporated. The group got some exposure in Chicago, but the venture was ultimately unsuccessful due to lack of central management (Snelson, in discussion with the author, September 20, 2010).

[278] Judd, "Specific Objects," *Arts Yearbook 8: Contemporary Sculpture*, 78.

[279] *Ibid.*, 78.

credited di Suvero with disseminating a "drawing in air" technique, which related closely to the gestural painting of Abstract Expressionism.[280] Similarly, Snelson's sculptures from the 70s and after employed drama, variety, representation, and naturalism.

New Ideas about the New Sculpture

Up until this point in this chapter, I have depended on period sources to define Minimalism to explore whether Snelson's work was in keeping with how the movement was presented and addressed in the 1960s. In the following section, I will turn to more recent literature, some of which suggests revisions in how Minimalism is considered, to explore further the relationship between Snelson and the new sculpture of the sixties. James Meyer's discussion in his 2001 text on Minimalism is structured in part by examining how artists approached two of the most criticized aspects of Minimalist art. First, that Minimalist work was "not-art-enough"—that through reduction of visual elements the sculptures had been rendered boring at the very least, and perhaps even so simplified that they could not be considered art at all. Second, based on critiques by Greenberg and others, that the artists who made Minimalist sculpture were too removed from the process of production, and not enough labor, skill, and emotion went into creating the piece.[281] Considering Snelson's work in both of these contexts sheds more

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[280] Rose, "Post-Cubist Sculpture," *American Sculpture of the Sixties*, 37.

[281] Meyer, *Minimalism: Art and Polemics in the Sixties*, 4, 81; Greenberg, "Recentness of Sculpture," *Minimal Art: A Critical Anthology*, 180-6.

light on what defined him as an artist and how his work can be differentiated from others of the time.

Although it seems contradictory to their literalist approach, Meyer theorized that Minimalist artists used illusionistic effects to achieve visual interest without sacrificing their adherence to simple geometry and regular compositions.[282] For example, Meyer wrote that through his use of reflective surfaces and repetition, Judd's Plexiglas and stainless-steel boxes confound the observer's sense of space, proportion, and directionality (Figure 73).[283] Comparably the floating arms and platforms of the 1960s sculptures described in this chapter challenged gravity and drew attention to ideas of weightlessness. In this vein, one of the remarkable traits of Snelson's work is that from far away the rods appear to float in space, unsupported. His pieces with long expanses of airborne tensile construction, such as *Tower (Cantilever)*, 1962 (Figure 64) and *Cantilever* (Figures 1-2) seem to defy the power of gravity even when the connecting cables are visible. In addition to having the appearance of levitation, Snelson's sculptures literally dispense with gravity. Most three-dimensional art composed of multiple parts depends on gravitational force. For example, if released in outer space, a cast-bronze figure by Auguste Rodin would become separated from its base and an earthwork by Smithson would become individual particles of dirt. A Snelson sculpture, in comparison, gains structural integrity through a balance of tension and compression

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[282] Meyer, *Minimalism: Art and Polemics in the Sixties*, 121-43.

[283] Meyer, *Minimalism: Art and Polemics in the Sixties*, 138.

and would therefore, hypothetically, remain immune to gravity and therefore unchanged in space.[284]

Grosvenor's work also employed gravity-defying drama. His extraordinary cantilever, shown in *American Sculpture of the Sixties*, extended impossibly far and high from its base (Figure 71), and his piece for *Primary Structures*, *Transoxiana*, 1965 (Figures 72 and 81) was a robust, thirty-one foot V-form that suspended from a single connection to the ceiling with extraordinary visual drama. Also defying gravity, Bladen's over-size and heavy rhomboids, included in both *Primary Structures* and *American Sculpture of the Sixties* (Figure 60), lean an impossible-looking sixty-five-degree angle making the viewer question how they do not topple to the ground. In the *American Sculpture of the Sixties* catalogue, Bladen described the visual excitement he found in gravity-defying moments: "My involvement in sculpture outside of man's scale is an attempt to reach that area of excitement belonging to natural phenomena such as a gigantic wave poised before it makes its fall or man-made phenomena such as the high bridge spanning two distant points."[285] Bladen was drawn to the large scale and drama he found in the awe-inspiring physical feats achieved in nature and by man. David von Shlegell, created pieces such as *The Wave*, 1964 (Figure 82), and *Untitled*, 1967 (Figure 83), stated similarly in the *Primary Structures* catalogue that he "would like to build sculpture a mile high based on the most tenuous and delicate of intuitions."[286] By challenging the physical limits of the possible and utilizing the drama of illusion and the

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[284] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[285] Tuchman, *American Sculpture of the Sixties*, 44.

[286] McShine, *Primary Structures*, n.p.

aesthetic of weightlessness, Snelson and many of his contemporaries made works that achieved visual excitement despite relative simplicity of form.

One way that Snelson's work differs from that of Judd, Smithson, Grosvenor, Bladen, and the other artists of this time who played with ideas of weight and illusion, is that Snelson employed the aesthetic of *Durchsichtigkeit* (that which can be seen through). Snelson stated, "It is most attractive to me to see through the sculpture—to view the other side at the same time and relate to all aspects at once."[287] With the exception of artists such as LeWitt (whose 1960s sculptures could also be "seen through") and Flavin (who worked primarily with florescent bulbs), many of the artists associated with Minimalism used substantial, opaque geometric boxes to compose their sculptures. The heaviness of much of this work was emphasized through large expanses of matte-finished surface. Morris was particularly well known for using this device and favored solid painted wooden forms. In contrast, Snelson's sculptures are composed of slender, gleaming rods and metal cables so thin they disappear at a distance, and he disdained works that enclosed space for "redundant use of material."[288]

Among art writers in the 1960s, the dominant perception was that artists associated with the new sculpture were enamored with machine production and new materials. This belief is reflected in essays by many art historians and critics of the time, including the *Primary Structures* curator McShine and Martin Friedman and Jan van der Marck who curated a show of Minimalist sculpture at the Walker Center in

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[287] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[288] Snelson, "How Primary is Structure," *Art Voices*, 83.

Minneapolis.[289] More recent scholarship has examined the issue of production and materials again, however, finding this previously established generalization problematic. Looking more closely at individual artists' ideas about materials and techniques helps both to compare and contrast Snelson with his Minimalist contemporaries. Snelson explained that "very practical reasons" motivated his decisions: "There's nothing that can do better in surviving the elements than stainless-steel aircraft cable, and the tubular materials that I use: stainless steel or aluminum, depending on various considerations, they're the best I can do."[290] Snelson believes that the choices he makes about materials are not infused with emotional or symbolic meaning. When asked in an interview about having an "emotional attachment" with his media, Snelson answered jokingly, "I would say that I do. Aluminum and stainless steel pipes and wire rope and I are old friends and old enemies, both. I struggle with them, we fight; I usually win."[291]

Snelson's adherence to practicality when it came to choosing materials is an attitude shared with many other 1960s sculptors. For example, LeWitt switched from wood to steel in his cube structures because it was sturdier and better able to retain crisp edges and absolutely regular forms. Before his more material-based work of the late sixties, Morris made a similarly motivated switch from plywood to fiberglass.[292] Like Snelson, these artists used whatever materials would best help them achieve the look that

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[289] McShine, *Primary Structures*, n.p.; Friedman and van der Marck, *Eight Sculptors: The Ambiguous Image*, 22.

[290] Snelson, in discussion with the author, December 8, 2009.

[291] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[292] Colpitt, *Minimal Art: The Critical Perspective*, 11-3.

they wanted. The selection was not about the materials *per se*, but about achieving a visual ideal of perfected surfaces, in which the artist's hand is invisible. For Judd, Morris, Flavin, Andre, and LeWitt the importance of their production methods and materials was that they did not reflect their "subjective selves."[293] Whether using readymade materials like Andre and Flavin, factory-enhanced or produced elements like Judd, or studio-built pieces like Morris and LeWitt, the aim of these artists was to avoid emotional expression and the personal. As Judd stated: "It [a painterly quality] certainly involves a relationship between what's outside—nature or a figure or something—and the artist's actually painting that thing, his particular feeling at the time. This is just one area of feeling, and I, for one, am not interested in it for my own work. I can't do anything with it. It's been fully exploited and I don't see why the painterly relationship exclusively should stand for art."[294] Judd, expressing an artistic theory that he shared with many of his peers, explained that aspects of a work of art that draw attention to the artist's hand, such as an imprecisely welded seam, make apparent the external subject of the artist and his interpretation. By obscuring any evidence of the artist's presence, the work of art's existence as a thing in its own right, rather than the creation of an artist, is enhanced. Snelson's work with its perfected surfaces and machine-age appearance is in keeping with this ideal.

Although Snelson and his contemporaries shared the desire for machine-perfected surfaces, there was a wide range when it came to theories of production. For example,

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[293] Meyer, *Minimalism: Art and Polemics in the Sixties*, 172.

[294] Glaser, "Questions to Stella and Judd," *Minimal Art: A Critical Anthology*, 161.

according to Meyer, Morris and Judd took opposing stances on this issue.[295] Once he was able to afford factory fabrication, Judd had his sculptures made for him in accordance with his designs.[296] He disdained the handmade look, and to express his visual ideas fully, his work required the perfection that could be gained only through the professional use of machines. Meyer, however, argues in opposition to popular conceptions, that Judd did not exalt the use of industrial technology or mass production in making art.[297] To support his argument, Meyer demonstrates that in interviews, Judd adamantly explained that his sculptures were the product of artisanal metalworking techniques from the nineteenth century.[298] And, in fact, the factory that Judd used was family run and too small for assembly-line production.

In contrast, although many of Morris's sculptures also had the perfected look of machine technology, he favored the handmade, and his artistic process was an important component of his work.[299] This emphasis can be clearly observed in *Box with the Sound of its Own Making*, 1961, a rough-hewn wood cube that referenced its own production through recorded hammering noises. Morris showed this piece and others like it alongside his purely geometric compositions. That said, this aspect of Morris's artistic philosophy was often not appreciated in the sixties, and if anything, overlooked in favor of the more polished forms. For example, in a 1966 Walker Art Center catalogue essay,

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[295] Meyer, *Minimalism: Art and Polemics in the Sixties*, 54.

[296] *Ibid.*, 57-60.

[297] *Ibid.*, 60-1.

[298] *Ibid.*, 60-1.

[299] *Ibid.*, 53-4.

his work is described as "seamless [with a] continuous and non-textured surface" and demonstrates "no interest in the 'truth to materials' dictum."[300]

An examination of Snelson's ideas about production demonstrates that he shares ideological elements with both Morris and Judd; however, this comparison also more profoundly brings into focus what makes Snelson's work different. Echoing both Bauhaus ideology and the Arts and Crafts movement outlook of William Morris and John Ruskin, Snelson believes that having the knowledge to produce the different elements of his sculptures is a key part of being "the artist." This production philosophy is in direct contrast with the theory Caroline Jones proposes in *Machine in the Studio*, in which she described how the 1960s artist adopted a hands-off corporate managerial role.[301] As Snelson explained:

> I like to do things by myself, really. I like to have the knowledge that I knew how to do it and did it. In part I suppose, it's an absorbed sense of ethics. Which is really ignored in today's world. I mean, people just make a sketch and then find someone who's smart enough to do it. Even when I was shooting movies, I had the lingering sense that I really should perforate the film myself, in order to really say this was mine. I had this feeling that that would be the proper way to do it.[302]

The process of production is extremely important to Snelson, and he believes that an artist should know how to execute his own visual ideas. Snelson not only developed the

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[300] Friedman and van der Marck, *Eight Sculptors: The Ambiguous Image*, 18.

[301] Jones, *Machine in the Studio*.

[302] Snelson, in discussion with the author, September 20, 2010.

basic structural principle of his work, but also designed the connecting hubs and performed most aspects of fabrication himself for many years. As he was developing his artistic practice in the late 1950s and early 1960s, Snelson taught himself to use the machine shop equipment that he needed to produce the component rods and cables.

Snelson's emphasis on the knowledge of production and its execution can be contrasted to the idea presented by "procedural" art, such as LeWitt's wall drawings. In such work, the artist creates the instructions for producing the work of art, but does not physically make the piece itself. Although Judd's factory-produced sculptures are not procedural art because they cannot be replicated infinitely from the artist's directions, their creation was similarly hands off. However, Kenneth Baker wrote that Minimalism demonstrated a "shift in emphasis from product to process.... Concepts are metaphorically prior to things and render them intelligible."[303] In this light, there is a correlation between Snelson's knowledge that allows him to make structures based on tension and compression and Judd and LeWitt's intellectual mastery over their projects. All three artists valued the cerebral, conceptual portion of their work. In contrast, Snelson believes that the role of the artist should include both the idea for a work of art and its execution. In Snelson's sculptures, the conceptual is in fact one and the same with the act of manual assembly because the physical composition, the balancing of tension and compression members, is essential to the piece's meaning.

Nonetheless, Snelson's desire to have mastery over all areas of production had practical limits. Despite his growing knowledge of machine-shop skills, the pristine

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[303] Baker, *Minimalism: Art of Circumstance*, 95.

aesthetic he wanted for his work has, like Judd, always required him to contract out aspects of production.[304] For example, when Snelson experimented with different surface treatments in pieces such as *Audrey I and II*, 1966 (Figures 13-15), and *Black E.C. Tower*, 2006, the tubes were powder coated with porcelain or anodized in a factory. Also like Judd's metal boxes, Snelson's decision to use factory production for aspects of his production was based on the desire to realize his aesthetic vision in the best manner possible, rather than a predilection for out-sourced manufacturing. It is important to stress that Snelson, like Judd and LeWitt, would not have been satisfied with an obviously handmade appearance. However, because of Snelson's belief in the importance of the artist's role in the production of works of art, through practice and stubborn desire, he was able to reconcile his visual ideas with his own abilities and the expertise of others.

Snelson's development of the hub that connects the rods and cables in his work is unique among his peers, and, therefore, its importance cannot be overstated. Snelson explained: "The kinds of connections which unite two parts of the sculptures are vitally important in my view. That very point of contact of one part to another is, in each case a miniature structural element which expresses the same attitude involved in the total sculpture."[305] Elsewhere he wrote succinctly, "seams are the essence of form."[306] To wed the elements of their sculptures, most 1960s three-dimensional artists used basic techniques such as carpentry, glue, and welding, sometimes hidden by paint. In contrast,

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[304] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[305] *Ibid.*, n.p.

[306] Snelson, "How Primary is Structure," *Art Voices*, 83.

Snelson's elegant and technically sophisticated joint of his own design is an important part of his art. Moreover, it is essential to Snelson's artistic philosophy, again recalling the values of the Arts and Crafts movement, that the joints are revealed to the viewer. Yet, these works go beyond simply acknowledging the technology of their own manufacture. Snelson's sculptures are *about* their structure. Therefore, how the piece is assembled is as important as how it looks.

One of the critiques that Snelson leveled against his 1960s contemporaries was that their sculptures were not "structures" because there was no visible reference to how they were constructed. When discussing LeWitt's work, as quoted in a 1977 *Artforum* article, for example, Snelson stated: "I noticed in the publicity blurb he [LeWitt] chose to call them structures. Now to me they're not structures at all. They're carved-out shapes of metal. They're all painted over white so that nothing shows where the joinery occurred, so therefore they're void of any reference to structure."[307] Snelson objected to a LeWitt sculpture being considered a "structure" because its manner of construction was visually unimportant and obscured. In this quotation, Snelson echoed an opinion that he had first publicly expressed in a 1966 essay in *Art Voices*. At that time, still a young art-world outsider, he railed dramatically against the "conspiracy to make the words 'form' and 'structure' mean the same thing."[308] Snelson wrote: "Wooden, steel or formica boxes although they may originally have required assembly, *are not* an expression of structure if they have been covered over as if the forms were made from *one* piece of material.

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[307] Perlberg, "Snelson and Structure," *Artforum*, 46-9.

[308] Snelson, "How Primary is Structure," *Art Voices*, 83.

Such objects are simple *forms* perhaps, but not primary structures."[309] Snelson firmly believed the term "structure" should be applied only to sculptures whose method of construction was both visible and essential to its form. Similarly, when asked to comment on the *Primary Structures* show in 1966, he stated: "What I find quite fantastic is that none of the sculptures in the *Primary Structures* exhibition at the Jewish Museum were structures: they were constructions or assemblies. Structure to me is involved with forces, the stressing of pieces together, the kind of thing you find in a suspension bridge, for example. It is a definition of what is going on to cause that space to exist."[310] Unlike the work of the Minimalist sculptors exhibited in *Primary Structures*, Snelson's sculptures make visible the essential physical principles that constitute their construction. Snelson is concerned quite literally with primary structures.

Meyer defines Minimalism as a debate, writing: "We come closer to the truth in viewing minimalism not as a movement with a coherent platform, but as a field of contiguity and conflict, of proximity and difference."[311] According to Meyer, in the 1960s, artists working in the Minimalist mode were better able to sharpen their own artistic philosophies through comparison with their contemporaries, and scholars can now understand their work better by examining their contrasting and conflicting views. By looking at Snelson's production ideology as more solidly based on structural concerns compared to that of his peers, it is evident that he was indeed engaged with the questions

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[309] Snelson, "How Primary is Structure," *Art Voices*, 83.

[310] Coplans, "An Interview with Kenneth Snelson," *Artforum*, 49.

[311] Meyer, *Minimalism: Art and Polemics in the Sixties*, 4.

artists of his day addressed, and like many of his contemporaries believed that he had found the correct solutions to these artistic challenges.

That said, there is an intellectual or conceptual quality to Minimalism that is not present in Snelson's work. As a 1977 article states, "Snelson is not a Conceptualist. He regards himself only as a formal sculptor, and as formal structures his work has specific and definite meaning."[312] Despite belief in the primacy of the visual, many of the Minimalists wrote extensively about their own work and artwork in general. They explained the philosophy of their artistic practices in treatises and articles, and engaged in on-going debate among themselves.[313] In contrast, Snelson's reflections on his work are concrete and succinct. For example, each of the artists included in *American Sculpture of the Sixties* provided a statement for the exhibition catalogue. Many of these go on for several paragraphs, while Snelson's states simply and in a single sentence: "My concern is with nature in its most fundamental aspect: the patterns of physical forces in space."[314] Snelson is unwilling to admit to any additional intellectual content in his work beyond the ideas related to structure and physical forces. In his unpublished memoir, he wrote, "I was never taken with manifestoes…for regardless of the artists' pronouncements, people either respond to the art or they don't."[315] In this way, his essay on structural sculpture notwithstanding, Snelson does not share the philosophical tendency that typified many of

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[312] Perlberg, "Snelson and Structure," *Artforum*, 46-9.

[313] McShine, *Primary Structures*, n.p; Colpitt, *Minimal Art: The Critical Perspective*, 4.

[314] Tuchman, *American Sculpture of the Sixties*, 52.

[315] Snelson, *Not in My Lifetime*, 90.

the 1960s generation of artists.[316] In fact, this is a distinction that Snelson himself has felt acutely and emphasizes in his personal narrative. Although he is knowledgeable in many and diverse areas, he prides himself on being plainspoken and is skeptical of complicated artistic theory. Despite his half century in New York's art world, he continues to self-identify as the outsider he truly was when he attended the heated lectures at the Artists Club in the 1950s.

This outsider status is in part based on biographical differences. Unlike Judd, LeWitt, Morris, Flavin, and Andre, Snelson spent his entire youth in the rural West and only arrived in New York as an adult in 1950. Unlike Snelson, each of these artists, with the exception of Flavin (who studied at the New School and Columbia University, in addition to Catholic seminary), holds a bachelor's degree. Judd and Morris also had master's degrees in Art History. Art historians have suggested that the theoretical nature of Minimalist art is related to the practitioners' familiarity with history, philosophy, and art of the past.[317]

Although artists like Judd and LeWitt emphasized the visual in their work, demanding that there was no symbolic or emotional content, their work was not without meaning. As Rose states, "The simple denial of content can in itself constitute the content of such a work."[318] The creation of their "content-less" art demanded a studied use of strategies such as a strong *Gestalt*, geometric form, and serial composition. And,

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[316] Crow, *The Rise of the Sixties*, 163-4.

[317] Colpitt, *Minimal Art: The Critical Perspective*, 4; McShine, *Primary Structures*, n.p.

[318] Rose, "A B C Art," *Minimal Art: A Critical Anthology*, 281, 287.

although these elements can be found in Snelson's work as well, the concerns of Minimalism are not what drive him as an artist.

Snelson's work, in contrast, is about its structure. As he wrote in a 1966 article, "It is possible to isolate the essence of structure—the dialogue between push and pull, compression and tension—and *make it the subject of form.* For the conflict between tension and compression resolved in a closed system is concisely what structure is about."[319] In other words, when Snelson explains that his work is about structure, he means that his sculptures are a visual manifestation of a physical principle: the balance between tension and compression. His work allows viewers to observe an invisible natural force—like electricity or magnetism. They reveal "how the fundamentals of nature work. Not simply mathematical geometry, but how forces get organized to make a structure."[320] Snelson's focus on the nature of structure is not only key to his artistic process, but also what he wants his viewer to perceive. Snelson sees exquisite magic in the physics of the natural world, and the beauty of his art is the revelation of these unseen forces.

Snelson compares looking at his work to the feeling of awe one can experience watching a bird take flight. "The thrill" Snelson explained, "is immediate–you don't have to be told about it."[321] Snelson hopes that the viewer will either have a natural understanding of the structure's push-and-pull or curiosity about the illusion of gravity-defying rods. Baker noted that this type of immediacy and empirical knowledge was

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319 Snelson, "How Primary is Structure," *Art Voices*, 82.

320 Snelson, in discussion with the author, December 8, 2009.

321 Snelson, in discussion with the author, December 8, 2009.

essential to Minimalist sculpture. He wrote that Minimalism was about "a rephrasing of the terms of 'art' to favor the object qualities of artworks and the observable, describable aspects of people's reactions to them."[322] In Baker's terms, Snelson's aims are in keeping with the Minimalist project of creating work that is about "a love of physical reality for its own sake."[323]

Returning to Judd's Fibonacci piece, however, helps to tease out what separates Snelson from the Minimalist mainstream. As Meyer explained: "A Judd Progression has an order, but it does not imply a meaning or order beyond itself. Yet—here is the crux of the matter—it could be seen *as itself*; it was a given."[324] In Judd's work, there is no *a priori* idea that can be separated from the physical piece. When Snelson explains that his sculptures are a physical manifestation of tensegrity, he is making a similar point. Tensegrity is not something apart from his sculpture—his sculpture is the only way we can *see* tensegrity. "Well, they don't *represent* anything," Snelson said in a 1993 interview, "they're exactly what they appear to be."[325] Fibonacci, in contrast, dictated how Judd's piece looked, but it is not what the work is *about*.[326] Snelson's work *is* about structure. The fact that Snelson's system of construction is more important to his work than Fibonacci was to Judd's cannot be overstated, and this distinction highlights an issue

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[322] Baker, *Minimalism*, 34.

[323] *Ibid.*, 22.

[324] Meyer, *Minimalism: Art and Polemics in the Sixties*, 208.

[325] Bruce Felton, "Kenneth Snelson," in *Creativity: Conversations with 28 Who Excel* (manuscript), 5 (later published, New York: Momentum Books, 1993).

[326] Bochner, "Serial Art, Systems, Solipsism," *Minimal Art: A Critical Anthology*, 94-8; Colpitt, *Minimal Art: The Critical Perspective*, 64.

in the relationship between Snelson and Minimalism. Judd and other Minimalist sculptors wanted their work to be only about what could be visually comprehended. They thought that the spoken or written word had no place in visual art because it was "too specific" and limited the possibility of true abstraction.[327] If Snelson's sculptures are visualizations of a physical principle, in a certain way they are not abstract at all. They are not merely about what can be observed in an instant, but about the pre-existing concept of structural integrity achieved through a balance of compression and tension.

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Snelson's emergence coincided with the rise of Minimalism in New York in the 1960s, and, as I have demonstrated, his work was understood by 1960s curators and critics under the rubric of this movement. Therefore, despite important intellectual difference between Snelson and his Minimalist contemporaries, this is a valid and useful context in which to examine his art. Snelson's sculpture shared much visually with Minimalism, including a geometric, perfected, and spare aesthetic. Like his peers associated with that movement, he also disliked the look of the handmade or time worn, his work had a tendency to take on architectural characteristics, and gravity played a role in his compositions. Also in keeping with Minimalism, in his pre-1969 work, Snelson frequently used seriality and modularity, contributing to a sense of *Gestalt* wholeness or a unitary aesthetic. Snelson shared some of the ideological intentions of his Minimalist contemporaries as well, including his desire to create work without subjective meaning or

[327] Meyer, *Minimalism: Art and Polemics in the Sixties*, 208.

emotional content. Snelson, however, does not have an abstract philosophical interest in the nature of art that was shared among the most well known Minimalists. In addition, as a demonstration of a structural principle, the construction and components of his sculptures take on a craft-like importance for Snelson that is also not in keeping with Minimalism. Snelson's concerns are concrete and physical: the visualization of natural tension-compression forces. A similar interest in the building blocks of structure also informed Snelson study of the atom that developed alongside his tensegrity sculptures in the 1960s. To better understand Snelson's body of work as a whole, in the following chapter, I turn to this aspect of his artistic practice to examine how it relates to his sculptural ideas and what motivated an artist to undertake a scientific project.

CHAPTER THREE: PORTRAIT OF AN ATOM

In 1960, Snelson began developing a theory of atomic structure that he expanded over the next fifty years into an ongoing multi-media art project entitled *Portrait of an Atom* that includes a scientific treatise, three-dimensional models, two patents, sculptures, and digitally produced illustrations.[328] Snelson's interest "in the fundamentals of how things work on a most basic level" inspires his artistic practice and unites his study of the atom with his tensegrity sculptures.[329] For Snelson, whether imagined on the micro-level of an atom or the macro-level of planetary alignment, all structural relationships are comparable through their dependence on natural forces. As he described poetically in 1966: "A wire or cable acting as a connection performs in tension as the force of gravity between planets or as the electrical field between charged particles. A bolt through a hole is structurally identical to a celestial or atomic orbit in frozen form—a pivotal center with another system with another system in motionless orbit surrounding the first. A string around a post, the links in a chain, or the coupling of a man and a woman all duplicate in mechanical terms the looping principle of celestial connections. *All are primary*

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[328] Kenneth Snelson, "Model for Atomic Forms," Patent No. 3,276,148 (United States Patent Office, October 4, 1966) (Appendix C) and Kenneth Snelson, "Model for Atomic Forms," Patent No. 4,099,339 (United States Patent Office, July 11, 1978) (Appendix D).

[329] Snelson, in discussion with the author, September 24, 2008.

structure."[330] Snelson believed size was irrelevant. Structures are dependent on the primary forces of tension and compression, under the influence of gravity and magnetism, whether the subject is as small and mysterious as an atom, as concrete as a piece of hardware, or as large and complex as the solar system.

At the root of Snelson's interests is, first, a desire to explore what holds things together, how structure is composed, and, second, to make that interior and invisible structure visible. In his tensegrity sculptures, the fundamental forces of construction—push and pull or tension and compression—are shown to the viewer with rods and wires. With his atomic model, Snelson gave something so minute that it cannot be seen with the most powerful microscope, a physical form. He describes: "The details of the atom's structure are equally invisible [as the tensegrity sculpture] and must be conjectured from scientific information. ...Because it is my work to imagine and build sculptures from physical forces, the electronic atom's form and working have seemed a kind of sculptural riddle; and as I see it, one not yet solved convincingly by science."[331] Snelson envisions his atomic work in terms of a "sculptural riddle"—an object that must be conjured from the invisible and composed from conjecture. He equates piecing together information about the structural nature of the atom to create a tangible model with creating sculptures that make visible natural forces.

There are, however, important distinctions between the tensegrity sculptures and the atom project that the artist does not discuss. First, Snelson formed the concepts for these projects in very different ways. The tensegrity sculptures were the product of

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[330] Snelson, "How Primary is Structure," *Art Voices*, 82.

[331] Snelson, *Portrait of an Atom*, 2.

experimentation and visual observation. By exploring the properties of small-scale building materials, Snelson came upon the principle of tensegrity and later, through trial and error, was able to explore the various structures that could be built using this principle. In contrast, as I will explain, although initially inspired by experimentation with magnets, Snelson's atomic theory was largely based on secondary research and his own imagination. A second and related distinction is that while a tensegrity sculpture literally makes visible the physical forces that give it structural integrity by showing the balanced push and pull of the tension and compression members, Snelson's atomic pieces are only representations of the structures he believes to exist. No physical forces are at work in any of his models of the atom. While his sculptures are demonstrations, his atoms are depictions. Because Snelson's atom is the product of imagination, rather than physical experimentation, it does not nor is it required to function structurally like his tensegrity sculptures. In Snelson's tensegrity sculptural work, structure is primary in a way it is not in his atom. In a certain manner, therefore, Snelson's tensegrity sculptures are the product of scientifically sound research in a way that his atom is not. His theory of tensegrity as a means of creating structural integrity was arrived upon through trail-and-error experimentation and has been proved repeatedly each time Snelson completes a sculpture.

There is, however, another aspect that unifies the two projects. During both initial periods of conception, inspired by Buckminster Fuller's vision of a Dymaxion comprehensive designer, Snelson believed that he was employing the creative approach of an artist to a real-world structural problem and that his research would make a practical contribution. Although, starting in the second half of 1960s, Snelson began to abandon these aspirations, rethinking his tensegrity work and his atomic model, so that he now presents them both as purely artistic projects with no applied use, this original context is essential for understanding Snelson's initial motivations. In the final chapter, I return to this issue to explore the idea of the potential for artistic contributions to science and technology in the cultural context of the United States in the 1960s.

Snelson felt that atomic science, in particular, was in need of artistic thought because scientists had abandoned the goal of a visual model of the atom, following a series of theoretical developments that began in the 1920s. In 1926, Bertrand Russell questioned the accuracy of the existing visual atomic models that I describe below and suggested that in the future atomic structure would be described only through mathematical models. Concurrently, Erwin Schrödinger presented his wave equation that predicts the probability of locating an electron at a particular location within an atom. Soon after, Werner Heisenberg published his Uncertainty Principle, stating that the more precisely the position of an electron is determined, the less precisely its momentum can be known. The acceptance of Schrödinger's and Heisenberg's work, which implied that any visual model of an atom could not be both accurate and complete, meant the end of any attempt within professional science to visualize atomic structure.

Snelson was inspired by science's abandonment of visual models: "My piece on the atom grew out of the same kind of disappointment many inquisitive people experience when confronted with science's mathematical, non-pictorial atom, which invariably leaves the visual, non-algebraic mind feeling deprived of real understanding. ...[Since scientists are not working to develop atomic models] artists are granted title to the plot of ground where atom models grow. Perhaps artists are indeed the last metaphysicians and speculative philosophers."[332] The scientific lack of interest in a visual model of the atom in the twentieth century was both a subject of frustration for Snelson and an opportunity. Because scientists had abandoned the project, it seemed to Snelson not only reasonable but important to pick up where they had left off. Moreover, he distinguished his work from the mathematical methods of contemporary science, embracing an older and more romantic definition that focused on the metaphysical.

As I discuss in the following chapter, Snelson was not the only artist in the 1960s inspired by the idea of an unknowable atomic world. In fact, I will establish that interest in visualization and internal structures was a common theme in 1960s sculpture. As I will also show, art writers of the period related this atomic interest not only to developments in research science, but also to the destructive power of nuclear weaponry that the United States demonstrated catastrophically at the close of World War II. Snelson's disavows a connection between his study of the atom and the pervasive concern about nuclear warfare that social historians of the postwar period describe.[333] Snelson's pure and metaphysical focus on structure can be interpreted as part of his identification with earlier models of atomic research from a time before the atom became so closely entwined in the popular imagination with weaponry.

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[332] Snelson, "An Artist's Atom," *Leonardo* 27, 231.

[333] Snelson, in discussion with the author, December 10, 2011; For example: Sargent Wood, *A More Perfect Union*; Henriksen, *Dr. Strangelove's America: Society and Culture in the Atomic Age*; Sohnya Sayres, Anders Stephanson, Stanley Aronotwitz, and Fredric Jameson, eds., *The 60s Without Apology* (Minneapolis: University of Minnesota Press, 1984).

Snelson's Atomic Theory

Although Snelson did not begin his atomic project in earnest until 1960, two earlier experiments suggest that his ideas began to take shape in the late 1940s. The first was the green glass marble and brass strip structure, inspired by Fuller's models, that Snelson made when he returned to Pendleton after his first summer at Black Mountain College in 1948 (Figure 38). In the summer of 1949, when Snelson returned to Black Mountain, he made a project out of rubber model airplane wheels, again drawing inspiration from Fuller's geometric models. Turning one wheel on this piece made the others spin, in the manner of a gear (Figure 84). Although this feature would later fascinate Snelson when he undertook his atomic research in the 1960s, it seems not to have sparked his imagination in 1949 as the piece remained anomalous for over a decade.

In 1960, when Snelson was living in his SoHo loft and had just begun to make large-scale tensegrity sculptures, he began to think about the rods in his tension-compression work representing movement and the broader implications of his tension-compression principle.[334] At that time, Snelson saw his exploration of tension and compression as a scientific study that would reveal what he called "the elusive first principles of some ultimate physical order and reality."[335] He wondered if there was a relationship between the physical principle that was the basis of his sculptural work and structures that existed in the natural world, and if everything in the universe related either through tension or compression. Snelson's structures could hypothetically be expanded

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[334] Snelson tells the story of the development of his atomic model in: Snelson, *Not in My Lifetime*, 99-123 and Snelson, "Circles, Spheres, and Atoms." snelsonatom.com (accessed July 8, 2011)

[335] Snelson, *Not in My Lifetime*, 99.

infinitely since their strength grew in proportion to their size, unlike traditional building techniques based on compression alone that are limited by the weight-bearing capacity of construction materials. Conversely, Snelson reasoned, the tension-compression structures could also be reduced in size infinitely, suggesting to him that they might have importance in the microcosmic composition of matter—atomic structure. Although he understood that in nature matter was constantly in motion, Snelson thought that he might be able to depict an atom in a frozen moment.

While these ideas were forming in 1960, Snelson began to experiment with round plastic circles with diameters of three, four, and five inches, industrial leftovers purchased on Canal Street, and later in May of 1961 with doughnut-shaped magnets that had a diameter of approximately one inch with a central hole that was approximately one-eighth of an inch. He used both types of circles in various geometric arrangements to form the surface of spherical forms, what he calls "circle spheres" or "spaceframe matrices" (Figures 85-86). During his earliest experiments with plastic circles, having painted some red, he discovered that certain size groupings—two, five, eight, ten, fourteen, eighteen, and thirty-two—allowed the circles to be arranged in a checkerboard pattern so that no rings of the same color would touch (Figure 87). The following year, when experimenting with the magnets, he mounted them on threaded bolts stuck into a plastic ball so that the magnets could spin freely (Figure 86 and Appendix C Patent Figure 8-16). Using the same checkerboard principle he had discovered with the plastic rings, he found that certain size groupings allowed the magnets to be arranged with attracting opposing north-south poles touching so that all of the magnets could be put in motion by spinning just one. Using certain size sets—again two, five, eight, ten, fourteen, eighteen, and thirty two—a chain of north-to-south connections could be made across magnetic spherical space-frames. Snelson later called his experiments with these forms "circle-on-sphere geometry" and demonstrated that unique aspects of these structures allowed the circles to join with like shapes infinitely.[336]

Snelson recounts that he began to relate these circle-sphere experiments to atoms by "wishful thinking," and he was motivated to prove the connection by the idea that this "trick" would not exist in nature if there was no purpose for it.[337] Coincidentally, Audrey Goldenstein, whom Snelson would later marry, was working on a science series for PBS and brought home a book that covered the show's subjects, including atoms. By reading this text, Snelson learned that the smallest electron shells contained two, six, eight, ten, fourteen, eighteen, and thirty two electrons—almost matching the numbers that Snelson had discovered "worked" with his magnetic and checkerboard models (only the second number in the sequence was different). Snelson became convinced that there was meaning to the seeming coincidence and began poring through scientific texts, by men such as Linus Pauling, G. N. Lewis, W. G. Palmer, and Paul Forman. From his research Snelson learned that current scientific practice had abandoned the project of a visual depiction of the atom in favor of mathematical equations that predicted the location of the electrons within the atomic structure. As an artist, Snelson saw this as a deficit that he would attempt to correct.

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[336] Snelson, *Portrait of an Atom,* 9.

[337] Snelson, *Not in My Lifetime*, 106.

Snelson continued his research and experimentation with models, finalizing his ideas by late 1962, and he received his first atomic patent in 1966 (Appendix C).[338] Snelson's atomic theory states that within the concentric layers of electron shells that surround the nucleus, each electron moves in a set circular pattern without overlapping with neighboring electrons (Appendix C Patent Figure 5). What shell an electron occupies is based on its wavelength and velocity. The circles of the electron orbits behave like the magnets from Snelson's earliest experiments by attracting neighboring electron orbits with opposing magnetic charges. Snelson uses this idea of magnetic attraction to explain how an atom retains its structure, despite the fact that electrons naturally repel one another. The electrons in Snelson's design behave like matter and occupy discrete pathways that cannot intersect or overlap. This matrix gives Snelson's atom structural integrity and resilience. As the sequential depiction of elements in the Periodic Table demonstrates, atoms are distinguished from one another by the number of electrons they contain. The number of electrons in the atom determines the number of shells and the geometry of the circular orbits in Snelson's model, giving each a distinct shape and way of bonding with other atoms.

Snelson's model is in keeping with current scientific theories in terms of its central nucleus with a positive charge composed of protons and neutrons, and the presence of a distinct number of electrons that move around the nucleus and define the

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[338] Snelson explains his atomic model in the following texts: Snelson, "A Design for the Atom" *Industrial Design*, 48-57; Snelson, *Portrait of an Atom*; Burrows, *Kenneth Snelson*, 12-4; Snelson, "An Artist's Atom," *Leonardo*, 231-36; Snelson, "Circles, Spheres, and Atoms." snelsonatom.com (accessed July 8, 2011)

atom's structure and behavior toward other atoms.[339] The distinction between Snelson's atom and the versions presented by modern science resides in the position and movement of electrons. Since the physicist J. J. Thompson discovered the atomic electron in 1897, scientists have proposed numerous atomic models. For example, Thompson envisioned electrons as raisins in plum pudding hovering at random among the positively charged atomic matter (Figure 88). Lord Ernest Rutherford determined that the positively charged protons were isolated from the electrons in a central nucleus. Between 1911 and 1913, building on this idea, Niels Bohr proposed the still visually familiar orbital system that became known as the Rutherford-Bohr model, in which electrons revolved around a central nucleus on set pathways like the planets around the sun (Figure 89). Electrons move from one pathway to another only when they gain or lose energy. Louis de Broglie challenged this model in 1923-4, proving that electrons do behave both like particles of matter and like waves of energy. Snelson incorporated elements of each of these models, with the radical difference that his electrons do not orbit the nucleus, but rather move in set circular pathways that create a matrix on the surface of each spherical concentric energy shell (Appendix C Patent Figure 5). In addition, Snelson uses the idea of magnetic attraction to account for atomic structural integrity, an idea that is unique to his work and is problematic scientifically because the electronic reactions between electrons and between the electrons and protons are much stronger than magnetic fields.[340]

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[339] Walter J Lehmann, *Atomic and Molecular Structure: The Development of Our Concepts* (New York: Wiley, 1972); David P. Mellor, *The Evolution of the Atomic Theory* (Amsterdam, NY: Elsevier, 1971); Andreas Gerardus Maria van Melsen, *From Atomos to Atom: The History of the Concept Atom* (New York: Harper 1960).

[340] Snelson, *Kenneth Snelson: The Nature of Structure*, 50.

Snelson, whose atom is mechanical and visual, gives his electrons the quality of matter so that no two can occupy the same space in accord with the Exclusion Principle that Wolfgang Pauli proposed in 1925. However, because the models that modern quantum physicists work with are mathematical and theoretical, rather than mechanical and physical, they describe electrons with interpenetrating and overlapping pathways.[341]

Fuller, Snelson, and the Atom

Fuller and Snelson not only shared the idea that science should not have abandoned visual models, but Snelson's one-time mentor also worked on an atomic model of his own. Fuller often lectured on the importance of visualization in science, explaining that with the growing focus on quantum physics and electrical energy, non-visible subjects, scientists had given up attempting visual models.[342] This development had, according to Fuller, created a divide between the sciences and the humanities and between scientific knowledge and the public. Fuller explained that scientists believed that the layperson could not understand science because nonprofessionals could not read the language of advanced mathematics.

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341 Hans Christian von Baeyer, "Snelson's Atom," in *Kenneth Snelson: The Nature of Structure*, 31.

342 Fuller discussed these ideas repeatedly, for example see: R. Buckminster Fuller, "Conceptuality of Fundamental Structures," in *Vision and Value: Structure in Art and in Science*, ed. György Kepes (New York: Braziller, 1965), 80; R. Buckminster Fuller, "Prevailing Conditions in the Arts," in *Utopia or Oblivion: The Prospects for Humanity* (New York: Bantam, 1969), 80-2.

Fuller and Snelson also shared a belief in the universality of structural principles regardless of scale. They thought that the same natural forces that gave structural integrity to the atom and chromosomes also supported Fuller's massive geodesic domes and Snelson's tensegrity sculptures. When Snelson first began to think about atomic structure in 1960, he pondered: "I was enticed by wonder and curiosity—to puzzle whether or not there could be a relationship between my elemental [tensegrity] structures in the macrocosm—and other structures in nature—especially in the microcosm. ...My faith in the universality of order, made me sure there must be a similarity between the two realms...between atoms and these basic structures...."[343] What he had learned about tensegrity principles inspired Snelson to explore the subject of atomic structure, and he wondered if balances between tension and compression could be essential to understanding the physical structure of the entire universe and of the smallest known unit of matter. Similarly, in *Synergetics*, Fuller wrote: "All structures, properly understood, from the solar system to the atom, are tensegrity structures. Universe is omnitensional tensegrity."[344] Fuller's atomic model combined the geometry of the tensegrity mast and the geodesic dome that made use of a continuous system of circular forms across its surface that could absorb tremendous pressure.[345] To envision atomic structure, Fuller

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[343] Snelson, *Not in My Lifetime*, 99.

[344] Fuller and Applewhite, *Synergetics*, 372 (700.04).

[345] Drexler, *Three Structures by Buckminster Fuller*, n.p; Fuller, *Ideas and Integrities*, 216; Sargent Wood, *A More Perfect Union*, 73.

In fact, in the 1960s, some nuclear physicists believed that the mathematical formula that dictated the structure of Fuller's geodesic dome also defined the structure of the atom's nucleus (Tomkins, "In the Outlaw Area," *Buckminster Fuller: Starting with the Universe*, 181).

instructed his readers to picture a tensegrity mast in which the solid struts are replaced with ever-smaller tensegrity masts until the atomic level is reached (Figure 90).[346]

In 1960, when Snelson first became inspired to explore atomic structure, he was anxiously aware that he was treading on ground that Fuller had already claimed. After all, Snelson had first learned about the idea of structural universality from Fuller at Black Mountain.[347] In his 1984 memoir, Snelson wrote:

> Somewhere I got the idea he was on the right track—that it might be possible, actually, to make visualizations of invisible things. ...But now I was troubled once again with the questions which seemed never to go away: what was his? What was mine? Could he have done it without me? Would I have done it without him? It is a fair certainty I would not have discovered, all by myself, those eight wheels which can surround a sphere in the manner of gears. But my ideas concerning the atom's form and structure were far from any notions he had proposed about any of these consideration; they were mine alone.[348]

Snelson credits Fuller for inspiring him to think visually about structure and to create models that would allow him to explore the properties of natural forces, such as magnetism. However, Snelson's specific ideas about atomic structure are distinct from Fuller's, and Snelson prized this authorship that was important to his sense of self-worth.

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[346] Fuller and Applewhite, *Synergetics*, 407 (Fig. 740.21).

[347] Snelson, *Not in My Lifetime*, 10.

[348] *Ibid.*, 112.

Atomic Art

Following his early models made from plastic circles and magnets, in 1964-5, Snelson made two series of sculptures, one in wood and the other in metal, inspired by his atomic theory. In the metal sculptures, Snelson represented his idea of circular electron orbits arranged across spherical energy shells with steel dowels bent into horseshoe forms in concentric formations (Figures 91-94). In Snelson's Dwan Gallery shows, during the second half of the 1960s, these pieces were presented as works of art alongside his small and large-scale tensegrity sculptures. Figure 95 shows Snelson's most developed metallic atom sculpture. It is based on a piece that he started to develop in the mid-1960s and finished for his 2009 solo show at Marlborough Gallery. In the final version, which has an almost four-foot diameter, Snelson abandoned the horseshoes for complete circles and eliminated many of the straight connecting dowels, creating a less chopped up appearance that is more visually cohesive. Although the concentric layers of circular orbits refer directly to Snelson's atomic vision, with its seamless and gleaming finish, the work fits in effortlessly with Snelson's tensegrity sculptures in the fine art gallery setting.

The wooden pieces, formed using a lathe, relate less closely to Snelson's atomic theory (Figures 96-97). In these pieces, large doughnut-shaped circles represent the electron pathways, which are arranged to form the structure of a cube. Inside the cube in each piece is another form representing the nucleus. *Homage to the Uncertainty Principle: A Device to Aid in Locating Electrons in an Atom if There Were a Means to Look for Them* moves further from Snelson's atomic theory, offering a humorous critique of twentieth-century science (Figures 96). Unique among Snelson's work for its irony, the piece presents itself as a stone-age microscope composed from rough-hewn wooden circles. The apparatus is fitted on top with a magnifying lens and toward the bottom with four large rotating wheels that suggest those used on a real microscope for focusing. Peering through the magnifying lens on the top of the piece into a viewing chamber, composed of four crudely formed wooden doughnuts, is a small plastic atomic model based on Snelson's theory. As the title indicates, the work is a statement about the state of scientific enquiry that, following the work of Schrödinger and Heisenberg, gave up on seeking a visual exploration of the atom. The work seems to draw a contrast between modern research science, represented by the antiquated-looking microscope, and Snelson's atomic model in perfected plastic form.

Snelson has also made reference to his atomic theory with tensegrity sculptures, such as *Double Shell Form*, 1979 (Figure 98). Although the straight lines of the tensions compression structures cannot replicate the shape of the circular electron pathways, Snelson refers to the layered geometry of the electron shells through concentric cube forms. Such small-scale tension-compression sculptures have been shown in fine art gallery settings, such as Dwan and Marlborough, where no distinction has been made between these works and Snelson's other sculptures.

Snelson's most recent visual work on the atom has been digital.[349] Using advanced imagining software, he has created illustrations, such as that in Figure 99.

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[349] In the 1980s, Snelson purchased and learned how to use a Silicon Graphics 3130 computer system to do three-dimensional digital rendering with Wavefront software. More recently, he has worked with an illustrator using a sophisticated animation program called 3D Max. Computers allowed Snelson to produce atoms that looked and behaved much more like the images in his imagination than traditional artistic tools and materials, as he discusses in his essay for *The*

Digital technology has allowed Snelson to create the most accurate portrayals of the atomic structure he imagines and—through the use of animation—show movement. The development of Stereolithography (three-dimensional printing) in recent years has added another aspect to Snelson's atomic project. He worked with a computer programmer to develop an atomic model with CAD software so that his atom could be "printed" in a semi-translucent resin in 2007 (Figure 100). The following year, Snelson was selected along with four other sculptors to participate in a show at the Today Art Museum in Beijing, China, sponsored by Autodesk, which was at the time one of the leading producers of three-dimensional printing software. Each of the selected artists used Stereolithography to render models for their sculptures that were produced in full size at Ding Lee Stone Works in China (Figure 101). Each of Snelson's five granite spheres weighs over 6,000 pounds and is four feet in diameter. Building on an idea that Snelson first suggested in the 1981 Maryland Science Center Catalogue, these pieces resemble layered Chinese ivory ball carvings (Figure 102).[350] In addition to being an appropriate subject for a Chinese exhibition, these ivory globes are a good visual analogy for Snelson's atom because they are also composed of layered spheres and use complex geometry in their ornament. Formed in solid granite, Snelson's version only suggests the

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Nature of Structure, 12-14, and in an interview in the same volume, 21-50. The role of computers in artistic expression is not addressed in this study, but Snelson would make an interesting addition to that discussion, particularly since he learned to use computers when he was well into his sixties. See, for example: Stuart Mealing, *Computers and Art* (Portland, Oregon: Intellect, 1997).

[350] Snelson, *Portrait of an Atom*, 8.

presence of interior spherical layers and hints at his atomic model through various interlocking circular patterns.

The Artist and the Scientist

Snelson's atomic theory was first presented to the public in an article he wrote for *Industrial Design* magazine published in February of 1963.[351] Soon after it came out, Snelson mailed copies along with diagrams to leading physicists and chemists, including Pauling, Eugene Wigner, and Richard Feynman. Many of the responses pointed to scientific problems with the theory, but many also congratulated Snelson on his efforts and expressed a shared interest in visual models. Feynman, a well-known physicist at the California Institute of Technology in Pasadena, wrote a typical response:

> By all means continue to make your structures and models -- they are beautiful. They do not, I believe, have anything to do with real atoms, however. They are not science, but art. The scientists' problem is not lack of imagination -- ideas like yours come a dime a dozen. The problem is to get rid of them as quickly as possible and try to find one which fits as accurately in detail with as much as possible. We find we must think of things so off-beat to understand nature that spheres and rings are grossly insufficient -- although they are fun to look at.[352]

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[351] Snelson, "A Design for the Atom," *Industrial Design*, 48-57.

[352] R. P. Feynman, California Institute of Technology, Pasadena, California, to Kenneth Snelson, May 3, 1963, Snelson Archive.

The scientists Snelson approached saw his model as art because it did not hold true to current scientific theories, and it did not address the complex structural problems of quantum mechanics that have been the focus of scientific research for most of the twentieth century. In his unpublished memoir, Snelson recalled feeling surprised that none of the scientists he contacted saw value in his model.[353] To this day Snelson's atom has made no impact on the scientific world.

Although Snelson's theory does not represent current scientific thought, the metal atomic sculptures and tensegrity atom sculptures were displayed alongside his scientific diagrams at two science center exhibitions. The first was at the Maryland Science Center in Baltimore in 1981.[354] The catalogue that accompanied the show presented Snelson's atomic theory in the context of the history of studies of atomic structure with diagrams, illustrations, and timelines. In 1989, his atom was again the subject of a science exhibition, this time at The New York Academy of Sciences.[355]

The reception of Snelson's theory in the context of these exhibitions was negative. In the catalogue text for 1981 Maryland Science Center exhibition, Snelson wrote that it was his intention to "do much more in this work than just create art" by

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[353] Snelson, *Not in My Lifetime*, 122-3.

[354] Snelson, *Portrait of an Atom.*

[355] Burrows, *Kenneth Snelson: The Nature of Structure*.

After closing in New York City, this show traveled to the California Museum of Science and Industry in Los Angeles and The National Academy of Sciences in Washington, D.C. Contributors to the catalogue included two scientists, Robert Root-Bernstein and Hans Christian von Baeyer, and the art historian Barbara Maria Stafford.

shedding light on the structure of the atom.[356] A review of the show in *Leonardo*, however, stated: "Unfortunately, Snelson's understanding of the physics of the atom, of quantum mechanics, is wrong enough that this is not, indeed, a working model. Many of his statement are in direct contradiction with experiment and known natural law—in short, they are unacceptable."[357] The reviewer found the ideas behind Snelson's model faulty, discrediting its possible importance to scientific scholarship. The review concludes: "Good art can of course emerge from the stimulation of misunderstood science. But then Snelson's sculptures should stand on their merit as art, and not only any presentations of either interpreting or advancing science."[358] Once again, Snelson's work was deemed art.

In The New York Academy of Sciences exhibition catalogue, Hans Christian von Baeyer similarly points out aspects of Snelson's ideas that are not in accord with scientific theory—most importantly that the magnetic forces that hold Snelson's atom together are less powerful than the pull between electrons and protons.[359] Within the same volume, Root-Bernstein, however, wrote: "Is Snelson's atom science? Art? Both? ...My own philosophy tells me that such questions are moot. For I am...a believer in complementarity. ...We can know nothing fully without the imagination embodied simultaneously in both the arts and the sciences, for it is only thus that measurement,

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[356] Schroeer and Slifkin, "Portrait of an Atom: Artist-Sculptor Kenneth Snelson's Visualization of the Atom's Electronic Structure," *Leonardo*, 240.

[357] *Ibid.*, 240.

[358] *Ibid.*, 240.

[359] Snelson, *Kenneth Snelson: The Nature of Structure*, 50.

analysis, model, prediction, and image merge and emerge."[360] Root-Bernstein argues that there is, and ought to be, imagination in science. That "All models—scientific or otherwise—are mental creations stemming from the imagination" and "One must be able to imagine a possible world before one can test it."[361] The opinions Root-Bernstein and von Baeyer expressed in this catalogue are in keeping with the views expressed in the responses Snelson received from scientists. Although many were impressed with his imaginative engagement with atomic theory, the model was ultimately inaccurate and therefore not useful.

Snelson believes that the scientific world has rejected his atomic model, first, because he is working outside the professional scientific arena and does not have formal academic training and, second, because of the current lack of scientific interest in visual models.[362] He also explains that it is common for the scientific orthodoxy to be suspect of radically new ideas.[363] Snelson feels that Naum Gabo's essay on sculpture in the *Circle: International Survey of Constructive Art* captures the isolation and rejection that Snelson has experienced as a practitioner who identifies as an artist, but works on

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[360] Robert Root-Bernstein, "Beauty, Truth, and Imagination: A Perspective on the Science and Art of Modeling Atoms," *Kenneth Snelson: The Nature of Structure*, 19-20.

[361] *Ibid.*, 17.

[362] Snelson, in discussion with the author, February 2, 2008.

[363] Snelson, in discussion with the author, February 2, 2008.

scientific problems.[364] Snelson also strongly identifies with Gabo's description of the resistance to new ideas:

> The growth of new ideas is the more difficult and lengthy the deeper they are rooted in life. ...The method of their fight is always the same. At the beginning they try to prove that the new idea is nonsensical, impossible or wicked. When this fails they try to prove that the new idea is not at all new or original and therefore of no interest. When this also does not work they have recourse to the last and most effective means: the method of isolation; that is to say, they start to assert that the new idea, even if it is new and original, does not belong to the domain of ideas which it is trying to complete. So, for instance, if it belongs to science, they say it has nothing to do with science; if it belongs to art, they say it has nothing to do with art.[365]

Gabo writes that people have an inherent resistance to innovative ideas and, therefore, naturally reject them as wrong, uninteresting, or irrelevant. Snelson believes similarly that scientists have invalidated his atomic model by calling it art.

The changes over time in how Snelson has presented his atomic theory perhaps reflect this rejection by the scientific world. In 1963, Snelson distributed the *Industrial Design* article about his atom to numerous scientists, believing that he had made an important discovery that the scientific community would appreciate immediately, and he

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[364] Naum Gabo, "Sculpture—Carving and Construction in Space," in *Circle: International Survey of Constructive Art*, eds. J.L Martin, Ben Nicholson, and Naum Gabo, (New York: Praeger, 1971), 103-12.

[365] *Ibid.*, 103.

was surprised when it was not.[366] His attitude had shifted somewhat by 1977 when he mused in an interview: "Is my portrait of an atom art or science? Well, I have taken the same material which science uses and drawn up a structural interpretation which comes directly out of my knowledge from the sculptures, as to how and why bodies are held together by forces. This is portraiture in the most classical sense, only the subject is the atom, and instead of oil paint I am using logic and three dimensional space."[367] As demonstrated in this quotation, by the late 1970s, Snelson saw the role of both science and art in his project. He admitted that his work is an "interpretation" and a "portrait," but still emphasized that it is based on his structural knowledge and logical cognition. In the same 1977 interview he stated, "The largest objection that physicists have to my interpretation of their own data touching on the atom's electronic structure (aside from the objection that I am not a member of the scientific fraternity) is that they can see no use for such conjectures as these. If this is actually true, that it is useless to speculate about the intrinsic structure of atoms, then this alone make it art."[368] Snelson's argument here is similar to how he distinguishes his tensegrity sculptures from the work of engineers. Because physicists have deemed the model to have no scientific usefulness, it must be art.

Snelson continued to skirt a middle ground in his unpublished memoir of 1984, writing, "My discoveries with magnets were not exactly science, but my interest in them

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[366] Snelson, *Not in My Lifetime*, 122-3.

[367] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[368] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

was certainly only on the fringe of art."[369] However, in a more recent essay he reversed his initial position entirely, stating, "this is a work of art and speculative reasoning, not science."[370] The homepage of Snelson's website currently reads: "Kenneth Snelson's 'Portrait of an Atom' is a multi-media art work that describes the atom's electronic architecture as a unique natural structure composed of forces: electrical, magnetic and mechanical. The electrons in the model are described as matter-wave orbits that reside on electrical spheres surrounding the nucleus and fill up its concentric shells. The electrons' circular orbits are the atom's space filling entities, its dynamic building blocks."[371] Snelson now presents his *Portrait of an Atom* as an on-going work of art that includes sculptures and models made from various materials, digital images and video demonstrations, his two atomic patents, and his texts in which he describes his theory.[372] And yet, to this day, Snelson believes there must be meaning in the relationship between the structures he made in 1960 with small plastic circles with checkerboard patterning and the number of electrons present in atomic shells.[373]

Although Snelson has shown his atomic sculptures in fine art settings, including Dwan and Marlborough Galleries, there has been little reaction to them in the art world. In one of the only reviews that mentioned them directly they are addressed as works of

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[369] Snelson, *Not in My Lifetime*, 104.

[370] Snelson, "Circles, Spheres, and Atoms." snelsonatom.com (accessed July 8, 2011)

[371] Snelson, "Circles, Spheres, and Atoms." snelsonatom.com (accessed July 8, 2011)

[372] Snelson, "An Artist's Atom," *Leonardo*, 231.

[373] Heartney and Snelson, *Kenneth Snelson: Forces Made Visible*, 116.

art, driven by "esthetic decisions."[374] Snelson believes that his *Portrait of an Atom* project has damaged his artistic career. He explained that because "the art world is a terribly prejudiced world," he would have been more successful if he "had skipped the atom and not let them know that it exists."[375] Though Snelson still believes "that the most important thing I've done is the deciphering of the atom's rhythm, but I'm the only one who thinks so."[376] Despite the international success of his tensegrity sculptures and consistent rejection of his atom over the past half century, Snelson retains a significant sense of pride in his atomic model.

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Although Snelson now publicly presents *Portrait of an Atom* as a work of art, it was initially conceived as scientific research, and his wavering opinions on the subject suggest that he might privately maintain a belief in its scientific importance. Snelson thought in the 1960s that his model would make a significant contribution to scientific knowledge, and, despite having publicly repositioned the project as the work of an artist, he seems to hang on to a belief in the real-world importance of his discoveries. The inherent tension between art and science this produces is reflected both in how Snelson has presented and discussed *Portrait of an Atom* and in how it has been received. Snelson's artistic and intellectual engagement with nature and structure raises larger

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[374] Kurtz, "Kenneth Snelson: The Elegant Solution," *Art News*, 48-51.

[375] Snelson, in discussion with the author, December 8, 2009.

[376] Snelson, in discussion with the author, September 24, 2008.

questions about the idea of science as a discipline for artists of his generation. In the following chapter, I address this subject by comparing Snelson's work with that of other sculptors in the 1960s who utilized a similar approach of experimentation or shared Snelson's interest in invisible structural forces. In the final chapter, I turn to the question of what it meant in the United States in the 1960s for an artist to take on scientific and technological subjects.

CHAPTER FOUR: STRUCTURE AND SCIENCE IN SIXTIES SCULPTURE

In the 1960s, the traditional conception of art making was that it is inspired by unconscious feelings, emotion, subjective reactions, personal narrative, and the imagination. In contrast, science was thought of as precise, rational, objective, impartial, analytical, and logical. While a work of art was perceived as unique, technology and science aimed to create predictable and reproducible results.[377] As one artist in the period explained, "Systematic thinking has generally been considered the antithesis of artistic thinking. Systems are characterized by regularity, thoroughness, and repetition in execution."[378] In 1959, the physicist C. P. Snow gave his now famous "Two Cultures" lecture at Cambridge University on the lack of communication, and even hostility, between "literary intellectuals" and scientists.[379] The idea of the divide between the worlds of art and of science was the premise for a book that György Kepes published in 1960 called *The Visual Arts Today* and a six-volume series, released in 1965-6, called

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[377] For more on the comparison between the fields of art and science see essays in Jacques Mandelbrojt, Giorgio Careri, and L. Alcopley, eds. *Leonardo* 27, no. 3, Art and Science Similarities, Differences and Interactions: Special Issue (1994), particularly Mandelbrojt, "Introduction," 179; and L. Copley, "Art, Science and Human Being," 183-4.

[378] Bochner, "Serial Art, Systems, Solipsism," *Minimal Art: A Critical Anthology*, 94.

[379] This text of this lecture was later published as C. P. Snow, *The Two Cultures: And a Second Look* (Cambridge: Cambridge University Press, 1964).

Vision and Value.[380] Despite this perceived dichotomy, Snelson, along with many other sculptors of the sixties, utilized scientific ideas and methods and employed repeating geometric forms and gleaming surfaces that were associated with the aesthetic of machines and modern technology when making art.

Susan Sontag observed that art of the 1960s, unlike that of earlier periods, did not rely on literary sources based in narrative and emotion.[381] She noted that key inspirational texts for the cultural production of the period were written by non-literary figures, many of whom focused on technology and science, such as Buckminster Fuller, Marshall McLuhan, Sigfried Giedion, and György Kepes. Period writers agreed with Sontag about "the potency of science and the scientific mind" for Contemporary artists.[382] According to Lucy Lippard and John Chandler, sixties art critics, "Artists of this period were drawn to the scientific attitude, empiricism, and the philosophical

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[380] György Kepes, ed., *Vision and Value* (New York: Braziller, 1965-6); György Kepes, ed., *The Visual Arts Today* (Middletown, Connecticut: Wesleyan University Press, 1960). See also Judy Wechsler, *György Kepes: MIT Years 1945-1977* (Cambridge, MA: Hayden Gallery, 1978).

[381] Susan Sontag, "One Culture and the New Sensibility," in *Against Interpretation and Other Essays* (New York: Farrar, Straus and Giroux, 2001), 298.

[382] John Coplans, "The New Sculpture and Technology," in *American Sculpture of the Sixties* (Los Angeles: Los Angeles County Museum of Art, 1967), 21. See also: John Gruen, "Art Meets Technology," *World Journal Tribune*, October 2, 1966, Magazine Section; and Douglas M. Davis, "Art and Technology – The New Combine," *Art in America* (January/February 1968). In addition, Frank Mailina initiated the journal *Leonardo* in 1968. Although not its initial purpose, the focus of the journal was soon the relationship between art and technology, particularly how new technologies could be used by artists in their work (Bijvoet, *Art as Inquiry*, 77-79.)

The 1960s popularity of Optical/OpArt and works of art that used movement and light was also related to the artistic interest in science and technology by writers in the period such as John Coplans, "The New Sculpture and Technology," *American Sculpture of the Sixties*, 21; and Willoughby Sharpe, "Luminism and Kineticism," in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 317-58.

objectivity and no-nonsense approach supposedly typical of a scientific mind."[383] Although there was art that is not consistent with these qualities, one strain of sixties artistic production was analytical, impassive, and technological.

In this chapter, I demonstrate that Snelson's proclivity for technology, mechanics, science, and structure was common to a number of American sculptors in the 1960s, and that this group shared ideas and historical sources that provided precedent for artistic uses of science and technology.[384] I will focus on the movements and figures that had the most resonance for Snelson: Constructivism, the Bauhaus (particularly the methods of Josef Albers), and Fuller. Like those associated with the Bauhaus and Constructivism, many sculptors in the 1960s mined science and technology not only for a visual vocabulary, but also for methods of production and subject matter. These earlier movements also provided historical models of the sixties' artistic interest in what was frequently called at the time, "the real." As discussed, Snelson and other sixties sculptors, particularly those associated with Minimalism, wanted to create objects that existed in their own right rather than works of art that were seen as representations of or allusions to something else. In this chapter, I demonstrate that drawing on science and

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[383] John Chandler and Lucy R. Lippard, "Visual Art and the Invisible World," *Art International* XI, no. 5 (May 20, 1967), 30.

[384] Hal Foster, "Some Uses and Abuses of Russian Constructivism" in *Art into Life: Russian Constructivism, 1914-1932* (New York: Rizzoli, 1990), 248-9; Hal Foster, "The Bauhaus Idea in America" in *Albers and Moholy-Nagy: From the Bauhaus to the New World*, ed. Achim Hume-Borchardt (New Haven: Yale University Press, 2006); Gabriele Diana Grawe, "Continuity and Transformation: Bauhaus Pedagogy," in *Teaching at the Bauhaus*, ed. Rainer K. Wick (Germany: Hatje Cantz Publishers, 2000); Jeanne Patricia Moynihan, "The Influence of the Bauhaus on Art and Art Education in the United States," Ph.D. diss., Evanston, Illinois: Northwestern University, 1980; Jeffrey Weiss, ed, *Dan Flavin: New Light* (New Haven: Yale University Press, 2006), 93; Gary Garrels, *Sol LeWitt: A Retrospective* (New Haven: Yale Yale University Press, 2000), 50-1.

technology was one way these artists conveyed a sense of "realness." By comparing Snelson's work with that of other sculptors of the period, a more specific aspect of the real emerges—the visualization of unseen structural forces. It is my contention that this concern can be related to the twentieth-century scientific focus on subjects and images, such as the atom, that are so minute and mysterious that their appearance cannot even be scientifically postulated. By demonstrating that Snelson's interests in unseen internal structure and natural forces was shared by a group of American sculptors in the 1960s, I position Snelson, an artist who has been largely left out of scholarly accounts of sixties art, within an important artistic current of the period. Moreover, I explore the intellectual and cultural context that shaped the artistic tendency toward these themes, examining what this particular interest in the secret interiority—what happens beneath the surface that cannot be seen—of the natural world indicates about 1960s culture.

Josef Albers: Experimentation and Optical Effects

Snelson was first exposed to the Bauhaus and to Albers's teaching methodology by his University of Oregon at Eugene professor Jack Wilkinson, who Snelson still describes as significant figure in his life.[385] Wilkinson's intellectual approach to art, taught through the various lenses of psychology, mathematics, geometry, and semantics, was reassuring for Snelson because it transformed art from a divine gift to an intellectual subject that could be mastered like any other. For the studio portion of his introductory

[385] Snelson, *Not in My Lifetime*, 2.

class, Wilkinson used a materials-based method inspired by the Bauhaus foundation course, and his students learned about form, structure, color, and texture by experimenting with simple materials such as cardboard, wire, balsa wood, glue, paint, and paper. Alongside these practical lessons, Wilkinson instructed his students about the history of the Bauhaus and Bauhaus masters, including Albers, Wassily Kandinsky, Lyonel Feininger, and Paul Klee.

Snelson was part of a generation of American artists who came of age after World War II and studied under Bauhaus-trained practitioners. About fifty Bauhaus masters and students moved to the United States following the close of the Bauhaus in Dessau, including most famously Albers, Walter Gropius, László Moholy-Nagy, Marcel Breuer, and Ludwig Mies van der Rohe.[386] These men carried on the pedagogical traditions of the Bauhaus by lecturing and publishing, and by instituting different versions of the foundations class at American schools, including the Chicago Institute of Design, Harvard University, and the Illinois Institute of Technology.[387] Through their lectures and publications, Bauhaus ideas about combining art, science, and technology were disseminated broadly among artists working in the United States.

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[386] Grawe, "Continuity and Transformation: Bauhaus Pedagogy," *Teaching at the Bauhaus*, 338.

[387] In addition to practicing as working architects, in 1937, Gropius and Breuer began to teach architecture at Harvard's Graduate School of Design, and van der Rohe became the director of the Illinois Institute of Technology. Moholy-Nagy was the founder and director of the short-lived New Bauhaus in Chicago from 1937-38 and, in 1939, founded Chicago's School of Design that became the Institute of Design in 1944 and merged with Illinois Institute of Technology in 1949. Gropius served as an adviser and later a board member to the Chicago design schools. Albers's teaching career in the United States was not limited to Black Mountain College. After leaving Black Mountain in 1950, he became the director of the Yale University School of Art and also taught at Harvard. See: Grawe, "Continuity and Transformation: Bauhaus Pedagogy," *Teaching at the Bauhaus*; and Moynihan, "The Influence of the Bauhaus on Art and Art Education in the United States."

Fascinated with the Bauhaus, Snelson pored through books in the small University of Oregon architecture library. In one volume, he read how the school had been closed by the Nazi regime, and that many of the masters had fled Hitler's Germany, some finding new homes in art and architecture schools in the United States. This book could have been the 1938 Museum of Modern Art Bauhaus exhibition catalogue that included a description of how the school was closed in April of 1933 by the National Socialists. The volume concludes with a section called "Spread of the Bauhaus Idea" that describes how the Bauhaus teaching methods were introduced to the United States at various colleges by former Bauhaus instructors including Albers at Black Mountain in North Carolina.[388] Interested and excited, Snelson applied to and was accepted for the 1948 Black Mountain summer session.

The promotional materials Snelson received from Black Mountain gave him a hint of the progressive and democratic nature of the program that had begun in 1933.[389] It was radically different from the University of Oregon, even in its architecture, as it had been transformed from a summer resort in 1940-41. Clustered around a man-made lake,

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[388] Herbert Bayer and Walter Gropius, eds., *Bauhaus: 1919-1928* (New York: The Museum of Modern Art, 1938), 206, 217.

[389] Archival materials relating to Black Mountain College are held by several collections, including Black Mountain College Museum and Arts Center Collection, D.H. Ramsey Library, University of North Carolina, Asheville; and Black Mountain College Collections 1933 – 1954, North Carolina State Archives, North Carolina Department of Cultural Resources, Division of Archives and History, Raleigh, North Carolina.

Several excellent histories of Black Mountain have been written, including Duberman, *Black Mountain College*; Mary Emma Harris, *The Arts at Black Mountain College* (Cambridge: The MIT Press, 1987); Vincent Katz, ed., *Black Mountain College: Experiment in Art* (Cambridge: The MIT Press, 2002); Mary Emma Harris, ed., *Starting at Zero: Black Mountain College, 1933-57* (Cambridge: Kettle's Yard Gallery, 2005).

faculty and student housing were created from the guest cottages, and the dining hall had become the campus center for meals, recreation, theatrical productions, and large lectures. During the school's first year on this campus, the Studies Building was erected on the opposite end of the lake to house classrooms, a library, an art room with exhibition space, and offices. The campus was rustic and un-manicured and included a farm on which the students worked. Coming from a traditional university, Snelson felt that the bohemian clothes and informal attitude of the students and faculty mirrored the informality of the surroundings.[390] Many of the other new arrivals shared his surprise. For example, a student who had studied at Valley Forge Military Academy and Michigan State College was shocked to see his classmates in "jeans, khaki pants cut off at the knees, dyed shirts, sandals, and sometimes even beards."[391]

Black Mountain had offered a summer course since 1944. Martin Duberman, who wrote a history of the school, hypothesized that students of these sessions had a more utopian vision of the experience than the full-time students.[392] Summer students came to work on specific projects or study with a certain professor; and because they were there for a short time, the general mood was lighthearted and cooperative. Eva Diaz wrote that the summer sessions at Black Mountain between 1948 and 1952 were "*the* place to be" [emphasis hers].[393] Snelson was one of about seventy-five students studying

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[390] Snelson, *Not in My Lifetime*, 4.

[391] Duberman, *Black Mountain*, 283.

[392] *Ibid.*, 281.

[393] Diaz, "Experiment, Expression, and the Paradox of Black Mountain College," *Starting at Zero*, 39.

at the college that summer, including the artists Kenneth Noland, Robert Rauschenberg, and Ruth Asawa. About half of the students were new to the school and many were there, like Snelson, courtesy of the G.I. Bill. The faculty included not only Albers, but also his wife, Anni Albers who taught weaving, the painter Willem de Kooning, the composer John Cage, the choreographer Merce Cunningham, the sculptor Richard Lippold, and, of course, Fuller.

Although Snelson studied at Black Mountain for only two summers, 1948 and 1949, his experiences there were fundamental in shaping his career as an artist. It was there he had his first sustained exposure to the contemporary art world. As Snelson wrote in his memoir thirty years later, when he arrived at Black Mountain he did not know who de Kooning was and barely knew of the existence of the New York School, "having come from the other end of the earth."[394] In addition, Snelson studied at Black Mountain under both Albers and Fuller, who I argue would have tremendous direct impact on Snelson's artistic methods and interests and his ideas about what it meant to be an artist

The Alberses had come to Black Mountain from Germany in 1933, following the close of the Bauhaus in that year, drawn to the unknown college in rural North Carolina because they had been told it was a "pioneering" enterprise.[395] The promise of something new and experimental reminded them of the Bauhaus mission, and Black Mountain College became their home for fifteen years. During the summer of 1948, Snelson was enrolled in Albers's *Werklehre* course adapted from the Bauhaus *Vorkurs*, or foundation

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[394] Snelson, *Not in My Lifetime*, 5.

[395] Duberman, *Black Mountain*, 56.

class, in which students experimented with basic materials, such as cardboard and wire to explore their textural and structural qualities.[396] Because Albers thought that students must learn through self-education and empirical comparison, his students worked independently on their projects and met just twice a week for three hours to present and discuss their work.[397] One of these biweekly meetings, following a few days spent working with wire, proved to be a pivotal moment in Snelson's life. As was the custom of the class, the students placed the projects they had completed for that session on the floor and gathered in a circle. Albers pointed to Snelson's work and said, "Ja, now—here is the work of a sculptor. We sometimes find ourselves on the wrong path, but these are the work of a sculptor, *nicht wahr*?"[398] Identifying and nurturing latent artistic ability was, as many of Albers's students attest, one of his great gifts as a teacher.[399]

Albers's effect on Snelson's development as an artist can be seen in Snelson's use of materials, the way he approaches new projects, and in his craft orientation. At Black Mountain, Albers presented his class with weekly "problems" in the form of simple materials, such as "paper, cardboard, metal sheets, and wire."[400] The aim was for

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[396] Josef Albers, "Concerning Art Instruction." *Black Mountain College Bulletin* 2 (June 1934), 5 www.bmcproject.org (accessed May 26, 2010); Eva Díaz, "The Ethics of Perception: Josef Albers in the United States," *The Art Bulletin* XC, no. 2 (June 2008), particularly 262-3.

During either the summer of 1948 or 1949, Snelson also took Albers's Color Class (Snelson, in discussion with the author, September 9, 2011).

[397] Duberman, *Black Mountain*, 65.

[398] Snelson, *Not in My Lifetime*, 7.

[399] Duberman, *Black Mountain*, 60.

[400] Albers, "Concerning Art Instruction," *Black Mountain College Bulletin*, 5; Díaz, "The Ethics of Perception: Josef Albers in the United States," *The Art Bulletin*, particularly, 262-3.

students to learn about the structural "possibilities and limits" inherent in different media through their own experimentation. Albers taught two approaches in what he called "construction exercises:" *matière* and *materials*.[401] The first focused on appearance or surface properties, such as texture, and the latter was a study of structural or functional qualities, such as "firmness, looseness, elasticity; extensibility and compressibility; folding and bending."[402] By exploring the structural qualities of different materials, Albers's students learned in a scientific manner through experimentation and observation. Albers saw the practice of art as a form of objective laboratory research more closely related to science than to the humanities.[403] For him, making art was not about self-expression, but about learning about the world through visual information.[404]

In their first experiments, Albers encouraged his students to rely only on their hands to encourage creativity and invention.[405] Tools meant to manipulate a given material suggest how that material can be altered. By using only one's hands, the imagination is unfettered from existing knowledge. For the same reason, Albers did not weigh down his students' minds with theory, preferring for them to have their own fundamental firsthand experiences. In a 1934 Black Mountain publication, Albers explained: "This method emphasizes learning, as a personal experience, rather than teaching. And so it is important to make inventions and discoveries. The idea is not to

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[401] Albers, "Concerning Art Instruction," *Black Mountain College Bulletin*, 5.

[402] *Ibid.*, 5.

[403] Hume-Borchardt, *Albers and Moholy-Nagy*, 101.

[404] Harris, *The Arts at Black Mountain College*, 16-7.

[405] Wick, *Teaching at the Bauhaus*, 175.

copy a book or a table, but to attain a finger-tip feeling for material."[406] Through this empirical method, students gained their own physical understanding of technique and materials and a visual knowledge of formal artistic principles, such as harmony and proportion.[407]

Albers's pedagogical technique relates closely to his artistic practices. His paintings and drawings can be seen as a series of experiments performed with the aim of demonstrating optical effects. In his most famous series, *Homage to the Square*, 1950-75, Albers used varying color combinations to demonstrate how there is a difference between the reality and perception of qualities, such as vibrancy, shade, and perspective (Figure 103).[408] To discover these optical properties, Albers applied the scientific method of trail and error experimentation with a constant (the arrangement of the colored squares) and a variable (the colors used). The comparison of "actual" perception and "factual" appearance was one of Albers's major concerns throughout his career.

Albers's influence can be seen in many aspects of Snelson's artistic process. As he learned in Albers's classroom, Snelson discovered new forms through trial-and-error experimentation with structural properties and limitations. He learned how to create structural feats by experimenting with miniaturized parts. Moreover, empirical knowledge of materials and the processes required to transform them into art works are essential to Snelson's definition of himself as an artist.[409] Snelson's work is the result of

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[406] Albers, "Concerning Art Instruction," *Black Mountain College Bulletin*, 5.

[407] Wick, *Teaching at the Bauhaus*, 175.

[408] Werner Spies, *Josef Albers* (London: Thames and Hudson, 1970), 44-5.

[409] Snelson, in discussion with the author, September 20, 2011.

rational planning, and every element is necessary to the structural integrity of his sculptures. Most fundamentally, Snelson, like Albers, pursues the answer to scientific questions through visual demonstrations. For Snelson, tension and compression structures are a way to make a basic physical force visible, and, through visualization, gain comprehension.

Snelson's descriptions of *Cantilever*, the piece he built for *American Sculpture of the Sixties* at the Los Angeles County Museum of Art (LACMA) in 1967 demonstrates the similarities between his approach and Albers's (Figures 1-2). This work is a dramatic thirty-foot-long protrusion that was attached to the façade of the museum. His description of the process of developing *Cantilever* in a 1967 *Artforum* interview demonstrates that, like his teacher, Snelson approached sculpture as a "problem" in need of an "answer:" "Until I had solved the *problem* of the nature of the structure there were continuously unanswered questions that required working on. The sculpture for the [Los Angeles] County Museum is an extraordinarily simple structure but it has taken eighteen years to arrive at this *answer* [emphasis mine]."[410] *Cantilever* was an early success for Snelson because it pushed the structural limits of his technique to a new extreme.

Snelson also shared Albers's interest in perception and optical effects, particularly the visual tension between "the actual and the factual." When Snelson's sculptures are seen from afar, the delicate tension wires are not visible, giving the illusory impression that the rods are free floating in space. Many of Snelson's contemporaries shared this

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[410] Coplans, "Interview with Kenneth Snelson," *Artforum*, 49.

interest in optical effects.[411] For example, the critic and art historian Rosalind Krauss, in a 1966 review, described how one of Donald Judd's Fibonacci pieces (Figure 76) "confounded" perceived interpretations of the work's physical structure.[412] When viewed frontally, it appears that a series of rectangular purple elements are suspended from a heavier-looking brushed-aluminum bar. However, when viewed from the side, it becomes apparent that the aluminum bar is hollow and supported by the solid purple parallelograms that are attached to the wall and serve as small shelves. Although the viewer initially perceives the aluminum bar to be the stronger element that provides support, the reverse is true. Krauss calls the inversion of this first impression an act of "denial and renunciation."[413] She explained that this does not disrupt the "literal" nature of the work because its "power" is not "of pictorial illusion but of lived illusion."[414] Similarly, Albers challenges perception not by making the viewer see something that is not there—in the manner of *trompe-l'œil*—but by creating a visual reality that is difficult to apprehend.

Robert Smithson also used similar ideas of confounding perception in many of his 1960s works. For example, *Enantiomorphic Chambers*, 1965 (Figure 104), is composed of a steel box whose interior is fitted with wedge-shaped mirrors that come to a point at the bottom of the cube creating a faceted and reflective surface. The piece refers to

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[411] Toby Mussman, "Literalness and the Infinite," in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 248-9.

[412] Rosalind Krauss, "Allusion and Illusion in Donald Judd," *Artforum* IV, no. 9 (May 1966), 24-6.

[413] *Ibid.*, 24.

[414] *Ibid.*, 26.

Smithson's interest in crystallography, both with its shiny, multi-planed appearance and its title—enantiomorph is a scientific term referring to molecular crystal structures that form a mirror image.[415] Because of the angles at which the mirrors are fixed, the viewer cannot see herself when she peers into the box. Rather, she is met with reflections of the other mirrored surfaces. Smithson described the work as "an illusion without an illusion."[416] The work plays on ideas of reality, vision, and perception. Robert Hobbs suggested that this turned Frank Stella's famous summation of Minimalism, "What you see, is what you see," on its head.[417] In *Enantiomorphic Chambers*, the viewer is denied the power of vision, blinded by the reflected image. This piece recalls Snelson's 1964 *Homage to the Uncertainty Principle: A Device to Aid in Locating Electrons in an Atom if There Were a Means to Look for Them* (Figure 96)—a crude wooden microscope form—that plays with ideas of scientific vision. In this work, the atomic model under the Medieval-looking instrument's magnifying lens is larger than a softball and ironically can be easily seen by the naked eye. As the title indicates, the work is a comment on atomic structure that cannot be seen, even using the most powerful scientific tools. The wooden microscope represents scientists' failure to visualize the atom, made ironic by the presence of Snelson's plastic atomic model in the instrument's viewing chamber. Like Smithson, in this work, Snelson is playing with the idea of looking without being able to see.

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[415] Robert Hobbs, *Robert Smithson: Sculpture* (Ithaca, New York: Cornell University Press, 1990), 59, 61.

[416] *Ibid.*, 61.

[417] *Ibid.*, 61.

Although Smithson's work visually suggests a relationship with Minimalism and rational objectivity through his use of industrial fabrication, geometric forms, and machine-perfect surfaces, his work from this period is often deliberately disorienting, confusing, irrational, and ambiguous.[418] Smithson's art is more complicated conceptually than Albers's, but like *Homage to the Square*, pieces like *Enantiomorphic Chambers* challenge the validity of the viewer's immediate perception. Smithson would eventually become better known for the earthworks that he began to plan in 1968—mile-size pieces that transformed outdoor areas, often those that had been disfigured by their use as industrial production sites. However in the mid-sixties he created abstract geometric sculpture, exploring the same themes of entropy, vision, and the passage of time that would occupy him throughout his career.[419] Although Smithson, unlike the other sixties artists discussed in this chapter, challenged the accepted objectivity of mathematics and science, he shared their interest in these fields, making sculpture that drew on subjects such as crystallography and cartography, as I discuss below.

Albers presented an educational model that emphasized scientific experimentation with materials, techniques, and effects that had lasting impact on Snelson's artistic practice. Albers's interest in optics and perception, comparing impressions of visual reality with truth, is reflected in the work of many artists during in the 1960s, including not only Snelson, but also other sculptors discussed in this study, such as Judd and

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[418] *Ibid.*, 20, 23.

[419] Mussman, "Literalness and the Infinite," *Minimal Art: A Critical Anthology*, 248-9, 236; McShine, *Primary Structures*, n.p.

Smithson. For these artists, an interest in optical effects often meant presenting work that made the viewer conscious of the limitations of perception. Yet Albers was also concerned with what could be learned through visual information, an interest that Snelson also developed and shared with Fuller, the man who would play the greatest role in shaping Snelson's career.

Buckminster Fuller: Structure and the Unseen

Studying under Fuller at Black Mountain in 1948 and 1949 affected the course of Snelson's life and provided what were perhaps the most formative lessons for his artistic practice. In his daily lecture course, described in Chapter One, Fuller introduced Snelson to the structural concerns of an engineer and sparked his interest in the geometric forms and structural properties found in the natural world. These lessons inspired Snelson's investigations into tension and compression structures that led to his discovery of the principle of tensegrity. Before studying with Fuller, Snelson thought like an artist: he was concerned with how things looked and not how they were made. In his memoir, Snelson recounts that prior to working with Fuller, he would have made a structure stronger by simply adding more glue, since "only engineering students studied things like triangulation or tension and compression."[420]

Fuller's innovations in engineering were motivated by a desire to develop new building techniques that would use fewer natural resources and create lightweight,

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[420] Snelson, *Not in My Lifetime*, 16.

portable structures that could solve international housing problems. He found that a balance of tension and compression could be used in place of traditional compression-based building techniques and applied this theory to his geodesic dome and, inspired by Snelson, to his tensegrity mast. Fuller believed that structures found in the natural world—both on a macro and micro level—could provide examples for improvements in engineering. Although Fuller's primary concern was with real-world applications for his innovations, looking more closely at his *Octet Truss*, 1959 (Figures 46-48), shows that his structural ambitions had much in common with Snelson's. Fuller created a hundred by thirty-five foot anodized-gold version of his *Octet Truss* for the 1959 *Three Structures* exhibition at the Museum of Modern Art (MoMA). This showpiece demonstrated how he could use tetrahedrons and octahedrons to disperse weight evenly throughout a structure, allowing for the dramatic cantilever of this piece. The method used to build the *Octet Truss* could be applied to the construction of large unsupported roofs, but the gold-toned version created for display at MoMA was, like Snelson's sculpture, built to show how Fuller could stretch structural capacities to extraordinary limits. Fuller and Snelson shared a desire to push limits to create structures unlike any that had been before, exploiting the physical properties of new techniques to create, for example, dramatic cantilevers, with extraordinary weight-to-strength proportions.

Several of the artists associated with the Park Place Gallery shared Snelson's interest in Fuller's theories and, more generally, in concerns related to physics and engineering that were described at the time as "rational" sources utilized to create art based on "an idea of reality."[421] This artist cooperative was named for the building at 79 Park Place near the southern tip of Manhattan where many of the members lived and first started, in 1963, to share art work and put on informal, collaborative exhibitions and jazz sessions.[422] The group was composed of five painters and five sculptors, including Mark di Suvero, Peter Forakis, Robert Grosvenor, and Forrest Myers. In 1965, they formalized their cooperative and with the help of funding from art patrons, including Virginia Dwan, opened a gallery space in the ground floor of 542 West Broadway.[423] It was one of the first galleries to open in a SoHo industrial building, and with 3,400 square feet of open space demonstrated the potential of these spaces for showing art.[424] John Gibson, and then Paula Cooper, curated the SoHo exhibitions until the gallery closed in 1967.

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[421] Harris Rosenstein, "Di Suvero: The Pressures of reality," *Art News* 65, no. 10 (February 1967), 37-8.

[422] Period sources on the Park Place Group cited by Dalrymple Henderson include David Bourdon, "E=MC2 à Go-Go," *Art News*, (January 1966); Edwin Ruda, "Park Place 1963-1967: Some Informal Notes in Retrospect," *Arts Magazine*, (November 1967); Harris Rosenstein, "Di Suvero: The Pressure of reality," Art News 65 (February 1967), 37. Current literature includes: Linda Dalrymple Henderson, *Reimagining Space: The Park Place Group in 1960s New York* (New York: Blanton Museum of Art, The University of Texas at Austin, 2008); and Claudine Humblet, *La Nouvelle Abstraction Américaine, 1950-1970*, (Geneva: Skira, 2003).

Snelson was a founding member of a similar collective called ConStruct, along with Mark di Suvero (who was also a member of Park Place), Charles Ginnever, John Raymond Henry, Lyman Kipp, Linda Howard, Frank McGuire, and Jerry Peart. ConStruct was a short-lived Chicago-based organization, spearheaded by Henry. Like Park Place, it was run cooperatively with pooled proceeds and founded with the aim of circumventing the gallery system that took fifty percent from art sales profits. ConStruct got some exposure in Chicago during the mid-1960s, but the venture was ultimately unsuccessful due to lack of central management (Snelson, in discussion with the author, September 20, 2010). See: David H. Katsive, *ConStruct* (Hempstead, NY: Fine Arts Museum of Long Island, 1979).

[423] Dalrymple Henderson, *Reimagining Space*, 11.

[424] *Ibid.*,1.

In the only scholarly work to address the Park Place group at length, Linda Dalrymple Henderson defined their shared interests and sources. As she described, they were occupied with ideas about space, in terms of the inspiring spaces created by urban architecture, the space age and outer space, and geometry.[425] The group was intellectually inclined, and they shared and discussed issues of *Scientific American*, science fiction novels, and books by Fuller and others who wrote about geometry, physics, math, and engineering.[426] As Dalrymple Henderson demonstrated, these texts directly influenced the Park Place artistic projects.

Like Snelson, di Suvero expressed structural interests in many of his sixties pieces, often employing tension cables that presented a visual and structural continuity with Snelson's and Fuller's work (Figures 80 and 105-107). The delicate balancing act of di Suvero's sculptures were seen at the time, like Snelson's, as a "brilliant merging of esthetics with engineering."[427] For example, the weight of the tetrahedron at the center of *Elohim Adonai*, 1966 (Figure 80), composed from four steel rods and two massive logs, is supported by steel cables connected to a central vertical support. The use of a tetrahedron is most likely direct reference to Fuller who believed that this shape was key to advances in structural engineering because of its inherent strength—a quality he made use of in his geodesic dome.[428] The hub that connected the tension wires to the vertical beam in this piece allowed the tetrahedron to spin. Di Suvero intended for viewers to use

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[425] *Ibid.*, 8.

[426] *Ibid.*, n.p.

[427] Rosenstein, "Di Suvero: The Pressures of Reality," *Art News*, 64.

[428] In another direct visual homage to Fuller, Forakis used tetrahedrons in his monumental-scale *Atlanta Gateway*, 1967 (Figures 106-107).

the top log in the sculpture to mount the piece, so that the work of art could function as a ride.[429]

The fact that di Suvero envisioned many of his sculptures as "sit and spin wheels" indicates another connection to Snelson. Di Suvero wanted his works of art to function as rides so that their structural strength would have a real purpose—he believed that his designs had to prove their "soundness" by enduring "the reality of people."[430] Although the mechanical function embedded in di Suvero's work is perhaps more intentionally playful than Snelson's ideas about demonstrating natural forces, both are subject to the tests of reality. Snelson's sculptures only serve as demonstrations if they are structurally sound; similarly, di Suvero's are only successful if they are strong enough to support human weight. For all the discourse of aesthetic refinement of surface in 1960s sculpture, the fundamental role of didactic experimentation was equally central to these artists' projects.

Grosvenor's work also demonstrates his interest in feats of structural engineering. For example, his *Transoxiana*, 1965 (Figures 72 and 81), which was a focal point of the Park Place group's 1965 opening exhibition in SoHo, is a robust thirty-one foot parallelogram bent in a v-shaped cantilever that suspended from the ceiling. This project was compared to the work of an engineer in terms similar to those used to describe both Snelson's and di Suvero's sculptures. For example, Irving Sandler wrote of *Transoxiania*: "To stretch a form as far as it will go, and Grosvenor does just that, is a

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[429] *Ibid.*, 64.

[430] *Ibid.*, 39.

feat of engineering. In fact, he treads the line where art and engineering meet."[431] Sandler echoes the desire that Snelson often expressed to push the physical limitations of his materials and techniques—a method Snelson also learned about from Albers. Snelson showed this interest, for example, in a discussion about *Cantilever*. He said, "Part of my struggle is to do something that is ultimate."[432] Reflecting the influence of Fuller who emphasized the importance of weight-to-strength ratios for new construction techniques, Snelson saw *Cantilever* as a tremendous achievement because it spanned thirty feet and weighed only fifty-two pounds. Snelson wrote:

> I pushed that structure to its material limit; light, and at the same time, strong as possible. The tubing was the thinnest-wall aircraft alloy. Its tensed wires could be plucked like a guitar, but their pitch seemed high enough to be heard only by neighborhood cats and dogs. The stresses could have been increased only by remaking it of heavier materials—and any added weight would require even greater stresses. I meant for it merely to hold itself out there; a sturdy big erection, curving up gently at its end; just a grace note to show that the feat was effortless.[433]

As I have already shown, sixties sculptors outside of the Park Place group, including Ronald Bladen and David von Shlegell, also shared the desire expressed by Snelson, di

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[431] Sandler, "Gesture and Non-Gesture in Recent Sculpture," *American Sculpture of the Sixties*, 43.

[432] Coplans, "An Interview with Kenneth Snelson," *Artforum*, 49.

[433] Snelson, *Not in My Lifetime*, 145-6; see also Coplans, "Interview with Kenneth Snelson," *Artforum*, 46-9.

Suvero, and Grosvenor to push the limits of their materials in their works of art. [434] While these men used their innovations to make art, rather than utilitarian projects, they share Fuller's interest in developing building techniques that would allow for the creation of dramatic structural feats.

Fuller's ideas about geometry, which Snelson first learned about at Black Mountain, were at the heart of the Dymaxion structural theories and experiments. Stimulated by Fuller's lectures, Snelson developed a fascination with geometry that would later become essential to his artistic pursuits. During the first of these talks, delivered on the evening of his arrival, Fuller demonstrated his Energetic Geometry using a model that could spring from a flat octahedron into a dome. Observing this transformation affected Snelson in a way akin to seeing proof of the divine: "Like Bucky, I felt it had cosmic implications, that it was more than it appeared to be, merely a flexible assembly of cardboard, or soda-straws and string. I too thought that such a unique and perfect mutation of form must occur somewhere in other realms of nature; for some unique and perfect role somewhere. It just didn't seem right that the universe would provide such an extraordinary principle only for a parlor trick."[435] Elsewhere Snelson summarized his fascination with geometry: "There is no simple answer as to why polygons and polyhedra fascinate us so, but is there any other class of visual experience which brings us quite so close to the mind's capacity to understand complex order, or puts us so directly in contact with the universal laws of space?"[436] Snelson, like Fuller,

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[434] Tuchman, *American Sculpture of the Sixties*, 44; McShine, *Primary Structures*, n.p.

[435] Snelson, *Not in My Lifetime*, 59.

[436] *Ibid.*, 16.

came to believe that within the mysteries of geometry there was secret knowledge about how the universe functioned. As I have indicated, both men believed in structural universality, a link between physical properties regardless of scale. Both Fuller and Snelson, for example, thought that the structures of innovations such as the geodesic dome and tensegrity were related to the physical composition of the atom. Similarly, Fuller believed, as recounted in the story of the failed attempt to erect a geodesic dome in 1948, that he had discovered a map of fruit fly chromosomes in geodesic patterning. Unraveling the secrets of invisible structural connections was a dominant theme for both Snelson and Fuller, and furthermore was shared by a wider circle of artists active in the 1960s.

Like Snelson, some of the Park Place artists were also inspired by Fuller's exploration of geometric secrets. Forakis's geometric pursuits, for example, led him to topology, the study, through mathematics, of qualities that remain consistent in geometric forms regardless of changes in shape.[437] The classic example given to explain topology is that a coffee cup and a doughnut can be considered topologically equivalent because the doughnut could be transformed into a mug by morphing its hole into the handle and working a depression into its surface to create the well of the cup. Forakis's *JFK Chair*, 1963 (Figure 110), formed from a single rectangular sheet of metal, is an artistic expression of topology. By bending the metal so that both ends rested on the ground, he

[437] According to Dalrymple Henderson, Forakis learned about topology from articles in *Scientific American* and from *Geometry and the Imagination* by David Hilbert and S. Cohn-Vóssen (New York, Chelsea Publishing Company, 1952).

created the legs and arms of the chair. The chair back was sliced from a u-shaped tab in the sheet's center.

Snelson's understanding of his own structural studies relates closely to topology, representing another link between his interests and Forakis's. The presentation in Snelson's 1965 patent starts with a simple two-rod kite frame (Appendix B: patent Figure 1). In the subsequent series of illustrations this image changes through a series of contortions, what Snelson called "translations," into different forms.[438] In the patent, Snelson demonstrated how by twisting and multiplying the basic structure of the kite frame—an approach not unlike the topographical principles that inspired Forakis—it is possible to construct various tensegrity forms.

Inspired by Fuller's work on complex vectoral geometry, Forakis's geometric explorations also sparked his interest in the fourth dimension, resulting in works of art such as *Hyper-Cube*, 1967 (Figure 111).[439] A hypercube is a four-dimensional cube, also known as a tesseract. To imagine how a hypercube is composed one must picture the creation of a three-dimensional cube from two two-dimensional squares. Three-dimensional cubic space is formed by connecting each corner of the square to the

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[438] Snelson, in discussion with the author, September 9, 2011.

Snelson only later learned that the Constructivist definition of structure started with a cross form, first articulated by the Constructivist Karl Ioganson in 1921. See Maria Gough, "In the Laboratory of Constructivism: Karl Ioganson's Cold Structures," *October* 84 (Spring, 1998): 102.

[439] Fuller, "Prevailing Conditions in the Arts," *Utopia or Oblivion*, vectors 89-94, fourth-dimensional modeling 97-100; Fuller and Applewhite, "Systems," *Synergetics*. For Fuller on the fourth dimension, see also: Fuller, *4D Timeclock* (Corrales, New Mexico: Lama Foundation, 1970). For more on the use of the fourth dimension in art see Linda Dalrymple Henderson, *The Fourth Dimension and Non-Euclidean Geometry in Modern Art* (Princeton: Princeton University Press, 1983).

corresponding corner of the other square (Figure 112). Similarly, the hypercube with four dimensions is made by connecting each corner of two three-dimensional cubes. The four dimensions in Forakis's *Hyper-Cube* create a difficult image to hold stable in one's mind. The struggle to retain a clear vision of this form causes a physical sensation, like that of the "flickering" images of OpArt of the same period.

Scientists and mathematicians express the fourth dimension mathematically since a true physical model is impossible. Forakis's attempt to create a visual demonstration of something science portrays with an equation relates this work closely to Snelson's atomic project. In fact, Fuller compared the visual challenge of the fourth dimension to the twentieth-century scientific treatment of the atom.[440] As I have argued, the idea of the visual expression of the non-visual or invisible is essential to Snelson's work. His tensegrity sculptures are a visual demonstration of an otherwise invisible natural force, and he was dedicated to the idea of a concrete atomic model, rather than the one modern science advocates, which describes the structure non-visually with mathematic equations. Fuller and Snelson shared the desire for a renewed interest in visual scientific models, and both men were inspired to create atomic structural plans that related closely to their

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[440] Fuller, "Prevailing Conditions in the Arts," *Utopia and Oblivion*, 82, 97.

The fourth dimension was an important intellectual theme in Park Place art, and Dalrymple Henderson explained that for these artists it stood for more than just complex space (Dalrymple Henderson, *Reimagining Space*, 8-9). One of books that members of the group passed around was *Flatland: A Romance of Many Dimensions by a Square* (1884), a Victorian novel by Edwin Abbott. Although primarily a critique of hierarchical English class structure, this work, written from the perspective of a two-dimensional square, popularized the idea of a spatial fourth dimension in the late nineteenth century. With its entry into popular culture, the fourth dimension also developed mystical meanings and was connected to a new realm of consciousness. These Victorian ideas were filtered down to the Park Place Group in the 1960s. In the twentieth century, time (as compared to space which is defined by the first three dimensions) came to be known as the fourth dimension based on Einstein's General Theory of Relativity.

macro-scale structural investigations. For both Fuller and Snelson there is a close connection between the worlds that can and cannot be seen. Both, when considering construction, think not only of the visible product, but also of the geometry and natural forces that give their projects structural integrity. In 1967, the art critic John Perreault, commenting on Bladen's sculptures, described how awe-inspiring constructions arouse interest in the interior structures that make such feats possible: "[Bladen's work] cannot possibly do what they are so obviously able to do. They should fall, but they don't. They have 'insides.' They have a secret. They provoke our curiosity and yet, because they also provoke our fear, they ignite our awareness by forcing us to consider their interiors and to consider what their smooth geometry makes invisible."[441] The almost magical constructions that artists such as Snelson, Bladen, and Grosvenor achieve imply that there is an unknown quality of interiority to their work—something going on beneath the surface that the viewer cannot see that allows the piece to stand. The unseen structural forces are the secrets of such works of art. Similarly, Fried wrote that the hollow box constructions that many Minimalists, such as Robert Morris (Figure 70), Grosvenor (Figure 72 and 81) and Bladen (Figures 60-61), employed also suggested an "inner, even secret, life."[442] In these works, the large expanses of unadorned surface give no clue as to the contents of the bulky geometric forms. The insides of these pieces are hidden forever, known only to the object's creator. Dramatic constructions that appear to defy

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[441] John Perreault, "Minimal Abstracts," in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 259-60.

[442] Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 129.

gravity and blank box forms that cannot be opened suggest the idea not only of structural secrets, but also metaphysical mysteries.

Fuller's work on the visual expression of ideas, so closely related to Snelson's driving interests, included not only geometric diagrams and models, but also a map and globe projects aimed at improving understanding about geography and international demographic concerns. His oddly shaped *Dymaxion Map* (1946) not only eliminated pre-defined directionality, but retained proportionality among the depicted land masses, unlike the well known Mercator projection, in which the size of masses increases with their distance from the equator. One of Fuller's most ambitious projects in this vein was the *Geoscope*, begun in 1952. It was a two-hundred-foot diameter spherical computer monitor that visually demonstrated demographic statistics of human need and activity across the world.[443] Through a system of lights, the globe could show information about numerous topics, including population, agriculture, climate, financial investment, and politics. With the *Geoscope*, Fuller translated non-visual information, such as population density, into a visual form.[444]

Fuller's cartographic work was a source of inspiration for Smithson, although the artist's mapping projects, which were initiated in 1966, often presented a nonsensical or abstract vision.[445] *A Nonsite, Franklin, New Jersey*, 1968 (Figure 113) presents one of

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[443] Fuller, "Keynote Address at Vision 65," *Utopia and Oblivion*, 116-7; K. Michael Hays, "Fuller's Geological Engagements with Architecture," in *Buckminster Fuller: Starting with the Universe*, 9-10.

[444] This is a subject that has been explored by Edward R. Tufte in books such as *The Visual Display of Quantitative Information* (Cheshire, Connecticut: Graphics Press, 1983).

[445] Miller, "Thought Patterns: Buckminster Fuller The Scientist-Artist," *Buckminster Fuller: Starting with the Universe*, 33.

Smithson's less fantastical uses of cartography. The work is composed of five trapezoid-shaped boxes filled with ore from a site in New Jersey and an aerial map of the same site, divided into boxes of the same shape. Although purporting to compare visions of the site, this work is actually about the molecular world we cannot see—like Snelson's atom. Smithson used two types of minerals (calcite and willemite) that glow two different colors—red and green—under ultraviolet light because of their structural properties. These colors, however, cannot be seen in the standard light of the gallery where the work was shown. In addition, Smithson had originally intended for the work to be composed of six boxes to correspond with the hexagonal molecular structure of the minerals he selected.[446] Smithson, taking the techno-scientific aesthetic to a new extreme and playing with the idea of invisibility, employed the machine-powered eye of the microscope to reveal the inner geometry of his subject. Although the composition is guided by this knowledge, he keeps it a secret from the viewer, adding another layer to the idea of seen and unseen and suggesting that nature can be known on different levels.

Smithson's fascination with crystalline structure, demonstrated in many of his 1960s works, including *A Nonsite, Franklin, New Jersey* and *Enantiomorphic Chambers*, is one that he shared with Judd, and it represents an interesting correlation with Snelson's work.[447] Crystallography is the study of the repeating geometric shapes that make up geological forms. Judd's interest is demonstrated artistically in most of his work from this period through the repetition of rectilinear shapes arranged according to an internal

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[446] Hobbs, *Robert Smithson*, 108.

[447] Robert Smithson, "Entropy and the New Monuments," *Artforum* IV, no. 10 (June 1966): 30; Hobbs, *Robert Smithson*, 12.

system of organization (the dimensions of the solid elements relates to the size of the interstices). The structural organization of crystals relates closely to Snelson's concentration on the natural forces that give tension and compression constructions and the atom structural integrity. The study of crystals, like those forms that interest Snelson, relates to the patterns and forces in nature that make up our physical world. In addition, although crystal forms grow their structure is static and unchanging, like the frozen moment of balanced push and pull that Snelson captures in his tensegrity sculptures.

Constructivism and The Real

Art critics of the 1960s often called Snelson a "Constructivist," when addressing the scientific and engineering aspects of his work. For example, Hilton Kramer wrote for the *New York Times*: "The work itself is a pure distillation of the constructivist esthetic—highly impersonal, handsomely made, and somehow very eloquent…."[448] And, in an earlier review, "Mr. Snelson follows conventional constructivist practice in making the interior space of the composition—rather than the masses used to articulate it—his principal interest."[449] Snelson recognizes an aesthetic and philosophical relationship between his sculpture and Constructivism stating, "The fact that I was schooled in art makes me feel most comfortable with the constructivists because, at root, we share a

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[448] Hilton Kramer, Kenneth Snelson Dwan Show Review, *The New York Times*, March 14, 1970, Arts section.

[449] Kramer, "Marsden Hartley, American Yet Cosmopolitan," *The New York Times*..

common interest: that of putting together separate parts to create a new whole."[450] In an interview he explained, "I admired them [Constructivists], too. And I could see a commonality—I could see similar interests—they were geometric, cold artists."[451] Snelson was not unique in this regard. The idea of Russian Constructivism was *en vogue* in the 1960s, and it appealed to artists, many of whom—like Snelson—were drawn to technology and science.[452] For sculptors of the period, Constructivism provided a precedent for abstract three-dimensional work that was about formal exploration, a deliberate removal of the artistic hand, and an attitude of quasi-scientific objectivity towards the natural forces, along with a fetishizing of the machine and mechanical production.

Constructivism developed amid the sweeping societal changes in Russia, in the years surrounding the 1917 Revolution. Inspired by Socialist principles, some Constructivists, most prominently Vladimir Tatlin and Alexander Rodchenko, espoused a theory of Productivism, stating that artists should learn technical skills and apply their creativity to the factory production of useful goods.[453] Their ideology, however, allowed for experimentation without a clear, immediate utilitarian goal in the form of "laboratory work."[454] They envisioned the artistic process as a communal project based on objective,

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[450] Snelson, "An Artist's Atom." *Leonardo*, 231; Snelson, in discussion with the author, April 16, 2008.

[451] Snelson, in discussion with the author, September 9, 2011.

[452] McShine, *Primary Structures*, n.p.

[453] Christina Lodder, *Russian Constructivism* (New Haven: Yale University Press, 1983), 1-4.

[454] Lodder, *Russian Constructivism*, 7.

scientific experimentation with materials, techniques, and colors, and they hoped that a useful discovery would result. Purely aesthetic art, created autonomously and driven by emotion, was corrupting and bourgeois; however, the role of the artist in society could be redeemed through productive work. Constructivism associated artistic production with technology, industry, or invention, rather than with upper-class taste and luxury consumption, in keeping with the new social and economic order of the Soviet Union.[455] In 1962, Camilla Gray published *The Great Experiment: Russian Art, 1863-1922*, the first significant work of Western scholarship about avant-garde Russian art. This well-illustrated survey of Russian Modernism included summaries of Constructivist theory with quotations from original texts and explained the history of the movement's formation. "The new Constructivist ideology was above all," Gray wrote, "concerned with a practical 'bridge between art and industry.'"[456] Gray's text was an important source for many 1960s sculptors (although Snelson has not read it), and these artists, particularly those associated with Minimalism, found in the earlier movement a precedent for using industrially inspired techniques to make non-representational three-dimensional work that explored issues of mass, shape, and line.[457] Among the most well-known Minimalists, Judd, Morris, Dan Flavin, Carl Andre, and Sol LeWitt all refer to Tatlin or

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455 Foster, "Some Uses and Abuses of Russian Constructivism," *Art into Life*, 241-2.

456 Camilla Gray, *The Great Experiment: Russian Art, 1863-1922* (London: Thames and Hudson, 1962), 245.

457 Friedman and van der Marck, *Eight Sculptors*, 7; Weiss, *Dan Flavin*, 90; Meyer, *Minimalism: Art and Polemics in the Sixties*, endnote 144; Garrels, *Sol LeWitt*, 50-1.

Rodchenko in their essays or through visual allusion in their sculpture.[458] Contemporary scholars such as Hal Foster, however, have noted that the admiration these sixties artists felt for the industrial aesthetic of Constructivism and theories about construction, materials, and laboratory invention, did not include the Socialist underpinnings about non-elite consumption and utilitarian production.[459] Minimalists did strive, like their Constructivist predecessors, to make works of art that were not only free of literal representation, but also from any form of reference to the human form or experience.[460] This was often achieved through the use of modularity and seriality, which, in the sixties, was understood as having direct antecedents in Constructivism.[461]

At the most basic level, the Minimalist interest in Constructivism is demonstrated by several pieces that were produced in visual homage to the artists of the earlier movement. For example, Flavin referenced Tatlin's *Monument to the Third International* of 1920 (Figure 114) in a series of approximately fifty works produced between 1964 and 1990, composed of white-fluorescent light bulbs (Figure 115). Flavin alluded to Tatlin not only in the title of these pieces, but visually with a stepped profile that mimics the three tiers of Tatlin's design, which was one of the best known works of

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458 Meyer, *Minimalism: Art and Polemics in the Sixties*, 4-5, 156-9, endnote 144; Morris, "Notes on Sculpture," *Minimal Art: A Critical Anthology*, 224.

459 Foster, "Some Uses and Abuses of Russian Constructivism," *Art into Life*, 244.

460 Morris, "Notes on Sculpture," *Minimal Art: A Critical Anthology*, 224; Colpitt, *Minimal Art: The Critical Perspective*, 102; Crow, *The Rise of the Sixties*, 109; Friedman and van der Marck, *Eight Sculptors*, 20.

461 Rose, "A B C Art," *Minimal Art: A Critical Anthology*, 282; Alloway, "Serial Forms," *American Sculpture of the Sixties*, 14.

Constructivist art. Tatlin's piece is only a model, standing approximately twenty-feet high, for a never-realized governmental building that was meant to be constructed on a tremendous scale in glass and iron to serve as a shining display of Soviet engineering and political idealism. Like a clock gear, elements of the building, planned for administrative and legislative offices, would turn at different rates, reflecting the passage of years, months, and days. Similarly, the black-and-white concentric squares painted on the wood beams suspended from the ceiling in LeWitt's *Hanging Sculpture with Stripes*, 1963 (Figure 116), was a direct visual reference to Rodchenko's *Spatial Constructions*, 1918-21 (Figures 117-118).[462] Rodchenko's plywood graduated forms were painted silver to imitate metal, which was in short supply in early Soviet Russia.[463] He suspended the geometric cutouts from wire, creating a three-dimensional, hanging structure by arranging the pieces on different angles. Andre also referenced Rodchenko with his *Pyramid*, 1959 (Figure 119), which closely resembles the earlier artist's *Construction of Distance*, 1920 (Figure 120) in its use of stacked industrial wood beams. Rodchenko's work is from a group of twenty-five composed of one or two commercially available sizes of wood blocks, and it was intended to provide an example of what could be achieved with standardized elements.[464] Although he did not share Rodchenko's

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[462] Although only one work from this series survives, *Spatial Construction, No. 12*, 1920, others are known through photographs, including images of the hexagonal and circular pieces that appear in Gray's 1962 publication.

[463] Lodder, *Russian Constructivism*, 24.

[464] Selim O. Khan-Magomedov, *Rodchenko: The Complete Work* (Cambridge, Massachusetts: 1987), 102.

practical concerns, Andre would continue to use readily available building materials, such as bricks and metal tiles, in his 1960s sculptures.

Naum Gabo's essays were also an important source of information about Constructivist ideas for sixties artists.[465] Gabo was interested in defining space and the internal structure of geometric forms.[466] He used various techniques in his work to make these ideas apparent. For example, in *Linear Construction No. 4*, 1959-6 (Figure 121), he wrapped a sculptural armature in delicate cord to emphasize the interior space of the object, and in *Translucent Variation on a Spheric Theme*, 1937/51 (Figure 122), he used see-through plastic to expose the geometry of a molded circular disc. In 1920, Gabo wrote:

> We renounce in sculpture, the mass as a sculptural element. It is known to every engineer that the static forces of a solid body and its material strength do not depend on the quantity of the mass...example of rail, a T-beam, etc. But you sculptors of all shades and directions, you still adhere to the age-old prejudice that you cannot free the volume of the mass.

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[465] Lodder, *Russian Constructivism*, 1.

Gabo and his brother Antoine Pevsner, Russian-born artists and early proponents of the Constructivist movement, left the Soviet Union permanently in the early 1920s to live in Western Europe, and the version of Constructivism that they disseminated through essays, including the 1920 *Realistic Manifesto,* eliminated the Socialist utilitarian focus of the original movement. (Lodder, *Russian Constructivism*, 38. See also Naum Gabo, "The Constructive Idea in Art," in *Circle: International Survey of Constructive Art*, eds. J.L. Martin, Ben Nicholson, and Naum Gabo (New York: Praeger, 1971).)

[466] Rosalind E. Krauss, *Passages in Modern Sculpture* (Cambridge, Massachusetts: The MIT Press, 1977), 57-61; Lodder, *Russian Constructivism*, 38.

> ...Thus we bring back to sculpture the line as a direction and in it we affirm depth as the one form of space.[467]

As Kramer noted in a period critique, Snelson's work has a similar effect in that he defined open geometric spaces.[468] Using rods and wires, Snelson created the outline of shapes, and, like Gabo, achieved stability not through the building up of mass, but through a revealed structural system. For Snelson the form, or structure, is the essential content or meaning of his work. Snelson's sculptures are composed of pushing and pulling members arranged in equilibrium, and they are a demonstration of these forces of tension and compression. In 1937, Gabo explained: "The Constructive point of view...does not separate Content from Form—on the contrary, it does not see as possible their separated and independent existence. ...The Constructive Idea...has revealed an universal law that the elements of a visual art such as lines, colours, shapes, posses their own forces of expression independent of any association with the external aspect of the world."[469] Gabo believed that a work of art should be complete in itself—that its meaning should be found in its formal elements, rather than in anything external, beyond the work itself. This idea is the basis of Snelson's work—the subject of his sculpture *is* its structure.

Minimalist sculptors echoed these ideas when they describe the literal nature, or in period terms "realness," of their work. Snelson's focus on structure can be compared,

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[467] Gabo and Pevsner, "The Realistic Manifesto, 1920," in *The Documents of 20th-Century Art*, trans. Naum Gabo, ed. John E. Bowlt, (New York: Viking Press: 1976), 213.

[468] Kramer, "Marsden Hartley, American Yet Cosmopolitan," *The New York Times*.

[469] Gabo, "The Constructive Idea," *Circle*, 6-7.

for example, with Judd's and Morris's interest in the physical qualities of sculpture—mass, form, and proportion—which also drew on Constructivist ideals.[470] Like their Russian predecessors, these artists were not creating mimetic abstractions based on or alluding to other forms. To emphasize this point, Judd referred to his work, and other sculpture like it, as "specific objects," rather than "art."[471] As Harold Rosenberg wrote in 1970, for Judd this meant using, "actual materials, actual colors, actual space…for example brown dirt rather than brown paint" and these decisions implied a desire "to purge art of the seeds of artifice."[472]

Morris's pursuit of the real is exemplified by the notarized statement that accompanies a 1963 piece called *Litanies*. Titled "State of Esthetic Withdrawal," it states: "The undersigned, Robert Morris, being the maker of the metal construction entitled Litanies, described in the annexed Exhibit A, hereby withdraws from said construction all esthetic quality and content and declares that from the date hereof said construction has no such quality and content."[473] By legally renouncing any aesthetic claims, Morris declared his creation of a real object, devoid of the synthetic and mimetic qualities associated with artistry. Elsewhere, Morris related this aspect of his artistic philosophy to Constructivism: "Tatlin was perhaps the first to free sculpture from representation and establish it as an autonomous form both by the kind of image, or rather

[470] Friedman and van der Marck, *Eight Sculptors*, 20.

[471] Judd, "Specific Objects," *Contemporary Sculpture*, 74-82.

[472] Harold Rosenberg, "De-Aestheticization," in *The New Art: A Critical Anthology*, ed. Gregory Battcock (New York: E.P. Dutton, 1973), 179.

[473] *Ibid.*, 178-9.

non-image, he employed and by his literal use of materials. ...In subsequent years Gabo...perpetuated the Constructivist ideal of a non-imagistic sculpture which was independent of architecture. ...Today there is a reassertion of the non-imagistic as an essential condition."[474] Tatlin and Gabo provided a point of departure for Morris and his peers because the work they created did not seek to replicate natural, anthropomorphic, or architectural forms, rather focusing on experimentation with mass, line, scale, and materials.[475]

"Object," "real," and "autonomous" were among the key words for sculptors of the sixties. As E.C. Goosen described in his introduction for *The Art of the Real* catalogue that accompanied a 1968 exhibition at the Museum of Modern Art:

> To propose that some art is more 'real' than other art may be foolhardy. Yet many America artists over the last few years have made this proposal by the nature of their works. They have taken a stance that leaves little doubt about their desire to confront the experience and objects we encounter every day with an exact equivalence in art. ...The 'real' of today as it is posited by this new art has nothing to do metaphor, or symbolism, or any kind of metaphysics. ...It does not wish to convey the notion that reality is somewhere else. ...Today's 'real,' on the contrary, makes no direct appeal to the emotions, nor is it involved in uplift. Indeed, it seems to have no desire at all to justify itself, but instead offer

[474] Morris, "Notes on Sculpture," *Artforum*, 43.

[475] Friedman and van der Marck, *Eight Sculptors*, 20.

> itself for whatever its uniqueness is worth—in the form of the simple, irreducible, irrefutable object.[476]

Sixties sculptors strove to make work that viewers would perceive in the same manner as non-art objects. The work was not visually or spiritually referential, it did not exist as a stand-in for something else, and it was not imbued with extraordinary meaning.

How these ideas were made manifest can be seen, for example, by comparing Tatlin's *Corner Relief,* 1915 (Figure 123) (illustrated in Rickey's *Constructivism: Origins and Evolution*, 1967), and Morris's *Untitled* (*Corner Piece*), 1964 (Figure 124). Krauss has explained that Tatlin's piece was radically "anti-illusionistic" and drew the viewer's attention to "the reality of the situation" through its relationship with the architectural context of the installation.[477] The work is made of bent sheets of metal suspended between the perpendicular corner walls by curved-wire props. Similarly, Morris's sculpture, composed simply of a flat metal triangle, is supported by and draws attention to the corner angle.[478] Describing how sculpture can approach the real in a way painting cannot, Morris wrote: "One of the conditions of knowing an object is supplied by the sensing of the gravitational force acting upon it in actual space. That is, space with three, not two coordinates."[479] Morris and Tatlin's works exist in the real space of the viewer and depend on the actual architecture of the room to stay in place. Importantly, these

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[476] E.C. Goosen, *The Art of the Real: USA 1948-1968* (New York: Museum of Modern Art, 1968), 7.

[477] Krauss, *Passages in Modern Sculpture*, 55-6.

[478] Marcia Tucker, *Robert Morris* (New York: Whitney Museum of American Art, 1970), 25.

[479] Morris, "Notes on Sculpture," *Artforum*, 43.

relationships remind the viewer that, like them, the work of art is subject to gravity. As I have shown, Snelson's work of this period also interacted with architecture and asked the viewer to reflect on gravitational forces.

In his 1968 book, *Beyond Modern Sculpture*, Jack Burnham described how what he calls "technics," a combination of science and technology, was the dominating influence on contemporary sculpture.[480] For Burnham, one of the significant distinctions between modern sculpture and that of the past was the abandonment of the base or pedestal. He wrote: "The base is the sculptor's convention for rooting his art to surrounding reality while permitting it to stand apart. …the base helps to create an aura of distance and dignity around the favored object. …the base has served to isolate and emphasize…."[481] The absence of a base meant that the art and the viewer shared the same, real realm of existence. The installation views of *Primary Structures* at The Jewish Museum (Figures 72 and 110) and Morris's 1964 Green Gallery show (Figure 70) demonstrate this effect. The sculptures in these exhibitions are situated directly on the floor or hung from the walls and ceiling without bases or frames. Burnham found an historical basis for the elimination of the base in Constructivism, and concluded, "thus, the sculpture base bestowed an *apartness*; it physically defined the aesthetic distance which necessarily remained between the viewer and art object."[482] Drawing on Constructivist inspiration, 1960s sculptors rejected the traditional relationship between

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[480] Bijvoet analyzes Burnham's text in *Art as Inquiry*, 67-74.

[481] Burnham, *Beyond Modern Sculpture*, 19.

[482] *Ibid.*, 34-39, 43.

sculpture and viewer, they embraced the quotidian physical environment, and made objects that existed in the real world, rather than in the ersatz world of "artistry."

Snelson and Rickey

Snelson's close friend George Rickey was perhaps the most closely identified with Constructivism in the 1960s. Rickey made large, outdoor, geometric metal sculptures with paddles and attenuated blades that tilt, revolve, and seesaw in the wind (Figures 125-126). Using Gabo's phrase, Rickey wrote in 1965 that his work is about "movement itself."[483] His kinetic sculptures are complete only when blown by the wind and are, therefore, constantly changing with the direction and strength of the breeze.[484] Accordingly, Rickey's work is also about the passage of time. As he described, "I have worked for several years with the simple movement of straight lines, as they cut each other, slice the intervening space and divide time, responding to the gentlest air currents."[485] The pace of the blades' movement measures the strength of the wind, just as the perpetual movement of the pendulum measures time in a grandfather clock.

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[483] George Rickey, "The Métier," in *Contemporary Sculpture: Arts Yearbook 8*, ed. Joseph James Akston (New York: Arts Digest, 1965), 164.

[484] A number of texts from the period provided histories of kinetic art, including: George Rickey, "The Morphology of Movement: A Study of Kinetic Art," in *Vision and Value: The Nature and Art of Motion*, ed. György Kepes (New York: Braziller, 1965); Philip Leider, "Looking at Kinetic Sculpture," *Artforum* IV, no. 9 (May 1966): 40-44; Jack Burnham, *Beyond Modern Sculpture* (New York: George Braziller, 1968), Chapter Six; Sharp, "Luminism and Kineticism," *Minimal Art: A Critical Anthology*, 317-58.

[485] Rickey, "The Métier," *Contemporary Sculpture*, 165.

Rickey had an on-going and complicated engagement with Russian Constructivism. He collected Constructivist art work,[486] he published a history of movement in 1967 called *Constructivism: Origins and Evolution*,[487] and he saw antecedents for his artistic concepts in Constructivist texts, particularly Gabo's 1920 *The Realistic Manifesto*.[488] Assessing his relationship with Constructivism, Rickey wrote: "I do not claim to be a Constructivist. Yet I respect the humility, rigor, self-effacement and regard for object-rather-than-process which characterized early Constructivist work and gave meaning to the "real" in Gabo's *Realist Manifesto*. I see no reason why analytical thought and rational systems need endanger an artist's work, nor do I mind temperament, if the show of it is not made the purpose. There is a bloom of temperament in Malevich and Albers just as there is a core of reason in Van Gogh and Klee."[489] Deviating from Gabo's emphasis on the abandonment of "sentiment," Rickey believed that there was no reason to exclude either reason or emotion from art. Indeed, visually his sculptures demonstrate both a scientific-minded interest in kineticism and a Romantic sensibility about the beauty of the natural world and fleeting quality of time.

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[486] Rickey's collection was the subject of an exhibition and accompanying catalogue: Ala Story, *Constructivist Tendencies: From the Collection of Mr. and Mrs. George Rickey* (Santa Barbara: University of California Press, 1970). A review of this volume shows that, at least in collecting, Rickey expanded his definition of Constructivism beyond the practitioners working in Russia in the first quarter of the century to a broad range of artists making geometric and in some manner technically-minded work, including Albers, Max Bill, and Alexander Calder.

[487] George Rickey, *Constructivism: Origins and Evolution* (New York: Braziller, 1967).

[488] Rickey, "The Métier," *Contemporary* Sculpture, 165-6.

[489] *Ibid.*, 166.

To understand how Gabo's idea of "the real" relates to Rickey's work, it is necessary to look more closely at *The Realistic Manifesto*. This text is Gabo's declaration of the fundamental principles and aims of Constructivism as a departure from Cubism and Futurism. "The realization of our perceptions of the world in the forms of space and time is the only aim of our pictorial and plastic art," Gabo wrote.[490] And later in the text, "We affirm in these arts a new element the kinetic rhythms as the basic forms of our perception of real time."[491] While the Cubists and Futurists used pictorial devices, such as line and color, to portray time, Constructivist art visually depicts space and time in real terms. For example, as discussed above, Gabo demonstrated interior geometric space in *Linear Construction No. 4*, 1959-6 (Figure 121), and *Translucent Variation on a Spheric Theme*, 1937/51 (Figure 122), and Tatlin planned to show the passage of different units of time through movement in *Monument to the Third International* (Figure 114). Similarly, Rickey's work is a genuine demonstration, rather than a visual description, of time and movement, just as Snelson's is a demonstration of the structural principle of balanced tension and compression.

Snelson and Rickey became close friends in the 1970s, and their work has been shown together several times, most recently as the subject of a 2006 two-artist show, *Deux Américains à Paris*, in the Jardin du Palais Royal, four years after Rickey's death in 2002.[492] While Snelson was at Black Mountain in 1948 and 1949, Rickey was a student

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[490] Gabo and Pevsner, "The Realistic Manifesto, 1920," *The Documents of 20th-Century Art*, 212.

[491] *Ibid.*, 214.

[492] Valerie Fletcher, "George Rickey: Poetry in Motion," in *George Rickey: Kinetic Sculpture,* ed. Lucinda H. Gedeon (Vero Beach, Florida: Vero Beach Museum of Art, 2007), 33.

at the Chicago Institute of Design (formerly the New Bauhaus), where Fuller was a professor. Rickey enrolled there after serving in the army because he wanted to switch his focus from painting to sculpture. Rickey was already at this time drawn to the idea of what he described as "art outside of art," and he thought he would be able to develop such ideas at the Bauhaus-influenced Institute of Design.[493] Rickey and Snelson share a similar approach to production that reflects their Bauhaus-influenced training. Like Snelson, Rickey learned the techniques he needed—such as tooling, soldering, and later welding—as his sculptural practice developed.[494] Rickey developed a shock-absorption device to control the speed of blade movement, in much the same manner as Snelson developed his hub joint, by working with simple machine-tooling techniques and the materials at hand. For both artists, being the inventor of the mechanical parts of their work was essential to their idea of being the creator.[495] In addition, both artists worked intuitively, using a trail-and-error process, rather than mathematical calculations.[496]

Furthermore, both Rickey and Snelson were motivated artistically by their interest in the natural world and universal principles. As Rickey wrote:

> Nature has offered to the artist's eye landscape, figure, still-life and also geometry.... But nature is also 'natural laws': gravity, Newton's laws of motion.... The artist finds waiting for him, as subjects, not the trees, not the flowers, not landscape, but the *waving* of branches and the *trembling*

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[493] Rickey, "The Métier," *Contemporary Sculpture*, 165.

[494] Fletcher, "George Rickey: Poetry in Motion," *George Rickey*, 18.

[495] *Ibid.*, 24.

[496] *Ibid.*, 23.

> of stems, the piling up or scudding of cloud…and those movements of sub-atomic particles never to be seen, but mapped and inferred from the tracks in the bubble chamber and vague and awesome accounts in the press. …Thus it is not in imitation of appearance that kinetic art is served by 'nature' but in recognition of its laws, awareness of analogies, and response to the vast repertory of movement in the environment.[497]

Reflecting the Constructivist sense of "the real," Rickey and Snelson, using the techniques of the engineer or machinist, created sculptures that are literal demonstrations of physical principles, rather than visually mimetic.[498] Although Rickey's work is about movement and change, and there is an inherent stillness and constancy to the perfected balance of Snelson's tensegrity sculptures, both artists were driven by a desire to make art that visually demonstrated the work of natural forces.

Howard Fox, however, described an essential distinction between Snelson and his Constructivist predecessors. He proposes that while Constructivists were interested in visually describing space and structure, Snelson's aim was to actually demonstrate what makes structure possible. For example, in Gabo's *Linear Construction No. 4,* 1959-61 (Figure 121), the wires delineate space in keeping with the artistic goals he described in *Manifesto*, but they are not important for the physical construction of the piece. As Fox explains: "Remove the steel wire [from Gabo's piece], and the aluminum armature remains intact; cut the cord in a Snelson sculpture, though, and there is no more form.

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[497] George Rickey, "The Morphology of Movement: A Study of Kinetic Art," *Vision and Value*, 110.

[498] Holliday T. Day, *Crossroads of American Sculpture* (Indianapolis: Indianapolis Museum of Art, 2000), 18-19.

Gabo's wires are formally significant but structurally irrelevant; Snelson's wires hold everything together, and their very activity is the subject of his structures."[499] The cords in Gabo's sculpture serve to define space in an artistic sense; however, in Snelson's work the wires provide tension that is essential to the structure in real terms, and therefore constitutes not just the mechanics of form, but also the work's meaning.

A similar contrast can be made between Snelson's and Rickey's work and that of Alexander Calder—one of the most well-known kinetic artists. Rickey first saw Calder's work in the exhibition catalogue that was published for a 1943 MoMA exhibition.[500] The images in this volume had a powerful effect on Rickey, and, in 1951, he visited Calder's studio to learn about his method first hand.[501] Although Snelson does not see the influence of Calder on his art, there is a visual relationship between the works of the two artists who both emphasize a delicate sense of balance.[502] In fact, the early experiments Snelson created in his parents' basement in the winter of 1948 are based on a principle of weighted equilibrium that relates closely to Calder's mobiles, and these experiments strongly resemble the models Calder prepared in wire when developing a piece (Figures 41-42). (It should be noted, however, that following these preliminary structures Snelson abandoned kineticism permanently and entirely.) Yet, as Fox described, there is an important difference between Snelson's work and Calder's: "Where Calder used balance

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[499] Fox, "Kenneth Snelson: Portrait of an Atomist," *Kenneth Snelson*, 12.

[500] Fletcher, "George Rickey: Poetry in Motion," *George Rickey*, 17.

[501] *Ibid.*, 18.

[502] Snelson, in discussion with the author, September 20, 2010.

anecdotally or for formal purposes, Snelson found in it the very subject (or object) of his investigation."[503] Scholars have made similar contrasts between Rickey's pieces and that of the older kinetic artist: movement animates a Calder sculpture, while it is *subject* of a Rickey sculpture.[504] Structure and motion are not ornamental for Rickey and Snelson, they are in fact the essence of their art.

The Real and the Invisible

As I have discussed in this chapter, the idea of "the real" is a commonality among the work of many of Snelson's 1960s contemporaries who were looking to science and technology as a source of imagery and technique.[505] In Snelson's tensegrity sculptures, this idea is manifest in his concern with structure and the demonstration of natural physical principles. As Snelson explained, he became an artist because of "the desire to *make* things rather than simply paint *images* of things."[506] Snelson is concerned with actual structural principles, rather than mimetic affects, building his work for real strength and not only aesthetic concerns. Other artists of the time who shared Snelson's

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[503] Fox, "Kenneth Snelson: Portrait of an Atomist," *Kenneth Snelson*, 10.

[504] Day, *Crossroads of American Sculpture*, 30.

[505] Hal Foster provides an analytical and historiographic discussion of the idea of "the real" and realism in Hal Foster, "The Return of the Real," *The Return of the Real: The Avant-Garde at the End of the Century* (Cambridge Massachusetts: MIT Press, 1996), 127-168. The presence of the real in art made within the last decade is discussed by Damian Sutton, Susan Brind, and Ray McKenzi, eds, *The State of the Real: Aesthetics in the Digital Age* (New York: I.B. Tauris, 2007).

[506] Felton, "Kenneth Snelson," *Creativity: Conversations with 28 Who Excel*, 5.

structural interest, such as Grosvenor, Bladen, di Suvero, and Rickey, also strove to make something real, and employed techniques of engineering to do so.

Minimalists, particularly Morris and Judd, similarly strove to create real things and engaged in a polemic about what Judd termed "specific objects"—work that existed as a thing in its own right, rather than a work of artifice. Like Snelson, Minimalists such as Judd, LeWitt, Flavin, Morris, and Andre, embraced industrial technology for materials and means of production, which is reflected visually in their sculptures through the use of modularity and seriality. In other words, by using repeated identical units, their work mimicked the industrial technology that at times aided their fabrication. In addition, these artists utilized predetermined geometric and mathematical concepts—which can be compared with Snelson's use of tensegrity—to dictate their compositions and to give their work scientific objectivity or realness.

Structural concerns motivated both Snelson and Rickey, and both artists were interested in making a natural force visible. Snelson expressed this interest not only with his sculpture, but also with his atomic model. In this way, Rickey's and Snelson's work can be compared to that of Forakis who attempted to make the not-visible fourth dimension visible, and, in a different way, to Smithson whose compositions employed the invisible world of molecular structure. The idea of secret interiority unites many of the works described in this chapter. For example, sculpture that appeared to defy gravity aroused interest in the unseen interior structure of the work. In addition, many of the pieces discussed played on issues of perception, making the viewer aware of the difference between what is perceived or apparent and what is real.

The sculptors discussed in this chapter also introduced different ways for viewers to have a "real" experience when viewing their work. For example, the unstable, hard-to-view effects of Forakis's *Hyper-Cube* caused a physical reaction in the viewer. Most of the mentioned sculptures did not have bases or platforms, and would therefore enter the "real" or physical world of the viewer, particularly when the piece interacted with the architecture of the room. As Goosen described in *The Art of the Real* catalogue, there was a trend toward work that elicited "basic responses as simple perception, sensuous appreciation, kinesthetics, and recognition of the tactile, objective experience of the work before us."[507] This relates to Snelson's desire to create gravity-defying art that would instill an immediate sense of awe in his viewer.[508] In a 1966 interview, Stella used baseball as an analogy to explain the wonder caused by simple but magnificent works of art. "Maybe that's the quality of simplicity," he said, "When Mantle hits the ball out of the park, everybody is sort of stunned for a minute because it's so simple. He knocks it right out of the park, and that usually does it."[509] Bladen's perspective is similar: "My involvement in sculpture outside of man's scale is an attempt to reach that area of excitement belonging to natural phenomena such as a gigantic wave poised before it makes its fall or man-made phenomena such as the high bridge spanning two distant points."[510] The "perceptual experience" itself was the goal of these artists, Goosen explained. Continuing, he wrote, the spectator is forced "to perceive himself in the

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[507] Goosen, *The Art of the Real*, 9.

[508] Snelson, in discussion with the author, December 8, 2009.

[509] Glaser, "Questions to Stella and Judd," *Minimal Art: A Critical Anthology*, 164.

[510] Tuchman, *American Sculpture of the Sixties*, 44.

process of his perception. The spectator is not given symbols, but facts, to make of them what he can. They do not direct his mind nor call up trusted cores of experience, but lead him to the point where he must evaluate his own peculiar responses."[511] Snelson and his peers hoped to arouse stupefaction, awe, or excitement, which--like the vague discomfort of trying to steady a difficult-to-see image—is a physical, and therefore real, reaction.

The visual trends of the real and the invisible are closely related for the artists discussed in this chapter to their techno-scientific interests, therefore one way to explain the cultural impetus for these artistic creations is to look at the dominant features of scientific research during this era. To do this, I want to return to the twentieth-century scientific innovations that inspired Snelson to create a visual model of the atom. Based on Erwin Schrödinger's theories and Werner Heisenberg's Uncertainty Principle, twentieth-century scientists abandoned the idea of an atom that could be defined visually, turning to statistical analyses represented by mathematical equations instead. The new quantum science, originating from the theories of these two men, presented not only the idea that the basic structure of the universe could not be seen, but also argued that ultimate and complete truth was unknowable, making uncertainty a new and permanent feature of science—a domain of knowledge that had previously promised reassuring definitiveness. Atomic research, however, presented even more than a metaphorical threat to mid-century Americans. The atomic bombs dropped on Hiroshima and Nagasaki near the end of World War II demonstrated the catastrophic power of this new weapon, a power that gained even more cultural resonance as the tension of the Cold War escalated in the fifties and sixties. I propose that the artistic preoccupation with the real

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[511] Goosen, *The Art of the Real*, 11.

and the visible in the 1960s relates to the dominant metaphor of quantum physics' unknowable and threatening atom.

Scientific research in the twentieth century can be distinguished from all earlier periods because of its focus on the atomic. In fact, historians have separated pre- and post-World War II into two cultural periods based on technological progress, dubbing the earlier part of the twentieth century the machine age and the post-World War II era the "atomic age."[512] As Carroll Pursell has discussed, the atom was different from the mechanical technology that preceded it in that it was not part of daily life, and its intricacies could not be understood by those outside of the professional sciences.[513] Recent histories of the post-war period, by scholars such as Pursell and Paul Boyer, demonstrate the power of the atomic idea that mingled fear of atomic warfare with hope for what might be achieved with this new energy source.[514]

Although Pursell and Boyer's observations are focused on the late forties and fifties, the continued intensity of the cultural preoccupation with atomic science is described by historians of the following decade, as well. However, cultural histories of the 1960s tend to focus on the relationship between nuclear energy and warfare and the political and social upheaval of the period—a subject that I will return to in the following

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[512] Kamin Rappaport and Stayton, *Vital Forms*, 24; Pursell, *Technology in Postwar America*, 1-2, 59.

[513] Pursell, *Technology in Postwar America*, 65.

[514] Pursell, Technology in Postwar America; Boyer, *By the Bomb's Early Light.*

chapter.[515] However, turning to art historical literature, there are discussions that can be related to the link between atomic science and the prevalent themes of the real and the invisible in 1960s sculpture.

For example, although he does not relate his ideas to scientific knowledge, in his 1988 work on Minimalism, Kenneth Baker discussed the importance of the real and of individual experience in art in terms of 1960s culture. He explained that aspects of modern life, such as television, that collapsed the reality of time and space had created a high level of acceptance of illusion. "With the eclipse of reality by representations comes an exaltation of fantasy," Baker wrote.[516] He theorized that a society that depends on representations will become "indifferent" to the importance of the first-hand observation of details and distinctions preferring to gloss over that which cannot be easily known. Baker saw the use of the serial in Minimalist sculpture to represent not indistinguishable repetition but the ability to see particularity among a multiplicity.[517] By using simple forms that can be seen in their entirety at once, Minimalist work asks the viewer to confront what is really before them rather than what they imagine they are seeing. Drawing on Krauss's earlier analysis, Baker looks at a work by Morris composed of three L-shaped forms each of which was oriented differently in relation to the floor, 1965 (shown partially in Figure 72).[518] In reference to Cartesian philosophy, he writes that the

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[515] For example: Sargent Wood, *A More Perfect Union*; Sayres, Stephanson, Aronowitz, and Jameson, eds, *The 60s Without Apology*; Henriksen, *Dr. Strangelove's America: Society and Culture in the Atomic Age*.

[516] Baker, *Minimalism: Art of Circumstance*, 80.

[517] *Ibid.*, 80.

[518] Krauss, *Passages in Modern Sculpture*, 266-7.

intent of this work is to let the viewer discover "the primacy of perception over concepts."[519] The viewer understands intellectually that the three elements are identical, but experiences each as unique since differences in positioning distort their proportions. This recalls Albers's exploration of the distinction between actuality and factuality, and the 1960s sculptors who also addressed this visual concern, including Smithson and Judd.

Foster raised a similar point in 1986, asking, "For example, is the minimalist stress on presence and perception not in part a resistance to a world of ubiquitous representation and intensive mediation? Moreover, is the minimalist insistence on specificity not in part a response to a world of serial copies without originals…?"[520] Like Baker, Foster sees a connection between the Minimalist emphasis on the viewer's physical relationship to a work of art and the particulars of what can be seen, to a culture in which the world is most often apprehended secondhand through media such as television and goods are mass produced and homogeneous. Vision and the real take on significance under such cultural conditions, and the idea that the true nature of an object might be known by discovering its inner structure gains resonance.

Although the connection between the real and the invisible in art and atomic science has not been discussed directly in current art historical literature, Fuller was not alone among writers in the 1960s in noting the cultural changes caused by the developments in quantum science and artists who were interested in the techno-scientific

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519 Baker, *Minimalism: Art of Circumstance*, 80-1.

520 Hal Foster, "The Crux of Minimalism" in *Individuals: A Selected History of Contemporary Art, 1945*-1986, ed. Howard Singerman (New York: Abbeville Press for The Museum of the Contemporary Art Los Angeles, 1986), 178.

often commented on the fearful and unknowable atom.[521] For example, the Bauhaus-influenced painter and designer Kepes described how, "our new image of nature now harbors strange forms, such as nuclear particles and radiation, none visible to the naked eye, none relatable to our own bodies."[522] According to Kepes and others, science had gained a potentially frightening mystique when its focus had turned to the invisible world of quantum physics. Atoms were everywhere, but presented an invisible, incomprehensible, and dangerous reality. 1960s art writers often saw a link between new trends in art production and atomic science. The art critic Dore Ashton wrote in 1966:

> The artist, along with other intellectuals, has experienced the revolution of scientific and philosophical thought. ...Science has swept away the notion of an objective universe, and with it the immovable, resistant entities we call objects. ...If science, philosophy, and psychology continue to dissolve the exterior world, showing that there is no ultimate indivisible unity, and if objects seem so vastly complex and susceptible to the dissolution bestowed on them by advanced thought, is it any wonder that the artist shares the general crisis? Science dissolves known reality and art attempts to restore it. The preoccupation with objects may be seen as a

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[521] The idea that science of the twentieth century had become increasingly abstract and concerned with natural structures and phenomena not visible to the human eye is a leitmotif of Kepes's *The Visual Arts Today* and his *Vision and Value* series. The concept is mentioned directly by many of the essayists in these volumes, including Lancelot L. Whyte, "Atomism, Structure, and Form: A Report on the Natural Philosophy of Form;" and Jacob Bronowski, "The Discovery of Form" both in *Vision and Value: Structure in Art and in Science*, ed. György Kepes (New York: Braziller, 1965).

[522] György Kepes, ed, *The Visual Arts Today* (Middletown, Connecticut: Wesleyan University Press, 1960), 7. Kepes expresses a similar sentiment in *Vision and Value: The Nature and Art of Motion* (New York: Braziller, 1965), ii.

> last-ditch bid of art to resuscitate an objective world. ...the artist still seeks the solid materiality, the common-sense verities that seem to have been swallowed up by the radical speculations of science. ...The word concrete itself has come to be a magical antidote. The flight from metaphor, which complicates, is symptomatic. ...The unadorned, unworked object, nude and divested of meaning, is one answer to the nonsense dinned in our ears daily.[523]

Ashton wrote that twentieth-century science, particularly Heisenberg's Uncertainty Principle, had created a new, destabilized vision of the world that was harder to define and to know. The new uncertainty had cultural traction and resonated beyond the domain of science. She believed the artistic tendency toward objectivity and reality had developed in opposition to the ambiguity presented by the new science. For Ashton, art had become a haven where complete truth and certainty could still exist. She believed that in light of the unstable world science presented, artists turned away from symbolism, metaphor, artifice, and other murky presentations, toward a precise and objective vision.

In 1968, in his discussion of the dominant influence of science and technology on sculpture of the period, Burnham presented a related theory: "Nature no longer revealed itself directly to the eye, but was conveyed more accurately through scientific hypothesis and its resultant models. Much of the seeming irrationality of science confronted with the fallibility of 'common sense' perception. Physics asked the still unresolved question, what is *real* on the sub-atomic level? If matter were actually a series of extremely brief,

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[523] Dore Ashton, "From Achilles' Shield to Junk," in *Vision and Value: The Man-Made Object*, ed. György Kepes (New York: Braziller, 1966), 207.

highly connected 'events,' then why was the sculptor creating a private and hermetic 'reality' in bronze and marble."[524] Burnham believed that the developments in scientific theory that dictated that people could not trust the world they observed with their eyes and that atomic structure was unknowable had caused a shift in sculpture from a human paradigm and a naturalistic aesthetic to an aesthetic based on the machine.

Also relating the history of science to changes in artistic expression Allen Leepa, in a period essay about Minimalism, described how his generation was presented with a vision of nature that was ultimately impenetrable.[525] Similarly the critics Chandler and Lippard wrote in 1967:

> The difference between the old and new ways of 'imitating nature' is once again the difference between looking at the surface and at the underlying structures, the difference between the way things look to the naked eye and the way they look to an electric supermicroscope. Non-representational art has no use for models from nature; it has ceased to imitate exterior reality and creates autonomous objects—paintings rather than picture of things as they appear to the eye. Appearances, as they were to Plato and to the medieval mind, have become if not illusions, then at least superficialities, and this art rejects them; it has replaced the model

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[524] Burnham, *Beyond Modern Sculpture*, 113.

[525] Allen Leepa, "Minimal Art and Primary Meanings" in *Minimal Art: A Critical Anthology*, ed. Gregory Battcock (New York: E. P. Dutton, 1973), 200-1.

> with the module, figure with configuration, subject matter with object matter.[526]

Art of the sixties, according to Lippard and Chandler, reflected the interior world rather than what could be seen on the surface. They suggested that what can be observed by the naked eye was no longer representative of important truths. Rather, to know something about nature, invisible secrets had to be explored. Along with the scientific developments of the twentieth century, there was a new cultural idea of the natural world as something that was not visible to unaided human senses and mimetic artistic representations of this world had become an outmoded vision of reality. Instead, artists like scientists found truth and the real in abstractions and in unseen internal structures and not-visible physical properties.

Addressing the fear caused by the unknown and unstable, in 1965, Sontag wrote: "Art, which I have characterized as an instrument for modifying and educating sensibility and consciousness, now operates in an environment which cannot be grasped by the senses. ...What other response than...the elevating of intelligence over sentiment, is possible as a response to the social disorder and mass atrocities of our time...."[527] Sontag theorized that in a time of heightened cultural fear, art turned away from the expressive and the emotional in search of the objective and impassive. The potential for catastrophic destruction in the atomic age was so frightening that it numbed emotional and expressive responses. Science then not only represented the cause of this fear, but also a

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[526] Chandler and Lippard, "Visual Art and the Invisible World," *Art International*, 30.

[527] Sontag, "One Culture and the New Sensibility," *Against Interpretation and Other Essays*, 301.

dispassionate domain of knowledge in which human feelings and concerns were irrelevant.

In their examination of the real in millennial works art, Damian Sutton, Susan Brind, and Ray McKenzie suggested that to understand the meaning of the real, it must be compared to its opposite. They asked, "Real as opposed to what?"[528] In the 1960s, artists defined the real in their work as visible, knowable, structural, and physical. In contrast, not only were the subjects that occupied twentieth-century scientists not visible, when the scientific community gave up developing a visual model of the atom its appearance was declared unknowable. Quantum physics created a body of scientific knowledge that was alien from common experience and threatening to common existence. Many sculptors of the 1960s dedicated themselves to the idea of the real and to addressing themes of secret interiority and unseen natural forces at a time when science was similarly focused on an aspect of the natural world that is so miniscule that its true structure and movement could not be observed. Snelson's work with tensegrity sculpture and atomic models is in keeping with both of these ideas, and in both projects he was motivated by the desire to visualize unseen structures.

In her 1977 analysis of Minimalism, Krauss compared it to Abstract Expressionism, explaining how works belonging to the earlier movement presented the painted canvas as the visible exterior that kept hidden the private interior of the artist's thoughts and experiences.[529] Minimalists, she wrote, by abandoning devices of pictorial illusion and metaphorical use of materials (metal as metal rather than as human skin, for

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[528] Sutton, Brind, and McKenzi, eds, *The State of the Real: Aesthetics in the Digital Age*, 5.

[529] Krauss, *Passages in Modern Sculpture*, 243-69.

example) created literal work that existed in real space. This located the meaning of the work on the exterior and ended the idea of a psychological dimension within. I would argue that an exterior cannot exist without an interior, and, moreover, that the meaning of interiority shifted in 1960s sculpture away from individual emotional experience and toward hidden physicality. For Snelson that meant the exploration of the invisible physical properties that make structure, the composition of all matter even that as small as an atom, possible.

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Although the art works discussed in this chapter draw on techno-scientific fields, it was not the intention of the artists discussed to make contributions beyond the artistic. The appropriated methods and subject matters are used only to create works of art. Snelson's atomic project is therefore unique among these examples because it was his intention and most ardent hope to make a true contribution to science. In the following chapter, I turn to the idea of a professional and intellectual division between art and science as it was defined in the 1960s to explore what it meant for an artist to attempt scientific discovery.

CHAPTER FIVE: ART AND SCIENCE EXPERIMENTS

When Snelson began exploring atomic science in 1960 he was, in his words, "deeply engrossed in what could only be called the philosophy of structure; that is, the elusive first principles of some ultimate physical order and reality."[530] Snelson's interest in structure was not entirely aesthetic. He was concerned with metaphysical questions, and his two major projects, tensegrity sculptures and *Portrait of an Atom*, both entered the domain of science or engineering and were intended, at least initially, to make a real world contribution. Although he later repositioned both of these interests, and today publicly identifies them as works of art, his recent adamant statements about the significance of his atomic research suggest that a belief in its practical importance lingers, at least privately. In addition, in May 2004 he received a patent for a three-dimensional weaving pattern, perhaps indicating that he continues to think about useful applications for his ideas separate the aesthetic world of art.[531] This gets to the crux of what distinguishes Snelson from many of the other artists discussed up until this point in this

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[530] Snelson, *Not in My Lifetime*, 99.

[531] Kenneth Snelson, "Space Frame Structure Made by 3-D Weaving of Rod Members," Patent No. 6,739,937 B2 (United States Patent Office, May 25, 2004).

Snelson first developed this idea in 1964 while working on tensegrity designs.

study and to the major defining feature of Snelson's career. Reflecting the early influence of Buckminster Fuller, Snelson continues to apply his artistic imagination to subjects related to science and engineering in the hope of making a practical contribution to the world. In the previous chapter, I looked at Snelson's interest in science and structure in the context of 1960s art. In this chapter I explore where science and art met in 1960s culture to contextualize the scientific research of an artist. It is my contention that Snelson's scientific work is representative of an historical idea that had renewed resonance in the 1960s: that the world of science and industry could be improved through the participation of artists.

Better Science Through Art

György Kepes was inspired by the perceived divide between the domains of art and science to publish seven volumes of collected essays between 1960 and 1966 addressing the shared intellectual territory of these two fields.[532] Kepes, a Hungarian painter and designer, came to the United States in 1937 to teach at the New Bauhaus in Chicago, under Lászl6 Moholy-Nagy, and in 1946, became a professor of visual design at the Massachusetts Institute of Technology (MIT). The series he published on the commonalities between art and science, titled *Vision and Value*, developed from seminars Kepes led at MIT in which scientists, architects, and artists participated. The books include essays by scholars and practitioners of art, architecture, engineering, philosophy,

[532] Kepes, *Vision and Value*; Kepes, *The Visual Arts Today*. See also Judy Wechsler, *György Kepes: MIT Years 1945-1977* (Hayden Gallery, Cambridge, MA, 1978).

psychology, anthropology, science, and mathematics. Following the publication of the *Vision and Value* series, Kepes established the Center for Advanced Visual Studies at MIT in 1967 as an institution where artists and designers could work with architects and engineers.[533] Inspired by the Bauhaus, Kepes wanted to redefine the role of artists so they could make contributions to the real world.[534]

In his introduction to *The Visual Arts Today*, a single-volume work that preceded the *Vision and Value* series, Kepes explained that the book was a response to problems he observed in modern commercial, industrial society. He expanded on the nature of those problems in the introduction to a volume of *Vision and Value*, writing, "Our contemporary art and literature reveal a menacing picture of contemporary man's inner chaos and self-alienation. We are displaced persons, not only historically and socially but within ourselves. Our feelings are intercepted and inhibited by cold reason; the joy in the richness of the sensual world is stifled by sentimentality; our thoughts are muddled by our emotions."[535] Kepes believed people were alienated from their own feelings by the modern emphasis on logic. In a world where emotion was disdained, trite sentimentality had replaced true experience. Kepes described artists as "seismographs"—attuned both to the world around them and to people's hopes and concerns.[536] He believed that artists,

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[533] See Bijvoet, *Art as Inquiry*, 36-45. Bijvoet cites Jane H. Kay, "Art and Science on the Charles," *Art in America* (Summer 1967), 62-7; Jud Yalkut, "Conversations with György Kepes," *Arts Magazine* (May 1970), 16-8; György Kepes, The Lost Pagaentry of Nature," *Artscanada* (December 1968), 32.

[534] Bijvoet, *Art as Inquiry*, 44-5.

[535] György Kepes, ed., *Vision and Value: Education of Vision* (New York: Braziller, 1965), iii.

[536] Kepes, *Vision and Value: Structure in Art and in Science*, i.

because they were capable of "clear, comprehensive thinking," were the key to creating a more humane world and healing the fissure between modernity and humanity.[537]

Although modern specialization appeared to isolate science and art from one another, there is a commonality between the fields, Kepes wrote, since "scientists and artists both reach beneath surface phenomena to discover basic natural pattern and basic natural process."[538] Scientists and artists were alike in their desire to observe and understand the natural world. One purpose of *The Visual Arts Today* and *Vision and Value* was to examine the importance of "vision"—understanding through visual knowledge, essential to both art and to science.[539] Kepes demonstrated this point by including in several of the volumes a series of images that showed natural subjects magnified with microscopes, made penetrable by x-rays, or from an extraordinary distance with aerial photography. These views, made possible through modern science and technology, emphasized the similarities of art and science in their pursuit of visual patterns and structure. Kepes believed that by learning to see, and therefore to better understand nature, people would set right their relationship with the environment by ending waste and pollution, developing a sense of common global welfare, and establishing internal harmony between rational thought and intuitive emotion.[540]

Kepes's ideas about specialization and the role artists could play in creating a better, more humanitarian future drew on many earlier writers, including Lewis

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[537] Kepes, *The Visual Arts of Today*, 8.

[538] *Ibid.*, 6.

[539] *Ibid.*, 3.

[540] Kepes, *Vision and Value: Education of Vision*, i.

Mumford, Sigfried Giedion, and Fuller. These three men were among the contributors to the cultural understanding of science and technology that prevailed in the decades following World War II.[541] In *Technics and Civilization*, first published in 1934, Mumford described how technological inventions, from the clock to the steam engine, affected cultural development since the Middle Ages.[542] The volume is divided into developmental stages, leading to the modern world where the regimented and controlled social order had come to resemble the machine itself. Over a decade later, after his emigration to the United States from Switzerland, Giedion published *Mechanization Takes Command*, in 1948, telling the history of the effects of industrialization on society.[543]

In the introduction to the 1963 edition of *Technics and Civilization*, Mumford wrote: "Though contemporary reviewers properly characterized *Technics and Civilization* as a hopeful work, I now congratulate myself rather on the fact that, even then, before the savage demoralizations and irrational projections that have attended the harnessing of nuclear energy menaced the world, I drew attention to the regressive possibilities of many

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[541] Other important twentieth-century figures who have addressed the relationship between technology and culture include Jacques Barzun, Jacob Bronowski, Jacques Ellul, Gerald Holton, Ivan Illich, Marshall McLuhan, and C.P. Snow.

The large body of secondary literature on this subject includes: David K. Cornelius and Edwin St. Vincent, eds., *Cultures in Conflict* (Glenview, IL: Scott, Foresman, and Co., 1964); Stephen H. Cutcliffe, *Ideas, Machines, and Values* (Lanham, Maryland: Rowman and Littlefield, 2000); William Henry Davenport, *The One Culture* (New York: Pergamon Press, 1970); Neil Postman, *Technopoly, The Surrender of Culture to Technology* (New York: Knopf, 1992).

[542] Lewis Mumford, *Technics and Civilization* (New York: Harcourt, Brace & Word, 1963).

[543] Sigfried Giedion, *Mechanization Takes Command: A Contribution to Anonymous History* (New York: Norton, 1969).

of our most hopeful technical advances…."[544] Similarly, in *Mechanization Takes Command* first published in 1948, Giedion described what he called "the illusion of progress:" "But the promises of a better life have not been kept. …Future generations will perhaps designate this period as one of mechanized barbarism, the most repulsive barbarism of all. …Now, after the Second World War, it may well be that there are no people left, however remote, who have not lost their faith in progress. Men have become frightened by progress, changed from a hope to a menace."[545] Giedion and Mumford saw their own age as a "savage" and "barbaric" time in which technology was used toward capitalist gain and military strength, rather than toward improving the lives of the masses through humanitarian and universal effort.[546] Alluding to the atomic bombs dropped on Hiroshima and Nagasaki near the end of World War II in 1945, Mumford and Giedion expressed a loss of faith in the purpose of scientific research. While technology may have promised a better future, the reality was a cause for fear rather than hope.

In *Mechanization Takes Command*, Giedion traced the source of the divide in modern culture between feeling and thought to its roots in technological and industrial development. Giedion had studied not only art history, but also mechanical engineering, and he was a supporter of the Bauhaus, which eventually advocated unity between art and industry.[547] In an earlier work, *Space, Time, and Architecture*, 1941, Giedion referred to

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[544] Mumford, *Technics and Civilization*, n.p.

[545] Giedion, *Mechanization Takes Command*, 715.

[546] Mumford, *Technics and Civilization*, 265-7; Giedion, *Mechanization Takes Command*, 715-6.

[547] Neumann Eckhard, *Bauhaus and Bauhaus People* (New York: Van Nostrand Reinhold, 1993), 84.

the modern division between logic and emotion as a "split personality" that was characteristic of an industrial age that divided the fields of art and science. He wrote:

> The question [of whether art and science have anything common] would not be raised except in a period where thinking and feeling proceed on different levels in opposition to each other. In such a period, people no longer expect a scientific discovery to have any repercussions in the realm of feeling. It seems unnatural for a theory in mathematical physics to meet with an equivalent in the arts. But this is to forget that the two are formulated by men living in the same period, exposed to the same general influences, and moved by similar impulses. Thought and feeling could be entirely separated only by cutting men in two. ...Contemporary artists and scientists have lost contact with each other; they speak the language of their time in their own work, but they cannot even understand it as it is expressed in work of a different character. [548]

According to Giedion, modern culture is not only characterized by a division between rational thought and emotion, but also professional specialization with a strict divide between the fields of art and science. Artists are thought to create within the realm of feeling, isolated from the world of technological discovery; while scientists are considered rational agents, unaffected by the cultural conditions of their time. Giedion believed that to make social, economic, and political progress this fissure between

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[548] Sigfried Giedion, *Space, Time and Architecture: The Growth of a New Tradition* (Cambridge, MA: Harvard University Press, 1997), 12-3.

thinking and feeling, caused by industrialization, had to be healed.[549] To make certain that the "social implications" of advances in science and technology were considered, the system of specialization had to be altered to allow for a "human scale" and "universal outlook."[550]

In her 1997 study, Margot Henriksen looked at technology, in particular atomic science, in the context of the cultural changes of the 1960s.[551] By examining literature, television, and film she described the cultures of "consensus" and "dissent" that developed in reaction to the American wealth, security, and political supremacy in the atomic postwar period. In the culture Henriksen described, the bomb represented both safety and, reflecting the views of Mumford and Giedion, a deep moral sickness in the culture of the United States. She examined some of Mumford's texts explicitly, for example describing how, in his 1953 essay "Social Consequence of Atomic Energy," he questioned the rationality of a society that would consider a war won if it resulted in the destruction of the human race and the validity of a scientific discipline that disregarded human and moral consequences.[552] Henriksen argues that living in the numbing and homogeneous mechanized society that Mumford described, galvanized 1960s social

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[549] Giedion, *Mechanization Takes Command*, v.

[550] *Ibid.*, 720-3.

[551] Henriksen, *Dr. Strangelove's America*.

[552] Henriksen, *Dr. Strangelove's America*, 144-5; Lewis Mumford, "Social Consequence of Atomic Energy," in *Interpretations and Forecasts: 1922-1972*, (New York: Harcourt Brace Jovanovich, 1973), 307.

upheaval. Participants, she wrote, fought to regain their humanity by confronting the "pain and panic appropriate to life in the atomic age" through explicit political protest.[553]

Fuller's plan for a Dymaxion revolution also began to take shape in the 1930s and relates closely to Giedion's and Mumford's ideas, and Fuller's theories about achieving wide-scale social change through improvements in technology and design continued to gain cultural currency throughout the 1960s.[554] Fuller believed that technology could be used to maximize human productivity, creating a world united in unprecedented peace and prosperity.[555] Nevertheless, Fuller wrote that "thus far in history *weaponry* has always been accorded priority over *livingry*."[556] The irony of the situation, he continued, was that technology was focused on the production of weapons owing to a fear that control of natural resources would be lost; however, technology could just as easily be used to create a more efficient world in which there would be no shortage of resources, eradicating global conflict and benefiting humanity the world over.[557] In the same essay, Fuller advocated for a "doing-more-with-less world" to be discovered by "scientific inventing and engineering competence" or what he called "design science" that would be

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[553] Henriksen, *Dr. Strangelove's America*, 147, 188.

[554] Snelson, in discussion with the author, September 9, 2011; Miller and Hays, *Buckminster Fuller: Starting with the Universe*, 30; Scott, *Architecture or Techno-Utopia: Politics after Modernism*, 35.

[555] Sargent Wood, *A More Perfect Union*, 56-8.

[556] Fuller, "Geosocial Revolution," *Utopia or Oblivion*, 170. Fuller also discusses these ideas in Fuller, *Operating Manual for Spaceship Earth* (New York: Dutton, 1963).

[557] Fuller, "Geosocial Revolution," *Utopia or Oblivion*, 171.

led by the young.[558] As Linda Sargent Wood discussed in her history of United States culture between the late 1940s and the mid-1970s, Fuller espoused an optimistic worldview in which technology could provide the way forward to "a better world and a sustainable future."[559] This vision, Sargent Wood explained, was part of a "holistic," "communal," and "utopian" trend that would inspire the 1960s environmental activists that made Fuller a "cult figure."[560]

For Fuller, artists were essential to the future of technical development, and Fuller, not unlike Giedion, expressed a desire to unify art and technology. In fact, it was Fuller who introduced Snelson to the idea that artists could make a practical and significant contribution to the world.[561] In a Fullerite universe, artists would be re-made into comprehensive designers who would be a "synthesis of artist, inventor, mechanic, objective economist and evolutionary strategist."[562] According to Fuller, artists-cum-comprehensive designers were uniquely qualified to solve the world's greatest problems: the feeding and housing of a rapidly growing population.[563] Fuller wrote: "Only the free-wheeling artist-explorer, non-academic scientist-philosopher, mechanic, economist-poet who has never waited for patron-starting and accrediting of his coordinate capabilities

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[558] Fuller, "Geosocial Revolution," *Utopia or Oblivion*, 176.

[559] Sargent Wood, *A More Perfect Union*, 56.

[560] Sargent Wood, *A More Perfect Union*, 55. See also Sam Binkley, Getting Loose, London: Duke University Press, 2007, 190.

[561] Snelson, in discussion with the author, September 9, 2011.

[562] Fuller, *Ideas and Integrities*, 176.

[563] *Ibid.*, 173-4.

hold the prime initiative today. If man is to continue as a successful pattern-complex function in universal evolution, it will be because the next decades will have witnessed the artist-scientists' spontaneous seizure of the prime design responsibility and his successful conversation of the total capability of the tool-augmented man from killingry to advanced livingry—adequate for all humanity."[564] Artists had the ability to think independently, and the imaginations of Fuller's comprehensive designers would be unfettered by traditional education, specialization, and desire for profit.[565] Unlike politicians or financiers, the comprehensive designers' only concern would be for the wellbeing of the world as a whole, and, unlike scientists, they would apply their efforts to real-world solutions.[566]

Fuller argued that the current model of specialization had marginalized and infantilized artists, relegating them to the creation of "mere decoration" without practical application:[567] "Thus the comprehending artist has learned to sublimate his comprehensive proclivities and his heretical forward-looking, toward engagement of the obviously ripening potentials on behalf of the commonwealth. The most successful among the artists are those who have affected their comprehensive end by indirection and progressive disassociations."[568] Fuller believed that in their current role, to be successful,

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[564] *Ibid.*, 249.

[565] See also Miller, "Thought Patterns: Buckminster Fuller The Scientist-Artist," *Buckminster Fuller*, 22-24.

[566] Fuller, *Ideas and Integrities*, 245.

[567] *Ibid.*, 76-8.

[568] *Ibid.*, 180.

artists had to eschew revolutionary ideas that had potential to effect real change, thereby wasting their creativity. Furthermore, Fuller emphasized, big business and government were responsible for ghettoizing artists in an effort to maintain economic and political and government hegemony.[569] Fuller spoke and wrote about the essential role artists could play in changing the world many times throughout his career hoping to inspire a generation of young designers and artists like Snelson to join his Dymaxion movement.[570] In one text, he provided the following call to action: "The time has arrived for the artist to come out from behind his protective coloring of adopted abstractions and indirections. World society, frustrated in its reliance upon the leader of might, is ready to be about-faced to step wide-eyed into the obvious advantages of its trending."[571]

In the introductory essays that Kepes wrote for *The Visual Arts Today* and the volumes in the *Vision and Value* series, he frequently echoed both Fuller's call for artists to play a role in effecting socio-economic change, and Giedion's belief that progress could be made by uniting the emotional and artistic with the logical and scientific. Kepes was not alone in drawing on such sources in the 1960s.[572] In his 1968 book *The Revolution of Hope*, Erich Fromm reiterates not only Mumford's and Giedion's ideas, but also those of other twentieth-century luminaries, including Thorstein Veblen, Sigmund

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[569] *Ibid.*, 30-1.

[570] For example, Fuller, "Prevailing Conditions in the Arts," *Utopia or Oblivion*, 112-3.

[571] Fuller, *Ideas and Integrities*, 181; Sargent Wood, *A More Perfect Union*, 56.

[572] Many intellectual and literary figures in the 1960s addressed the threatening aspect of technological progress, including: René Dubos, *So Human an Animal* (New York: Scribner, 1968); Mark R. Hillegas, *The Future as Nightmare* (New York: Oxford University Press, 1967); and Gerald Holton, ed., *Science and Culture* (Boston: Beacon Press, 1967).

Freud, and Karl Marx, in his critique of the pervasive role of technology in the late-1960s cultural crisis. Although Fromm wrote scholarly texts within his own field of psychology, *The Revolution of Hope* was written for a general audience. Fromm explained: "This book is written as a response to America's situation in the year 1968. It is born out of the conviction that we are at the crossroads: one road leads to a completely mechanized society with man as a helpless cog in the machine—if not to destruction by thermonuclear war; the other to a renaissance of humanism and hope—to a society that puts technique in the service of man's well-being."[573] Recalling earlier theorists, including Marx, Fromm argued that technological advances had created an economic system based on maximizing consumption, a passive workforce organized only for efficient productivity, and governments able to wreak mass-scale destruction with atomic weaponry.[574] Fromm theorized that the current society valued machine-like regularity and productivity at the expense of individuality, privacy, inter-personal connections, and hope.[575] People, unable to achieve "a joyful, meaningful existence," were placated into passivity, soothed by modern consumer goods.[576] Salvation from mechanized society could be found in rediscovering emotional and spiritual existence and creating a world focused on human values.

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[573] Erich Fromm, *The Revolution of Hope: Toward a Humanized Technology* (New York: Harper and Row, 1968), xvii.

[574] *Ibid.*, 1-2.

[575] *Ibid.*, 32-33; 45.

[576] *Ibid.*, 5-6.

The 1968 Museum of Modern Art (MoMA) exhibition *The Machine as Seen at the End of the Mechanical Age* presented the history of artistic reactions to technological progress, starting with Leonardo da Vinci drawings and continuing chronologically to Fuller's Dymaxion Car. In the exhibition catalogue introduction, the curator K. G. Pontus Hultén wrote:

> The bombs dropped on Hiroshima and Nagasaki were the most terrible shock that the world has ever received. Fear and horror sapped the faith in technology and the confidence in rational behavior that might have been expected to follow a long period of destruction. There is no doubt that if we are not to become the victims of what we ourselves produce, we must quickly attain a society based on other values than buying and selling. ...The decisions that will shape our society in the future will have to be arrived at, developed, and carried out through technology. But they must be based on the same criteria of respect and appreciation for human capacities, freedom and responsibility that prevail in art.[577]

Reflecting the growing cultural upheaval that Henriksen described, Kepes, Fuller, Fromm, and Hultén saw the conflict over the direction of the world's future coming to a head in the 1960s, and technology and science at the fulcrum of that conflict. They believed that the techno-scientific domain had to be infused with the emotionally attuned and creative spirit associated with art to shift its focus from the industrial-military complex to humanitarian goals.

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[577] K. G. Pontus Hultén, *The Machine as Seen at the End of the Mechanical Age* (New York: The Museum of Modern Art, 1968), 13.

These ideas provide an intellectual background in which to understand Snelson's deviation from art into science. Although these writers portrayed a dire vision of a world dominated by the quest for technological advancement without regard for human needs—a world that had created the atomic bomb—they presented a hope for this world if the divide between the logical and the emotional, the profitable and the beneficial could be healed. Artists as creative individuals were presented as the key to this new and more humane future.

Art and Science Experiments

When Snelson first met Fuller at Black Mountain in the summer of 1948, Snelson was enthralled by the idea that he, as an artist, could be an important player in a movement that would change the world. The inclusion in Snelson's 1965 tension-compression structure patent of a roof and dome supported by his tensegrity method demonstrate that he continued to believe into the 1960s that he could make an important contribution to the world with his visual imagination beyond the realm of art. This belief is also reflected in the period interviews in which Snelson only begins to identify himself as a "pure" artist without interest in practical applications for his work around 1967. Similarly, Snelson earnestly distributed his atomic theory to physicists across the country in 1963 with the expectation that his visual model would revolutionize science.

Snelson's notion that he had something to contribute as an artist to science and technology was shared by others in the 1960s. For example, in 1967, Maurice Tuchman and Jane Livingston, Los Angeles County Museum of Art (LACMA) curators, launched a project later called Art and Technology with the aim of bringing together the financial resources and industrial knowledge of technology-based companies with the imagination and skills of leading artists. The program placed artists on corporate campuses for three months during which time the artists could avail themselves of industrial materials and work with the company's scientists and engineers to create a work of art. Corporations gained tax deductions and positive publicity, and had the opportunity to keep the work of art, which in many cases was more valuable than the minimum financial donation of $7,000. Tuchman, however, saw the intangible benefits of co-existing with a creative personality for a period of no less than three months as the real gain.[578] Participating corporations included IBM, Lockheed Aircraft, Universal City Studios, Hewlett-Packard, and The Rand Corporation. Andy Warhol, Claes Oldenburg, Roy Lichtenstein, and Richard Serra were among the twenty artists whose projects came to fruition. Eight of these were featured at the American Pavilion at Expo 70, held in Osaka, Japan, and the following year at LACMA an expanded selection was exhibited.

The Bell Telephone engineer Billy Klüver and the artist Robert Rauschenberg staged a comparable project called Nine Evenings: Theatre and Engineering at the Sixty-Ninth Regiment Armory on Twenty-Fifth and Third Avenue between October 13 and 23, 1966.[579] Klüver had already helped many artists with technical aspects of their work, including Warhol, Oldenburg, Jean Tinguely, and Jasper Johns, and it was his goal for

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578 Maurice Tuchman, *A Report on the Art and Technology Program of the Los Angeles County Museum of Art, 1967-1971* (New York: Viking, 1971), 12.

579 Texts on Nine Evenings include: Billy Klüver, *Nine Evenings: Theatre and Engineering* (New York: Foundation for the Performing Arts, 1966); Catherine Morris, *9 Evenings Reconsidered: Art, Theatre, and Engineering, 1966* (Cambridge, MA: MIT List Visual Arts Center, 2006); Bijvoet, *Art as Inquiry*, 31-36.

Nine Evenings to create works of art that seamlessly blended the efforts of engineers and artists.[580] The event was comprised of ten performance pieces produced through the collaborative efforts of an artist and an engineer. Although subject to many technical difficulties and reviewed negatively at the time, the cultural impact of the program that included well-known artists, such as Rauschenberg, John Cage, and Robert Whitman, and had over 1,500 visitors on each of its nine nights, is unquestionable.[581]

Later that year, in December of 1966, Rauschenberg and Klüver teamed up again with Whitman and a second engineer, Fred Waldhauer, to launch Experiments in Art and Technology (E.A.T.).[582] They established a center at 9 East Sixteenth Street in Manhattan where they hosted open house events, lectures, and demonstrations, which both artists and scientists attended. These events focused on broad themes of incorporating new technologies into works of art and on specific practical issues, such as holography and paint chemistry.[583] Suggesting ties among those interested in finding mutually beneficial links between art and science, Kepes and Fuller were among the members of E.A.T.'s board of trustees and some of E.A.T.'s early meetings were held in the Park Place Gallery on West Broadway.[584] Like the LACMA group, E.A.T contributed to the 1970 Expo in Osaka by providing art installations for the Pepsi

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[580] Bijvoet, *Art as Inquiry* 23, 31.

[581] Morris, *9 Evenings Reconsidered,* 65, 75.

[582] See Bijvoet, *Art as Inquiry*, 16-32.

[583] Barbara Rose, "Art as Experience, Environment, Process," in *Pavilion: Experiments in Art and Technology*, Billy Klüver, Julie Martin, and Barbara Rose, eds. (New York: E. P. Dutton, 1972), 94.

[584] Dalrymple Henderson, *Reimagining Space*, 14.

pavilion that were produced through collaborations between artists and engineers or scientists.[585]

Later E.A.T. hosted an art competition for technologically advanced creations in conjunction with MoMA's 1968 exhibition *The Machine as Seen at the End of the Mechanical Age*, which presented an historical survey of art work that commented on or reflected the development of technology. The winning works of art from the E.A.T. competition were displayed at MoMA, during the run of the show, while other submissions were on view simultaneously at the Brooklyn Museum. The call for submissions stated: "Experiments in Art and Technology is established to develop an effective collaboration between engineer and artist. The *raison d'etre* of Experiments in Art and Technology is the possibility of a work which is not the preconception of either the engineer or the artist but which is the result of the exploration of the human interaction between them."[586] Like the LACMA program, E.A.T. advocated collaboration and a mutually beneficial partnership between art and technology.

Period texts about these projects aimed to unite the worlds of art and the techno-scientific reflect ideas similar to those of Mumford, Giedion, and Fuller. For example, in her essay in the LACMA publication, Livingston described the benefits of collaborative work, explaining how modern day scholars and practitioners were isolated within their fields of specialty, how there was a "sinister possibility" of systematic control in a technology-dominated society, and how artists, as "the last freelance agents" could

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[585] Klüver, Martin, and Rose, eds., *Pavilion: Experiments in Art and Technology*, n.p.

[586] Experiments in Art and Technology, *Some More Beginnings* (New York: Experiments in Art and Technology, 1968), n.p.

"humanize" technology.[587] Barbara Rose espoused similar ideas in her essay in the E.A.T. publication: "Engineers and scientists, by collaborating on a one-to-one basis with artists, have learned how artists think. ...Many have spoken of how their attitudes and values have been changed through firsthand contact with the creative process. ...As a basic principle, the organization is devoted to mending the breach between art and science fostered by the industrial division of labor...."[588] Like the earlier thinkers, Livingston and Rose suggest that marrying art and technology could be curative in an age of corporate, industrial control. In fact, mentioning Fuller along with Marshall McLuhan and other thinkers, Rose continued, "But in contemporary society, the idea of group effort, collaboration, integration of various spheres of artistic and scientific thought, submersion of the individual ego in the service of a common goal, and art as an active agent of social change, go directly against the individualistic antisocial values of the art of the past hundred years."[589] Subverting the modern social structures that had created a specialized and autonomous work force would create a new and collaborative system in which the common good would be promoted. Rose believed that projects like E.A.T. could do more than promote art; they could also be agents of widespread social change.

Tuchman's introduction in the LACMA *Report* cited Russian Constructivism and the German Bauhaus as precursors of the "esthetic urge" he hoped the project would

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[587] Jane Livingston, "Thoughts on Art and Technology," *A Report on the Art and Technology Program*, 43-6.

[588] Rose, "Art as Experience, Environment, Process," *Pavilion*, 95.

[589] *Ibid.*, 97.

realize.[590] (Livingston also discussed "historical antecedents" among European Modernist movements, though largely to critique their success at combining art and technology.[591]) Similarly, Rose saw the E.A.T. projects as the culmination and "realization" of the ideas of twentieth-century European avant-garde movements.[592] The Bauhaus and Constructivist artists, like other European Modernists during the first third of the twentieth century, advocated for artists to contribute their talents to industrial production. Not unlike Fuller, the proponents of these movements believed that artistic imaginations could be harnessed for utilitarian purposes to improve not only art and industry, but also society in a broad sense. Although not ultimately realized, the Bauhaus and Constructivism established an ideal of collaborative work and bringing together talents from different fields. The E.A.T. and LACMA programs shared a similarly utopian vision with their European Modernist predecessors. However, rather than introducing the talents of artists to industrial design, these 1960s projects, drawing on the ideas of figures such as Fuller, Giedion, Mumford and others, focused on the more abstract notions of introducing the humanitarian values of artists to the world of science and technology.

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[590] Tuchman, *A Report on the Art and Technology Program*, 9.

[591] Livingston, "Thoughts on Art and Technology," *A Report on the Art and Technology Program*, 43.

[592] Rose, "Art as Experience, Environment, Process," *Pavilion*, 98.

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Twentieth-century thinkers who addressed the history of technology, such as Giedion, Mumford, and Fuller, were a strong influence on sixties writers, and they painted a bleak picture of modernity run amok with a focus on profit and military power that created a dehumanized and isolated labor force in the United States and Europe, and a powerless and impoverished developing world. They described how scientific research had been used for the development of weapons, namely the atomic bomb, rather than for improving people's lives. Such ideas about the application of scientific and technological knowledge to weaponry had renewed cultural resonance during the Vietnam War period in the 1960s and early 1970s. These writers also depicted a culture with strict professional specializations and a division between thinking and feeling. The rational world of science was envisioned as separate from human emotions. The world could be improved and science harnessed for progressive humanitarian purposes, these writers believed however, by uniting the realms of thought and feeling and the professions of science and art. As representatives of emotion and creativity, artists were seen by some as key to a universal and humanitarian vision for the modern world.

Snelson's work in atomic science and engineering, along with projects such as Art and Technology at LACMA and E.A.T., brought these ideas about blurring the boundaries of specialized knowledge and humanizing the techno-scientific with artistic imagination to life in the 1960s. In particular, artist participation in the LACMA program, whose partner companies included Lockhead Aircraft—a supplier of military airplanes—suggests a sense of hope that the very corporations that represented the most threatening applications of technological research could be reformed. In his historical analysis of the project, Howard Fox recognized the inherent tension in a union between artists, who tend to be liberal and progressive, and industry, during a period when corporate power was, as he saw it, related in public opinion to the "moral corrosion" that allowed American participation in an unjust war in Vietnam.[593] Although Snelson was not politically motivated, his atom also stood for a humanized vision of science that was less threatening because, unlike complex quantum mathematics, it could be understood by the laity. Moreover, by focusing on structure—what held the atom together, rather than what could split its nucleus apart—Snelson divorced atomic research from the frightening subject of weaponry.[594] This approach was metaphysical and romantic and harkened back to a period before World War II when the atom was a subject of pure scientific inquiry and did not stand for destruction. Both Snelson's tensegrity sculptures and his atom represented the idea of a hopeful future in which the creative and human concerns of an artist were brought to bear on science and engineering.

[593] Howard Fox, "In context: LACMA's Art and Technology Program, 1967–1971." collectionsonline.lacma.org/mwebcgi/mweb.exe?request=epage;id=502074;type=803 (accessed April 27, 2011)

[594] Snelson, in discussion with the author, December 10, 2011.

CONCLUSION

Although Snelson's own words on his work have been few, a consolidated review of these sentiments completes an understanding of his artistic practice. "My concern," he wrote in 1967, "is with nature in its most fundamental aspect: the patterns of physical forces in space."[595] In 2008, he simplified, explaining, "I'm profoundly interested in the fundamentals of how things work on a most basic level."[596] Snelson's tensegrity sculptures and *Portrait of an Atom*, twin interests that he has pursued without interruption for the past half century, are about the natural forces that give all substances in the universe structural integrity. Snelson defines structure—the concept at the heart of both projects—as "the dialogue between push and pull, compression and tension…resolved in a closed system."[597] Elsewhere he stated, "Structure to me is involved with forces, the stressing of pieces together, the kind of thing you find in a suspension bridge, for example. It is a definition of what is going on to cause that space to exist."[598] In Snelson's terms, structure is made possible and its shape defined by the balance of

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[595] Tuchman, *American Sculpture of the Sixties*, 52.

[596] Snelson, in discussion with the author, September 24, 2008.

[597] Snelson, "How Primary is Structure," *Art Voices*, 82.

[598] Coplans, "An Interview with Kenneth Snelson," *Artforum*, 49.

opposing physical forces. Snelson also believes that the essence of structure can be found in the connection of parts that combine to make a whole. He wrote: "The kinds of connections which unite two parts of the sculptures are vitally important in my view. That very point of contact of one part to another is, in each case a miniature structural element which expresses the same attitude involved in the total sculpture."[599] Therefore, when defining structure as "the subject of form" in his sculptures, Snelson means that his work is about harnessing tension and compression to join elements together.[600] Snelson's subject is structure both in terms of the physical, the design of the joining parts, and the elemental, the balancing of natural forces.

Exploring structural properties is important to Snelson because he believes it relates to broader, metaphysical questions about what he calls "the universal laws of space."[601] He defines his domain as "the philosophy of structure" concerned with "the elusive first principles of some ultimate physical order and reality."[602] Snelson sees his tensegrity and atomic projects as significant because they are visual demonstrations of essential physical forces and atomic structure that cannot be seen. By viewing his work, he wrote, we learn "how the fundamentals of nature work. Not simply mathematical geometry, but how forces get organized to make a structure."[603] The fact that his tensegrity pieces are a demonstration of physical principles is also essential to Snelson

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[599] Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

[600] Snelson, "How Primary is Structure," *Art Voices*, 82.

[601] Snelson, *Not in My Lifetime*, 16.

[602] *Ibid.*, 99.

[603] Snelson, in discussion with the author, December 8, 2009.

because of his "desire to *make* things rather than simply paint *images* of things."[604] His sculptures are not an imitation of something external. As Snelson put it, "they don't *represent* anything."[605] Rather, they *are* a display—an actual demonstration—of balanced tension and compression.

The idea of a physical demonstration of natural properties is essential to Snelson's artistic philosophy, but it is also the subject of the conflict about his work evident both in Snelson's own reflections and in the texts that address his sculptures. Such comments obliquely ask the classic question, "but is it art?" In 1962, when the first article about Snelson's work was published, he was identified as a "structural designer," and, as I have demonstrated, even after he began to establish a reputation as an artist in the mid-1960s, art writers continued to describe how his work treads the line between sculpture and engineering.[606] When his work first came into the public eye, Snelson embraced this ambiguity, saying, for example in 1964, that "It is something between art and science…maybe it isn't sculpture…I don't care whether it's sculpture or not…."[607] And reflecting back on this time, he wrote, "Sculptural space versus structural space was once again unimportant…."[608] In addition, his 1965 tensegrity patent included a design for a roof supported by the "Continuous Tension, Discontinuous Compression" method.

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[604] Felton, "Kenneth Snelson," *Creativity: Conversations with 28 Who Excel*, 5.

[605] *Ibid.*, 5.

[606] "Sculpture to Build With," *Fortune*, 121.

[607] *The New York Times*, "Artist Designs 30-Legged Giant for Utility Exhibition at Fair," Arts section.

[608] Snelson, *Not in My Lifetime*, 90

As I have shown, the opinion Snelson expressed publicly began to shift in the latter half of the 1960s when his artistic renown began to solidify. In the late 1960s and '70s, to distinguish his work from that of engineers, he pointed to that fact that his sculptures lacked utilitarian purpose.[609] This distinction was based on the idea that engineers were concerned with solving real problems and creating functional objects, while artists' pure focus on aesthetics allowed them to disdain usefulness. However, more recently he has returned to the ambiguity of his original position, stating in 1989, for example, "No…I'm not even sure I'm a sculptor. I'm interested in three-dimensional space…."[610] That said, Snelson continues to state that tensegrity has been successfully applied only to purely aesthetic creations: "I see the richness of the floating compression principle to lie in the way I've used it from the beginning, for no other purpose than to unveil the exquisite beauty of structure itself."[611]

Perhaps these vacillations relate to the trajectory of his career. As he explained, until his first gallery show in 1966, Snelson did not feel comfortable calling himself an artist.[612] Establishing a reputation in the world of fine art not only allowed Snelson to give himself permission to claim the role of artist, it also made it possible for him to distinguish his work from that of non-artists or engineers. One could argue that by the 1980s, the comfort of age and security of a well-established career allowed him to

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609 Coplans, "An Interview with Kenneth Snelson," *Artforum*, 49; Schneider, "Interview with Kenneth Snelson," *Kenneth Snelson Skulpturen*, n.p.

610 Burrows, *Kenneth Snelson: The Nature of Structure*, 21.

611 "From Kenneth Snelson to R. Motro," *International Journal of Space Structures*.

612 Snelson, in discussion with the author, September 20, 2010.

speculate that he might not be an artist after all. After twenty years as a recognized professional, there was little risk that such a statement would nullify his status.

Snelson's atom complicates this story. I demonstrated that Snelson originally, in the early 1960s, believed that his atomic model was a significant discovery that was going to revolutionize the scientific world by reintroducing visual modeling, which had been abandoned in favor of statistical methods after the discovery of electron resonance in the first quarter of the twentieth century. By the end of the 1960s, after many physicists had dismissed Snelson's theory, he had begun to abandon the idea of a scientific discovery, eventually reframing the project publicly as an artistic work. Yet, his private conviction in the importance of his model has persisted to the present day. However, Snelson also believes that his focus on the atom damaged his artistic reputation because it is not what he calls a "legitimate subject" for art.[613] In Snelson's view, where artistry is defined by a lack of utilitarian value, declaring his atom a work of beauty and imagination, rather than useful scientific research, rescues his status as an artist, preserving his professional reputation.

Snelson's ideas about utilitarian applications for artistic work and more generally his on-going struggle with the concept of identifying himself as a sculptor can be traced to his relationship with Buckminster Fuller. It was Fuller who introduced Snelson to the idea of a marriage between artistic imagination and practical invention that could solve real-world problems. As discussed, Fuller's theories represented a theme in twentieth-century thought expressed both by proponents of European Modernist movements, such as the Bauhaus and Constructivism, and by thinkers, including Lewis Mumford and

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[613] Snelson, in discussion with the author, May 13, 2009.

Sigfried Giedion. The idea of improving science and technology by introducing the creative and human concerns of the artist had renewed resonance in the 1960s and inspired projects such as Art and Technology at the Los Angeles County Museum of Art and E.A.T. Fuller's version of this idea was based on the Dymaxion comprehensive designer who would turn his attention from the purely aesthetic concerns of an artist to global issues such as the construction of housing. The idea of being part of something important was enthralling to Snelson as a young man, and when he first developed the principle of tensegrity in 1948, he thought he had made a discovery that would solidify his role in Fuller's Dymaxion revolution. When Fuller seized upon Snelson's invention and publicly claimed authorship, Snelson's hopes were crushed and his idealized vision of his mentor shattered. Snelson eventually turned away from structural projects altogether until his contribution to the principle of tensegrity was first publicly acknowledged in the 1959 Museum of Modern Art (MoMA) exhibition of Fuller's work. Following this show, Fuller began to mention Snelson's role in the development of tensegrity, but marginalized Snelson's importance by describing him as an artist who did not understand the potential real-world applications of the structural principle.[614]

The simplest version of the narrative would be that Snelson, in turn, retreated to the aesthetic world of art where he could achieve success that was his all own and claim mastery of his discovery without being challenged by Fuller. However, the story is more complicated. As described above, in recent years, Snelson seems to have wavered from his adamant statements of the 1960s and '70s that he is an artist with no interest in

[614] Fuller, "Tensegrity," *Portfolio and Art News Annual*, 112-27, 144, 148; Fuller, "Everything I Know," Session 8, Part 5 and Session 9, Part 13.

practical applications. In 1990, reflecting on the influence of two most significant figures in his artistic development—one an artist and the other an architect and inventor—Snelson wrote of his work: "Were they structures or sculptures? They incorporated the attitudes of both Fuller and Albers."[615] Throughout his career, published discussions of Snelson's work have referenced the role of Fuller in his development, showing that even within the world of fine art there was no escape for Snelson from his mentor. And, indeed, Snelson's ideas were indelibly stamped with Fuller's influence. Although Snelson has not faced the same struggle for authorship regarding his atom, aspects of this project are also influenced by Fuller who was shared Snelson's interests in the visual display of information and the universal nature of structural principles.

In my discussion of the reception of Snelson's work, the idea of his role as an artist in comparison to an engineer or scientist is central, just as this question is paramount in his own consideration of his career. However, grappling with professional identification to some degree obscures the art historical meaning of Snelson's interest in structure, natural physical forces, and atomic modeling. A more complete understanding of his oeuvre is achieved by looking at Snelson's work in contrast with that of his artistic peers of the 1960s. From these comparisons, it becomes clear that Snelson's "desire to *make* things" rather than representations was one that he shared with many sculptors in the 1960s.[616] Like Snelson, many of the artists discussed in this study wanted to create "real" objects that existed in their own right, free of references to the physical or

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[615] Snelson, "Letter to R. Motro," *International Journal of Space Structures*.

[616] Felton, "Kenneth Snelson," *Creativity: Conversations with 28 Who Excel*, 5.

emotional. Also like Snelson, many of these artists drew on fields of knowledge such as mathematics, science, and geometry that were seen as rational and objective. In fact, Snelson was not even unique in thinking of his work as structures in contrast with sculptures. Both Clement Greenberg and Michael Fried commented that 1960s sculptors associated with what came to be known as Minimalism employed different strategies to align their work with "non-art" objects.[617] In keeping with this idea, Donald Judd distinguished his artistic creations from earlier sculpture by calling them "specific objects,"[618] and Robert Morris made similar statements, for example in 1963, describing what he called a "metal construction" as devoid of "esthetic quality and content."[619] For Minimalists, such as Judd and Morris, distinguishing their work from aesthetic creations had to do with eschewing emotional content and creating work that could be taken in by the viewer as whole. They used different strategies for reducing their presence in a work of art, such as basing the arrangement of parts on a pre-existing mathematical equations or using modular units in repetition. Snelson utilized a similar strategy, limiting the compositions of his sculptures to what could be achieved through the balance of tension and compression. Moreover, as I demonstrated, during the 1960s, Snelson also favored modular repetition and static compositions whose forms could be easily interpreted by the viewer. However, although the end result was work that had much in common with Minimalism, Snelson was not motivated by a desire to reduce subjective decisions or

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[617] Fried, "Art and Objecthood," *Minimal Art: A Critical Anthology*, 120-8; Greenberg, "Recentness of Sculpture," *Minimal Art: A Critical Anthology*, 183.

[618] Judd, "Specific Objects," *Contemporary Sculpture*, 74-82.

[619] *Ibid.*, 178-9.

psychological content. Snelson did not engage in such artistic polemics, and his artistic practice was shaped by a genuine fascination with structural properties. The fact that Snelson's work achieved the impassivity and objectivity that Minimalists desired is secondary for him. That said, there were other abstract geometric sculptors of the period, such as George Rickey, Robert Smithson, and the three-dimensional artists associated with the Park Place Gallery, who shared Snelson's structural concerns or interest in aspects of mathematics and science. For many of these artists, along with those associated with Minimalism, and Snelson primacy was given to the immediate visual experience of seeing a work of art over external associations or meanings. Snelson hopes to thrill his viewer with metal bars that almost appear to float in space unsupported and extraordinary structural feats, such as tall towers and expansive cantilevers.

Snelson's interest in structure and hope of making a practical contribution to the world were ignited when he studied under Fuller at Black Mountain College. Although the specific circumstances are particular to his biography, these aspects of his artistic practice were not unique among 1960s artists, raising the question of why sculptors in this period created work that approached non-art objects divorced from emotion, vested rather in rational concerns related to science and mathematics. Based on period essays, I have suggested that a partial explanation, one that is particularly apt for my study in light of Snelson's work on the atom, can be found in the invisible, unknowable, and threatening world presented by nuclear science. Unlike earlier scientific fields, nuclear scientists investigated an aspect of nature that is so small, invisible even under the most powerful microscope, that its true form cannot not be known. In addition, nuclear research had resulted in a new type of weapon that could cause unprecedented levels of destruction, giving the atom a frightening power. Modern physics portrayed a world that was indeterminate and at a certain level unknowable. In contrast, art based on immediate experiences and objective factual sources provides a haven. Just as Snelson saw himself filling a void left by scientists when they abandoned visual atomic modeling, perhaps the sculptors discussed in this study were creating work that supplied facts, objectivity and certainty, in light of the new scientific ambiguity.

I have also proposed that the theme of invisible secrets hidden beneath the surface demonstrated in many 1960s sculptures relates to the concept of the unknowable atomic structure. Snelson draws attention to the unseen or secret structural forces of tension and compression in his work by composing dramatic structures that appear to defy gravity, such as long unsupported horizontal extensions. Other artists, such as Ronald Bladen and David von Shlegell, used similar effects, arousing curiosity in the viewer about the invisible interior structures that made such forms possible. The large blank surfaces employed by sculptors such as Morris, Bladen, and Robert Grosvenor also invited questions about secret interior worlds. The ability to see and understand in concrete terms were central concerns for Snelson and other sculptors of his generation. For Snelson, this meant an exploration of the invisible worlds of structural properties and atomic form. His work is an artist's vision of the elements and forces that make up our world.

Appendix A: Sculpture Typology

Date	Name	Dynamic	Symmetrical	Animal Form	Cantilever	Tower	Modular	Arch
1960	Arcuate Lip Superstar		x				x	
1961	Column		x			x		
1962	Tower (Cantilever)		x		x	x		
1963	Trigonal Tower					x		
1964	Spring Street		x					
1966	Sagg Main Street	x						
1966	Audrey I	x						x
1966	Audrey II	x						
1966	Vine Street		x				x	
1966	Six I		x					
1967	Sun River	x						
1967	Cantilever		x		x			
1967	Six II		x					
1968	Newport	x						
1968	VX		x					
1968	Avenue K		x				x	
1968	Four Module Piece		x				x	
1968	Four Module Piece, Form 1		x				x	
1968	Four Module Piece, Form 2		x				x	
1968	Key City		x				x	
1968	Double City Boots		x				x	
1968	Needle Tower		x			x	x	
1969	Needle Tower II		x			x	x	
1969-2006	Black E.C. Tower		x			x	x	
1969	Fair Leda	x		?				
1969	Northwood I		x					
1970	Northwood II							
1970	Northwood III	x						
1970	Easy K	x			x			
1970	Osaka	x						
1970	Landing	x			x			
1974	Free Ride Home	x						x
1975-6	Tall Tale	x						
1975-7	Forest Devil	x		x				
1975-7	New Dimension/Soft Lanc	x			x			
1975-93	Greene Street III	x						
1977	Easter Monday	x						
1977	Easy Landing	x		x	x			x
1978	Able Charlie	x						
1979	Tall Star		x					
1979	B-Tree I	x						
1980	Coronation Day		x					
1981-2006	B-Tree II	x						
1982	Mozart	x						x
1991	Triple Crown	x		x				x
1999-2000	Dragon	x		x	x			
2000	Indexer	x						
2001	Rainbow Arch		x					x
2002	Vortex III		x					
2003	Sleeping Dragon	x		x				x

Appendix B: Continuous Tension, Discontinuous Pressure Structures Patent

United States Patent Office 3,169,611
Patent issued: February 16, 1965

The present invention relates to structural framework and more particularly, to a novel and improved structure of elongate members which are separately placed either in tension or in compression to form a lattice, the compression members being separated from each other and the tension members being interconnected to form a continuous tension network.

The present invention forms a part of a recently developed class of structures possessing, what may be termed discontinuous compression, continuous tension characteristics. This type of structure is an outgrowth of much earlier forms such as, for example, the wire or tension spoked wheel in which use of tension members has been made to support external compressive loads. Significant weight/strength ratios have been achieved in structures of this type by eliminating heavier compression members and supplanting them with lighter tension members wherever possible. It has been found that materials may be selected which, for a given weight, have tensile strengths several times greater than their ability to withstand compression loads. In fact, most advances in strengths of materials have seen an increase in tensile strengths while compression strength has remained relatively static being determined by the number of planes defined generally by the ends of the elongated compression members throughout the structure.

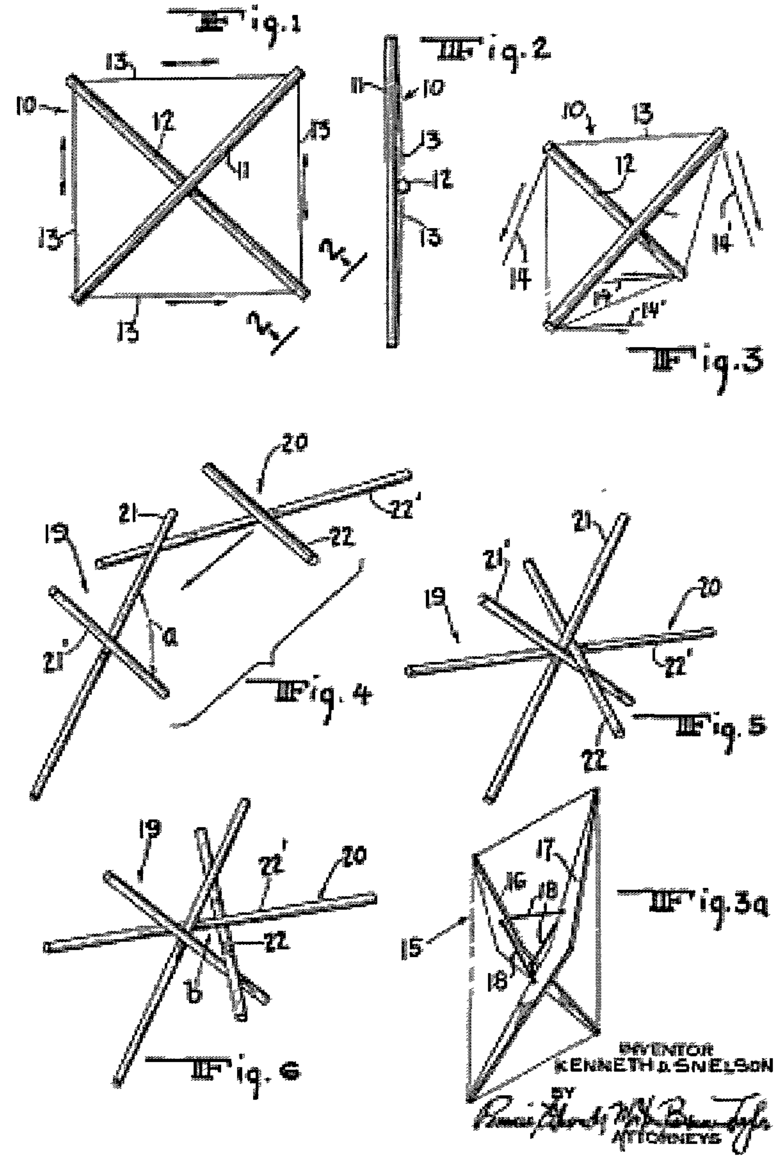
It is the basic object in utilizing the foregoing principles to produce an ultimate structure (such as a dome, sphere, etc.) which can absorb large loads relative to the amount of a given material used. Practically, this requires the greatest use of tension members and the least possible use of members in compression, since the former may be made considerably lighter to withstand tensional forces than the latter to withstand compressional forces. In the evolution or development of new modules there has been a constant attempt to develop simpler forms, i.e., units or modules which contain fewer and fewer compression members. To date, the simplest known structures resemble a 3-legged collapsible chair, wherein three elongate compression members are held by a continuous tension network to be self-supporting. The three compression members cross in a spiral intermediate their ends to make this structures resemble the familiar tripod spiral of a sling scaled 3-legged collapsible chair.

It is a basic purpose of the present invention to disclose the simplest modular form thought to be possible for a structure of this type. Because of its basic simplicity, the module of the invention lends itself naturally to many applications for use as a basic building block in constructing more complicated structures. Consequently, this structure utilizes tension more efficiently than before possible with the more complicated module forms to thus bring about a corresponding decreased weight/load ratio.

Feb. 16, 1965 K. D. SNELSON 3,169,611

CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

Filed March 14, 1960 9 Sheets-Sheet 1



Feb. 16, 1965 K. D. SNELSON 3,169,611

CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

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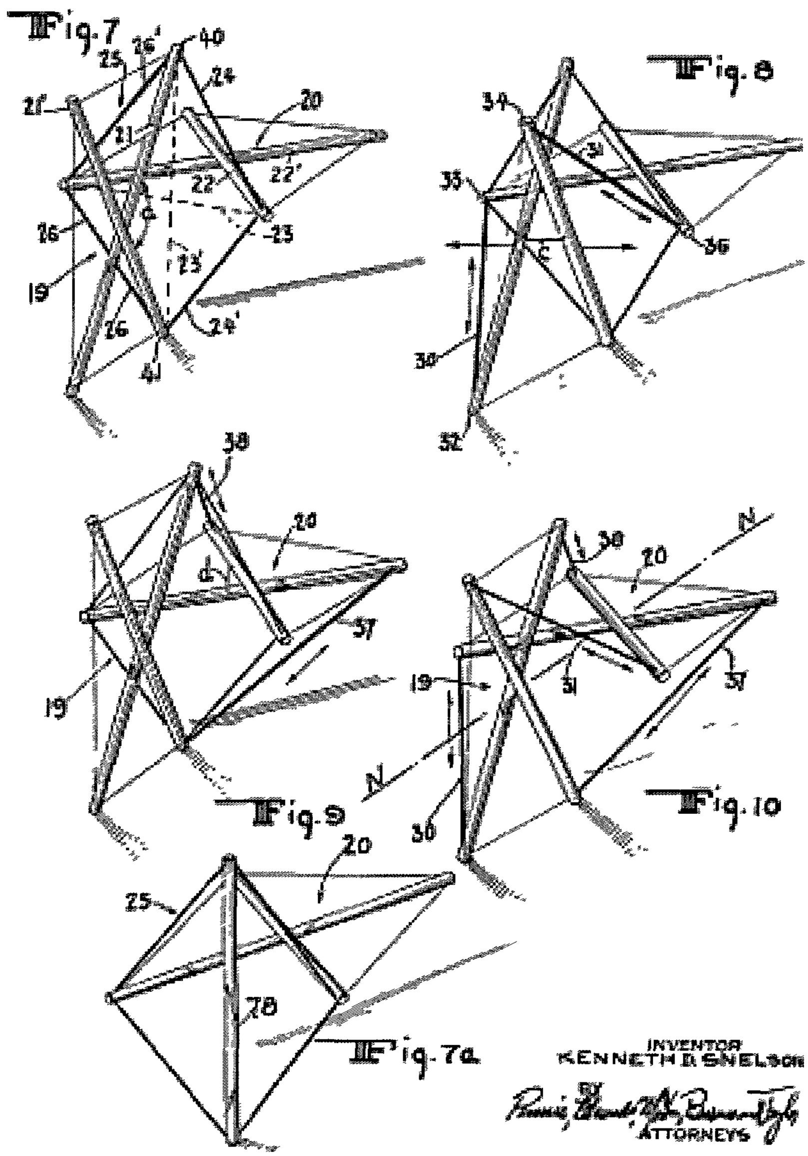

INVENTOR
KENNETH D. SNELSON

BY
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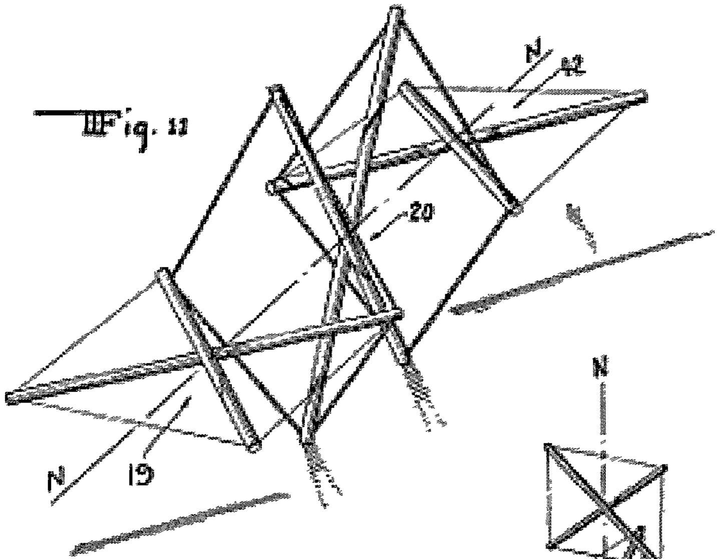
Feb. 16, 1965 K. D. SNELSON 3,169,611

CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

Filed March 14, 1960 8 Sheets-Sheet 3

Fig. 11



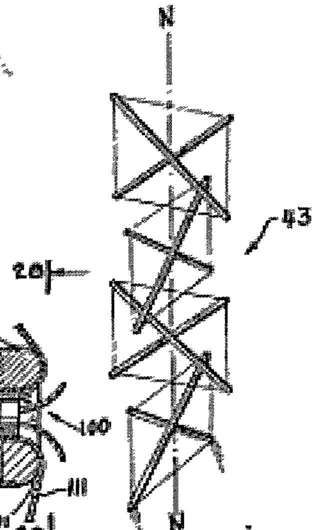


Fig. 12

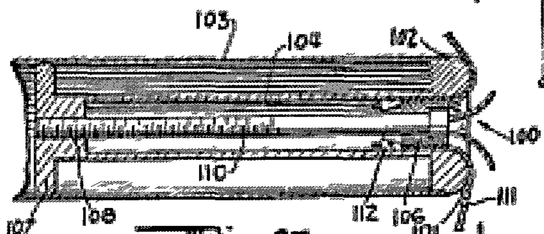


Fig. 27

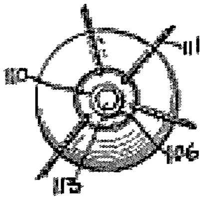


Fig. 28

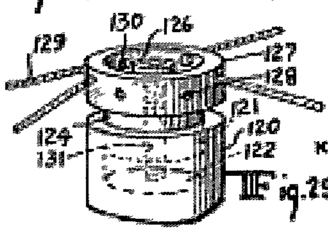


Fig. 29

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CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

Filed March 14, 1960 9 Sheets-Sheet 4

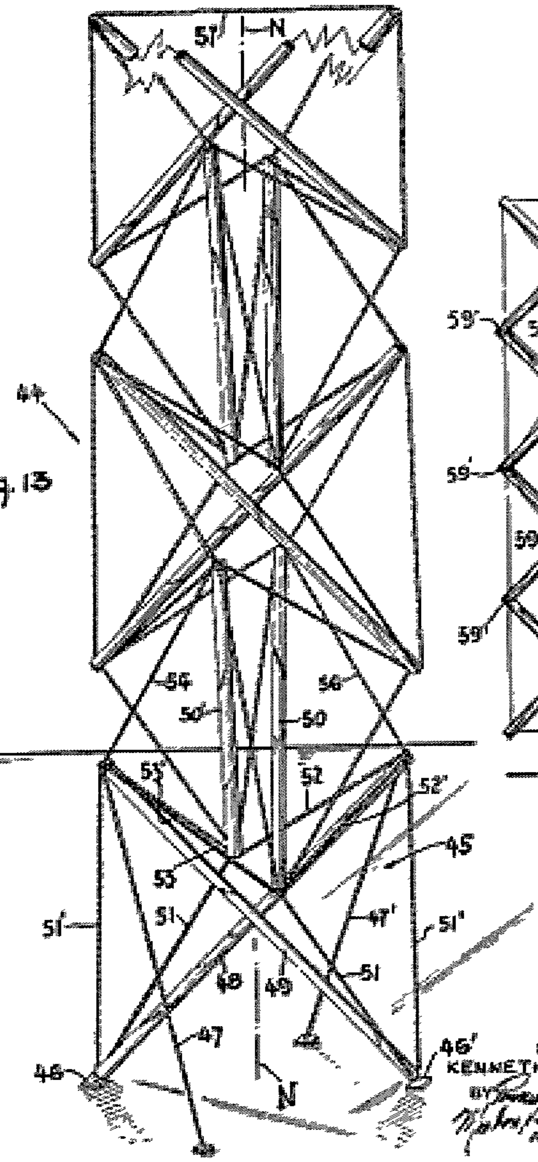

Fig. 13

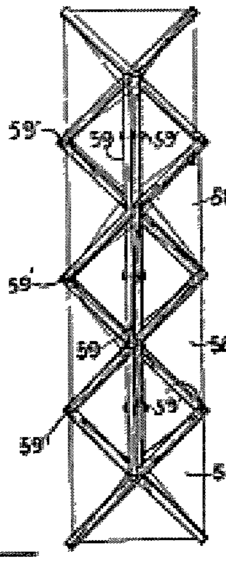

Fig. 14

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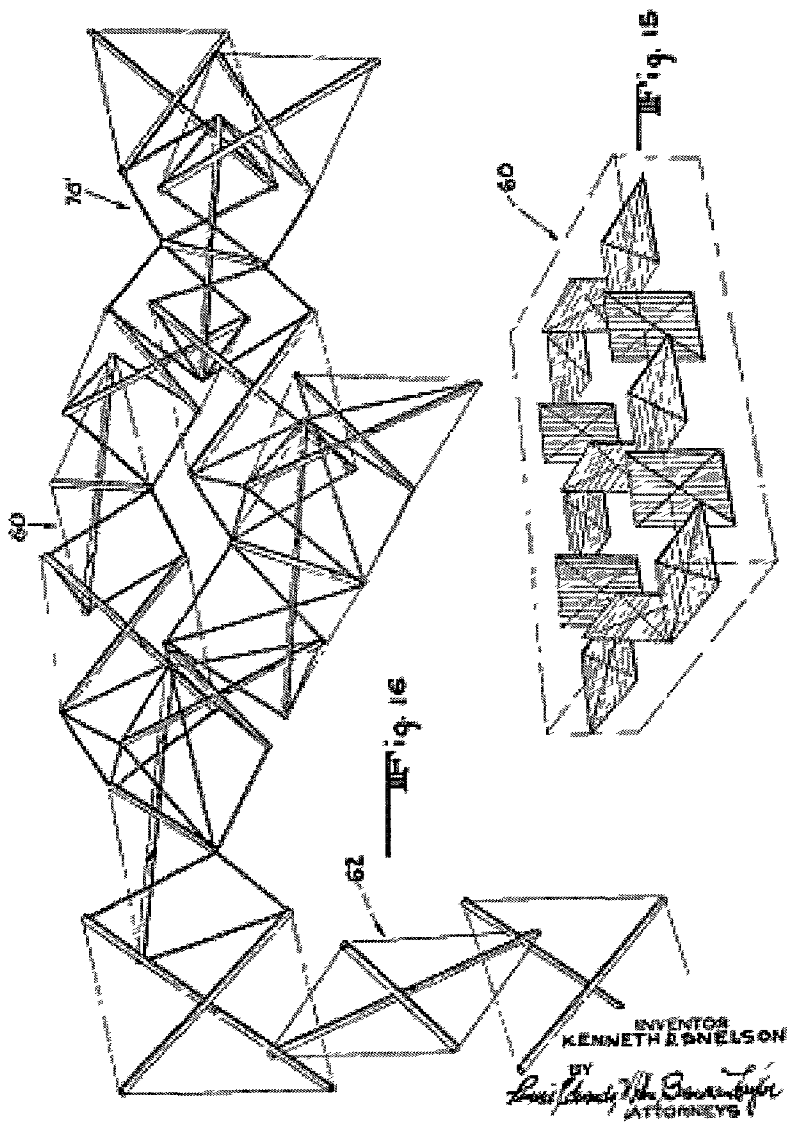
Feb. 16, 1965 K. D. SNELSON 3,169,611

CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

Filed March 14, 1960 9 Sheets-Sheet 5



INVENTOR
KENNETH D. SNELSON
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[signature]
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Feb. 16, 1965 K. D. SNELSON 3,169,611
CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES
Filed March 14, 1960 9 Sheets-Sheet 6

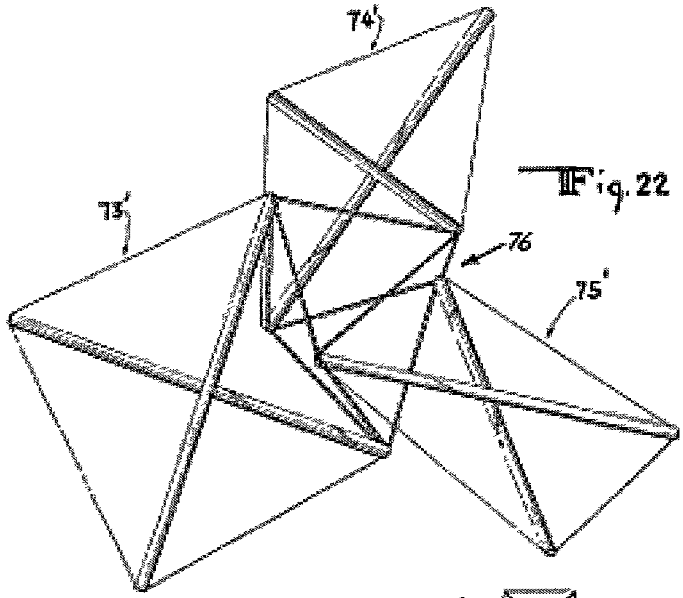

Fig. 22

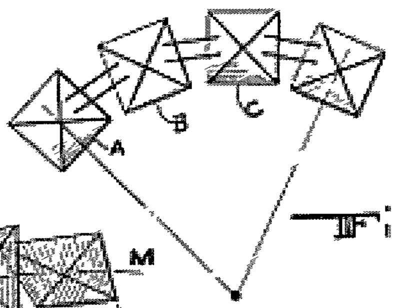

Fig. 18

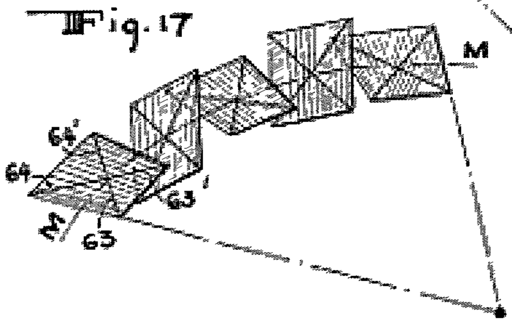

Fig. 17

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Feb. 16, 1965 K. D. SNELSON 3,169,611

CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

Filed March 14, 1960 9 Sheets-Sheet 7

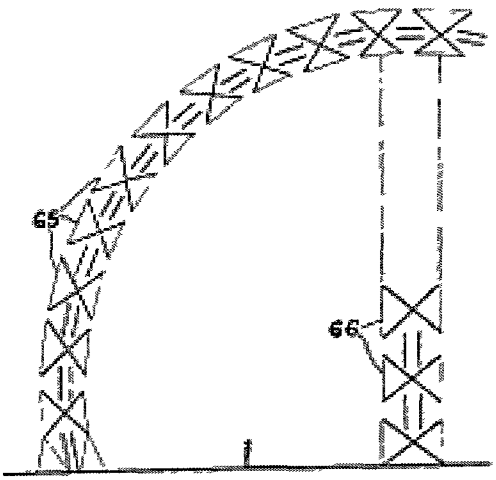

Fig. 19

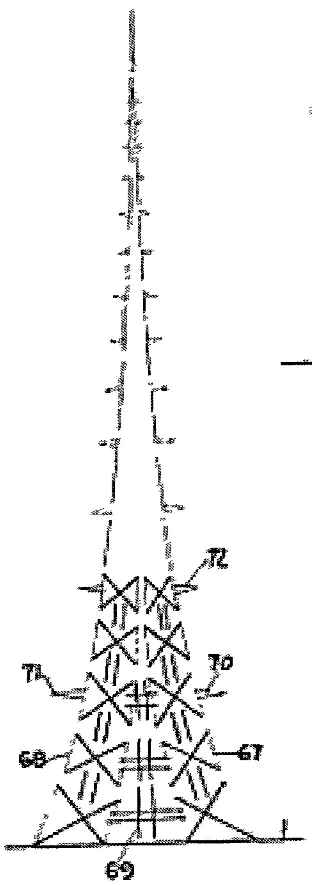

Fig. 20

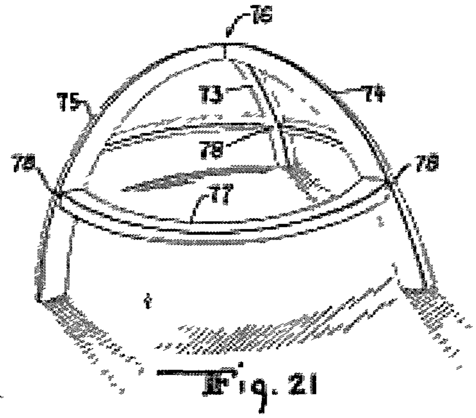

Fig. 21

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Feb. 16, 1965 K. D. SNELSON 3,169,611

CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

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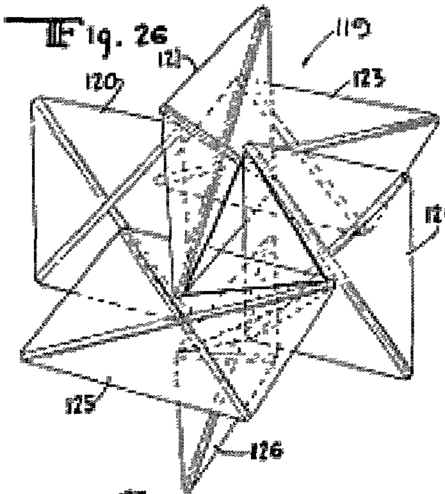
Fig. 26



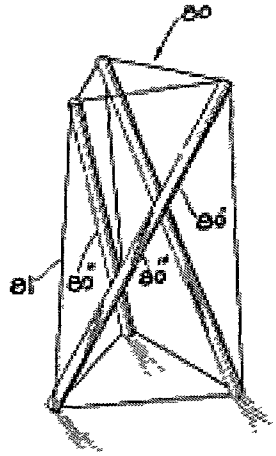


Fig. 22b

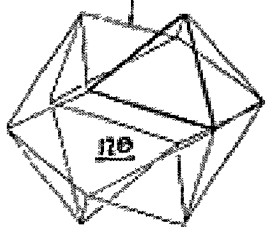
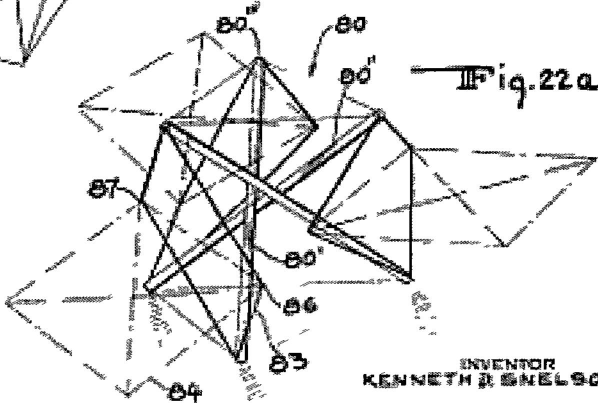


Fig. 26b

Fig. 22a



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Feb. 16, 1965 K. D. SNELSON 3,169,611

CONTINUOUS TENSION, DISCONTINUOUS COMPRESSION STRUCTURES

Filed March 14, 1960 9 Sheets-Sheet 9

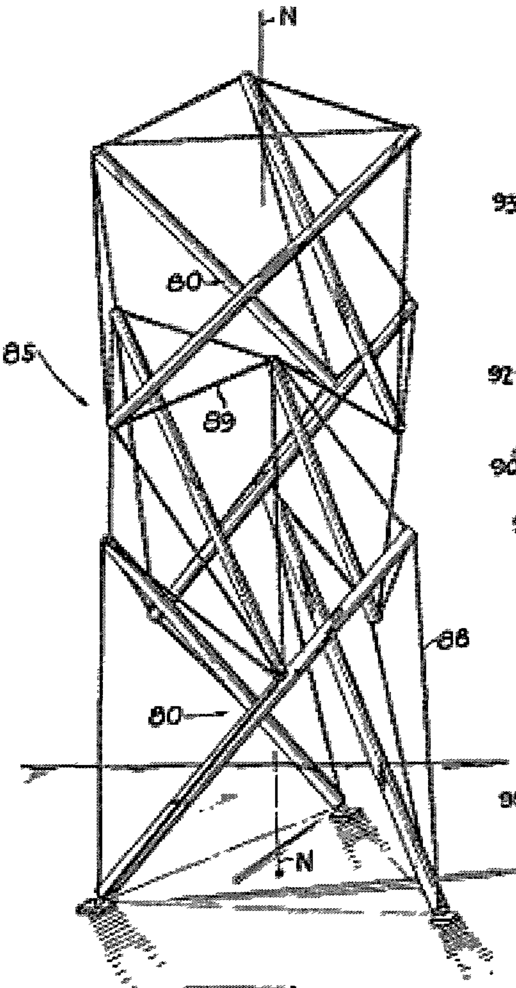

Fig. 25

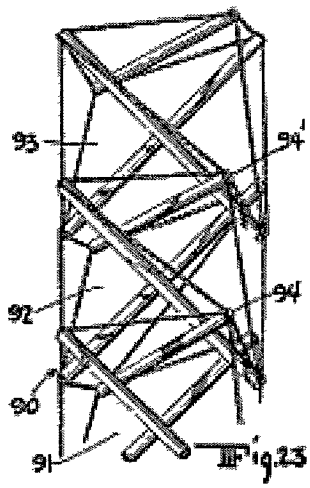

Fig. 23

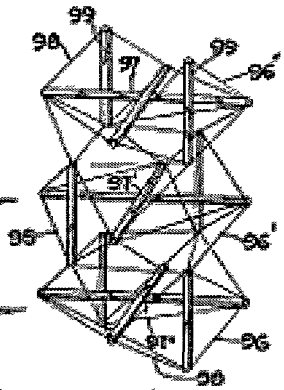

Fig. 24

INVENTOR
KENNETH D. SNELSON
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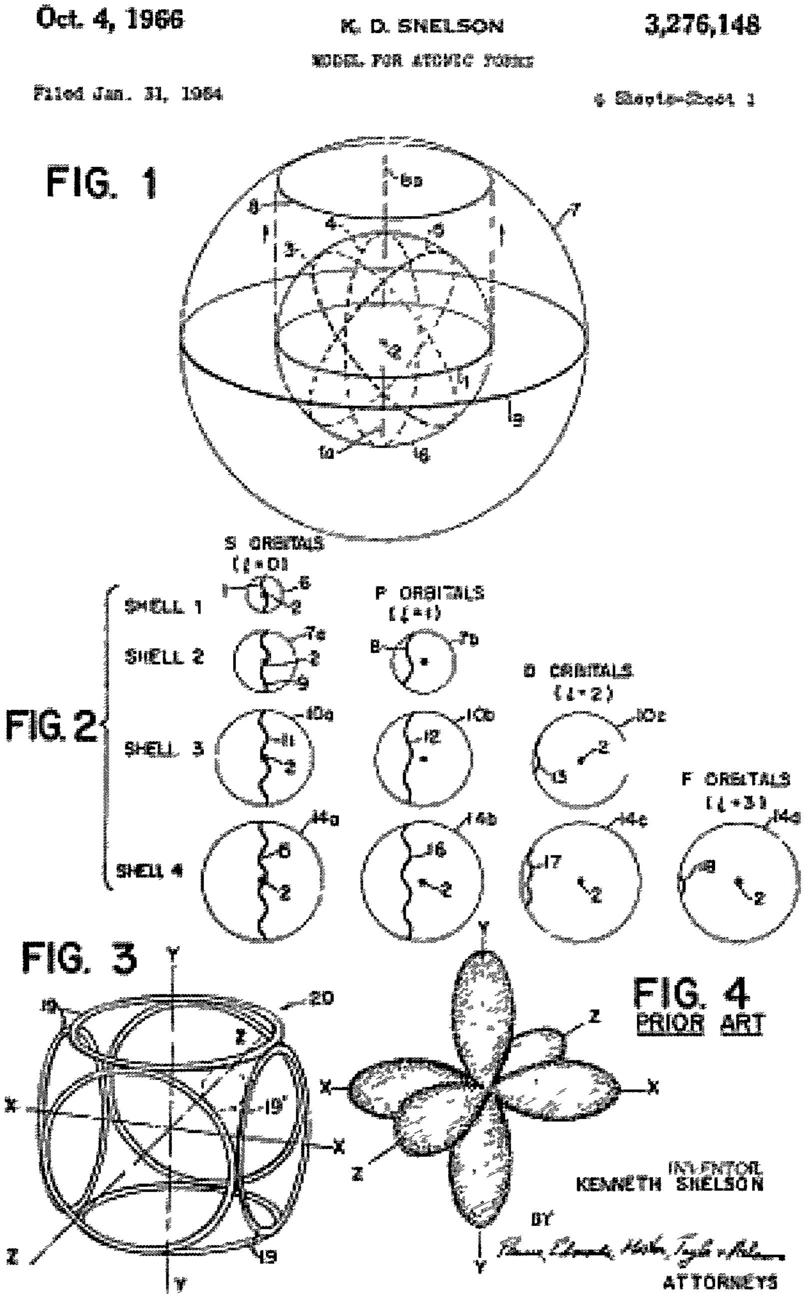
Appendix C: Model for Atomic Forms Patent

United States Patent Office 3,276,148
Patent issued: October 4, 1966



Oct. 4, 1966 K. D. SNELSON 3,276,148

MODEL FOR ATOMIC FORMS

Filed Jan. 31, 1964 6 Sheets-Sheet [illegible]

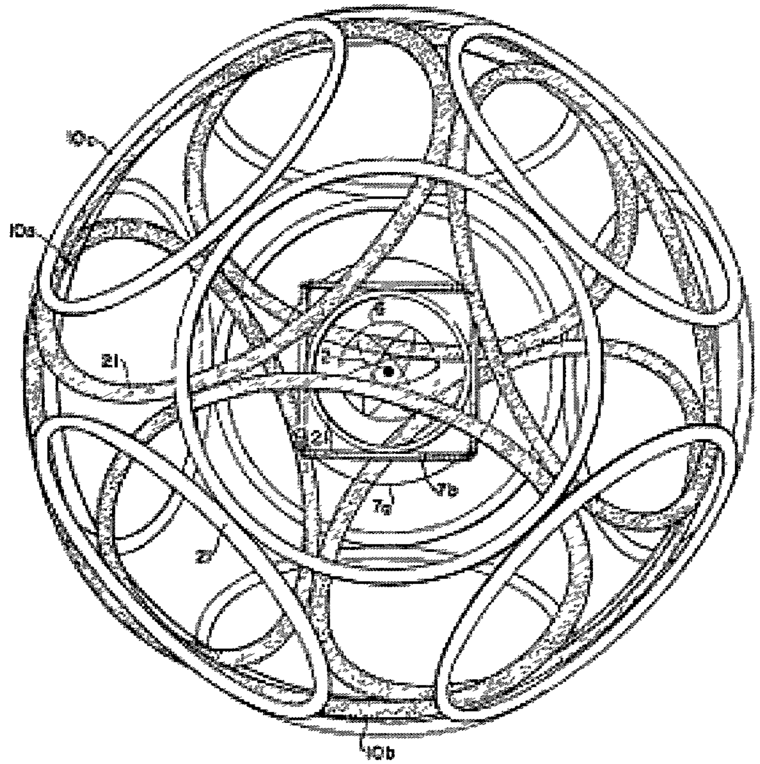


FIG. 5

INVENTOR
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BY

ATTORNEYS

Oct. 4, 1966 K. D. SNELSON 3,276,148
MODEL FOR ATOMIC FORMS
Filed Jan. 31, 1964 6 Sheets-Sheet 5

FIG. 6

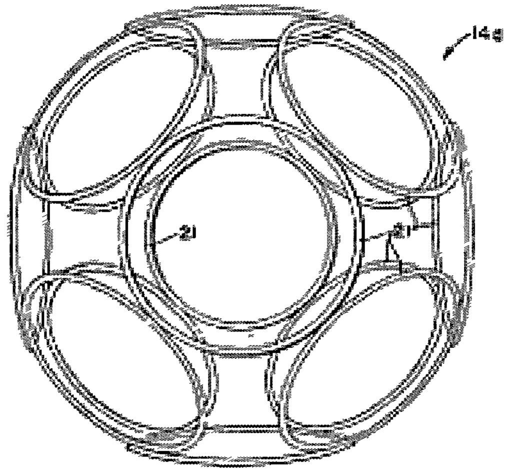
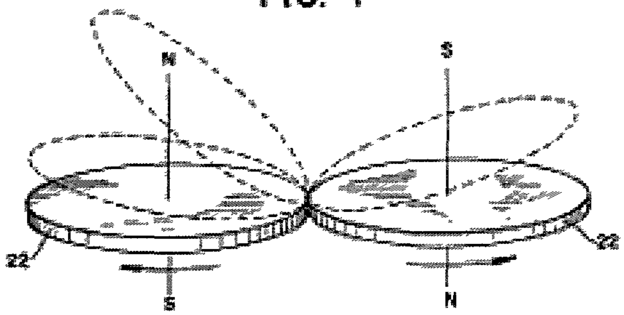


FIG. 7



INVENTOR
KENNETH SNELSON

BY
ATTORNEYS

Oct. 4, 1966 K. D. SNELSON 3,276,148

MODEL FOR ATOMIC FORMS

Filed Jan. 31, 1964 6 Sheets-Sheet 4

FIG. 8

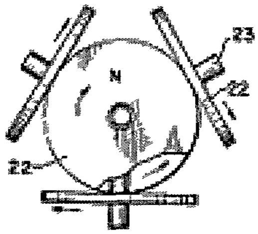


FIG. 9

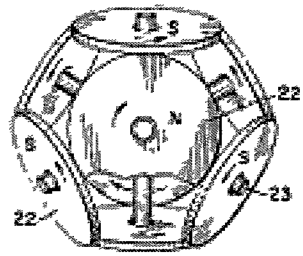


FIG. 10

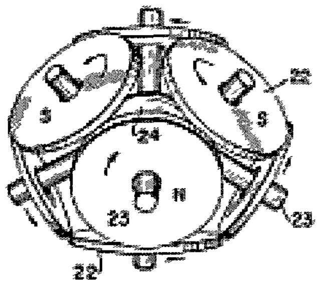
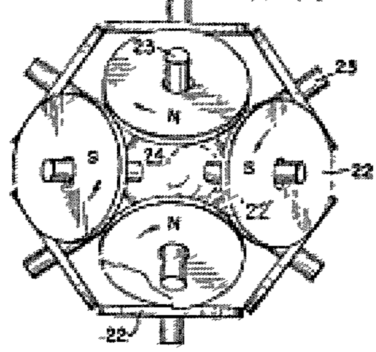


FIG. 11



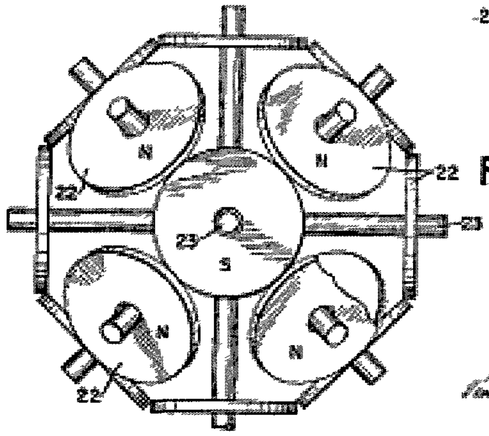


FIG. 12

INVENTOR
KENNETH SNELSON

BY

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Oct. 4, 1966 K. D. SNELSON 3,276,148

MODEL FOR ATOMIC FORMS

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FIG. 13

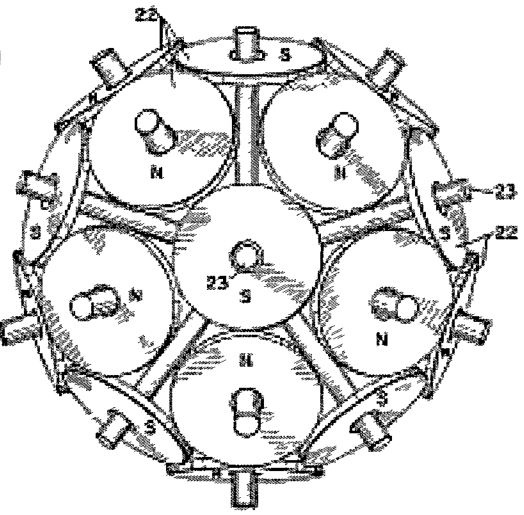
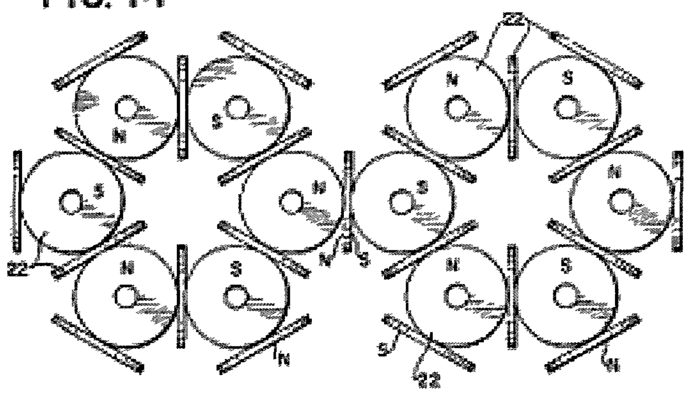


FIG. 14



INVENTOR
KENNETH SNELSON

BY

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Oct. 4, 1966 K. D. SNELSON 3,276,148
MODEL FOR ATOMIC FORMS
Filed Jan. 31, 1964 6 Sheets-Sheet 6

FIG. 15

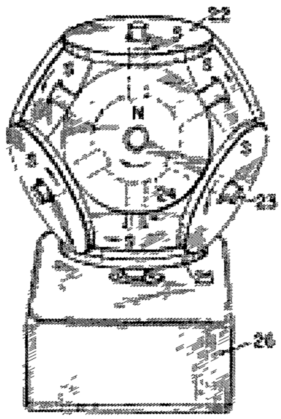
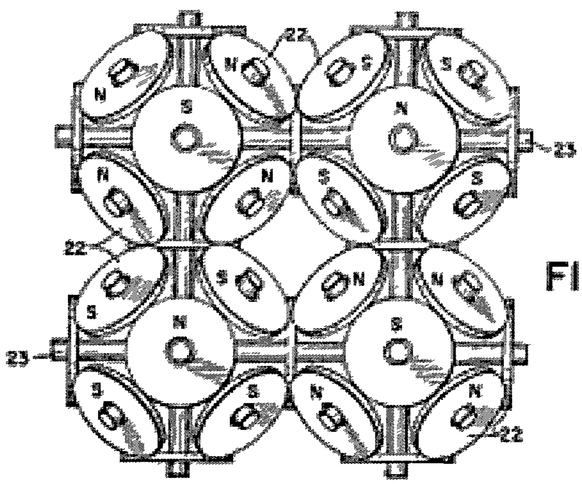


FIG. 16



INVENTOR
KENNETH SNELSON
BY
ATTORNEYS

Appendix D: Model for Atomic Forms Patent

Unıted States Patent Office 4,099,339
Patent ıssued: July 11, 1978

United States Patent [19] — [11] **4,099,339**

Snelson — [45] **Jul. 11, 1978**

[54] MODEL FOR ATOMIC FORMS

[76] Inventor: Kenneth Snelson, 140 Sullivan St., New York, N.Y. 10012

[21] Appl. No.: 773,582

[22] Filed: Mar. 2, 1977

[51] Int. Cl.² G09B 23/26
[52] U.S. Cl. .... 35/18 A
[58] Field of Search .... 35/7 A, 18 A, 34

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3,921,321	12/1975	Garnaas	35/7 A

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L. Pauling et al., "Introduction to Quantum Mechanics", (McGraw Hill, New York, 1935), pp. 36-45.
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Primary Examiner—Harland S. Skogquist
Attorney, Agent, or Firm—Pennie & Edmonds

[57] ABSTRACT

The present invention relates to a model for atomic forms which includes pairs of ring magnets for representing pairs of electrons in an atom or molecule.

8 Claims, 8 Drawing Figures

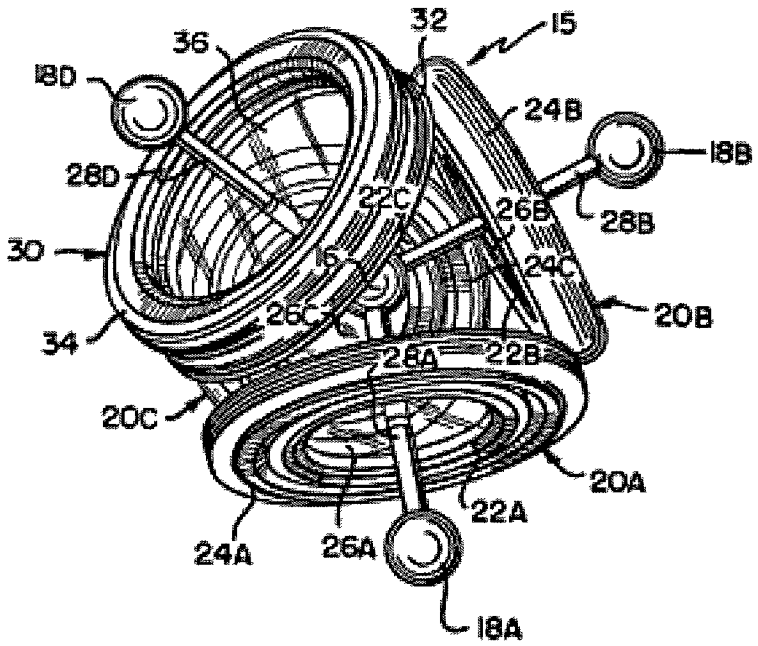


FIG. 1

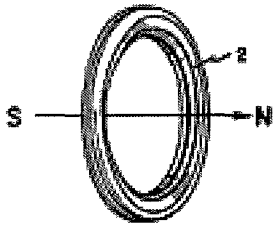


FIG. 2A

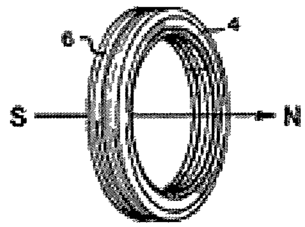


FIG. 2B

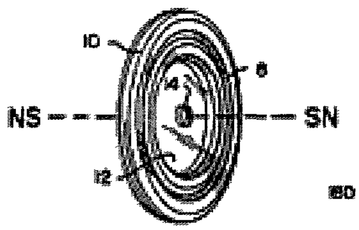


FIG. 3

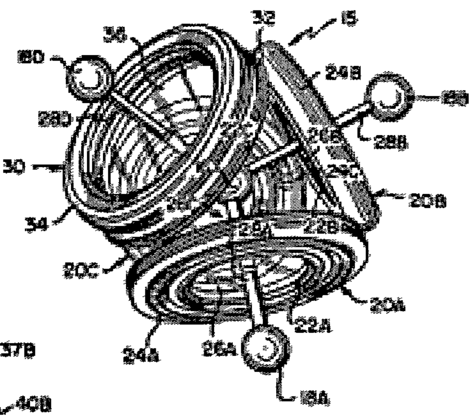


FIG. 4

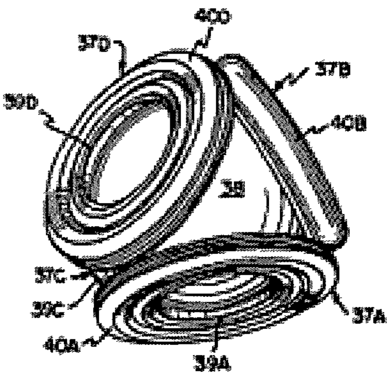


FIG. 5

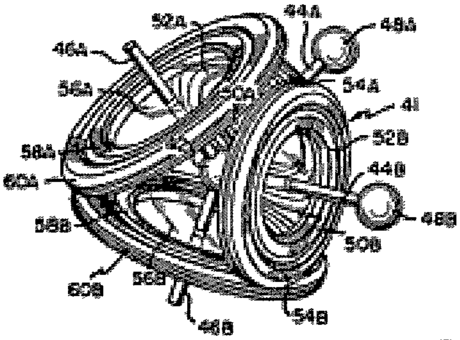
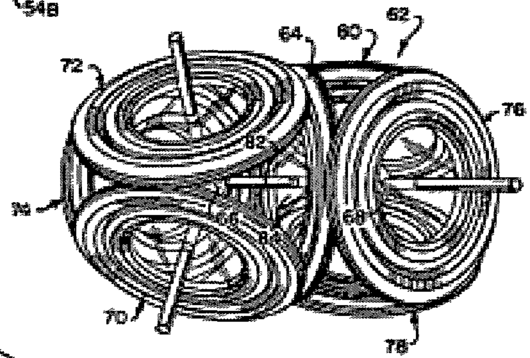


FIG. 6



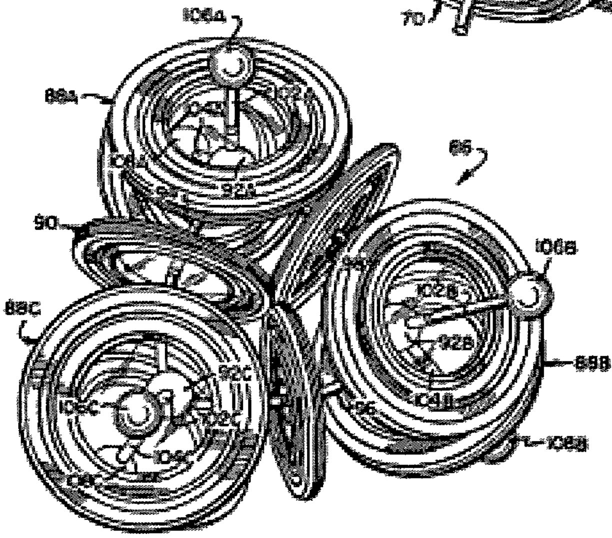


FIG. 7

Appendix E: Selected Transcriptions of Snelson Interviews

Snelson Interview: September 24, 2008

ASF: Is there emotional content in your work?

KS: No, I wouldn't say there's narrative content—no emotional content.

ASF: Do you see an idea expressed by your work?

KS: I wanted to invent something that I haven't seen before. I'm profoundly interested in the fundamentals of how things work on a most basic level.

KS: The atom project seems strange, but it makes sense to me. I think that the most important thing I've done is the deciphering of the atom's rhythm, but I'm the only one who thinks so.

Snelson Interview: October 28, 2008

KS: I'm a one man movement with no following.

Snelson Interview: May 13, 2009

KS: I've just started thinking about the idea of career as a personal asset that one can enhance. I never really understood what people meant when they said, "that is a good career move." I always did one thing and then another. If it was successful, that was good, if it wasn't that was bad. ...I never cultivated an artistic persona. Like Carl Andre. It's like, "hey there's that artist who wears those overalls."

ASF: Do you think you should have appropriated some sort-of garb?

KS: No. You know, that's not me, but—sticking with the atom was the worst career thing.

ASF: But you love your atom. How could you have not done it? Hasn't it made you happy?

KS: I'm obsessed with it. There's this issue of it being a legitimate subject of art. If I'd been studying trees or flowers in an art with this intensity no one would have made anything of it.

Snelson Interview: December 8, 2009

ASF: When you were in Navy, you went to classes at the Corcoran. So, were you already interested in art at that point?

KS: I was so terribly uneducated then. It's very hard to know when the word art becomes a significant word in your life. Because art was not a well-defined word in my vocabulary at all. It was those things that the teacher told you it was—Michelangelo, Madonna of the Chair of Raphael—those were art. We had art classes in school. We took out pencil and glue and such and made stuff—that was not art. It was craft or something. When I was in the Navy—I don't know how I heard about the Corcoran classes, but I heard about them somehow. It was a studio class—drawing. It wasn't for very long a time, I wasn't there for very long, and there were not that very many evenings I could go. But I remember an older student showed me a painting, and he said, "In a painting like this you might see someone's hand reaching up like that—and look at the shape—and put it all together and all that occurs magically is geometry" [while drawing a triangle]. And I thought, "Wow." So, that was like a revelation. But I didn't really think myself capable of doing any such thing. Then I got into the University of Oregon and found the wonderful Jack Wilkinson, and I was able to tie it all together.

ASF: Do you feel that your involvement in the World's Fair led to Dwan at all?

KS: No, Dwan wouldn't have seen those pieces. Someone doing a piece for the World's Fair—that was no high-class stuff for the art world. It's a strange world. It's is a terribly prejudiced world. The art world is so weird in this way that's why I'm so suspect because of these other associations. Chuck Close said to me one day, we were talking about careers and successes, and he was telling me that during the 80s he had had a very tough time. And I said, "Well, I've never had that kind-of fame, anyway." And he said, "Well, you had your atom." Which was like saying, "Well, you did it to yourself."

ASF: But compared to 99.9% of people who call themselves artists you're incredibly successful.

KS: You're right. I agree with that, I am. That's very true. But still, if I had joined the crowd and called myself a Minimalist, I would have had my name in the paper a lot more often. If I had skipped the atom and not let them know it existed, I would have gotten points.

ASF: How did you initially come to show so much work in Europe?

KS: That's a good question. Well, I was prominent at the time, what they call now *hot*, which doesn't last very long. I had my first show in '66, and it got a great review in the *Times* by a man who was important at the time, John Canaday. So suddenly I had an overnight name. It was bewildering. It was wonderful and bewildering. I remember, Jimmy Ernest—I was out in Long Island, and there were a lot of people from the Abstract Expressionist times there. And I was friends with Jimmy Ernest, and he said to me before this [first Dwan] show, "It's great to have a show and your first show, but I got to tell you don't expect too much because it just doesn't happen the first time." And I said, "Oh, well, I'm not expecting too much." And then after Canaday's glowing review came in, Jimmy said, "Jesus Christ, you lucky bastard." So, I was suddenly in the contemporary group at the time, and there is such a contemporary group today, but it was much more in one folder then, then it is now, so when you were riding the wave it was very heady. My gallery was a high-end gallery, Virginia Dwan, and people come to you when you're hot at a gallery like that. So I had a show in Bryant Park, which she didn't generate—that I generated—and that show went to a couple of other places. To Texas, then to the Kröller-Müller in Holland, and to an outdoor show in Düsseldorf. So work got shown and some museums bought the pieces, and that's how I got to Germany and Holland. That was in '71. Then after Amsterdam we came back here and got started with our baby.

ASF: My second set of questions is about how you think about your art. I wondering if you have a favorite piece, or if you have any that you don't like?

KS: I wouldn't say I have any work I don't like. I have lots of maquettes that I haven't done anything with because they weren't something that was satisfying. Really, I have two modes in approach to form and structure. In the one way, I have a deep aesthetic appreciation and love of purely symmetrical forms—they appeal enormously to me. On the other hand, the aesthetic I that grew up with was really derived from the fundamentals of formal old art—that was distilled by the Cubists. Now I don't see many people doing work that has the considerations of my time. But what I wanted to say is that I grew out of that time, and it had to do with how to make formal arrangements of geometrical relations of one thing to another, and in that realm, purely symmetrical things are totally fulfilling. If I go that other root, if you try to build in dynamics, you're in another realm. And that has interested me greatly in pieces like *Forest Devil* or *Mozart I* or *Free Ride Home*. In those sorts of things there isn't that symmetry. On the other hand, that other world is like *Needle Tower* where things are wonderfully simple and demandingly kept in symmetry and in pure geometry. And there are people who have spoken about my work to me or behind my back who think that one or the other is, well, "Why in the hell is he doing that?" Because they have had affinities to one or the other.

ASF: That was actually one of my questions—do you distinguish between your pieces that are more free form and those that are repetitions of modules?

KS: I distinguish, but really I feel like there is wonder and delight in all these things. When I was involved with the people at Dwan Gallery, Sol LeWitt said to me one time, when he had his repetitive cubes, he said something with a dot dot dot ending, which was, "I don't know why you're doing—I wish I had something that was—." And I understood what he meant because at the time, he was stuck with cubes, and he wished that he had some foundation thing to begin with. Something with dynamics. On the other hand, other people have said about the other things, "they're so static." But I can see the wonder in both kinds.

KS: After Black Mountain when I came to New York, de Kooning said come by the studio sometime, and the truth is I didn't dig his work at the time. I had come from the world of Cubism and orderliness and such. And he was already into the very wild stuff in 1948—the black and white paintings. And I said, you know—I'm a kid, I had the chutzpah to say, "Well I like that painting, but not that one so much." And, he said, "When someone comes here and says, they like this one or they like that one, you know they're lying because either you like a man's work or you don't."

ASF: Among your own work, are their pieces you like more than others?

KS: No, but everyone once in a while when I finish a piece I really like, I think that's what I want to do forever—I love that. But then I look at the thing, and I think, well on the other hand…

ASF: In terms of pieces that you start to develop and never realize: what's something that might be wrong with them?

KS: They're like a joke that goes flat.

ASF: You just don't find something visually arresting in them?

KS: Yeah. It just doesn't make it.

ASF: Can you take me through how you develop a new piece?

KS: Depending upon which vein I'm headed for, in the sense of the dynamic—I hate the word dynamics, but the non-symmetrical pieces. Those pieces are more redo and redo. Trial and error sort of thing, because usually if it's pretty much purely symmetrical geometry, I pretty much know where I'm trying to get to. It's just laborious to get to it. Because those pieces that are symmetrical are harder to do because if something is loose or too tight, I have to redo every one of them. That's why a lot of people aren't doing these things—because they're very hard to do.

ASF: With a symmetrical piece do you know in advance what you're trying to make?

KS: Yeah, usually. I have a vocabulary of pieces that I can arrange in my head.

ASF: Do you know where you're going with the asymmetrical pieces?

KS: I have a general idea.

ASF: And where do you get that general idea from?

KS: It's hard to tell. Well, for instance, in the piece called *Forest Devil*, I sort-of imagined that it would be a kind-of creature. And so the vertical part—what I call the back of the piece, and then it takes and plunges and comes back up again. And I had that sort-of plunge in mind. Also, for instance in the piece at Storm King—*Free Ride Home*—I thought of a piece that would have possibly two or three arches, so you could walk under it.

ASF: Did you know you were building that piece specifically for Storm King?

KS: No, I half cannibalized the piece I had done in Holland. About the time I'd met Katherine, I'd done this maquette for a show in Arnhem, Holland. There was a little park called Sonsbeek. That was the cantilever piece over the water called *Easy K*. It was named because I found a woman finally that I could get along with quite easily. It wasn't that she was *easy*. And, so that piece was in a summer show and after the show was over it came back in crates and went into our new basement on Sullivan Street. And on our street was a lovely woman, who died [Doris Friedman], and she was head of the Art Council—the people who put the sculptures all around in parks, like opposite the Plaza Hotel. We got together for some reason about having a show at Waterside Plaza on Twenty-Fifth Street and the [East] river. So I had this piece, but it wouldn't have worked up there at all because it needed a pond or a reflecting pool. So I had all the materials and the model, and I simply took the pieces that were in the basement and made *Free Ride Home* from that. I didn't use every piece, but almost.

ASF: For *Forest Devil* were you thinking of a critter from the get go?

KS: Yeah. I wasn't thinking of the devil.

ASF: Do you work directly with the materials in miniature from the start or do you sketch first?

KS: The sketch is in my head—I don't need to sketch. And besides, it's very hard to read a sketch. I think that if I were more fluid and conversational with 3D Macs, I might work in that, but since I learned at my age, it's been more satisfactory to build a model.

ASF: Do you decide in advance what scale you're going to work on?

KS: Very often, it's prescribed by the place it's going. *Easy Landing* in Baltimore: I went there to see the place where the sculpture was going to go, and I knew, one, that it was going to be public and, two, that the space was large. So right away I thought this can't be in harm's way because you can't have kids climbing and swinging—like in gym. So I developed the shape with little sketches based on the scale that was required. In the park in Holland, the Sonsbeek piece [*Easy K*], I knew how big the pond was, and I sort-of imagined what a wonderful reflection it would be in the water and the cantilever was based on that. *Free Ride Home* was based on imagining an arch that would arch over a person. So often it's informed by where they're going to go and what materials are available.

ASF: Is there any difference in the pieces that are intended for indoors and outdoors?

KS: Well, all my big pieces are thought of as bigger than an indoor—there are a lot of pieces that I've thought, well that's big enough—a room size piece. But since the potential to build them is always there—it's always inviting.

ASF: Why do you like to build them big?

KS: The difference between the model and the big one. If you saw the model and then walked out into the open space and saw the big one, you wouldn't ask because it's so different. It's just so wonderful. It becomes like an architectural something. Klaus Oldenburg does the same thing. It's just a deal you can't refuse.

ASF: Do you feel that your work relates to or gives away that it's from certain a place or time?

KS: No. I mean, I'm sure to the art world it says 1960s. But, in fact, I don't know anyone's work who's going to be more eternal than this pure stuff. Looking at it a different way, so many schools around the world assign a tensegrity-something project. My presence is indelible there because no one who's doing those and would Google anything would miss my website. I'm interested, as every artist is, in being loved by the art world, but the art world is very fickle, but this part of the work is eternal and I like that. I value it more than I value the art world because you see how temporal things are.

ASF: Have you ever asked yourself why you're attracted to the materials and form and scale that you use?

KS: For very practical reasons. There's nothing that can do better in surviving the elements than stainless steel aircraft cable, and the tubular materials that I use: stainless steel or aluminum, depending on various considerations, they're the best I can do. There are exotic materials, like carbon fiber, that don't really make very much sense to substitute for metal.

ASF: How do you hope that people will interact and react to your work? What kind of impressions or emotions do you hope they'll have?

KS: Chuck Close said he wants to do things that will knock your socks off. I want people to react the way I see people react—people who do react, many probably don't—but when they do, it's because they get it. They see that it's an uncanny combination of forces. When I do my talks, I usually talk about that aesthetic that's connected to watching a bird in flight. What in the world is it about seeing a bird in flight that's so remarkable, that makes you say, "Wow, I wish I could do that." So I think that, I'm sure

I told you that story about the guy who used to be head of Dia—I can't remember his name. He said the reason he didn't want to take me on for his gallery was because people understand it right away, and his job as a dealer is to introduce them to things they can't understand. He had Gilbert & George at the time and maybe that needs explanation. And I think there's something like that that goes on with the art critics who are not turned on by it. It's too generally appealing, maybe. I feel like for most people the thrill is immediate. And with Gilbert & George you have to talk to people about it and tell them why it is wonderful.

ASF: I think the magic trick aspect of your sculptures is so appealing, but I don't think the viewer knows how they stand up just by looking at it.

KS: No, people don't know how I do it. It's not that they understand it in that way. The pieces at the Hirshhorn and Kröller-Müller, the two towers, I hear over and over again from the curators that it's people's favorite pieces. And probably they're flattering me, but to a certain extent I think it's true. People are astonished—particularly by the piece at the Kröller-Müller—it's so slivery and so tall and so gossamer. I think it puts people in awe.

<u>Snelson Interview September 20, 2010</u>

ASF: When you started experimenting with your *X-piece* in 1948 were you familiar with Calder?

KS: Oh, yeah. At the University of Oregon, we were really hip. [sarcasm]

ASF: Do you think you were thinking about his work?

KS: I didn't start out intending to make anything move, it just came to me. It was because of those little toy things. The idea of stacking them was obvious. And then to join them together while you stacked them and have them sit on something like a golf tee. It looked like one step to another was fairly obvious. I was not doing something because of Calder. Although I suppose that Calder legitimized moving sculpture. I don't think that anybody, even the Constructivists did anything that was particularly made to move. Calder's was made to move. It doesn't take much to leap with an idea. I always felt that some very clever person with a sense of association could start out with almost anybody's work, copying it, and then leap off. George Rickey is a perfect example. When George did his first things, I'm sure everyone said Calder did that, but look how different his work became from Calder's. Anyway, that's a long answer to a short question.

ASF: Do you think of your work relating to Calder?

KS: No, I don't really. Calder is one of those people who it's easy to envy because he cut a large swath. And, he was inventive and his work is almost immediately identifiable, no matter whatever he did. I don't feel I was influenced by him at all. I've made shapes, in trying to experiment with shapes pieces that I've thought, well that's Calder-esque.

ASF: When you were experimenting with painting in the late 1950s, and you were getting back into being an artist. You wrote in your memoirs that you hung out at the Tenth Street Artist's Club—

KS: Hang out is really not the right word because you didn't stay there all day.

ASF: But it was a place that you went to. Can you talk more about that experience?

KS: Yeah, one can easily say it was a rather frightening place. The reason it was a frightening place is there was a hierarchy, a pecking order. And I wasn't any part of that. I was, in effect, a youngster, and a novice in the language they were using. And, the atmosphere was very nervous making. Because there was a room full of people, maybe up to 50 to 200—no, less than 200—folding chairs, a funky room. I don't remember if they charged admission, but you could have a cup of wine. There was a lot of smoking—I wasn't smoking, but there was a lot of smoking. Did you ever see Mad Men? I think my goodness! Was there that much smoking and that much drinking! Certain people had the respect or prerogative to speak up. There was usually a panel of three or four people about some subject, say modern interpretive dancers, and there would be a discussion about "The Dance" and art and all of that. But mostly it was painters, but some sculptors. And, some people by the fact they were bold and reckless would speak up, and "the hell with you," sort-of thing. Paul Georges, for example, was a good friend. Our parents had been friends in Oregon. So I knew him at the University of Oregon. And he had come to New York, and I came to New York. Paul Georges was a representational artist at the time when that was really out on the edge because all these people were Abstract Expressionists, and they felt it was a cause. It was a *cause* for the New York school. Pat Passlof had organized—she's a painter, she was married to Milton Resnick—she took proprietorship often. Maybe she was a program counselor, but the one thing I remember her saying to somebody who spoke up audaciously was, "Oh for god's sake, we got rid of that word a long time ago." And, this was the spirit. They had the belief, the inner urge to say New York is moving forward—or the U.S.—but it was really in New York, and we are consolidated. And it was a funny thing, I wouldn't doubt that someone examining the sociology of it at the time would say it was like the Communist movement of the '30s. There was that same feeling of camaraderie, and if you indicated in any way that you were bourgeois, somebody would pick on you. So if you indicated that you were a realist painter somebody might pick on you. I mean, I remember someone saying to Paul Georges, "So what are we going back to Bouguereau, then?" That sort-of thing. Georges would say, "I don't know who the hell Bouguereau is." He [Bouguereau] represented the worst of the academy. I don't know what more I can say about it.

ASF: Did you find it interesting—what they were talking about?

KS: Yes, in a way. But in another way, it wasn't. I wasn't totally knowledgeable about a lot of the arguments. There was an "in" vocabulary. And, I truly didn't know what they were talking about when they were talking about Hoffmann space. It's in the nature of—what is the saying? "Everything profession is a conspiracy against the laity."

ASF: If you didn't find it interesting, did you go to feel a part of things?

KS: Yeah, that's what one did. There were the Tenth Street openings, Tangiers Gallery and all those early galleries. And one made the rounds. I think it was on Tuesdays. That's about all I can tell you about. I went there to immerse myself in it. It didn't help me very much politically.

ASF: Was it fun going to the openings?

KS: It was tense because I felt like a nobody there, sort of.

ASF: Did you know people?

KS: I knew some of the people. I knew de Kooning because of Black Mountain, and I knew I knew Georges, and Pat Passlof, someone who was also at Black Mountain.

ASF: Did you feel like you made friends?

KS: No, I wasn't very aggressive. As you can see I never became very good at politics in that way. I didn't have any skill with it or any urge to do it. I was loner. But it was an interesting experience for that time in New York.

ASF: Did you hang out at Cedar Tavern?

KS: I didn't because I wasn't a drinker. I went in there and all that smoke! I've never hung out at bars. I just don't like the atmosphere. Even to make pick ups, it never worked.

ASF: The article in *Fortune Magazine* in 1962 calls you a structural designer. Is that how you identified yourself to them? Or did they just make up that term?

KS: They had to have a hook to hang it on. I didn't object to that term at that time. There was no such thing. It was just—"what should we call you?" I think the title of that article was "Sculptures to Build" with.

ASF: Would you have introduced yourself as an artist at that time?

KS: When I was at the University of Oregon, I was a painter. And, the hesitation to claim that one was an artist was difficult in Oregon. It [being an artist] was a strange thing. It was about as strange as being a Jew. I didn't know what a Jew was, and I didn't know what an artist was. It's a good question. Yeah, I think that because of Fuller's influence at the time it wasn't comfortable. I was thinking of grander things. I knew not what that was. Was I going to be another Buckminster Fuller in some fashion? He was an extremely powerful a presence at the time.

KS: What I really think now—contrary to what I thought then, I think people are born artists. You might not be born a *talented* artist, but to a certain extent being isolated in a room all by yourself, thinking about what you're going to do is almost I think an innate thing. Or something that developed for psychological reasons to avoid things that you're less equipped to deal with. So, I think there is a set of stuff genetically and environmentally that will lead you automatically to be an artist. Because that's what you do. Now, you may have talent, in the sense of intelligence, to put things together in ways that no one has seen before and to be a novel performer within that field. Or, all these people who are up and down University Place are also artists. They really *are* artists. They just may not have the skills nor the smarts to know to provide themselves with a way of escalating into another strata in the art world. So anyway that's what I now believe. I didn't believe that at the time because it was too unpleasant to believe in anything special that you had initially.

ASF: So when do you think you were able to claim that artist role for yourself?

KS: When I had my first show. I was tying very hard to be a painter when I went back to painting. When I went into film, I imagined I would be a maker of movies—an artist making movies that were really never so different from art. Except I got a job as a cameraman, and then I realized this is really hack work, in a way. And, so, the question of when you declare yourself an artist: If you paint a lot, and you paint every day, and you sign your work, and you like what you're doing, and you do something today because of what you did yesterday, and there was a thread to it, and so forth—it's up to you to call yourself an artist. You don't have to be good.

ASF: You were involved with a group call ConStruct—can you tell me about them?

KS: John Henry—do you know his work? He was a Chicago artist, he now lives in Kentucky. Hard working artist who does sculptures that are geometrical forms. Crystal-like things. And, John was living in Chicago, and he knew Mark di Suvero and several other artists who were involved in it. Chuck Ginnever, I think. He got the idea that it would be possible to form an artist coop and not have to pay a gallery 50% of what you did. Some fantasy because you had to get—what was difficult to find—was the person to manage that gallery. So if you got someone to manage that gallery who was any good, then they would have a gallery [of their own already]. This idea was counter to the way the art world works, really. We did have a guy. I think what we put into it was—I put a sculpture into it, and the sculpture was sold, so that went to support the gallery. Each of us did that.

ASF: Where was it located?

KS: I can't tell you the address. It was all in Chicago. We had stock forms: ConStruct, incorporated. John was very energetic, and he got openings in the Chicago Pier show, which was a yearly show. And we got exposure in some places. It didn't work very much. I had a photo show with them, and I think I sold two or three pieces, and then it just sort-of fizzled out. The guy who we had hired to manage the gallery was okay, but he wasn't that savvy, or he would have had his own gallery, as I said. That's really the extent of what I can tell you about it. I still have the stock certificate somewhere. I don't think we've been in business in thirty years, but all things have a life of their own. And often they start out with great aspirations.

ASF: I also have a couple of construction questions. When you were first in a big studio downtown were you cutting your own tubes and such?

KS: Well, first I was on York Avenue, and that was a cold-water flat on the fifth floor. And I began to get some machine tools. I bought a small lathe and one of those machines that enables you to do all sorts of things by changing the parts. A Delta device. It had a saw, it had a drill. I didn't know anything about machine work, really. This had a saber saw, so that is what I was using on those bead chain things.

ASF: Did you teach yourself how to use the machines?

KS: Yeah, you do it, and you don't cut your finger, and you make a mistake, and you get better at it. It's funny looking back, I'm surprised I was able to do what I did with what little knowledge and skill in machine stuff as I had.

KS: That was not really an adequate space because I needed a loft. Then I found this place downtown. At the time, at York Avenue, I thought I needed a machinist. And, I found a guy—he was a French machinist. I don't know where I met him. He made some of the first tubes for me. But I realized it was kind of silly to be spending money I didn't have to get stuff this stuff done that was fairly simple. I didn't know a lot. I learned by making mistakes. Which is the only good way to learn, isn't it? So then, I moved down to Spring Street.

ASF: When did you start routinely sending out plans and having the pieces produced?

KS: It wasn't quite routinely. There were parts of things I couldn't do myself—like anodizing. So, I found places that anodized.

KS: I had invented the little strange joint thing—it's called an arcuate lip. It's the way that I did the World's Fair piece in '64 with this peculiar little joint. A mouth, in a way, is an arcuate lip in that it's a round with a soft edge—like half of a donut. The cables came around this and into a retainer which had slots in it. So you tightened this thing down, and the little elevator thing tightened all the cables at the same time. Totally impractical because they each have to be tightened and adjusted individually, but I didn't know that. So I had this great invention, I thought. Which is in that patent. But the question was making the stuff. So, I found on Canal Street blocks of nylon, and I had this little lathe—this is on York Avenue—so I made on the lathe all of the arcuate lip forms. And made the stainless steel covers. All handmade. It worked to an extent, but it was a very bad idea finally because all of the stress for all of the cables relied on that one bolt. But the question was about making things myself. I learned how to do it by making mistakes and an awful lot of tenacity. As you know by now, one of my main gifts is that I just keep at something until I get it right. Because I'm a workaholic. So I learned to make things by making mistakes and doing it. I am *not* a good machinist. I mean, anyone who goes to a machine school can really operate a lathe. I would depend on him, if I could get him to do something for me. Because I can do rudimentary stuff—I can taper things, make edges smooth and so forth, but the fine German craftsmanship, for instance, of really knowing how to do refined work—I'm not that good.

ASF: What about the hubs that you use now—when did you come up with that design?

KS: That evolved. The World's Fair thing had the joint that I was talking about [the arcuate lip joint]. After the World's Fair, then I suddenly had all of this money—$17,000! And, so Audrey and I moved out to Sagaponack. And I started thinking about how to connect cables. In fact, someone just called me the other day about one of the two pieces that was in the first show [at Dwan in 1966]. *Audrey I* and *II*—they were ones that had porcelain coating. In that thing what I did was to take the cables—it seems very awkward now—but that piece is still alive, strangely enough. But I had castings done that were like a cup that instead of fitting over the thing, it fit in it with a shoulder. Those casting cups—I bored holes in them and used what is called a Nicopress sleeve—Nicopress is something that the telephone company uses—a big crimper. It's a cylindrical piece of copper—you put it around the cable and then you crimp it. And it crimps hard enough that it builds itself into the cable. It's pretty strong, but doesn't take the full pull strength of the cable. But I was not using the full strength of the cable. So what I did was drill a hole, pull the cable into this cup, and put a swage on it. Then the cable couldn't pull out of that hole because the swag was bigger. So, then I started thinking, well that's a good idea, but what if it was removable? What if there was a screw device? It was a simple next step as all of these things are. So instead of having the cable go in and crimping on the inside, I made a screw thing out of set screws. I drilled holes in the set screws, passed the cable through the set screw, then I bored a whole the hub itself. So then I could take the whole thing in and out. So, that was the evolution of it. And then, this does not exist in normal technology. I stopped, by the way, using Nicopress sleeves and started using solder instead. So the thing that took up the space was a ball of solder. High-tensile solders. So anyway, that was the evolution.

ASF: And this was all done while you were working in Long Island?

KS: Yeah, I developed it in Long Island and that's what is used in the towers and so forth.

ASF: And did someone do the soldering for you? Or did you do it yourself?

KS: No, I made them. I never had anyone doing the cables for me until Stew came along ten years ago.

ASF: So, you started working with Stew ten years ago?

KS: Yeah, I was putting up a piece at the Marlboro Gallery—it was on Nineteenth Street then. Stew was working with Chihuly. And, Stew said, "Well, let me help." So he helped, and we got to talking, and he said, "I do machine work." And I said, "Well that's interesting, where are you?" "I'm in Seattle." "Oh, well that's not really practical." But then I got a commission, I forgot what it was and turned to Stew. And he became really involved in the whole technology. And yeah, that was ten years ago. I had built the tower that was in Paris at the Jardin du Palais Royale a number of years before, but it really needed to be rebuilt. So I called on Stew, and he completely rebuilt the thing. And he became—just by his brilliant inventiveness—he developed all of these very helpful ways of doing things.

ASF: Before Stew—during the bulk of when you were working—you were primarily making things yourself. Was it important to your process?

KS: Well, yeah. I like to do things by myself, really. I like to have the knowledge that I knew how to do it and did it. In part I suppose, it's an absorbed sense of ethics. Which is really ignored in today's world. I mean, people just make a sketch and then find someone who's smart enough to do it. Even when I was shooting movies, I had the lingering sense that I really should perforate the film myself. In order to really say this was mine. I had this feeling that that would be the proper way to do it.

ASF: To have craftsmanship and ownership over the piece as a whole?

KS: One might call it total control. But I'd call it total knowledge of the entirety of it.

ASF: So to be the maker of this thing you have to have the knowledge to make each of its parts.

KS: Artists in the glorious Renaissance—they could do the whole thing themselves, but they would have a shop full of people who did it well enough that they could get it done. Not too different from today.

ASF: What about people like Donald Judd who wanted that very perfect machine aesthetic, so preferred—once he could afford it—to have someone else making his work?

KS: Yeah, well that's a perfectly reasonable way to look at it. It's a personal thing.

ASF: Your sculptures look perfect—they don't look handmade. [Gesturing at small tower]

KS: Yeah, well in that particular piece for instance, the tubes were ground on a centerless grinder, which I don't have. It's a thing that you send the tube through, and it grinds from the outside. And then it was anodized by an anodizing company. I couldn't do that. I don't have a factory. A lot of it has to do what you can you do and what you can't do. And in our world, with all of its technology, it's absolutely foolish. You know, Russell Wright, the designer, he said something to the effect of "It's silly to do something that someone else can do better than you can." And that's Judd's point of view totally. I never thought much of Judd's work.

Snelson Interview: September 9, 2011:

ASF: What classes did you take at Black Mountain other than Albers's foundations class?

KS: I took two classes with Albers. His color class and his foundations course. And then Fuller. Fuller was one class a day, but he talked endlessly.

ASF: Was it just Fuller teaching Fuller?

KS: Yeah, totally. I think the title of the course was Comprehensive Designing. The Bauhaus course, as I've probably said, was very much like the Bauhaus German framework class. And I didn't even realize at the time—you know when you're that age and you're ignorant about so many things in the world—I didn't realize that the Bauhaus had a social purpose when it was originated. They felt that artists ought to be integrated with society and designing for society.

ASF: So you didn't know that then?

KS: At the University of the Oregon, where I heard about the Bauhaus and read about the Bauhaus, I was interested in the people that were there—Paul Klee and Kandinsky and so on. So I was interested in the artists.

ASF: So then when Fuller introduced you to the idea of artists making useful contributions, you received that as his idea?

KS: Yes. I only thought it about later that Fuller's idea, if you distilled it could have sounded like Bauhaus. Fuller had contempt for the Bauhaus though. Because Fuller was Fuller and the Bauhaus was not Fuller. He did not recognize the significance of the Bauhaus. His idea that artists should be redesigning the world was his own shtick.

ASF: Do you remember when Camilla Gray's book on Constructivism came out in 1962? Did you read it at that time?

KS: I'm sorry to say, I don't know about it.

ASF: When do you think you became familiar with Constructivism?

KS: We knew about Constructivism at the University of Oregon. I admired them, too. And I could see a commonality—I could see similar interests—they were geometric, cold artists. I didn't know about Ioganson then. He was probably the first one to make one of those sculptures.

Snelson Interview: December 10, 2011:

ASF: When you began working on the atom in 1960, were atomic weapons and the destructive use of nuclear science (in World War II or potentially in the Cold War) on your mind? Did you make this connection at the time? If so, do you think you had an "anti-nuclear weapon agenda"?

KS: No, not at all. I was interested in the early twentieth-century history of atom models that attempted back then to explain how the atom's electrons move around the nucleus. The question of atomic weapons is irrelevant to my interest in the riddle of the atom's electronic architecture.

ASF: One could say that an artist taking on a scientific project was "anti-establishment" in that you disregarded the idea of scientific knowledge belonging to trained professionals. Do you think you were conscious of the boundary-breaking aspect of your project at the time?

KS: I did not choose to be anti-establishment, and I'm not alone in thinking that serious questions have been swept under the rug ever since Heisenberg's Uncertainty principle gave physicists a way out of their dilemma.

ASF: Were you politically active in the 1960s-70s? Did you participate in anti-war or Civil Rights demonstrations? Did you ever make art connected to these movements?

KS: I've never like crowds. During the Vietnam War everyone I knew was opposed to it. Political art doesn't interest me.

ILLUSTRATIONS

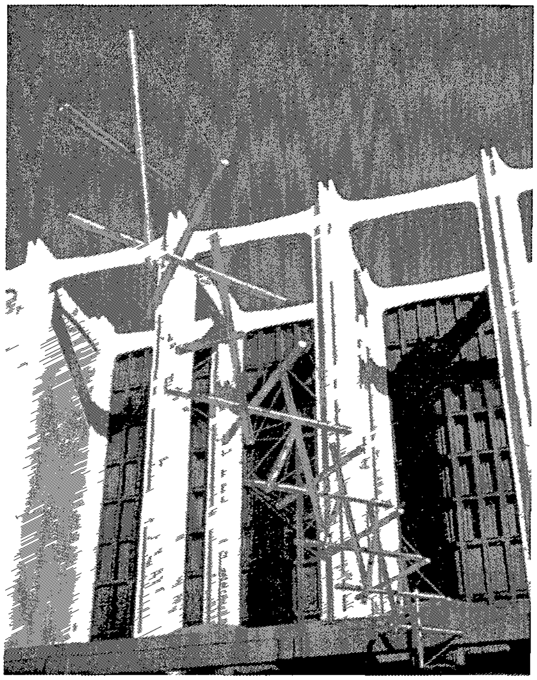


Figure 1 Snelson, *Cantilever*, 1967 (*American Sculpture of the Sixties*, Los Angeles County Museum of Art, 1967)

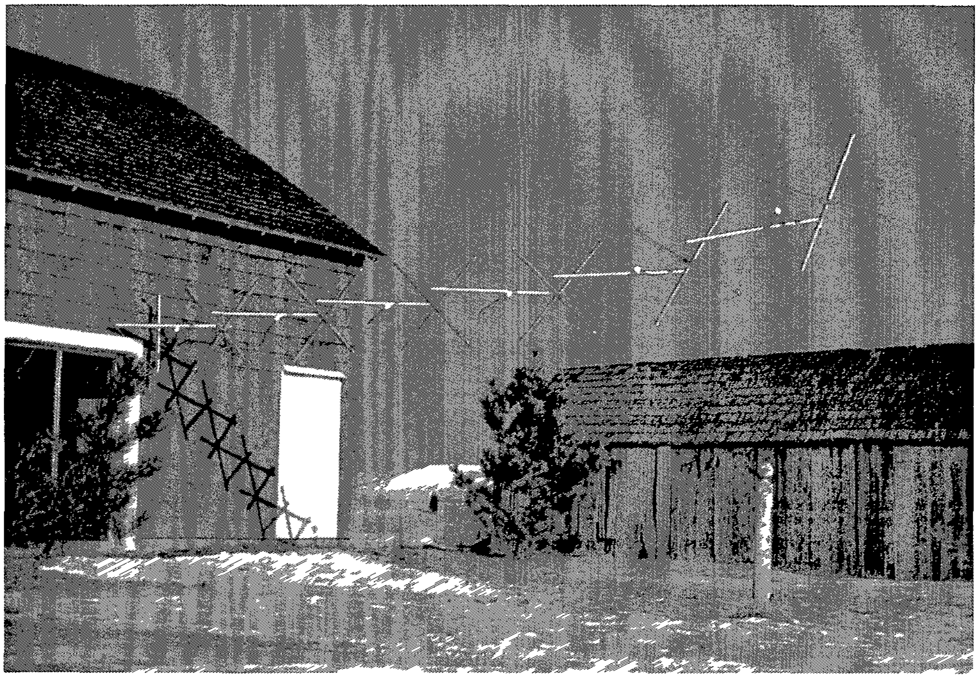


Figure 2 Snelson, *Cantilever*, 1967 (Snelson Archive)

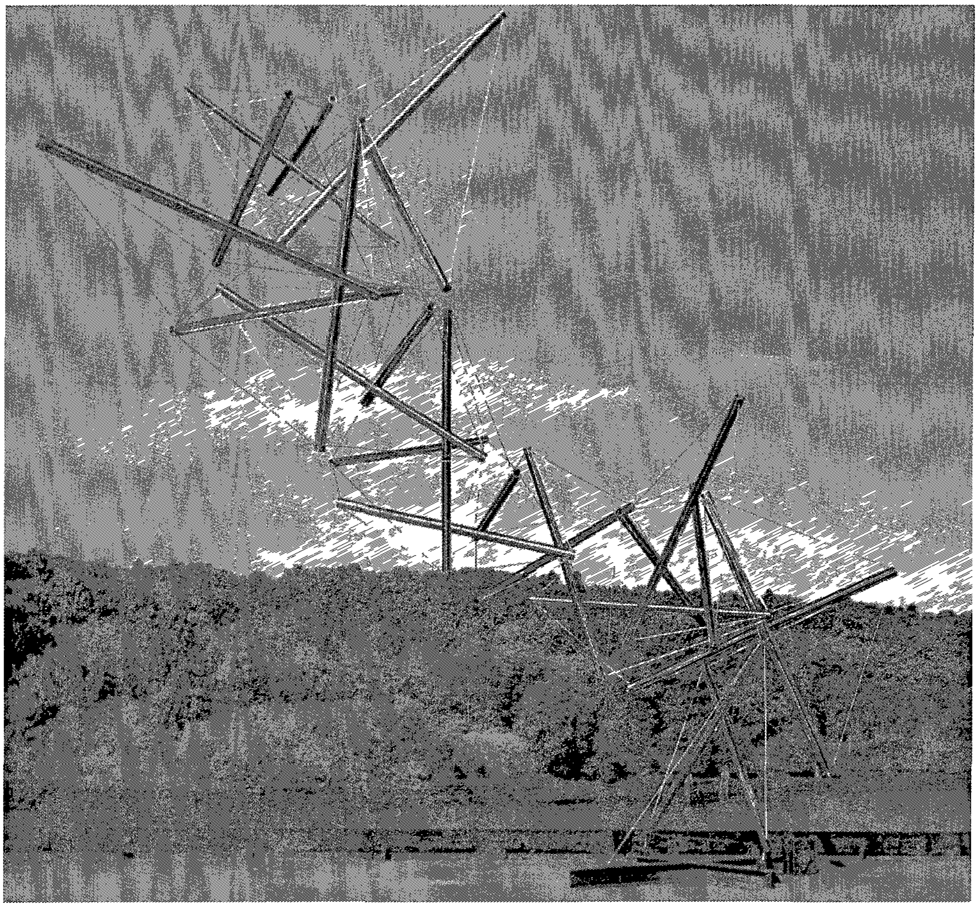


Figure 3 Snelson, *Dragon*, 1999-2000 (Snelson Archive)

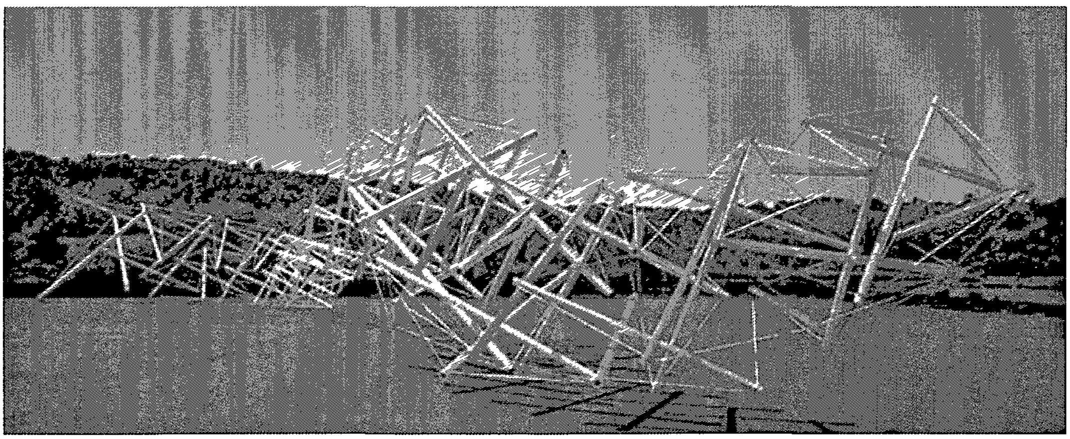


Figure 4 Snelson, *Sleeping Dragon*, 2002-3 (Snelson Archive)

Figure 5 Snelson with a model airplane, c. 1935 (Snelson Archive)

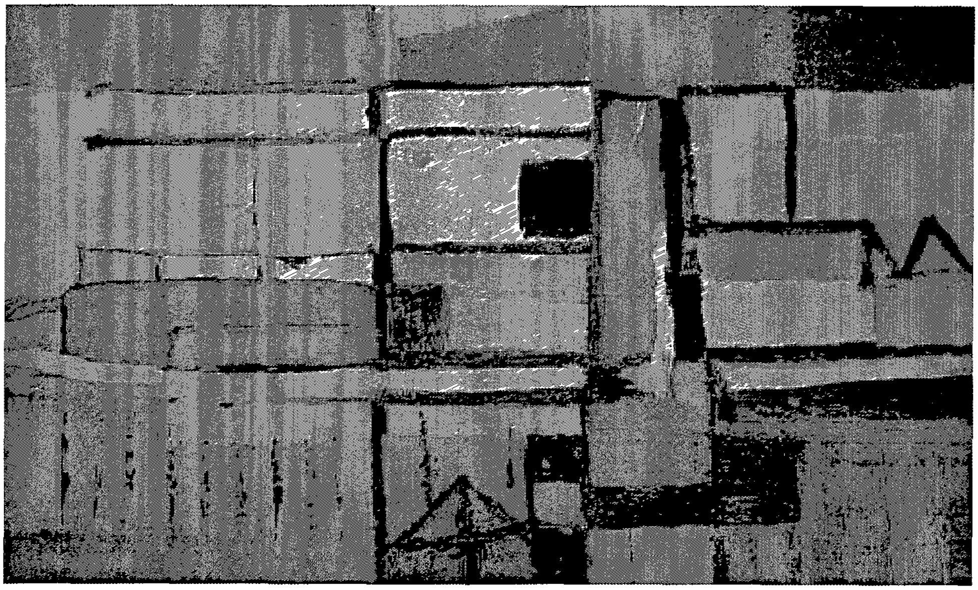


Figure 6 Snelson, *Untitled*, 1946 (completed at the University of Oregon) (Snelson Archive)

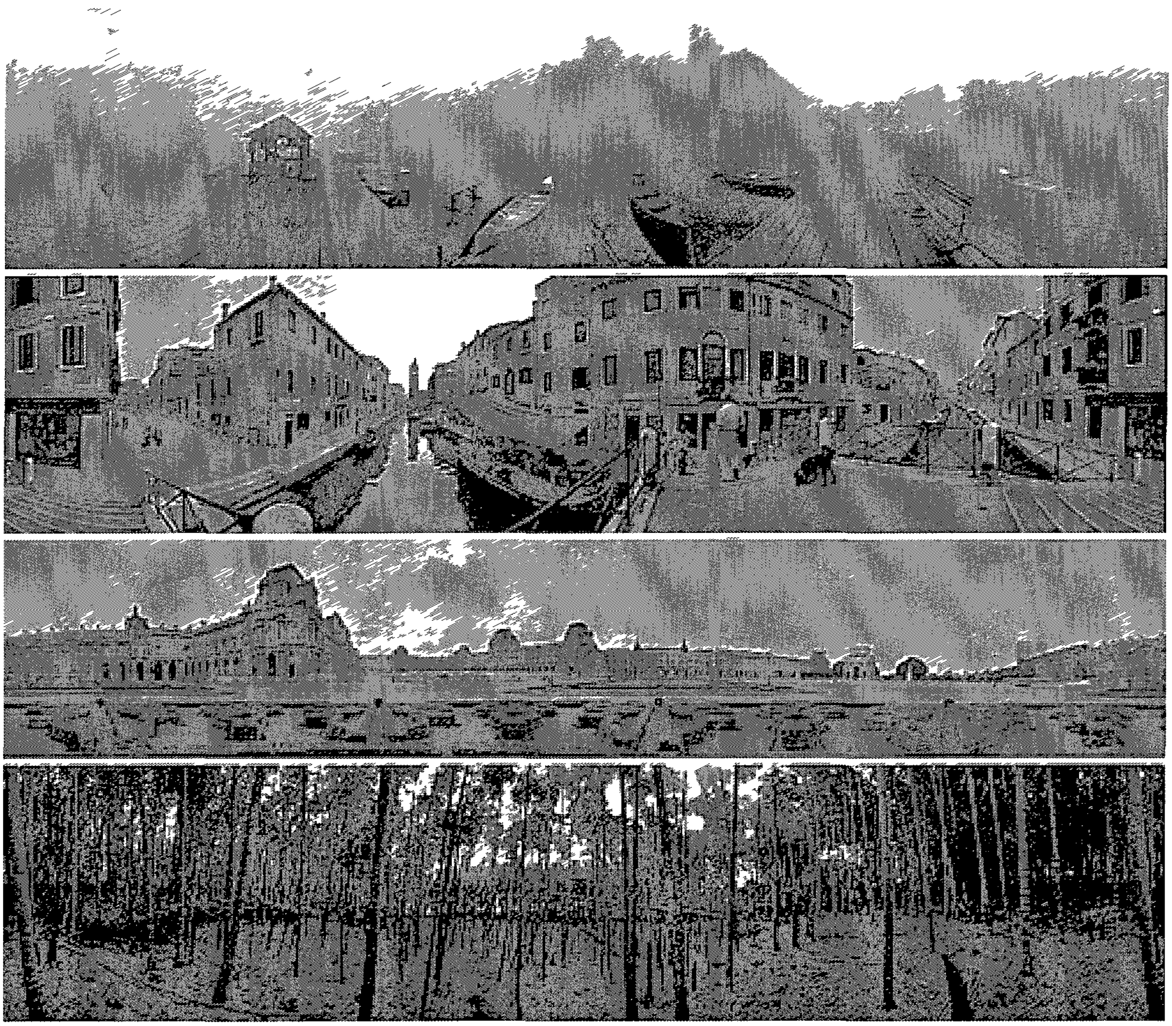


Figure 7 Snelson, Panoramic photography (Wieder and Snelson, *Full Circle: Panoramas of France, Italy, and Japan*, 1990)

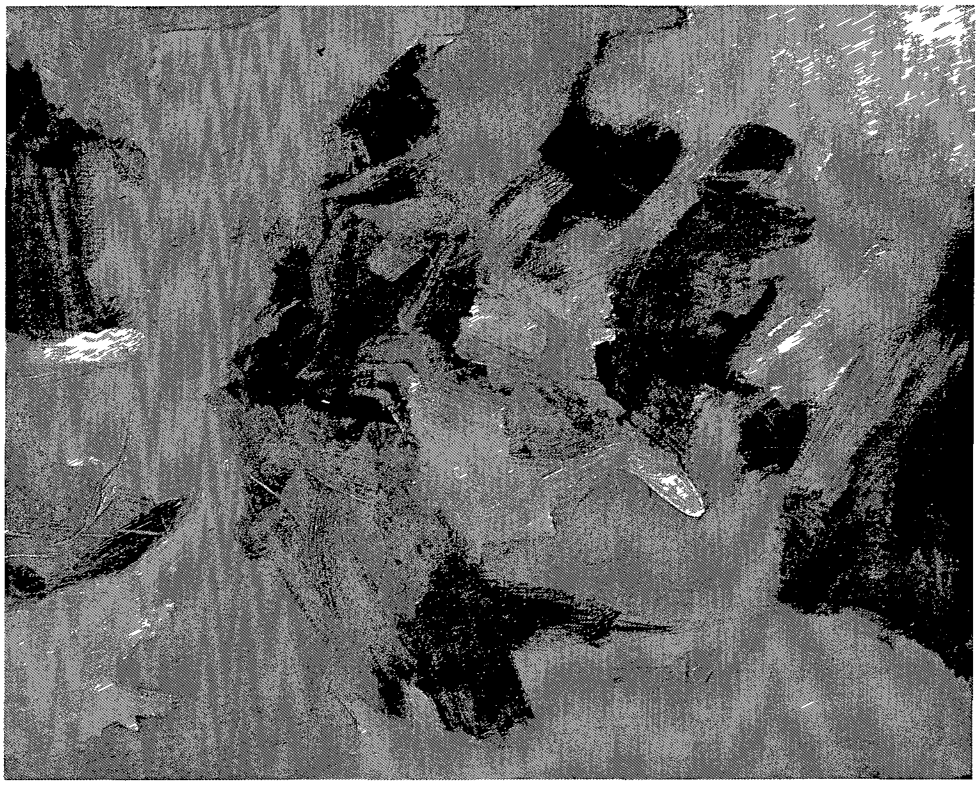


Figure 8 Snelson, *Untitled*, 1958 (Snelson Archive)

Figure 9 Snelson, *Untitled*, 1958 (Snelson Archive)

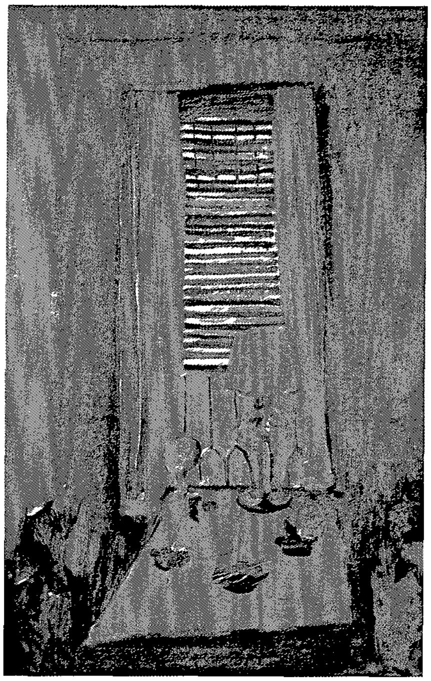


Figure 10 Snelson, *Untitled*, 1958 (Snelson Archive)

Figure 11 Snelson, *Untitled*, 1958 (Snelson Archive)

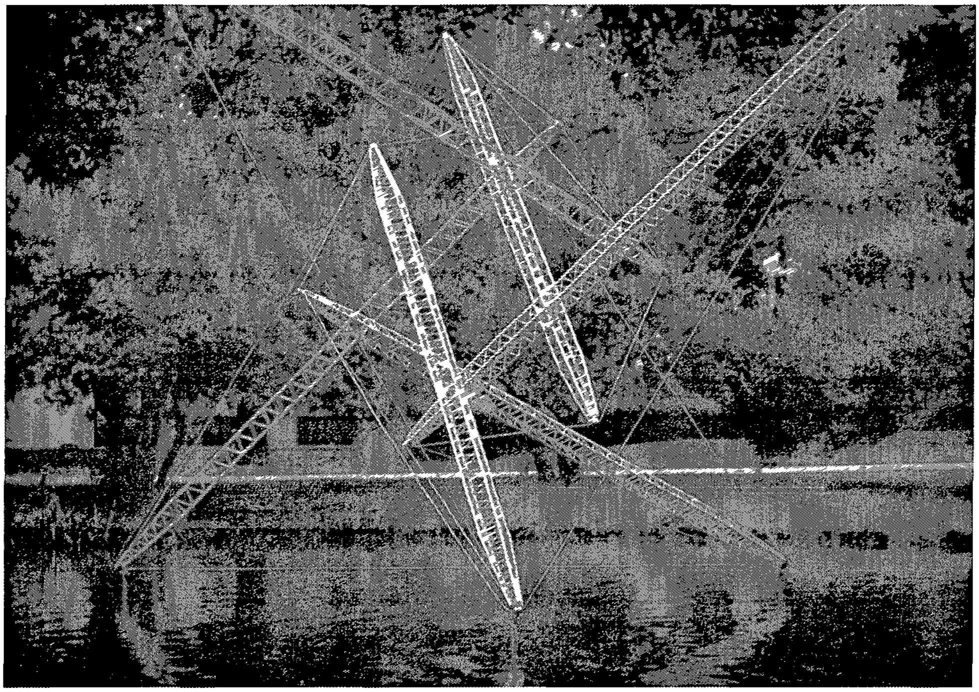


Figure 12 Snelson, *Northwood I*, 1969, Northwood Institute, Dallas, Texas (Snelson Archive)

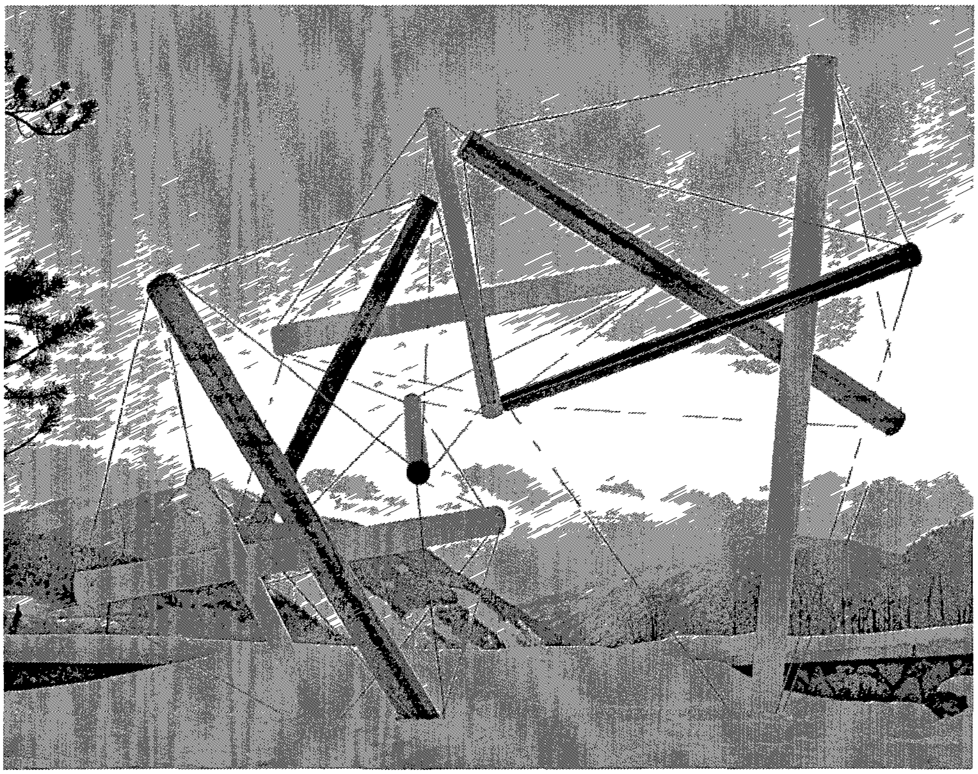


Figure 13 Snelson, *Audrey I*, 1966 (Snelson Archive)

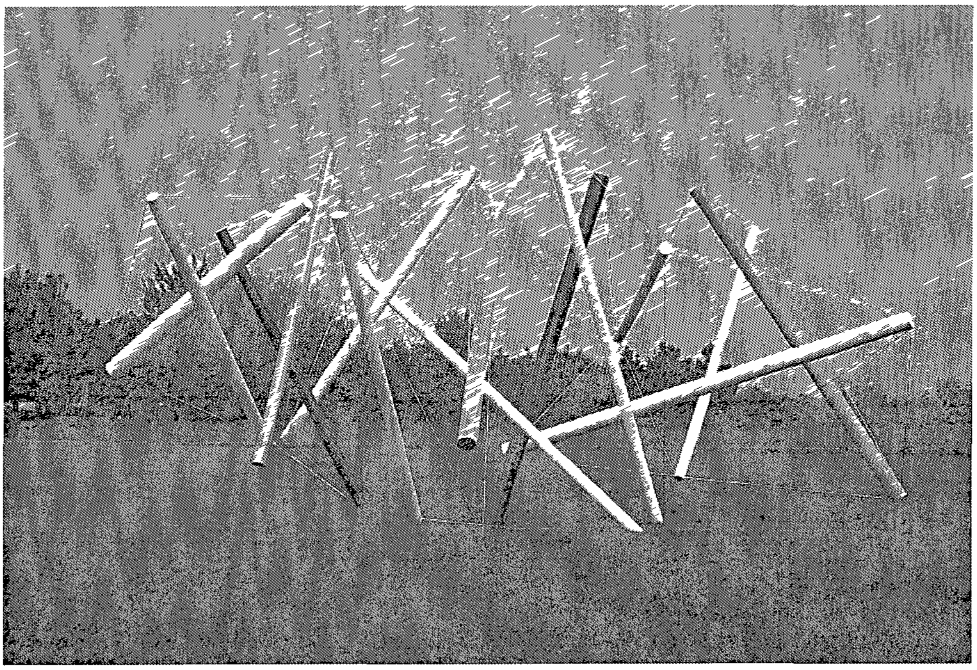


Figure 14 Snelson, *Audrey II*, 1966 (Snelson Archive)

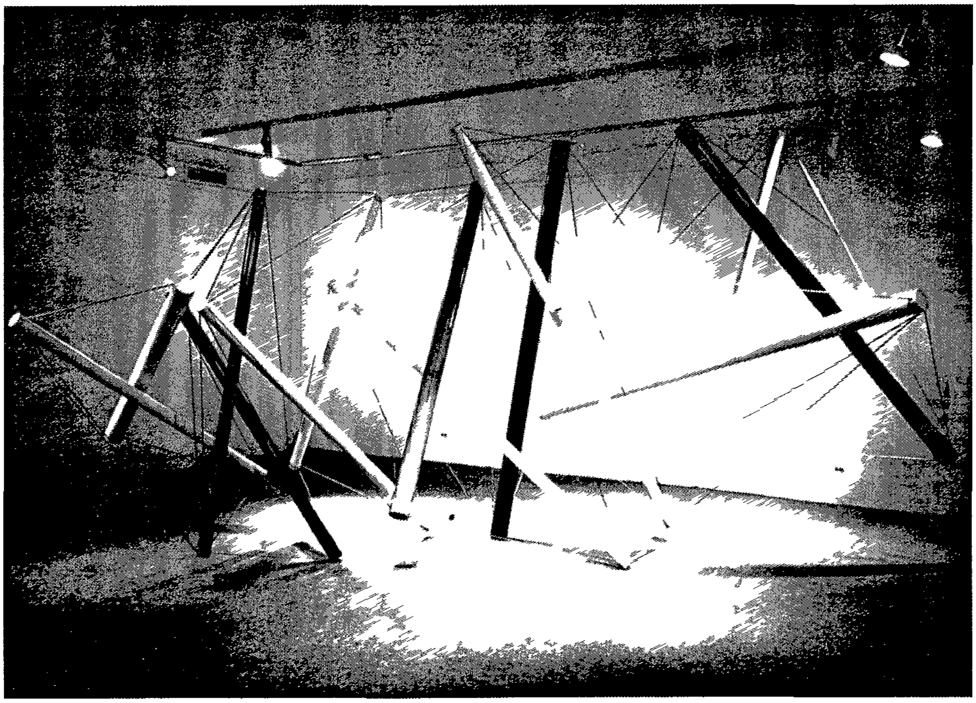


Figure 15 *Audrey II*, 1966, Snelson show, Dwan Gallery New York, 1966 (Courtesy Dwan Gallery Archives)

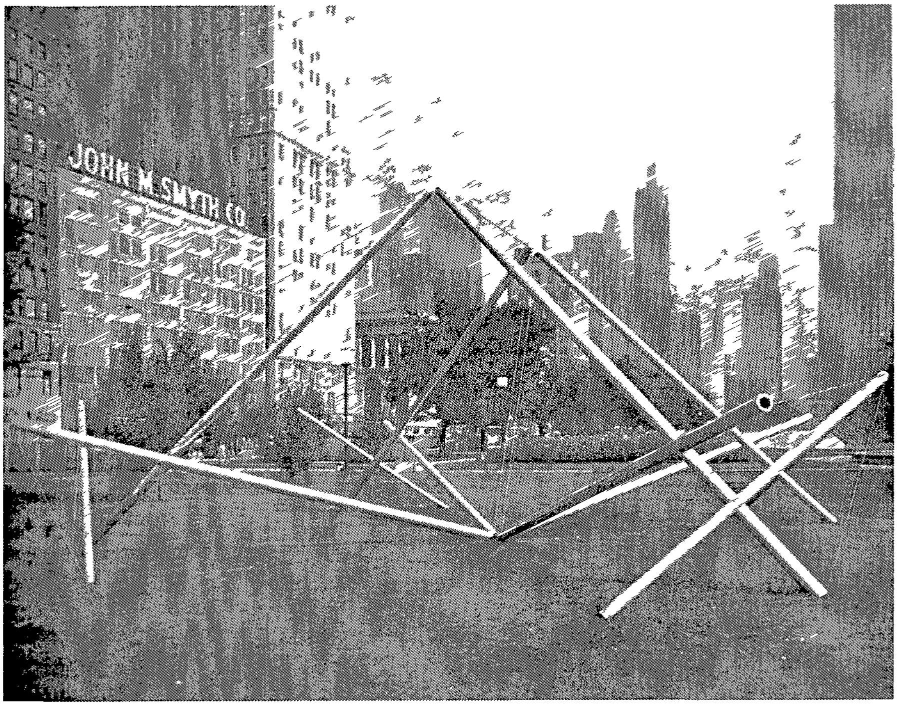


Figure 16 Snelson, *Four Module Piece Form II*, 1968 (*Sculpture in the Park*, Grant Park, Chicago, 1974)

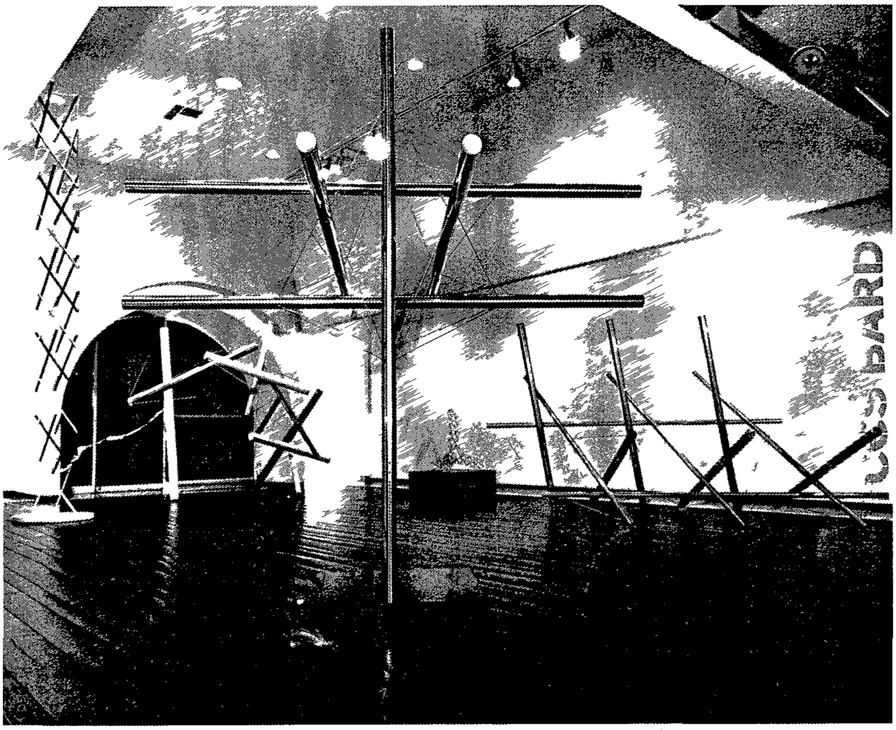


Figure 17 (starting back left) *Column*, 1961-7, *Audrey I*, 1966, *Trigonal Tower*, 1963, *Vine Street*, 1966, *Six I*, 1966, Snelson show, Dwan Gallery Los Angeles, 1967 (Courtesy Dwan Gallery Archives)

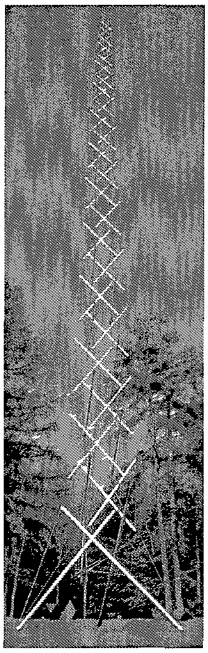


Figure 18 Snelson, *Needle Tower II*, 1969, Kröller-Müller Museum, Otterlo, Netherlands (Snelson Archive)

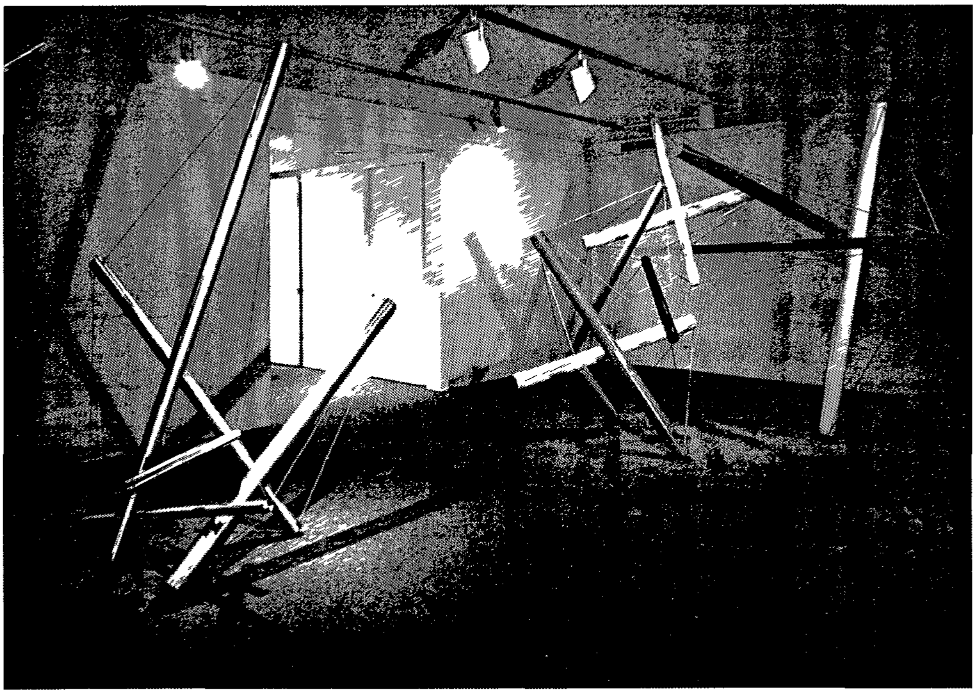


Figure 19 *Sagg Main Street*, 1966, and *Audrey I*, 1966, Snelson show, Dwan Gallery New York, 1966 (Courtesy Dwan Gallery Archives)

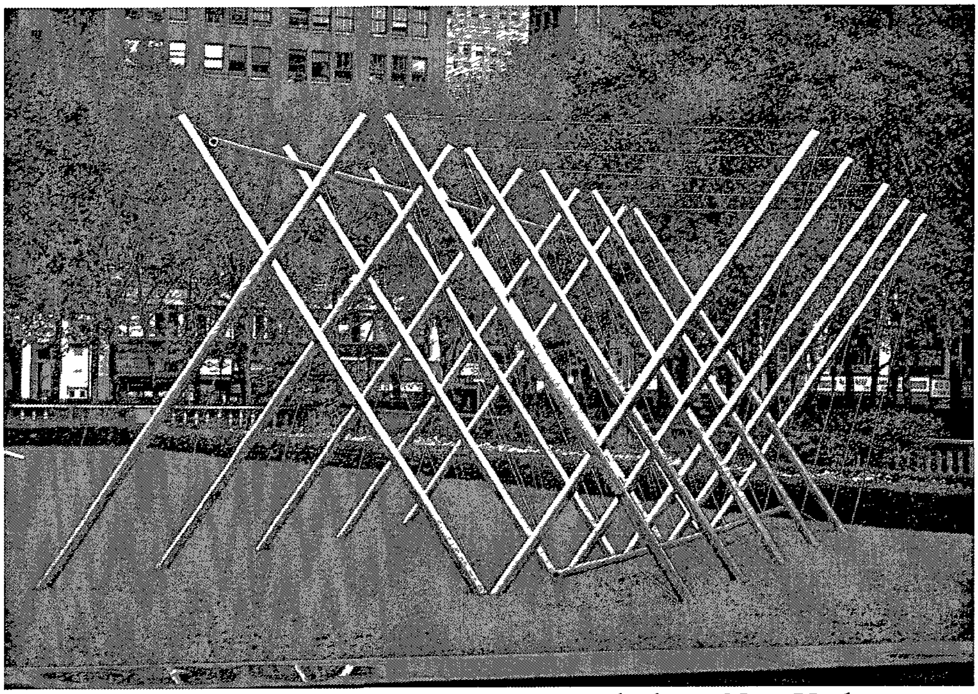


Figure 20 Snelson, *Avenue K*, 1968, Bryant Park show, New York, 1968 (Snelson Archive)

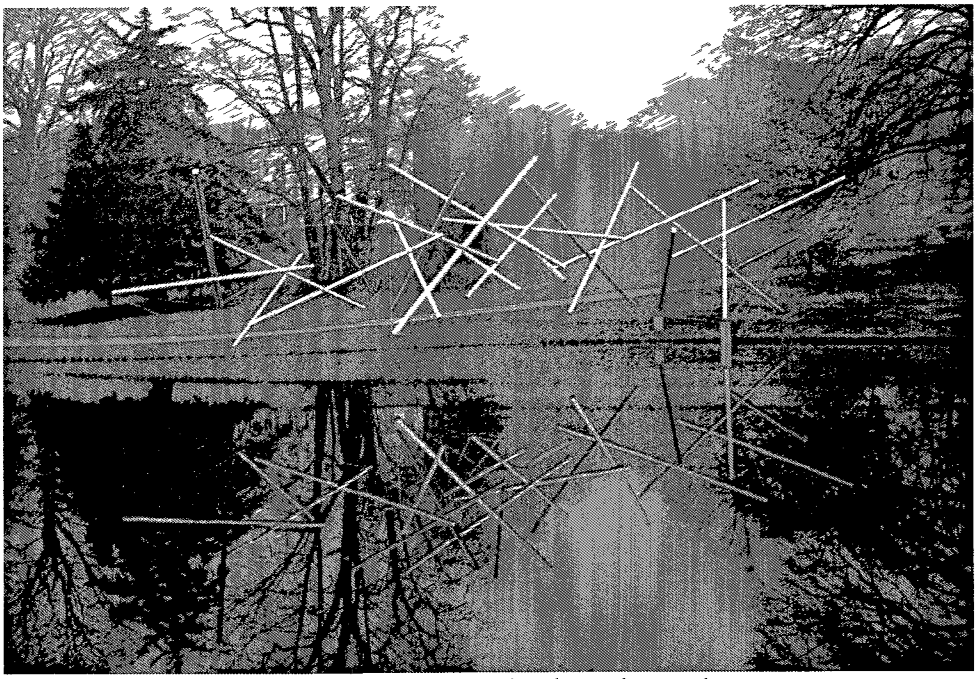


Figure 21 Snelson, *Easy K*, 1970, Sonsbeek Park, Arnhem, Netherlands (Snelson Archive)

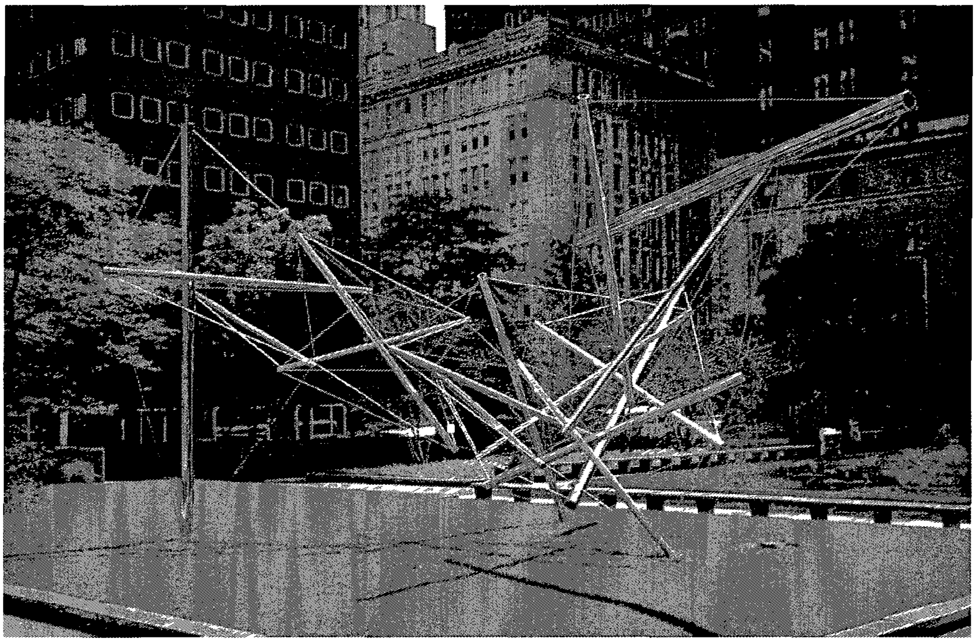


Figure 22 Snelson, *Forest Devil,* 1975-77, Museum of Art, Carnegie Institute, Pittsburgh, Pennsylvania (Snelson Archive)

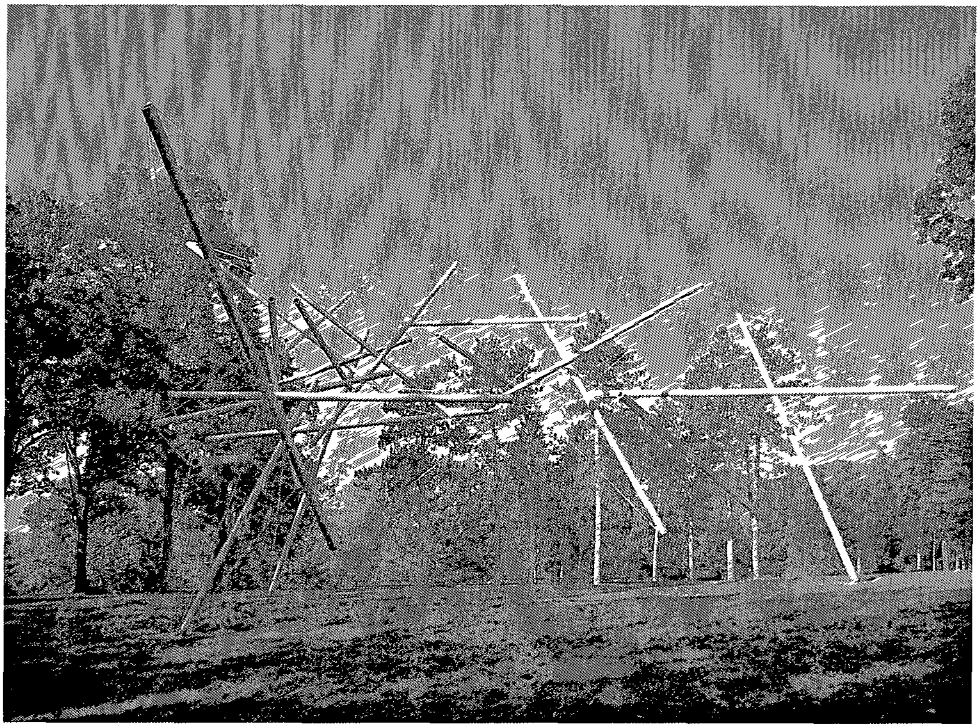


Figure 23 Snelson, *Free Ride Home*, 1974, Storm King Art Center, Mountainville, New York (photograph by the author)

Figure 24 Snelson, *Free Ride Home*, 1974, Storm King Art Center, Mountainville, New York (Snelson Archive)

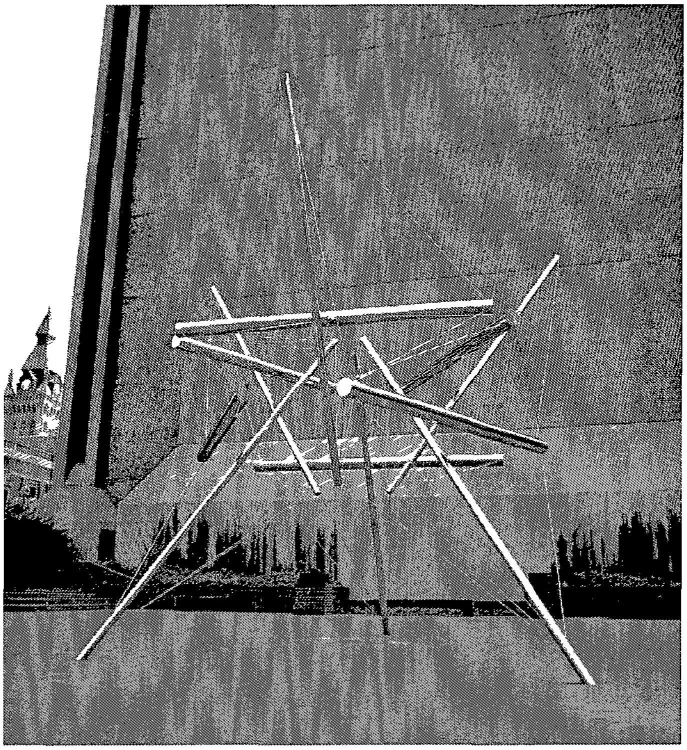


Figure 25 Snelson, *Coronation Day*, 1980, Buffalo, New York (Snelson Archive)

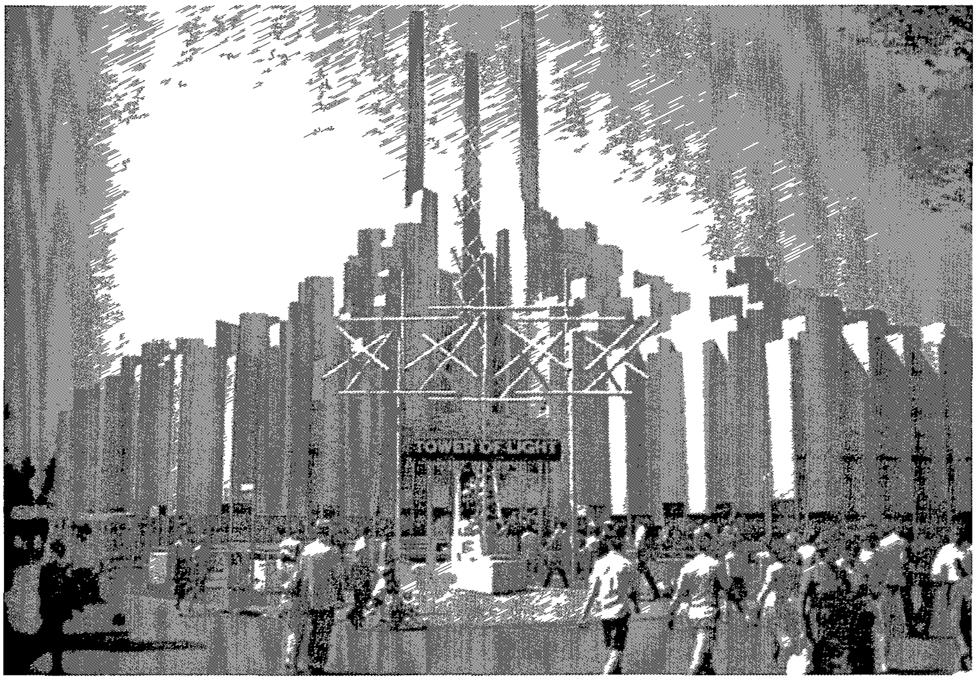


Figure 26 Snelson sculpture in front of Electric Power and Light Company's Pavilion, New York World's Fair, 1964-65 (Cotter and Young, *Images of America The 1964-1965 New York World's Fair*, 63)

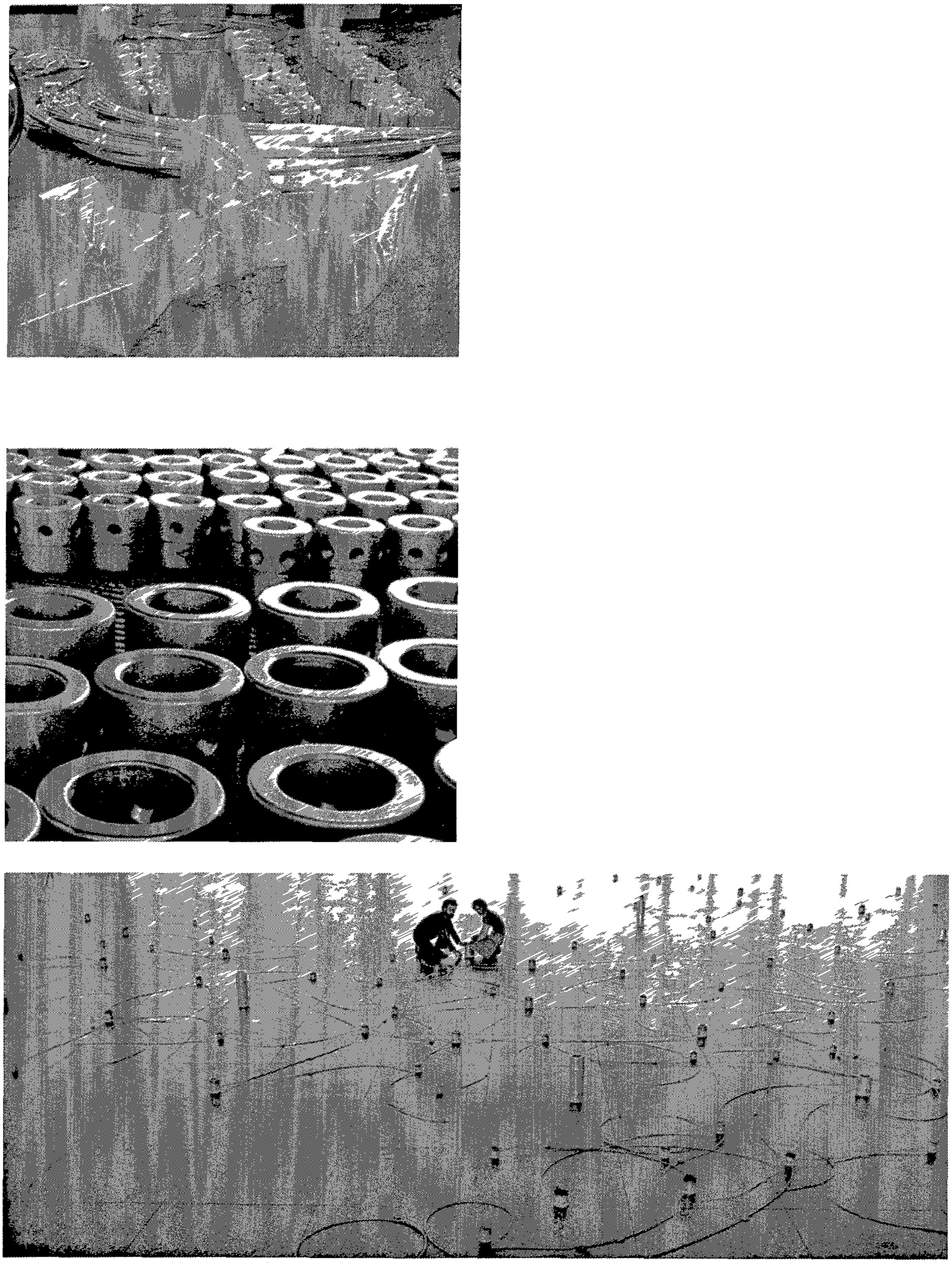


Figure 27 Installation of *New Dimension*, 1977, Nationalgalerie, Berlin, Germany (Snelson Archive)

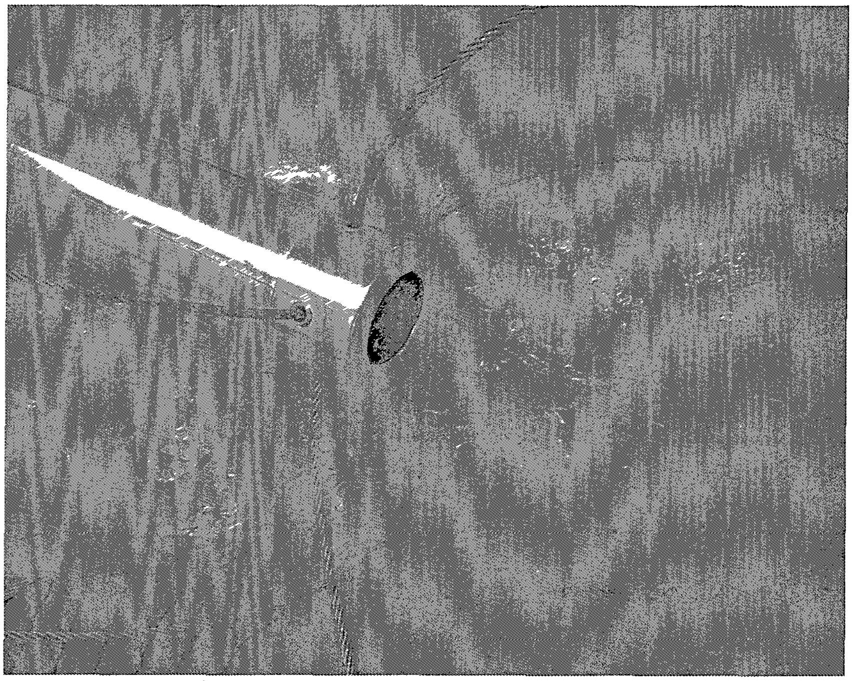


Figure 28 Installation of *Easter Monday*, 1975, *Geometry as Image*, Robert Miller Gallery, New York, 2008 (photograph by the author)

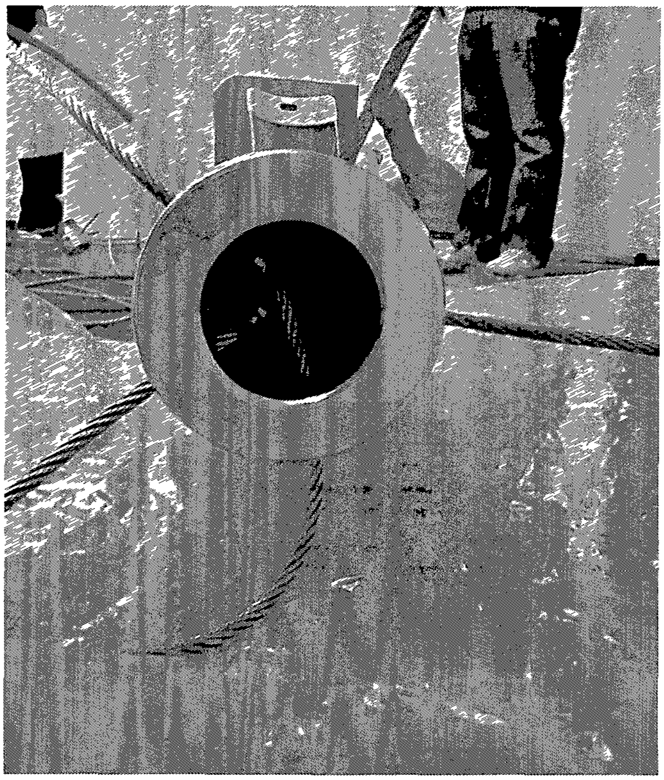


Figure 29 Installation of *Easter Monday*, 1975, *Geometry as Image*, Robert Miller Gallery, New York, 2008 (photograph by the author)

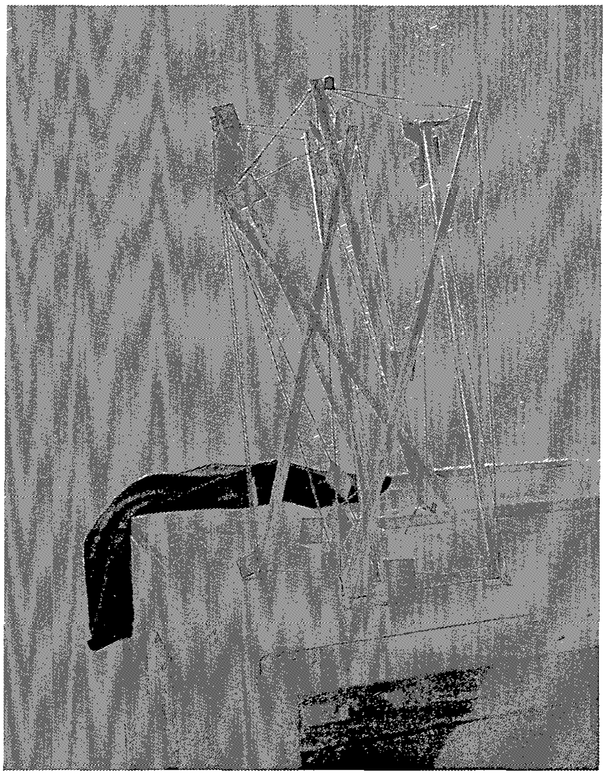


Figure 30 Maquette for *Easter Monday*, 1975 (photograph by the author)

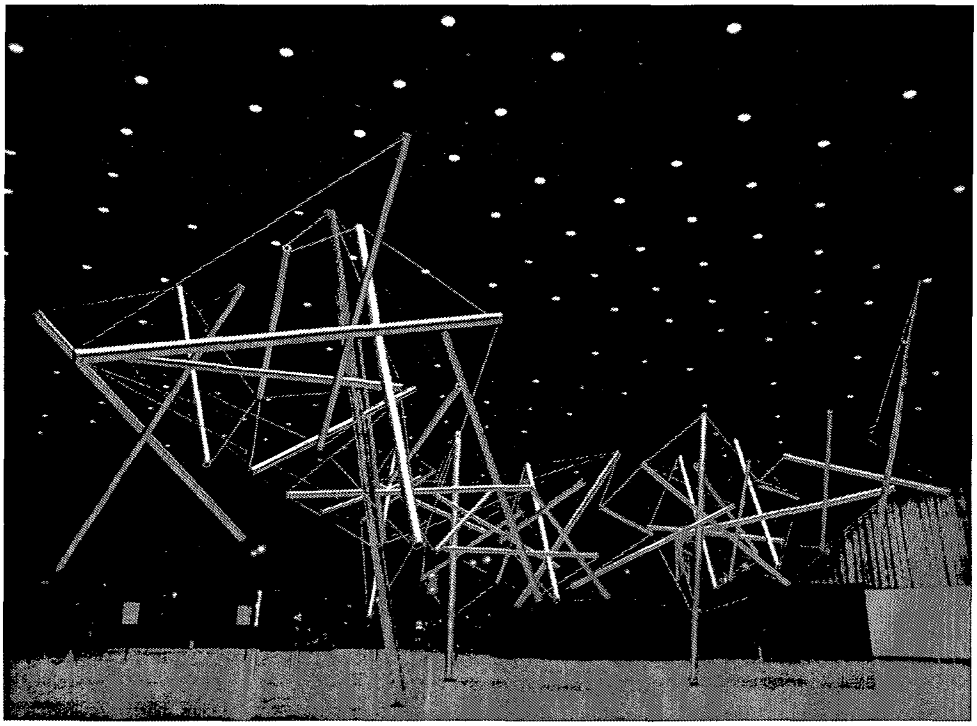


Figure 31 Snelson, *New Dimension*, 1977, Nationalgalerie, Berlin, West Germany (Snelson Archive)

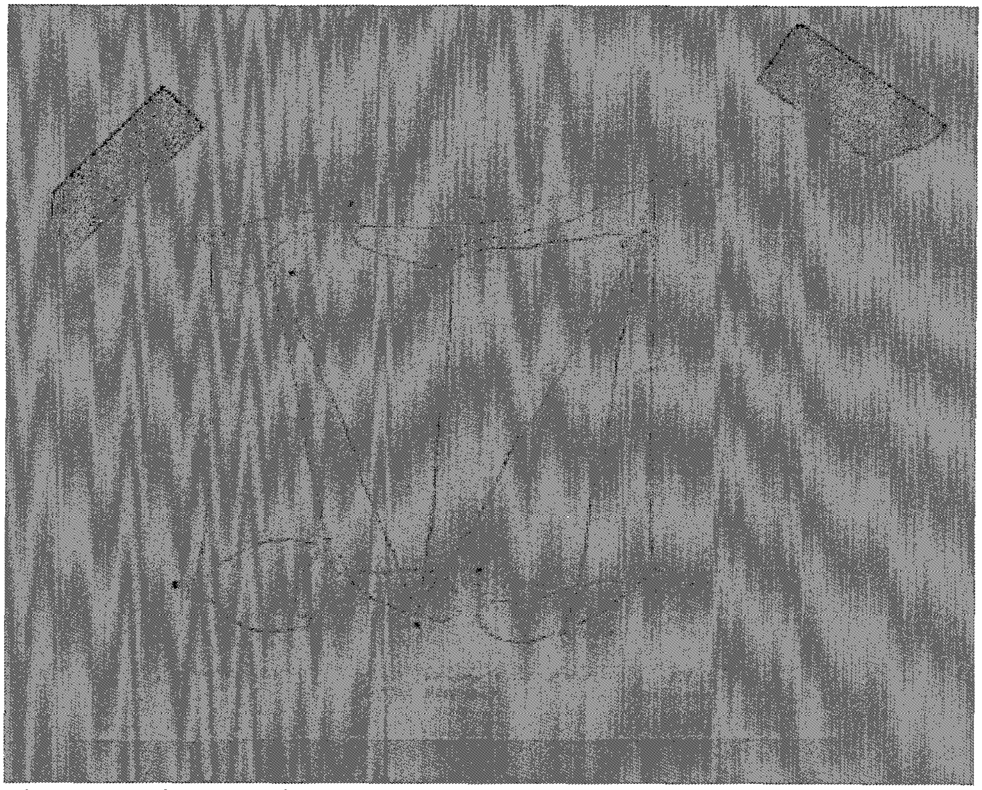


Figure 32 Diagram of *Easter Monday*, 1977 (photograph by the author)

Figure 33 Snelson and Marlborough Gallery art handlers during installation of *Easter Monday*, 1977, *Geometry as Image*, Robert Miller Gallery, New York, 2008 (photographs by the author):

Figure 33A

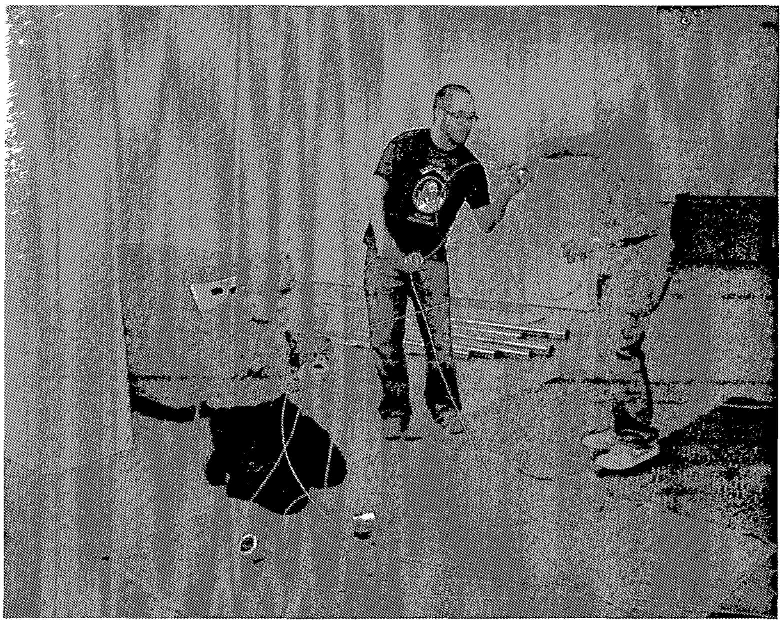


Figure 33B

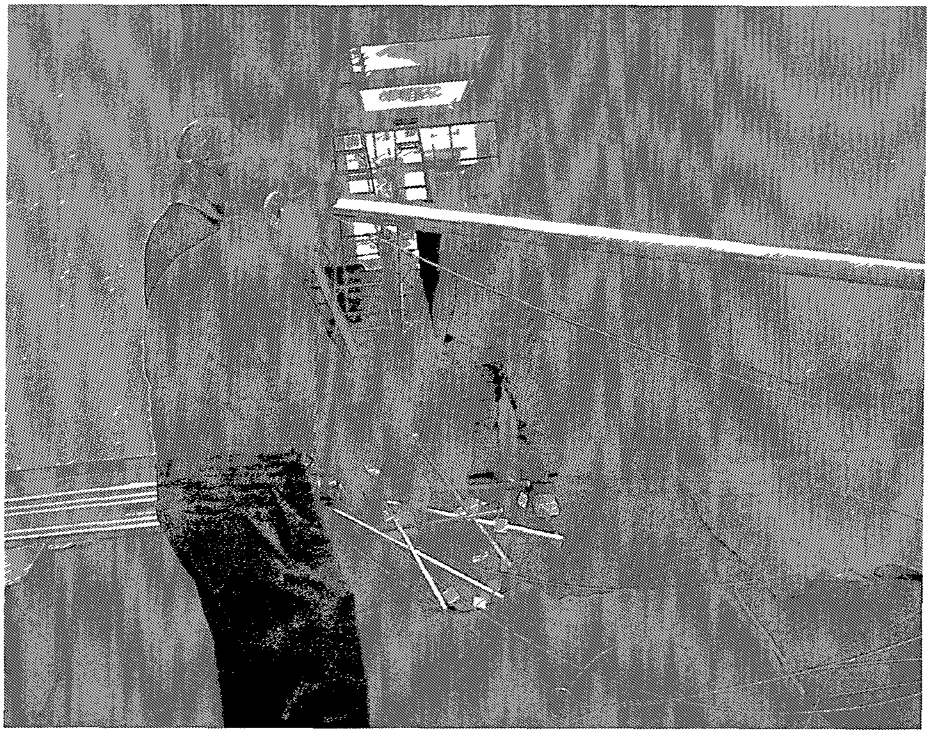


Figure 33C

Figure 33D

Figure 33E

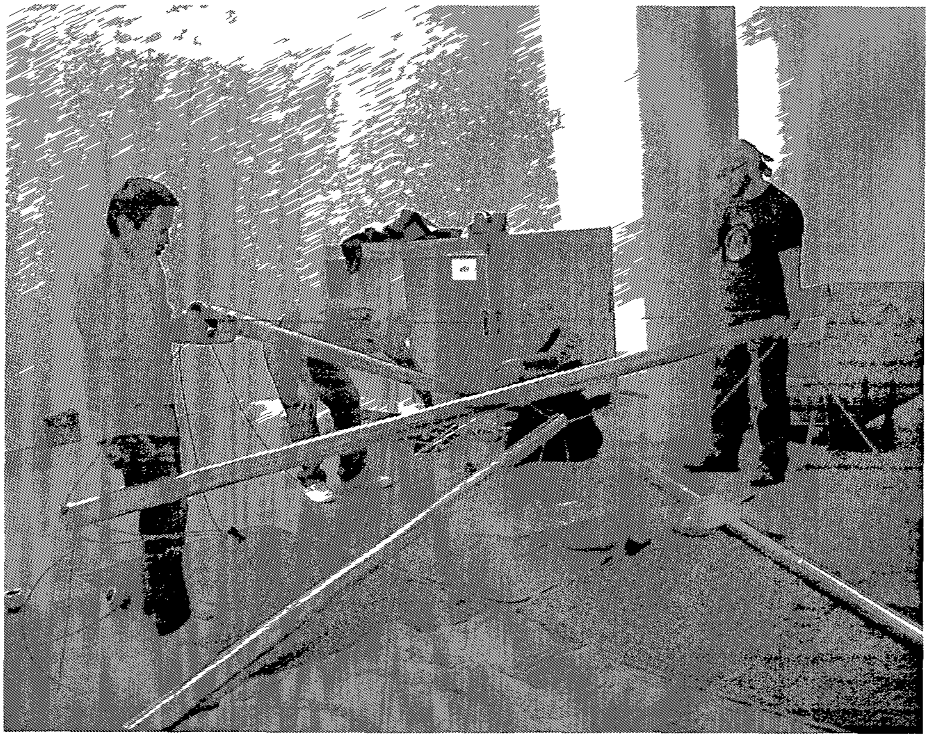


Figure 33F

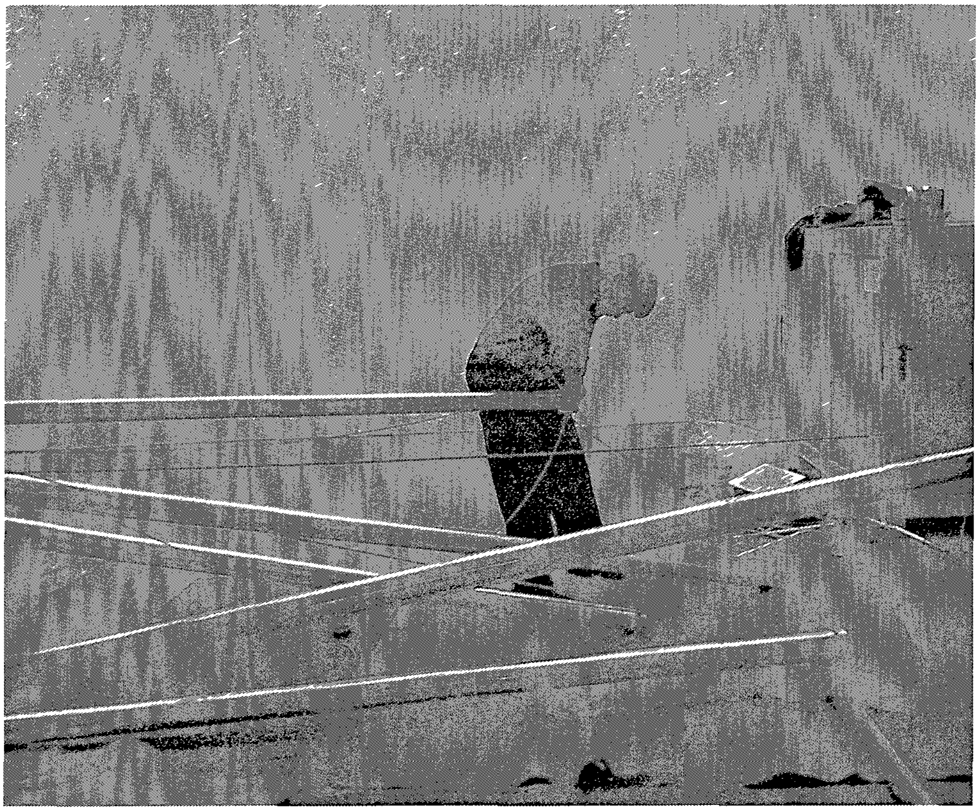


Figure 33G

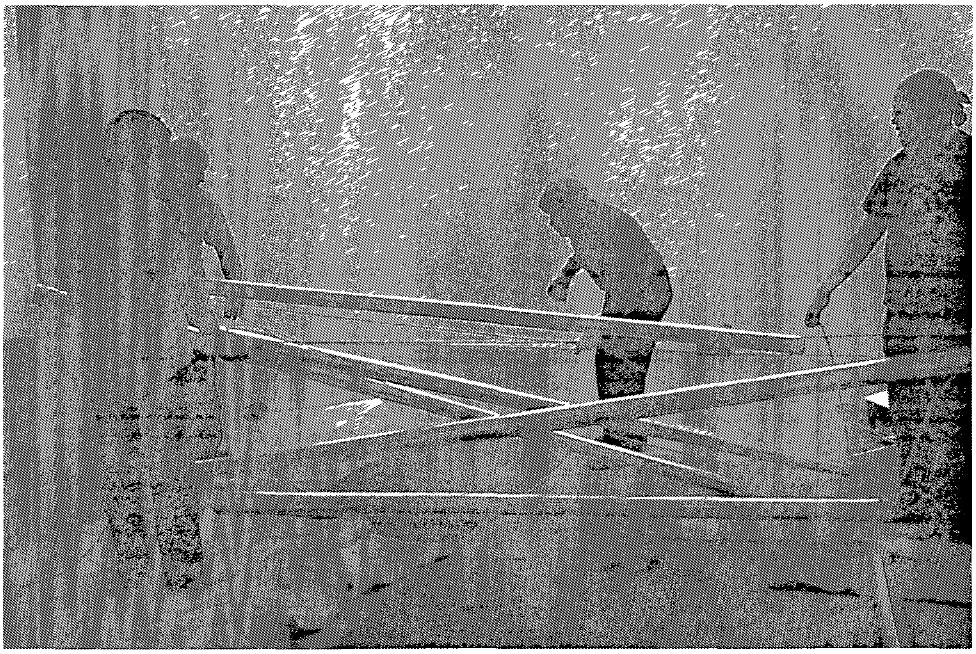


Figure 33H

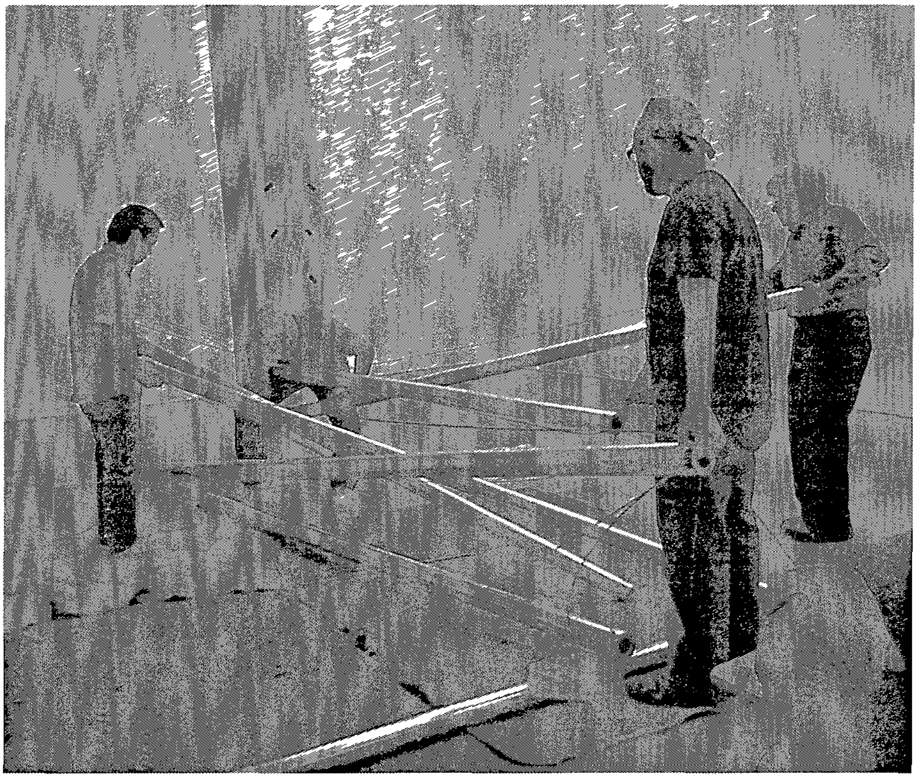


Figure 33I

Figure 33J

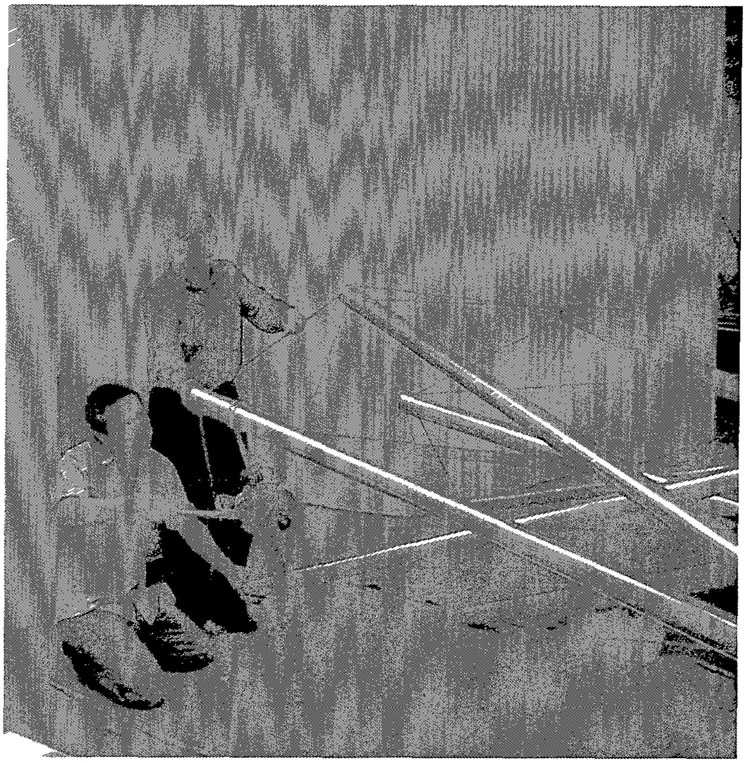


Figure 33K

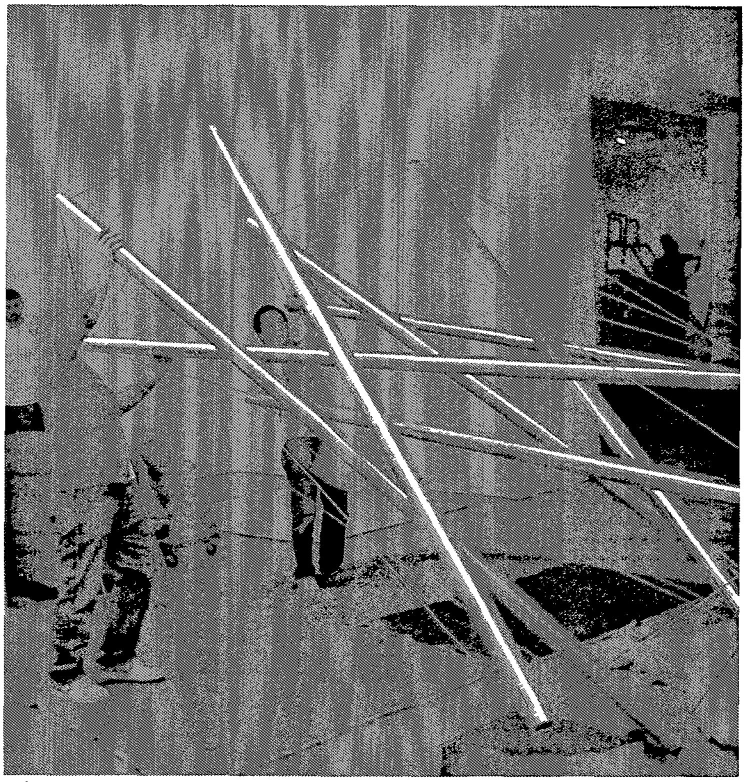


Figure 33L

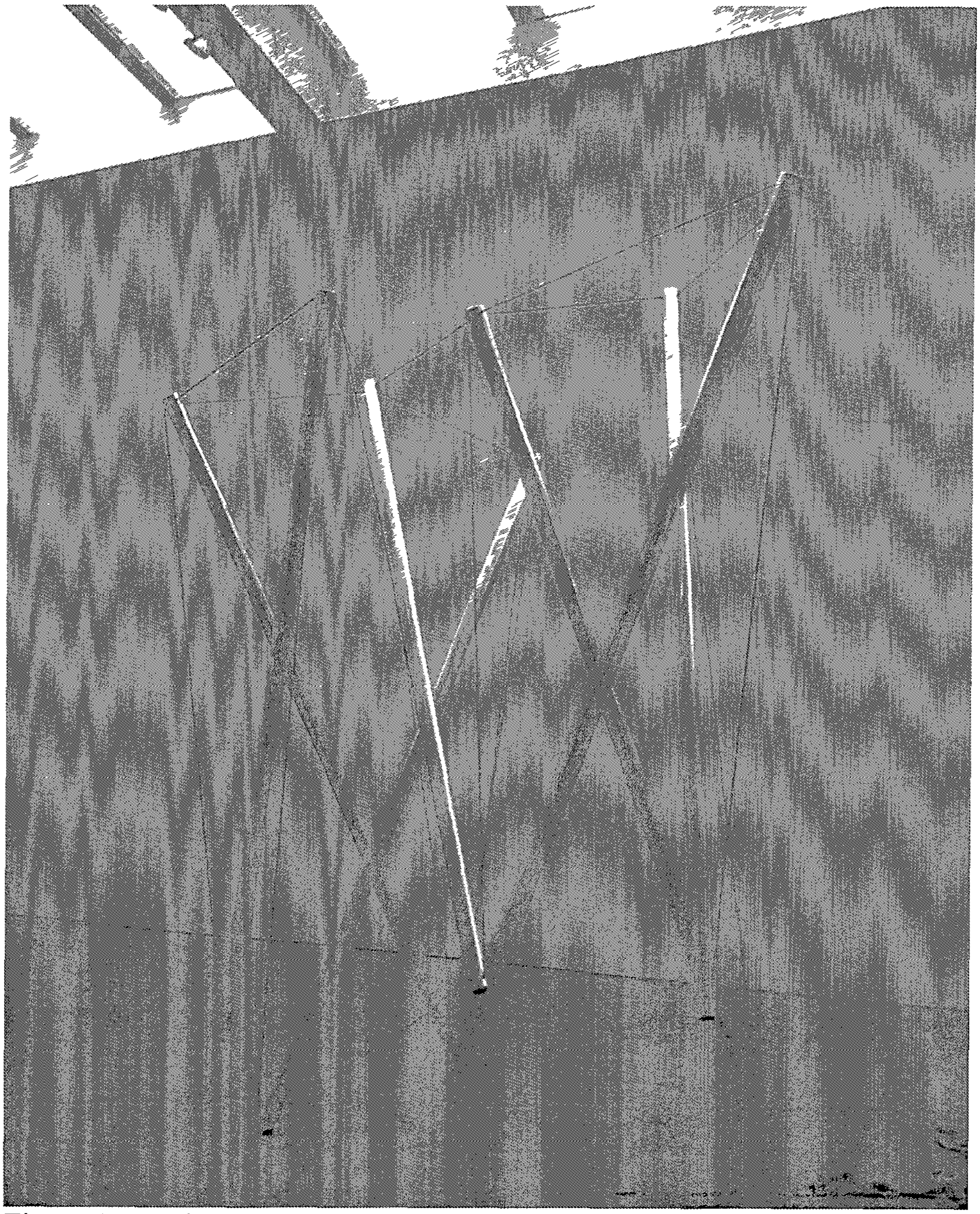


Figure 34 Snelson, *Easter Monday*, 1977, *Geometry as Image*, Robert Miller Gallery, New York, 2008 (photograph by the author)

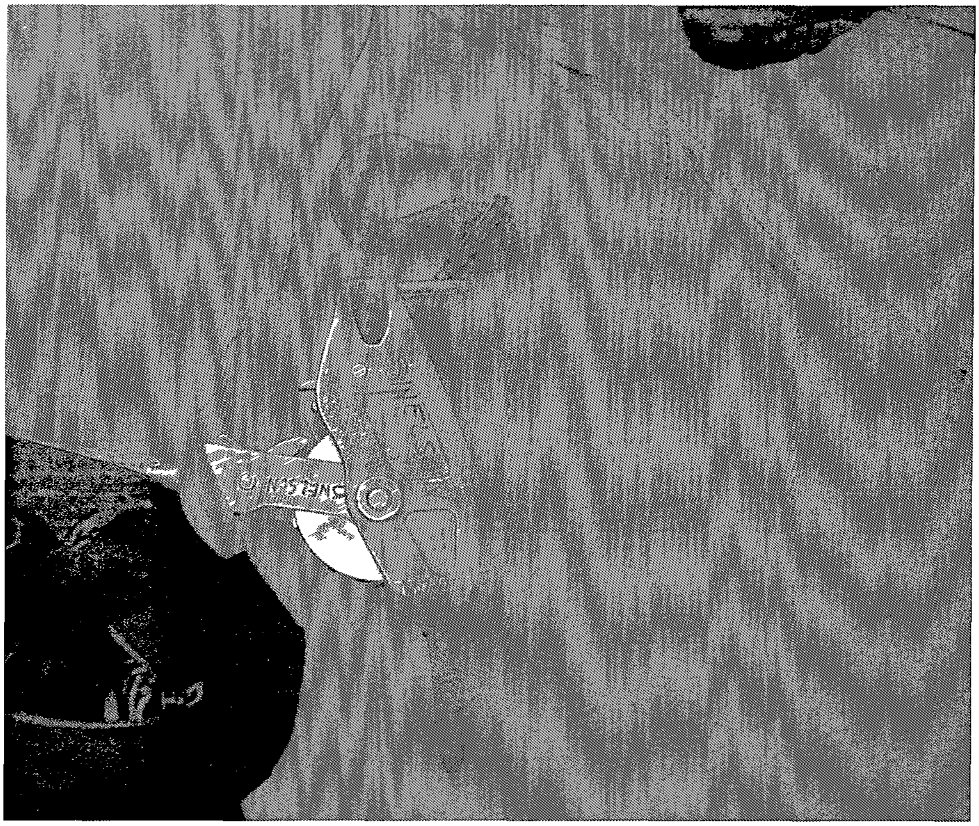


Figure 35 Snelson's Ratchet (photograph by the author)

Figure 36 Installing *Easy-K*, 1970, Sonsbeek Park, Arnhem, Netherlands (Snelson Archive)

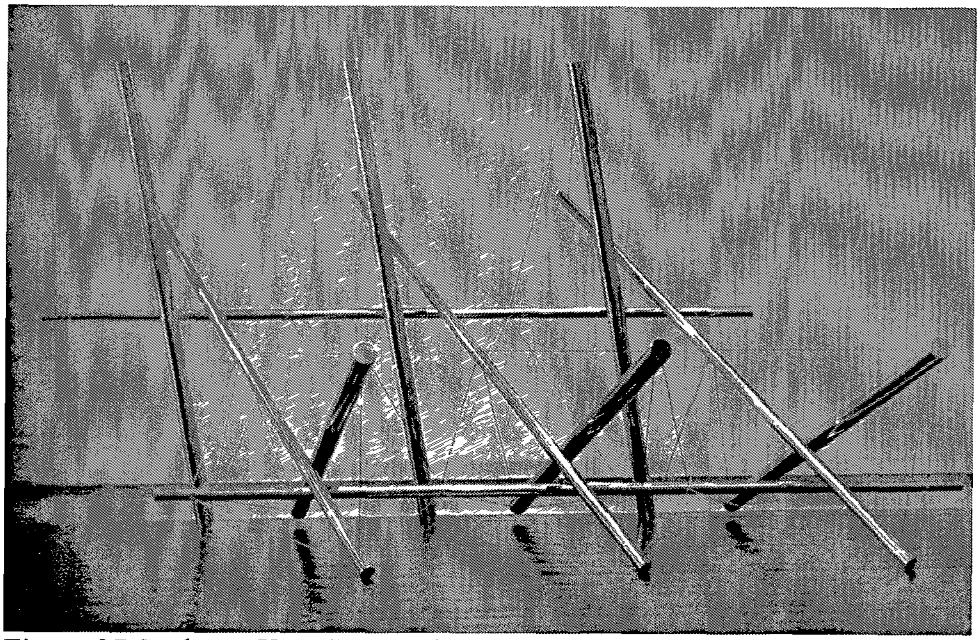


Figure 37 Snelson, *Vine Street*, 1966, *Sculpture: A Generation of Innovation*, The Art Institute of Chicago, 1966 (Snelson Archive)

Figure 38 Snelson, Marble and brass strip atom, 1948 (Snelson Archives)

Figure 39 Snelson, Self portrait at home in Pendleton, 1948 (Snelson Archive)

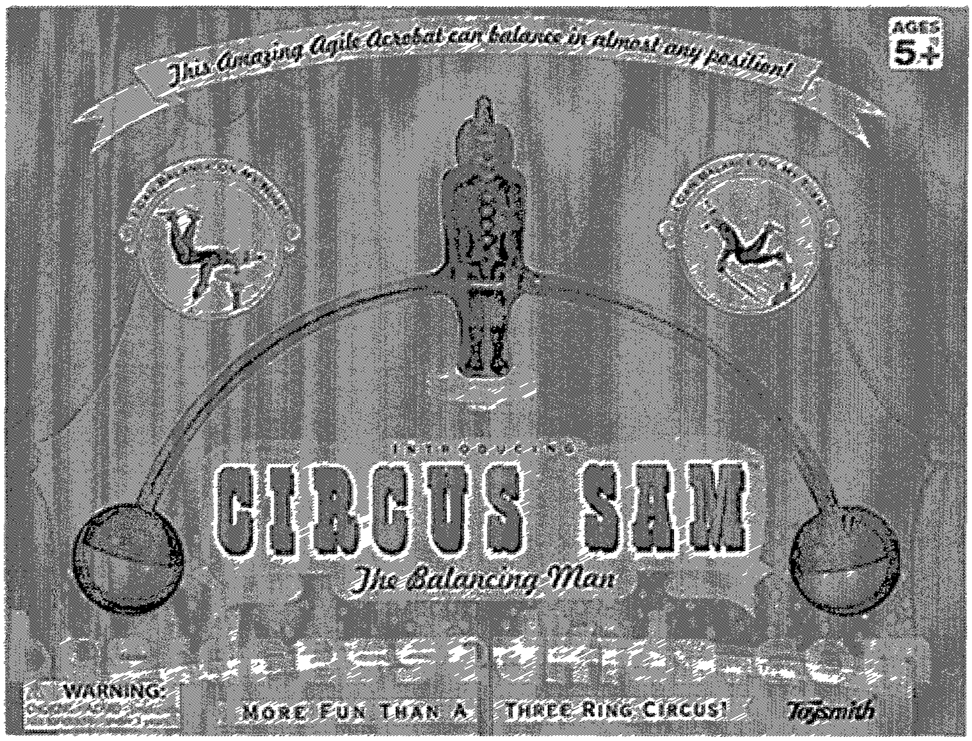


Figure 40 Balancing toy

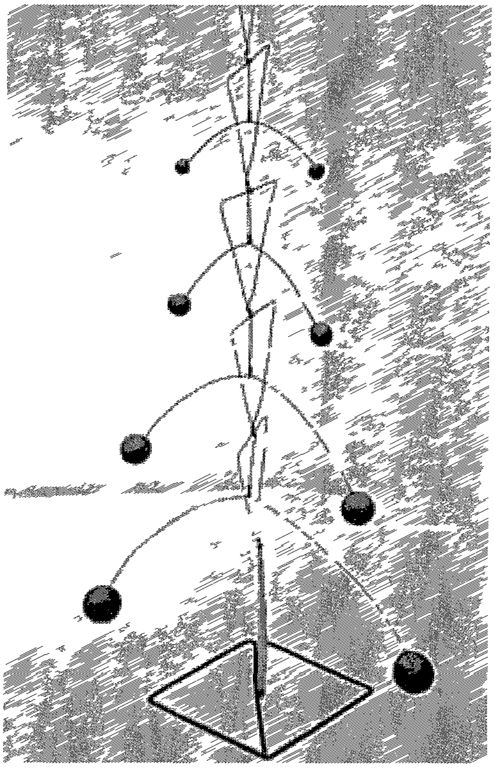


Figure 41 Snelson, *Moving Column* (First Study), 1948
(Snelson Archive)

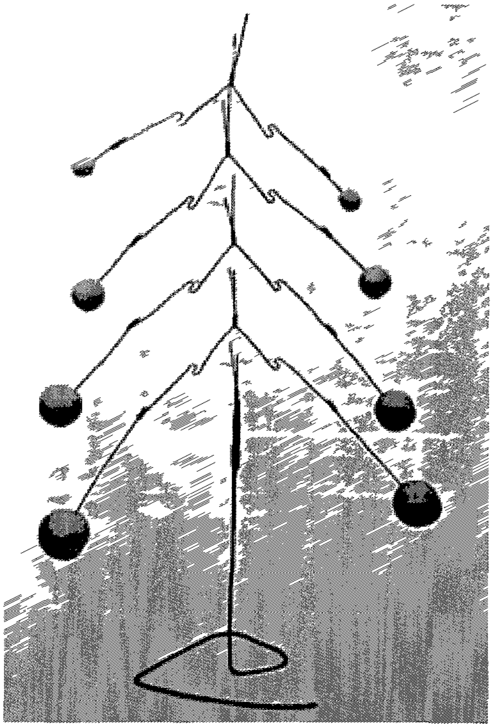


Figure 42 Snelson, *Moving Column* (Second Study), 1948
(Snelson Archive)

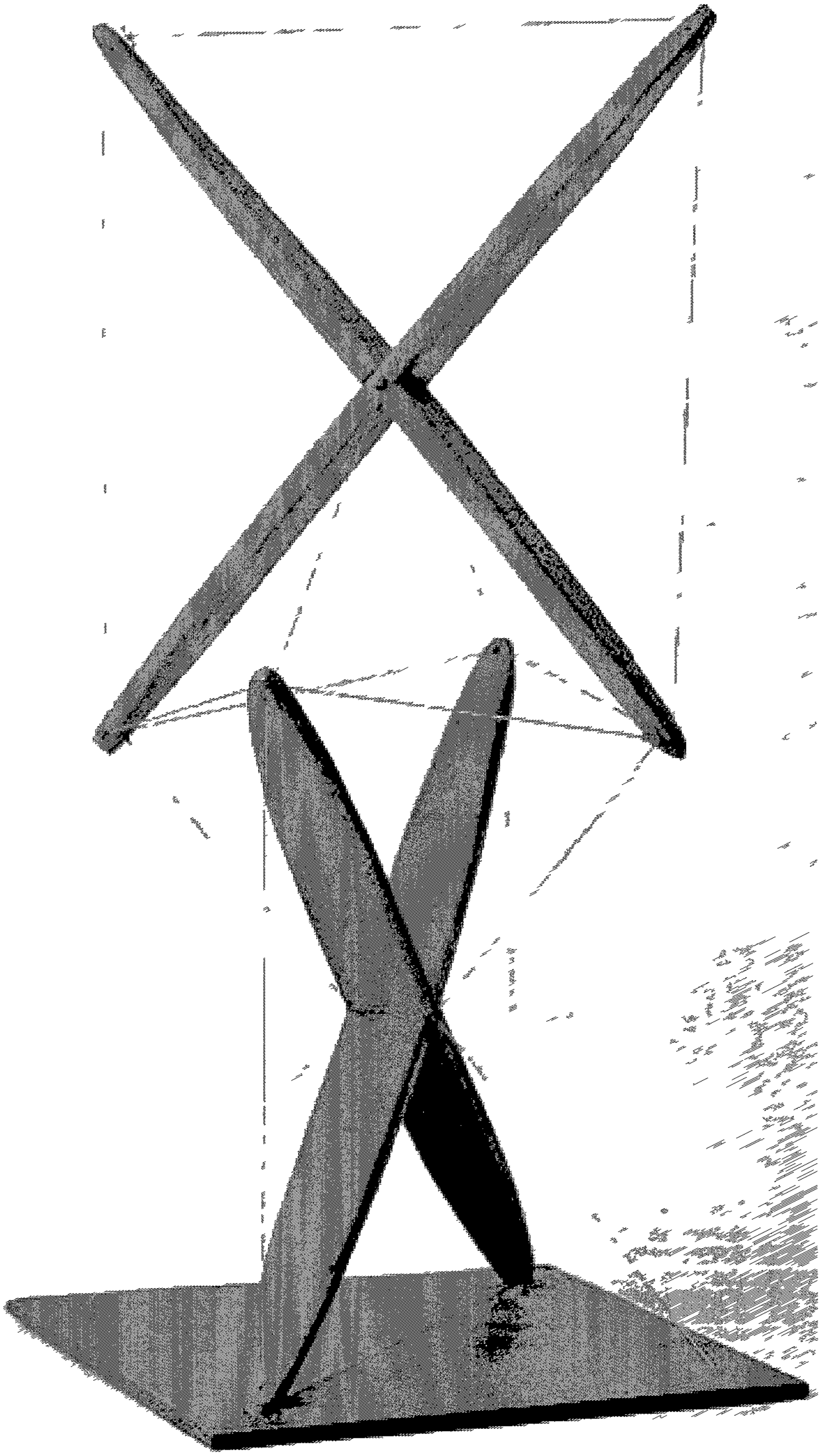


Figure 43 Snelson, *X-Piece*, 1948 (Snelson Archive)

Figure 44 Buckminster Fuller, Tensegrity Dome at Southern Illinois University, n.d. (Fuller, *Ideas and Integrities*, n.p.)

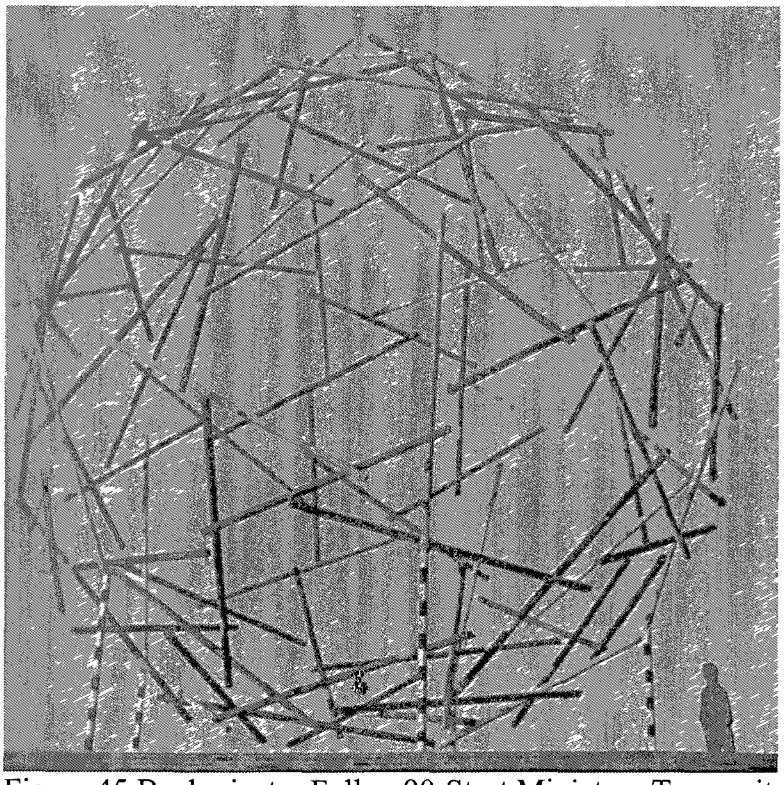


Figure 45 Buckminster Fuller, 90-Strut Miniature Tensegrity Sphere, Princeton University, n.d. (Fuller, *Ideas and Integrities*, n.p.)

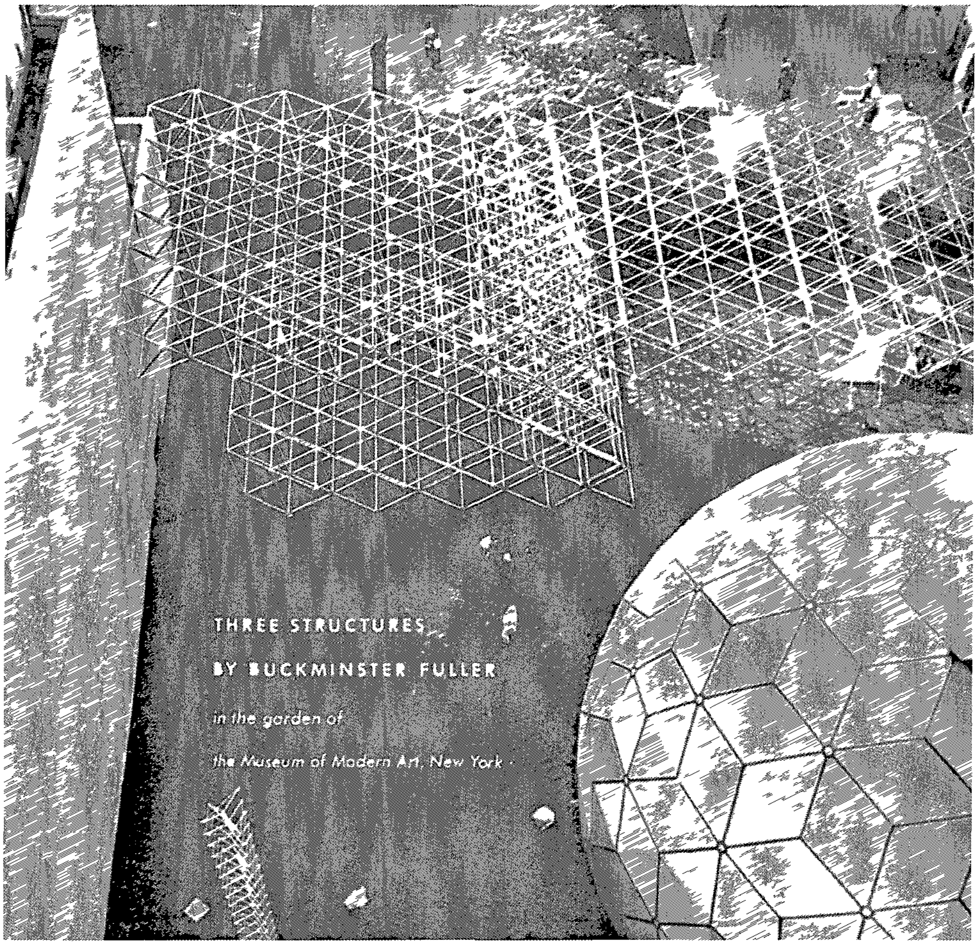


Figure 46 *Three Structures by Buckminster Fuller*, curated by Arthur Drexler, The Museum of Modern Art, New York, 1959, catalogue cover

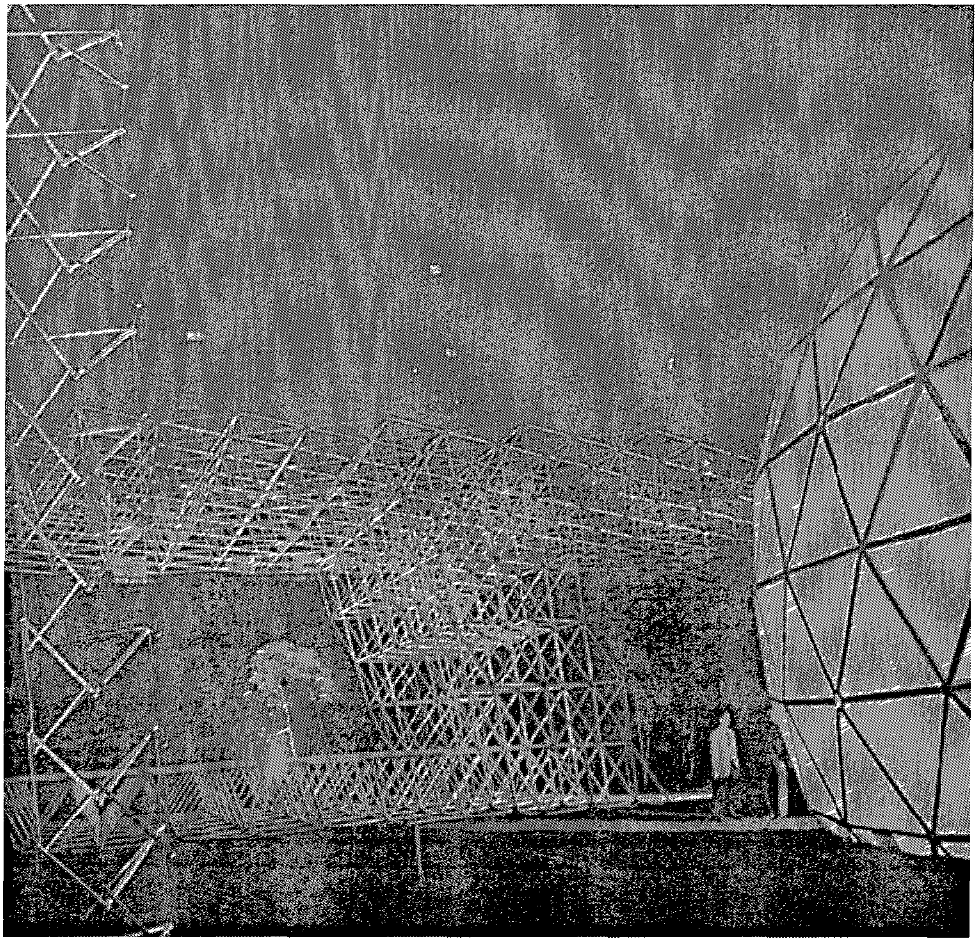


Figure 47 *Three Structures by Buckminster Fuller*, The Museum of Modern Art, 1959 (Fuller, *Tensegrities*, 1961)

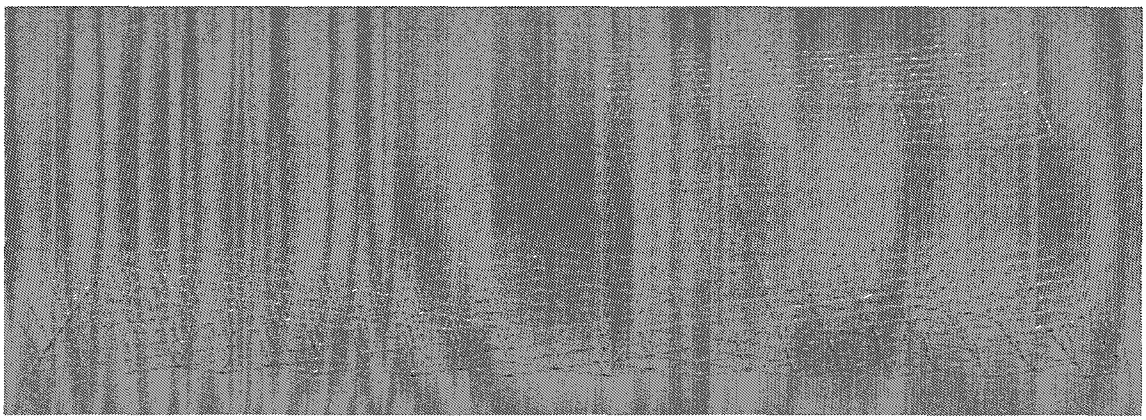


Figure 48 Buckminster Fuller, *Octet Truss Maquette*, 1953 (The Museum of Modern Art, New York)

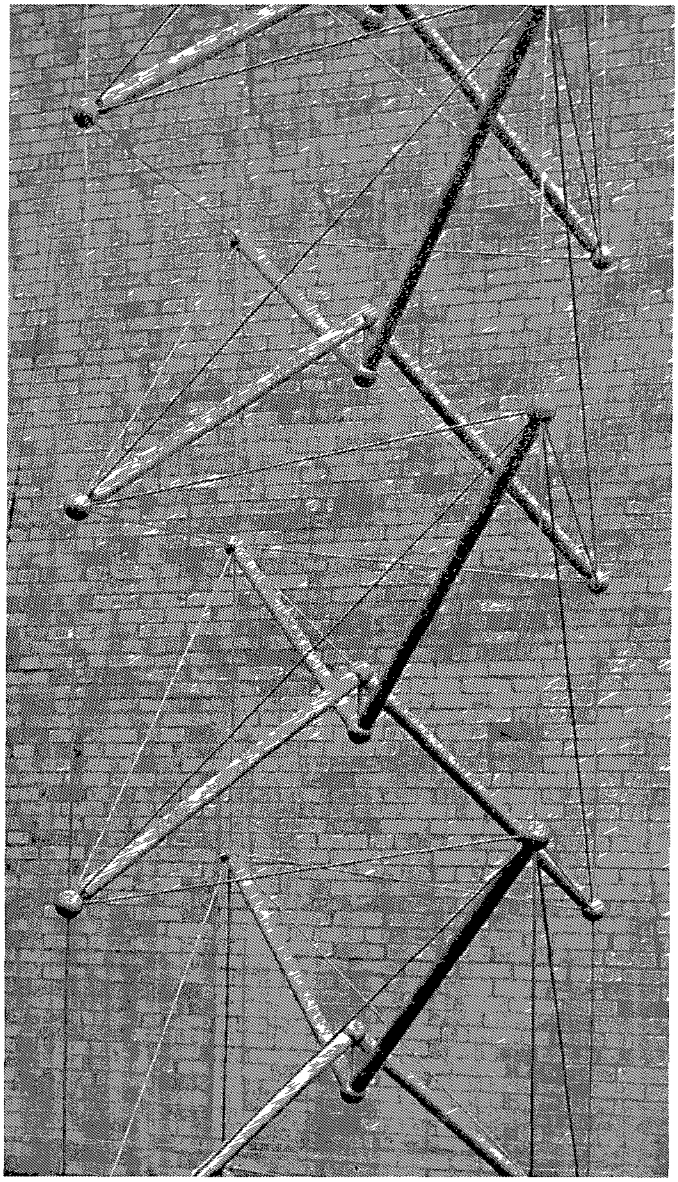


Figure 49 Tensegrity Mast, constructed by Shoji Sadao and Edison Price, Inc., 1959 (*Three Structures by Buckminster Fuller*, The Museum of Modern Art, 1959)

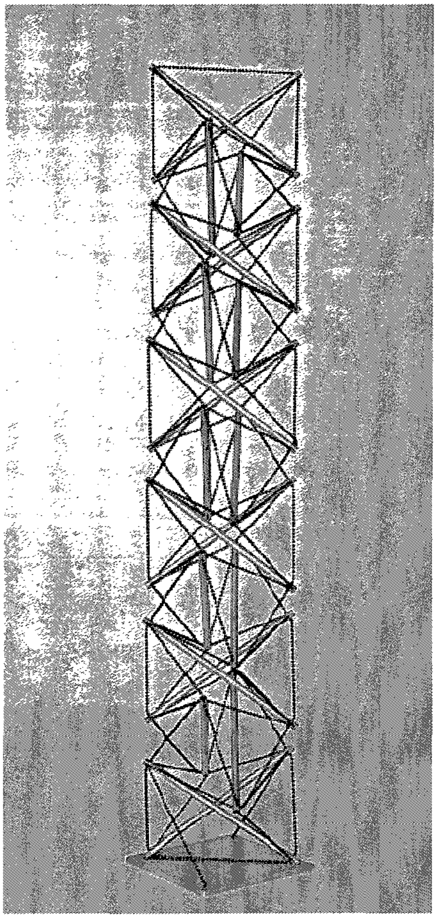


Figure 50 Snelson, *X-Column*, 1959 (Snelson Archive)

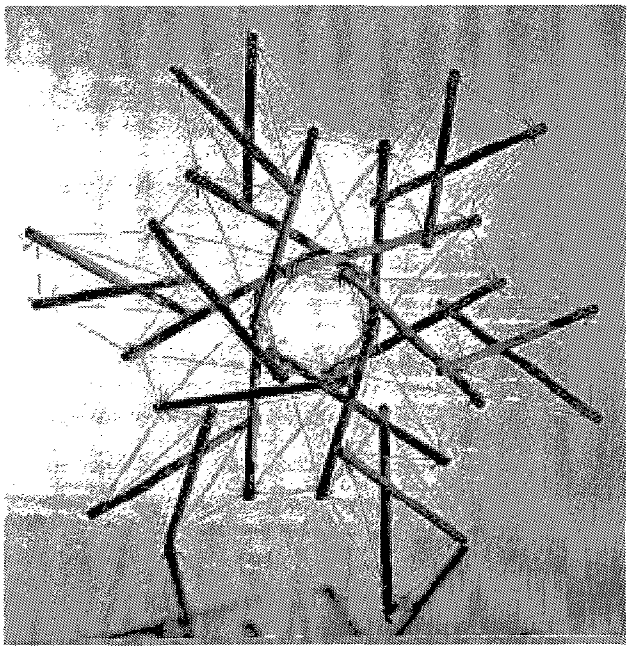


Figure 51 Snelson, *X-Module 6-Way Juncture*, 1959 (Snelson Archive)

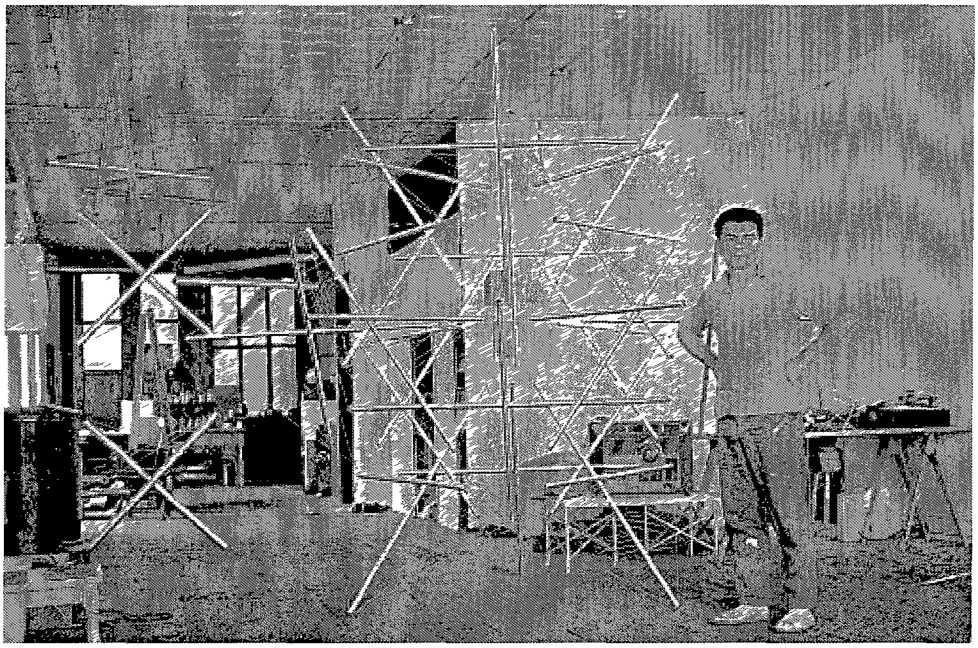


Figure 52 Snelson in his Spring Street studio with *Arcuate Lip Superstar*, 1960 (Snelson Archive)

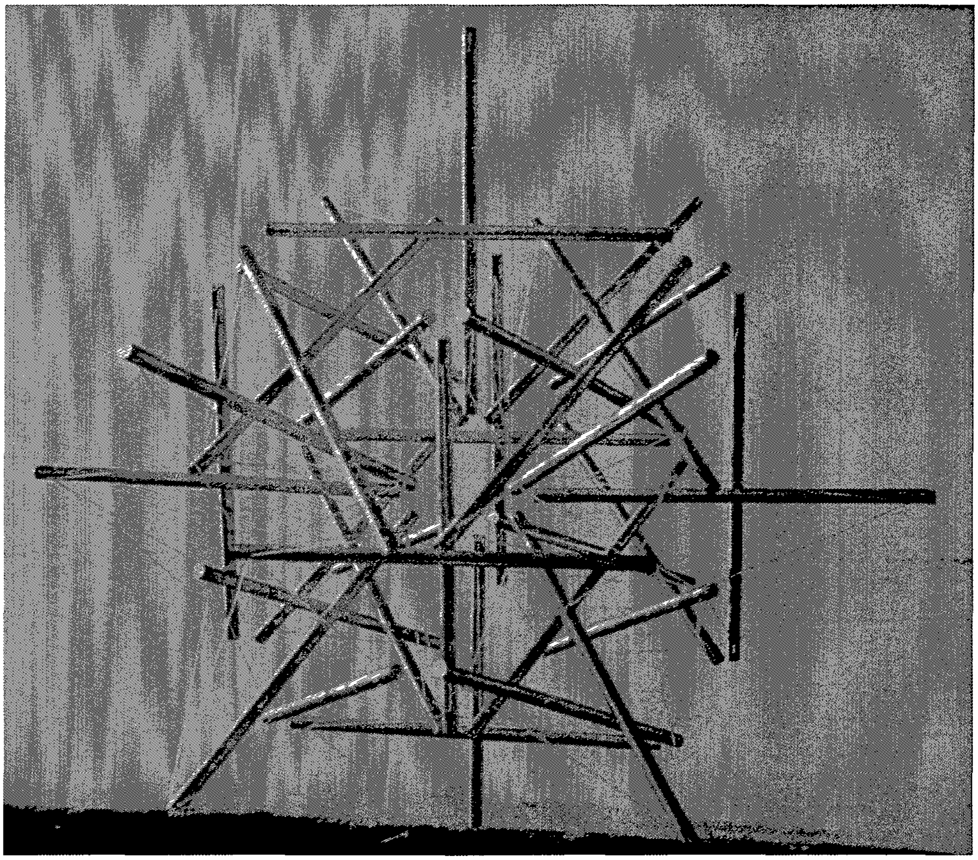


Figure 53 Snelson, *Arcuate Lip Superstar*, 1960 ("Sculptures to Build With," *Fortune* 66, no. 5, November 1962, 122)

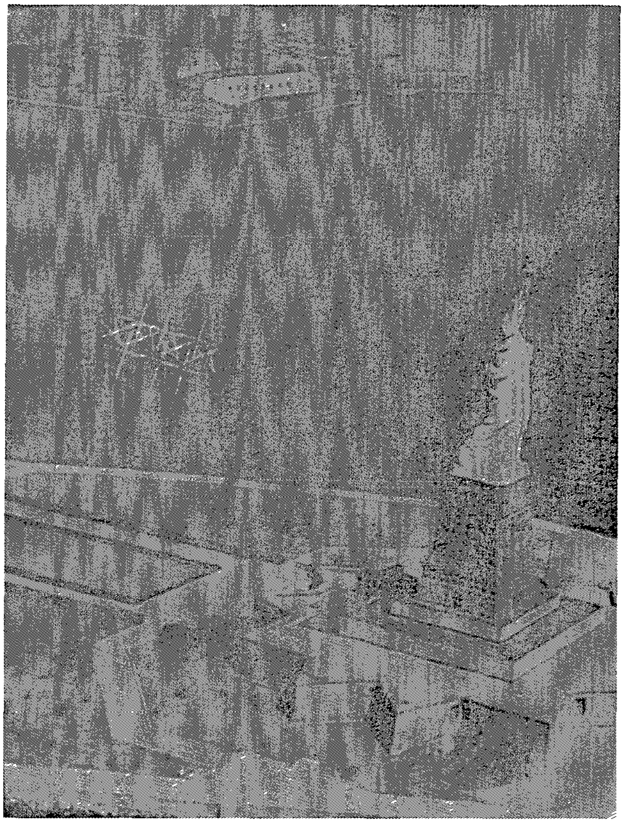


Figure 54 Snelson sculpture being airlifted to New York world's fair site, 1964 (Rosenblum, *Remembering the Future*, 155)

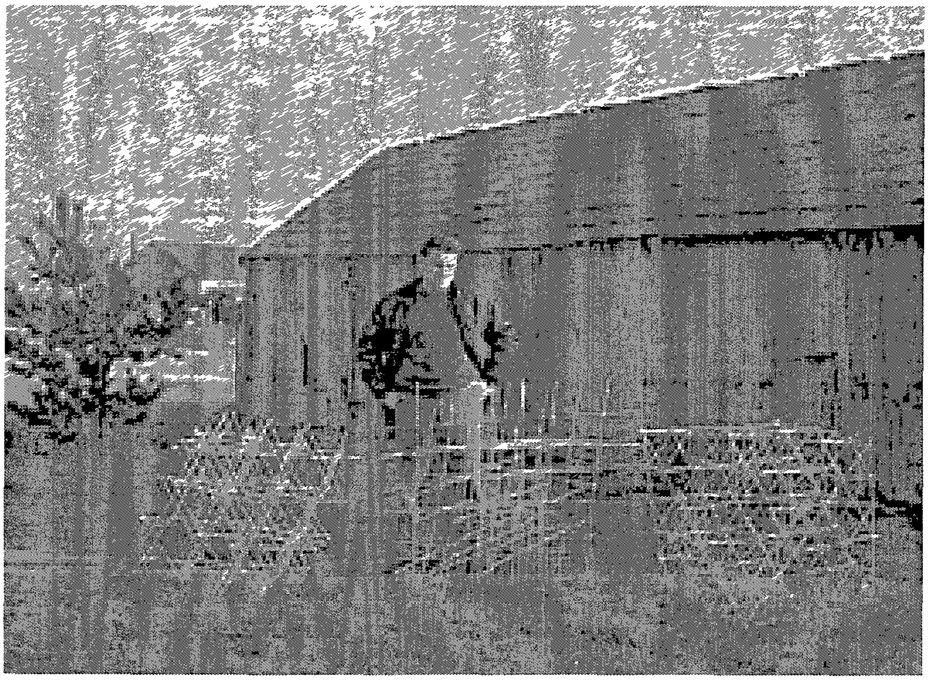


Figure 55 Snelson in Sagaponack, Long Island, c. 1965 (Snelson Archive)

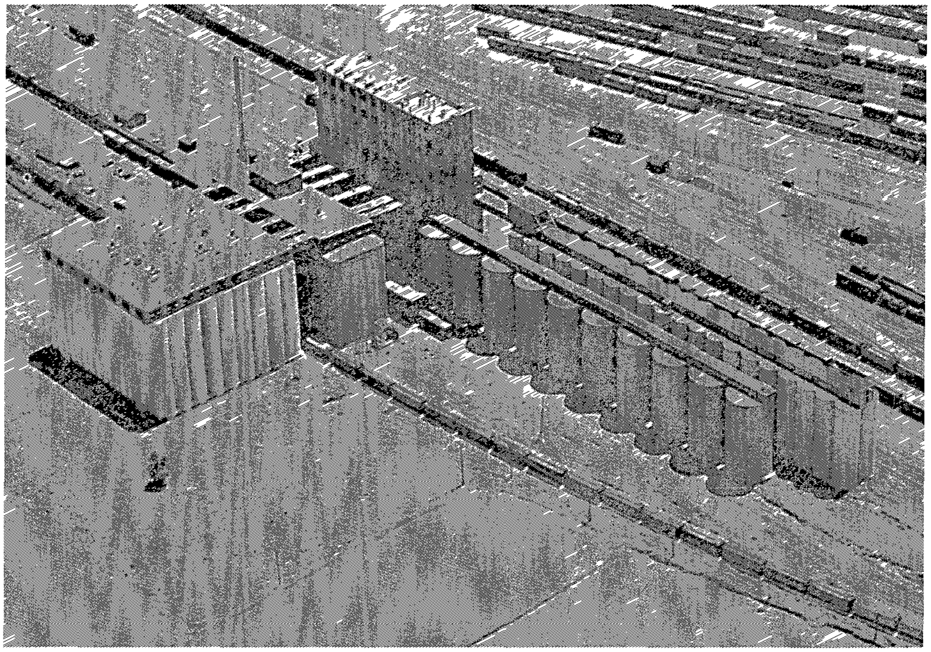


Figure 56 Folwell-Ahlskog Company, Grain Elevators, Kansas City, Missouri, 1904-30 (*Twentieth Century Engineering*, Museum of Modern Art, 1964)

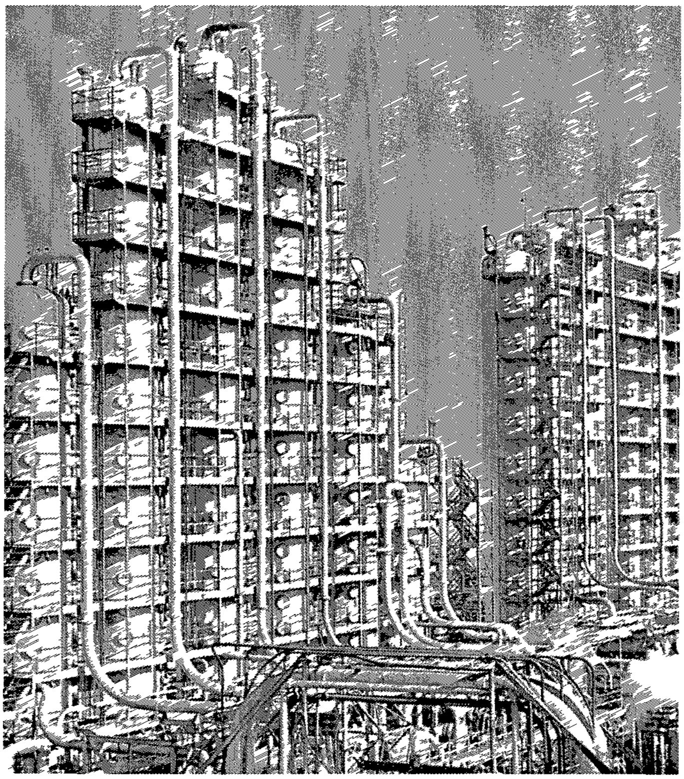


Figure 57 Electricité de France, Nuclear power station, Chinon, France, 1960 (*Twentieth Century Engineering*, Museum of Modern Art, 1964)

Figure 58 Riccardo Morandi, Parco del valentine exhibition Hall, Turin, Italy, 1959 (*Twentieth Century Engineering*, Museum of Modern Art, 1964)

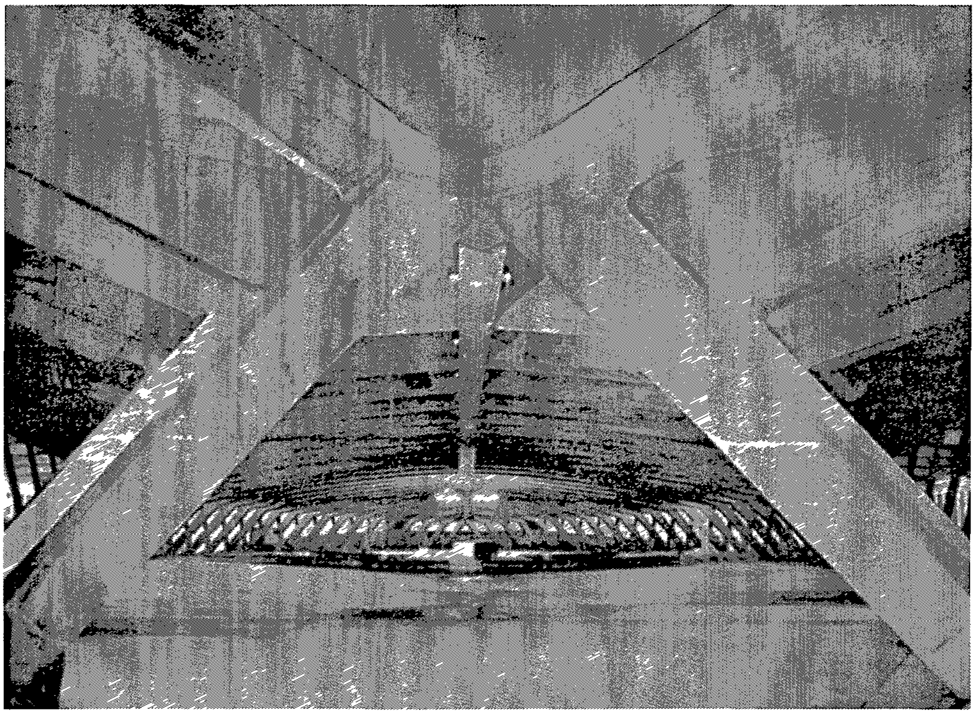


Figure 59 Eugène Freyssinet, Vago, LeDonne and Pinsard, St. Pius X Basilica, Lourdes, France, 1958 (*Twentieth Century Engineering*, Museum of Modern Art, 1964)

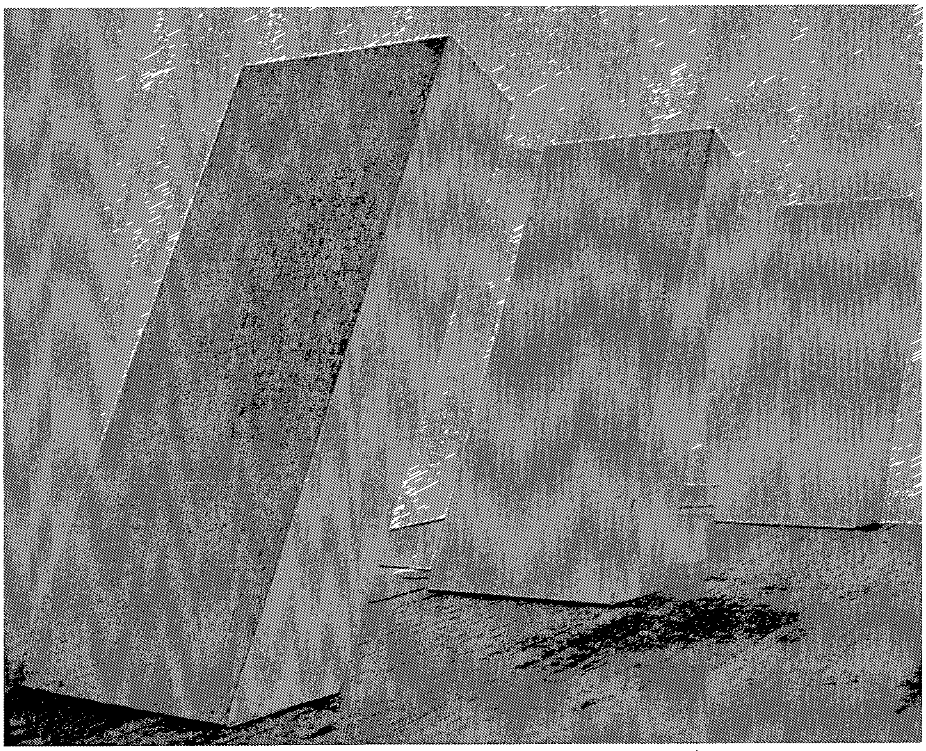


Figure 60 Ronald Bladen, *Untitled (Elements)*, 1965 (*American Sculpture of the Sixties*, Los Angeles County Museum, 1967, 73)

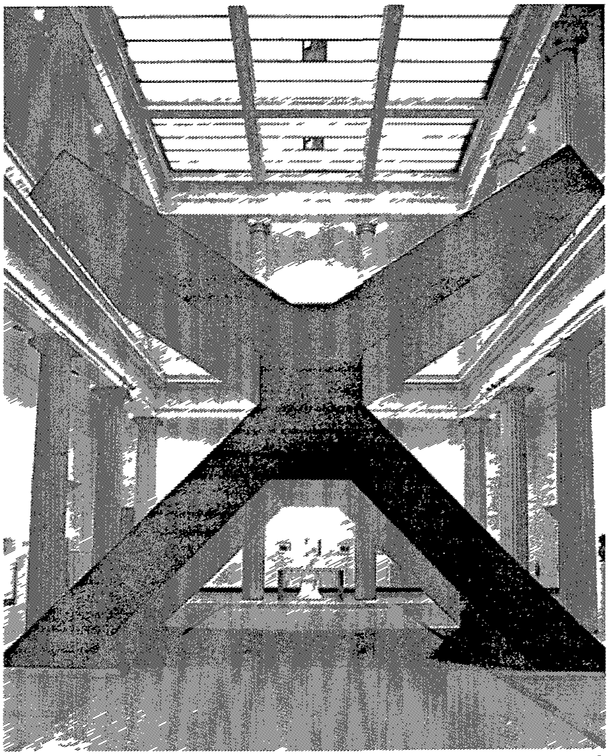


Figure 61 Ronald Bladen, *The X*, 1967-8, *Scale as Content*, Corcoran Gallery, Washington, D.C., 1967

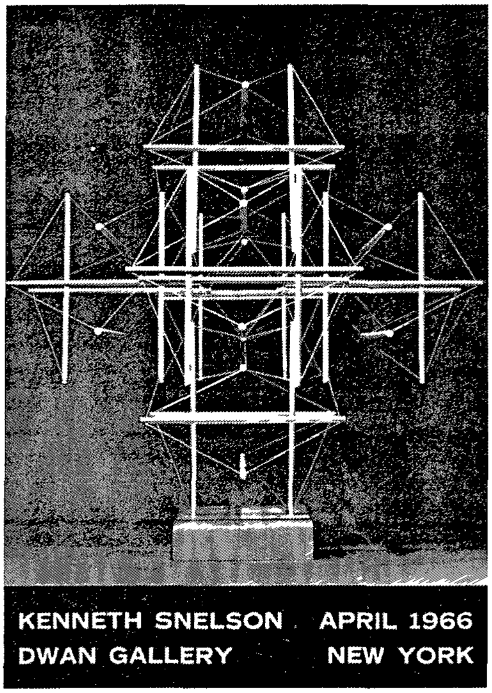
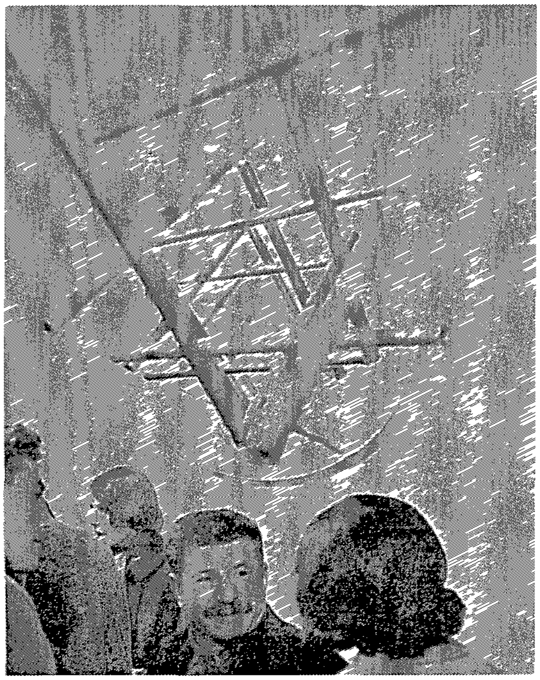


Figure 62 Advertisement for Snelson show at Dwan Gallery, New York, 1966 (*Art Voices* 5, no. 3, Summer 1966)

Figure 63 Snelson at Dwan opening, 1966 ("New York Scene: People in the Arts," *Art Voices* 5, no. 3, Summer 1966, 65.)



Figures 64 Herman Cherry and Marta Zogbaum at Dwan opening, 1966, under Snelson, *Tower (Cantilever)*, 1962 ("New York Scene: People in the Arts," *Art Voices* 5, no. 3, Summer 1966, 66.)

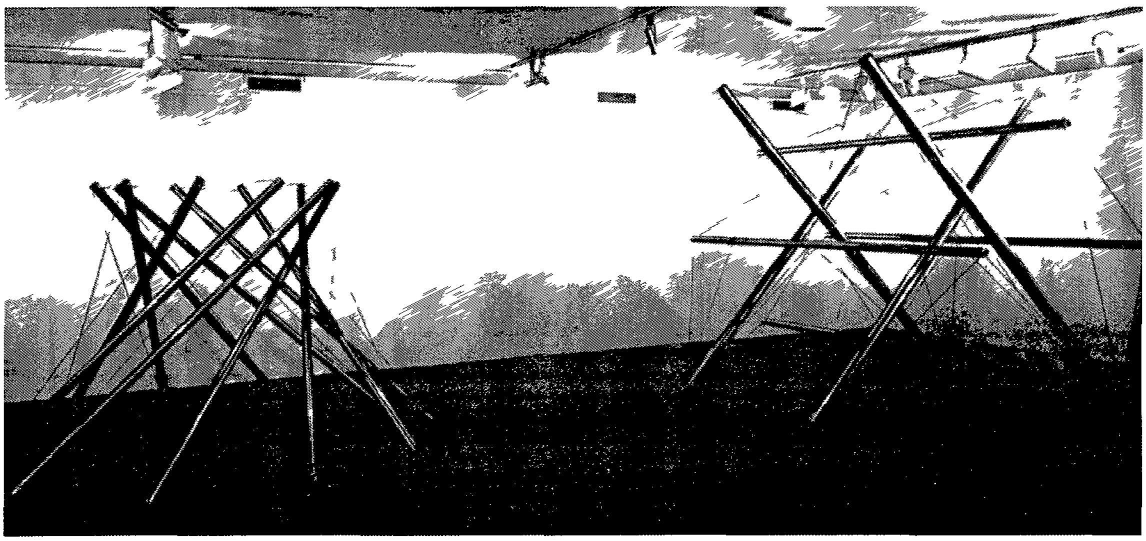


Figure 65 *XV*, 1968, *Double City Boots*, 1968, Snelson show, Dwan Gallery New York, 1968 (Courtesy Dwan Gallery Archives)

Figure 66 *Six II*, 1967, Snelson show, Dwan Gallery New York, 1968 (Courtesy Dwan Gallery Archives)

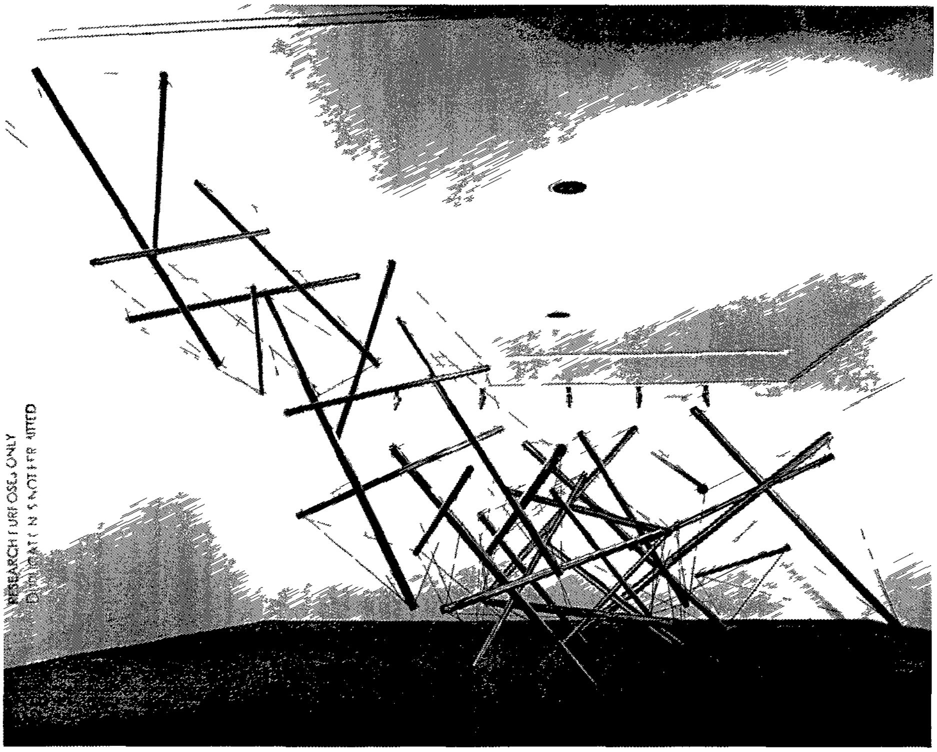


Figure 67 *Landing*, 1970, Snelson show, Dwan Gallery New York, 1970 (Courtesy Dwan Gallery Archives)

Figure 68 Snelson Bryant Park Exhibition, 1968 (Snelson Archive)

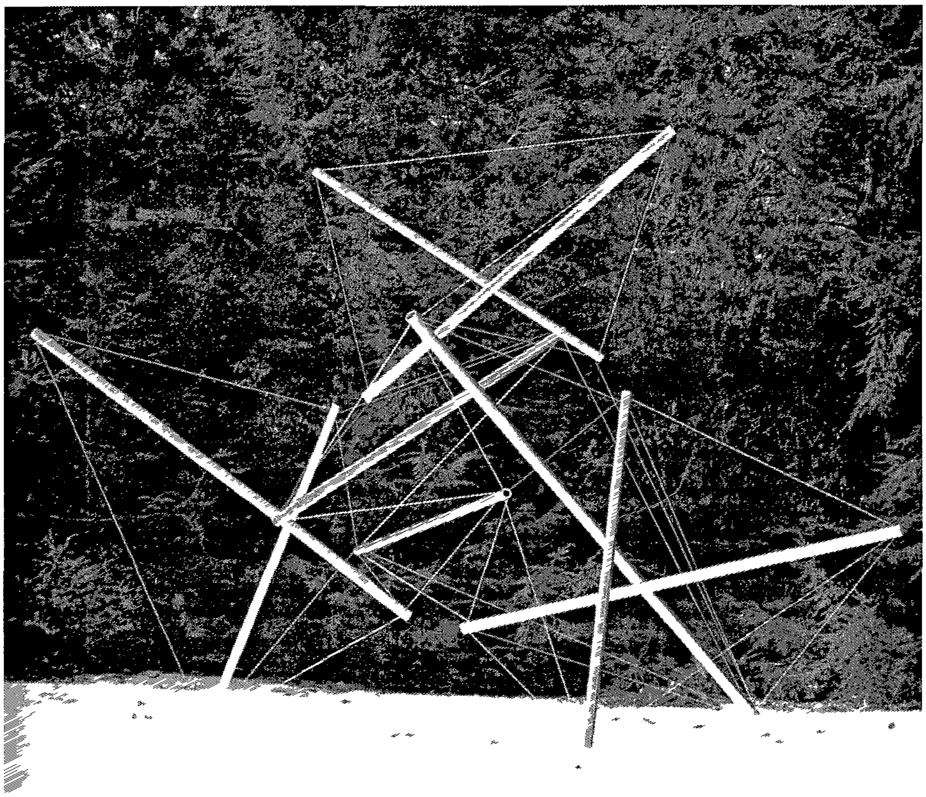


Figure 69 Snelson, *Fair Leda*, 1969 (*Twentieth-Century Art from Nelson Aldrich Rockefeller Collection*, The Museum of Modern Art, 1969, 121)

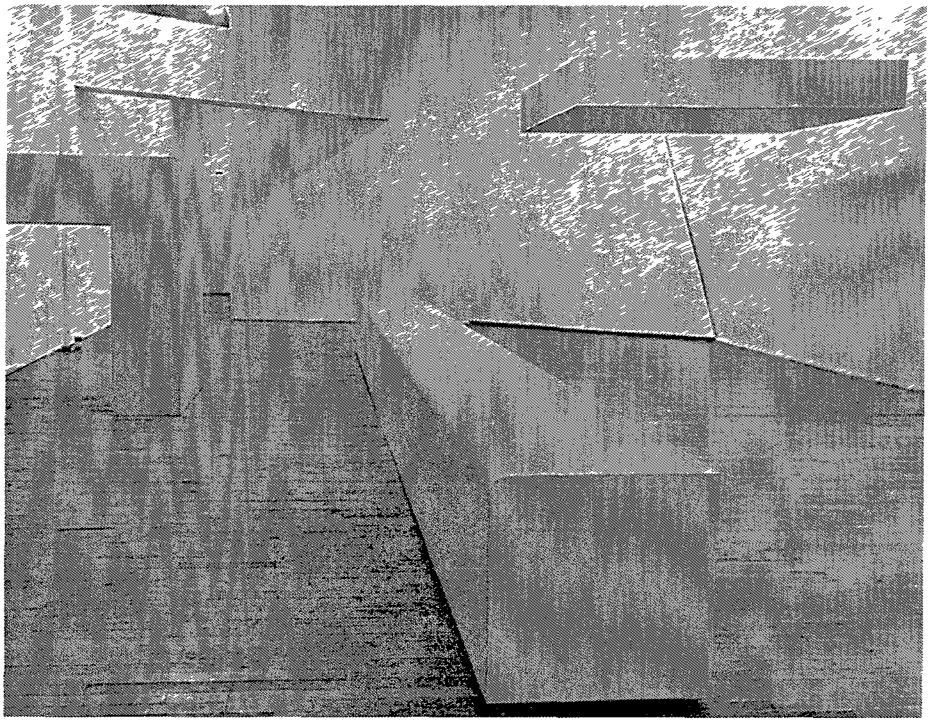


Figure 70 Robert Morris, Green Gallery, New York, 1964 (Meyer, *Minimalism: Art and Polemics in the Sixties*, 114)

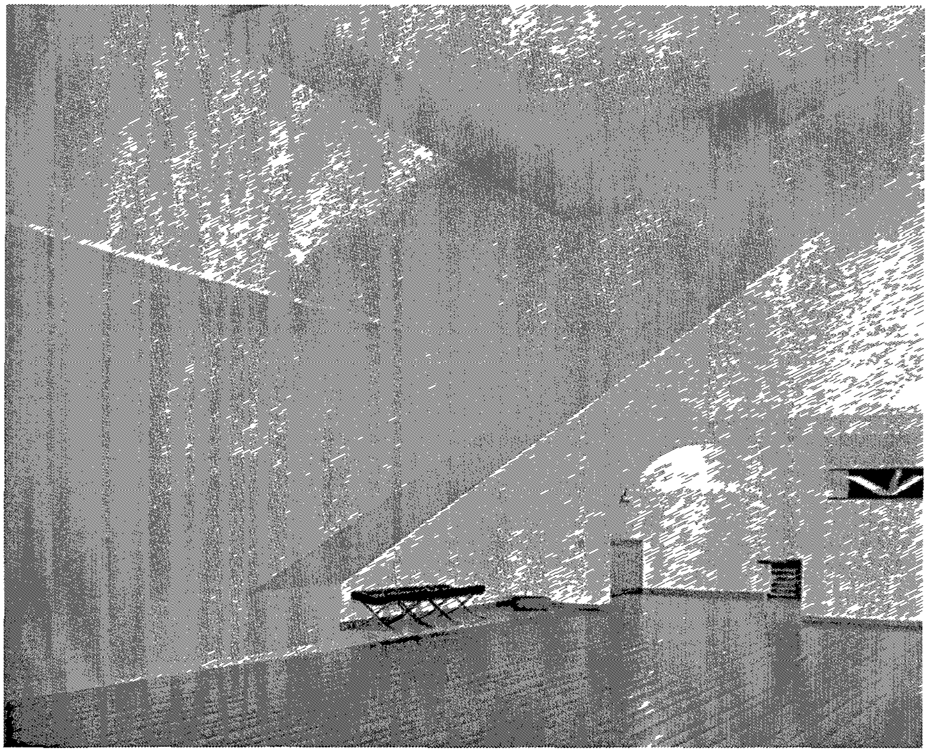


Figure 71 Robert Grosvenor, *Still No Title*, 1966 (*American Sculpture of the Sixties*, Los Angeles County Museum, 1967, 123)

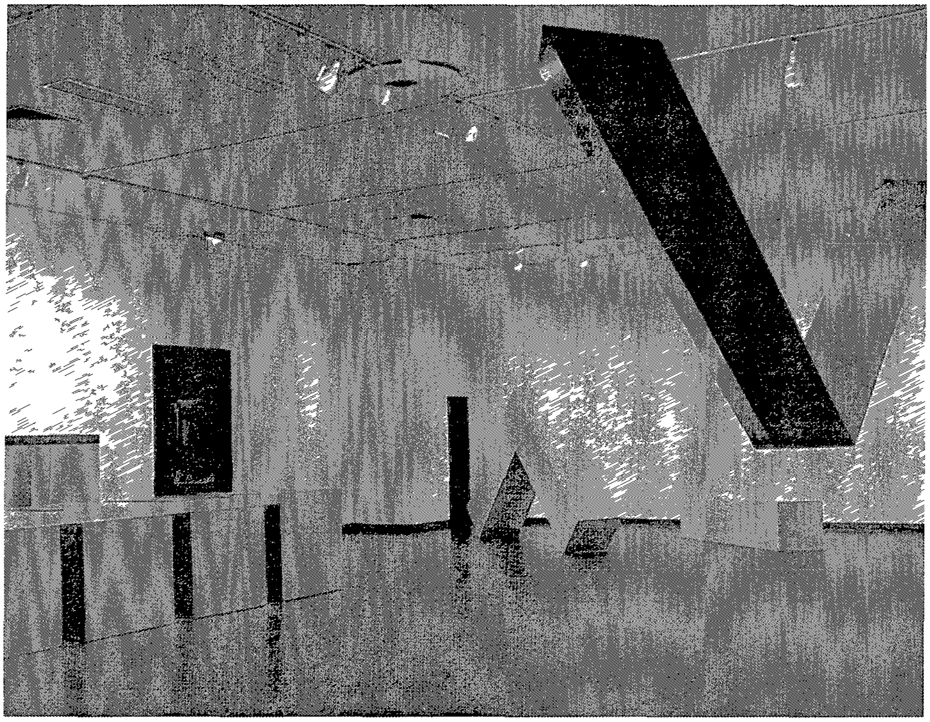


Figure 72 Gallery 5, *Primary Structures*, The Jewish Museum, 1966, including work from left to right: Donald Judd, *Untitled*, 1966 and *Untitled*, 1966; Robert Morris, *Untitled (2 L Beams*), 1965-67; and Robert Grosvenor, *Transoxiana*, 1965 (Meyer, *Minimalism: Art and Polemics in the Sixties*, 14)

Figure 73 Donald Judd, *100 Untitled Works in Mill Aluminum*, 1982-86, Chinati Foundation, Marfa, Texas (photograph by the author)

Figure 74 Carl Andre, *Equivalent VIII*, 1966, Tate Gallery, London, England (Meyer, *Minimalism: Art and Polemics in the Sixties*, 191)

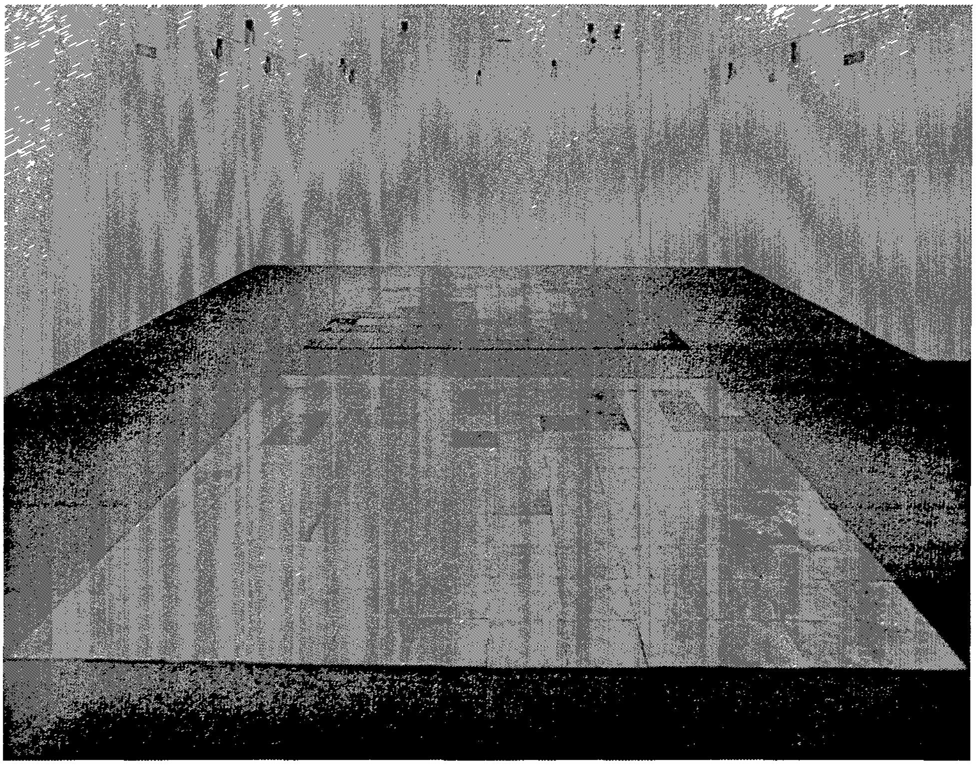


Figure 75 Carl Andre, *144 Pieces of Magnesium* (foreground) and *144 Pieces of Lead*, Dwan Gallery, New York, 1969 (Meyer, *Minimalism: Art and Polemics in the Sixties*, 198)

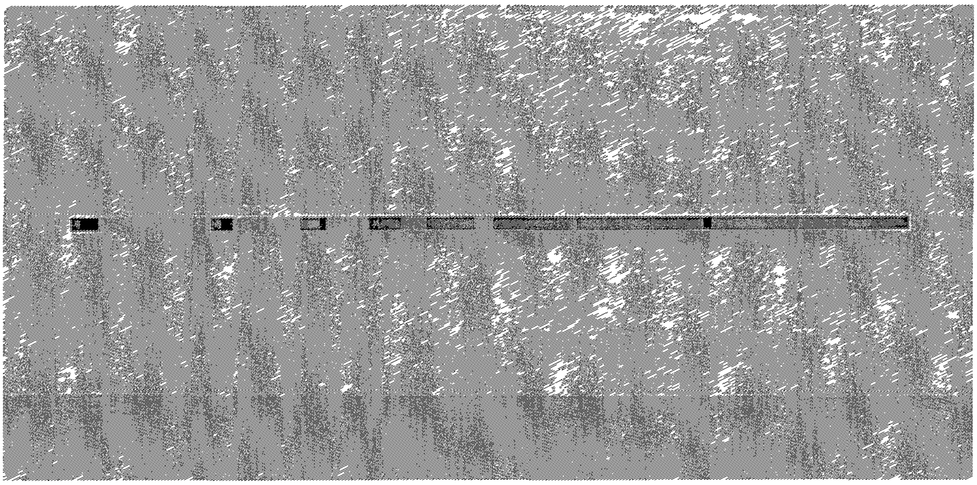


Figure 76 Donald Judd, *Untitled*, 1970 (Solomon R. Guggenheim Museum, New York, Panza Collection 91.3715. © Judd Foundation, Licensed by VAGA, New York, NY. Photo: David Heald)

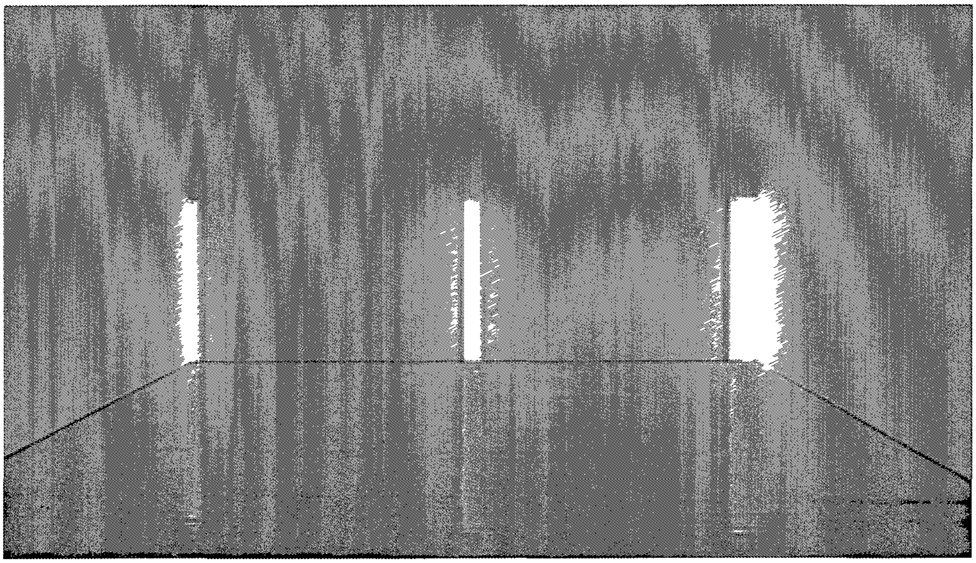


Figure 77 Dan Flavin, *the nominal three (to William of Ockham)*, 1963 (Solomon R. Guggenheim Museum, New York, Panza Collection 91.3698, © 2009 Stephen Flavin/Artists Rights Society (ARS), New York. Photo: David Heald)

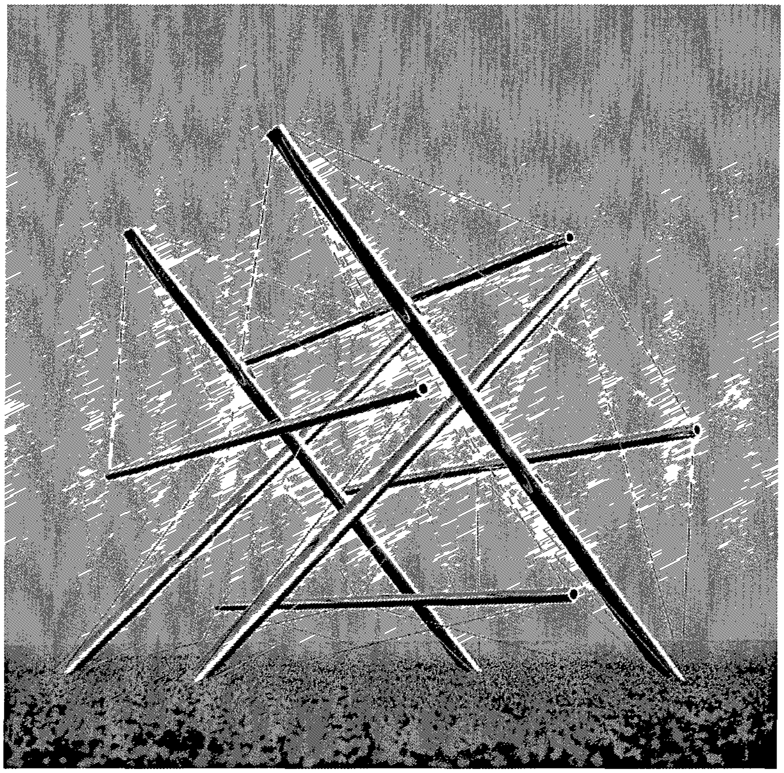


Figure 78 Snelson, *Double City Boots*, 1968, Miami-Dade Art in Public Places, Miami, Florida (Snelson Archive)

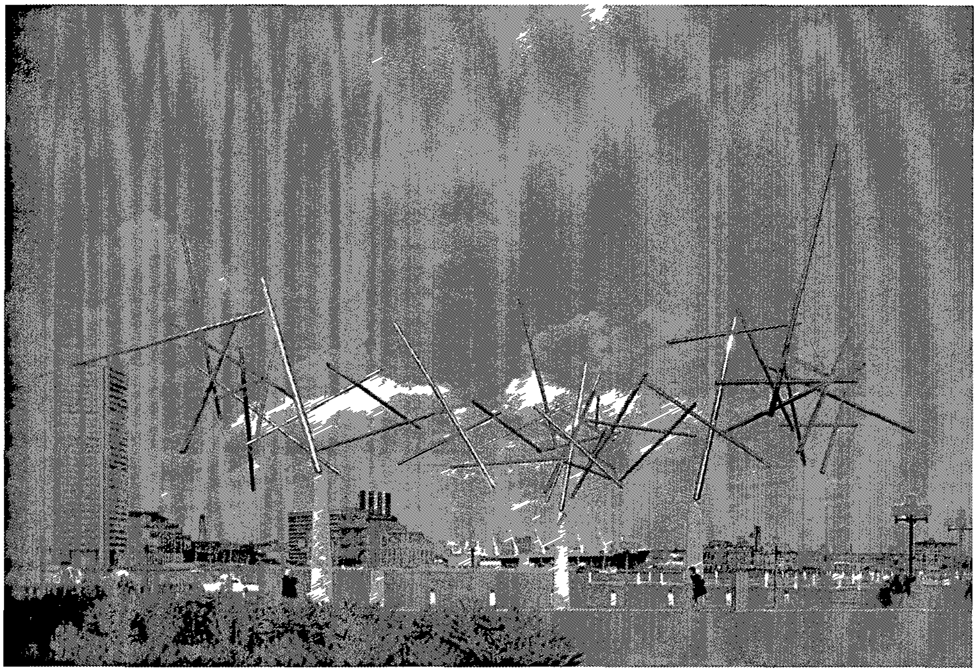


Figure 79 Snelson, *Easy Landing*, 1977, Baltimore, Maryland (Snelson Archive)

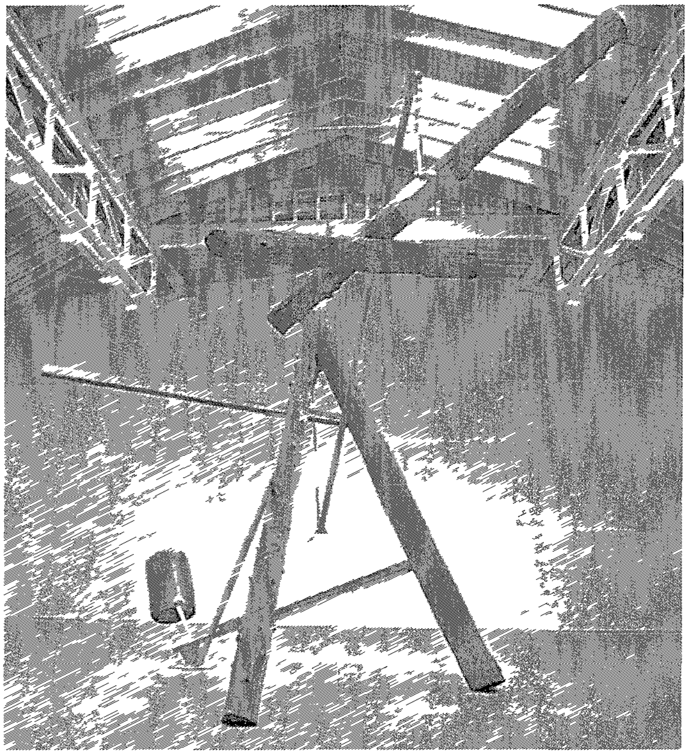


Figure 80 Mark di Suvero, *Nova Albion*, 1964-65 (Paula Cooper Gallery, New York, 2010)

Figure 81 Robert Grosvenor, *Transoxiana*, 1965 (*Primary Structures*, The Jewish Museum, 1966, n.p.)

Figure 82 David von Schlegell, *Wave*, 1964 (*Primary Structures*, The Jewish Museum, 1966, n.p.)

Figure 83 David Von Schegell, *Untitled*, 1967 (*American Sculpture of the Sixties*, Los Angeles County Museum, 1967, 214)

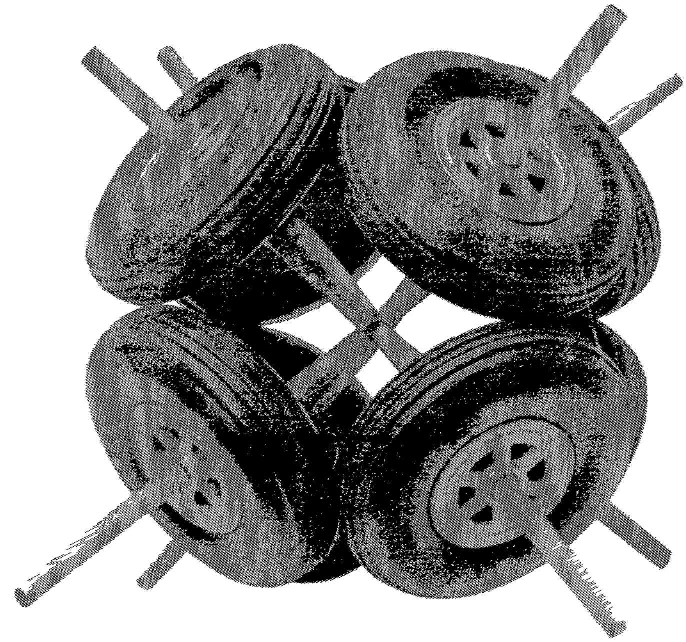


Figure 84 Snelson, Rubber tire structure, 1949 (Snelson Archive)

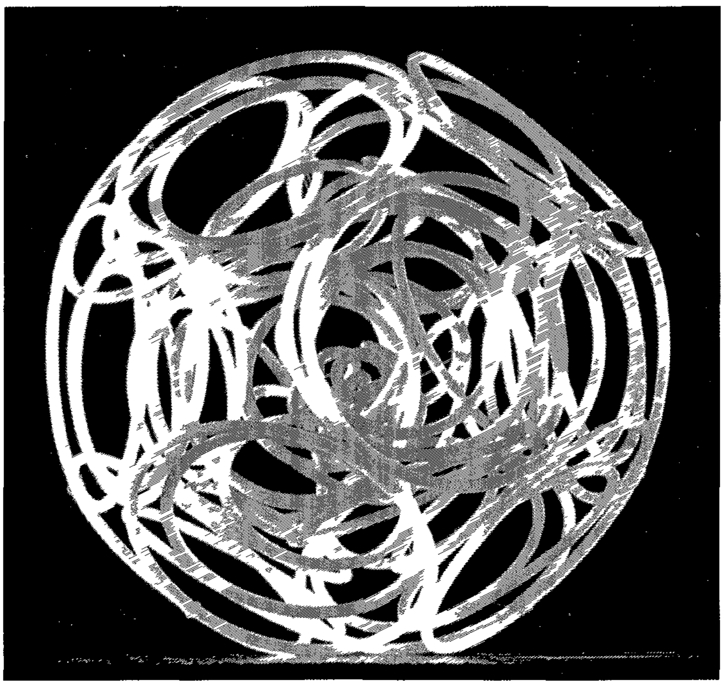


Figure 85 Snelson, Spaceframe matrice, Atomic model with plastic rings, 1960 (Snelson Archive)

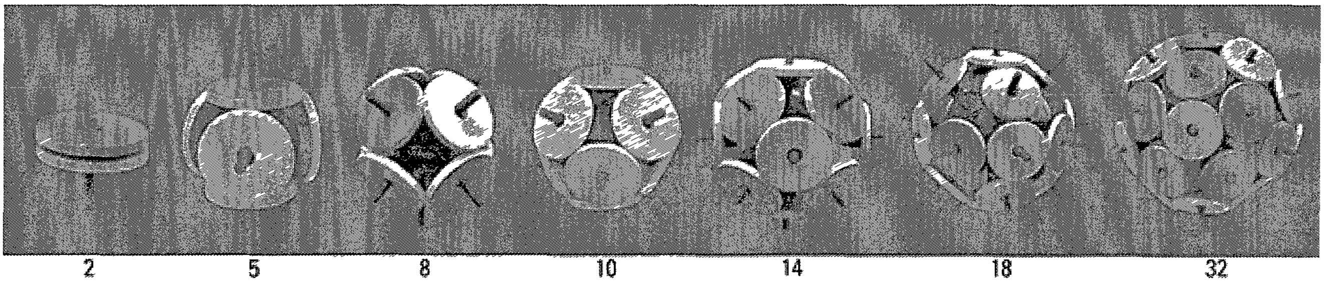


Figure 86 Magnetic structures demonstrating checkerboard pattern (snelsonatom.com)

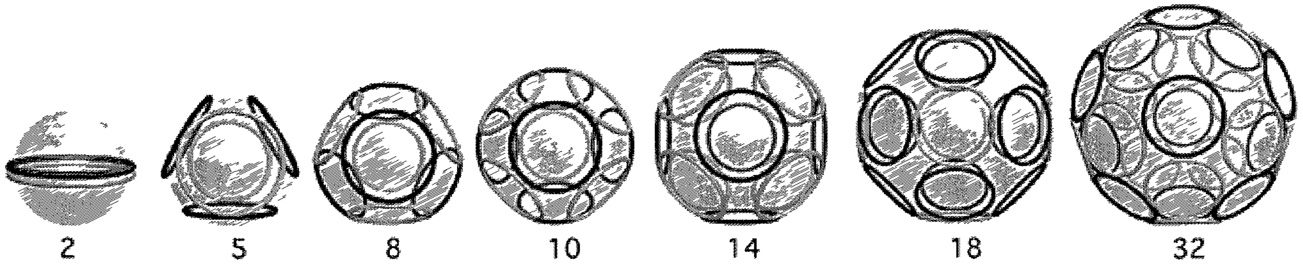


Figure 87 Snelson, Digital image of Spaceframe matrices, showing checkerboard pattern (snelsonatom.com)

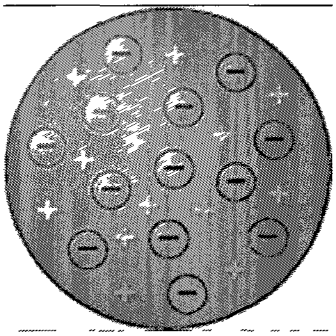


Figure 88 J. J. Thompson, Plum Pudding atom model

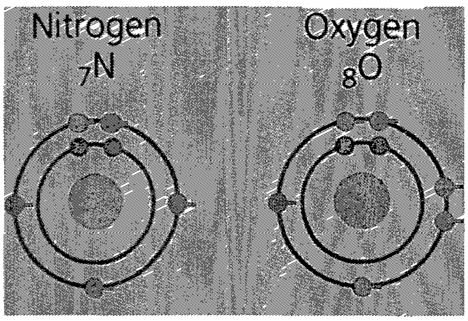


Figure 89 Rutherford-Bohr, atom model

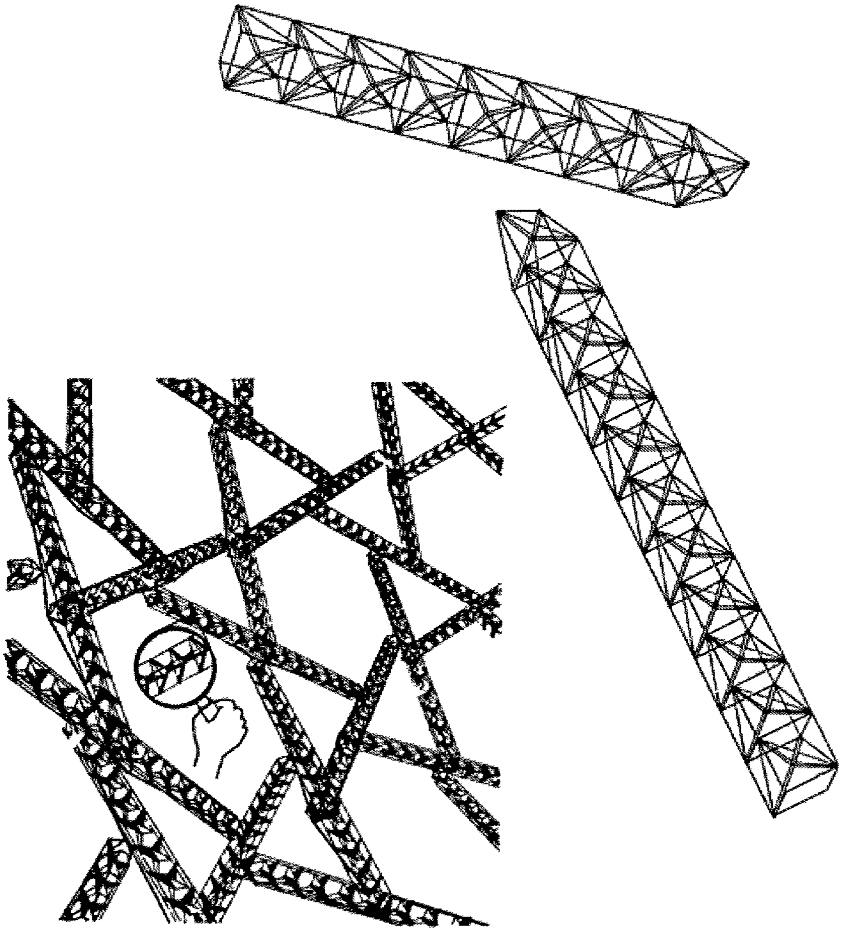


Figure 90 Buckminster Fuller, Tensegrity Masts as Struts: Miniaturization Approaches Atomic Structure (Fuller, *Synergetics*, p .407, Fig 740.21) Copyright © 1997 Estate of R. Buckminster Fuller

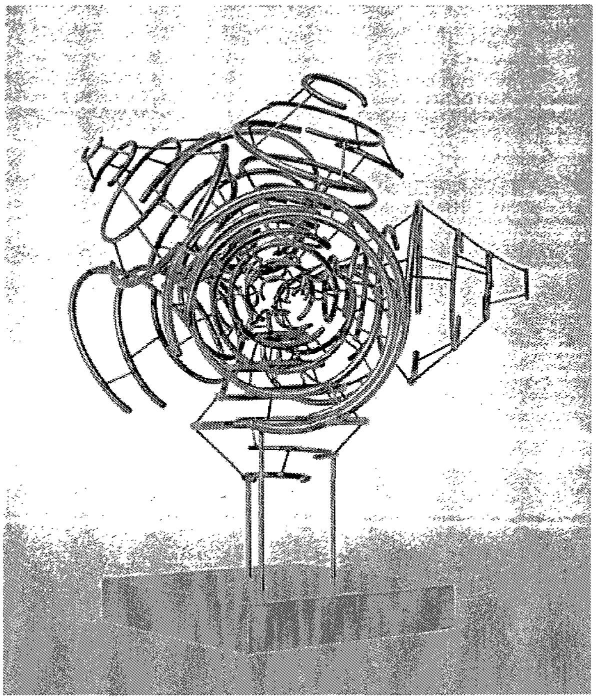


Figure 91 Snelson, *Study for Atomic Space 1*, 1964 (Snelson Archive)

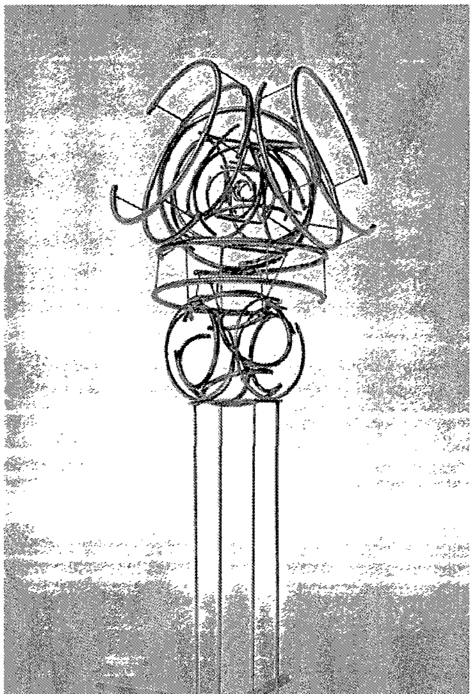


Figure 92 Snelson, *Study for Atomic Space 3*, 1964 (Snelson Archive)

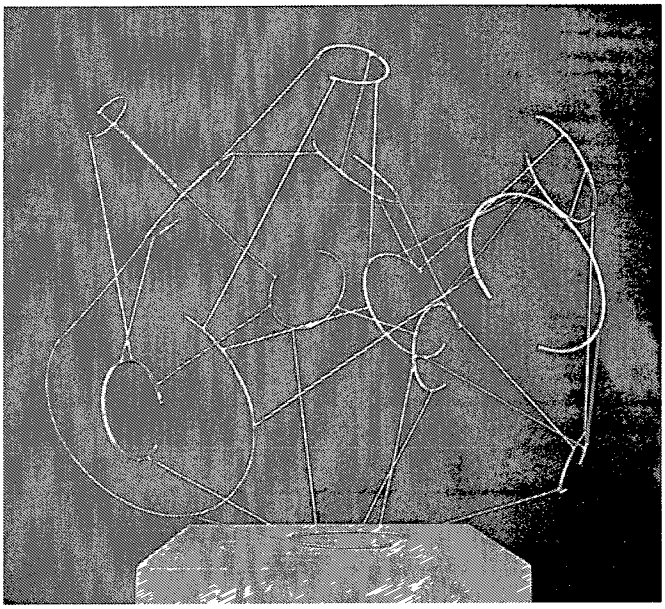


Figure 93 Snelson, *Study for Atomic Space 6*, 1965 (Snelson Archive)

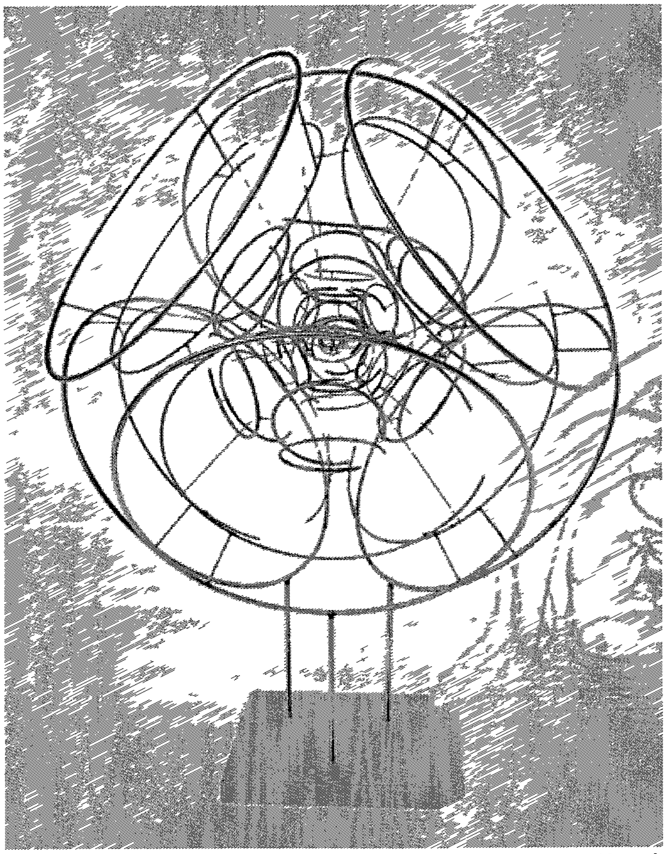


Figure 94 Snelson, *Study for Big Atom*, 1965 (Snelson Archive)

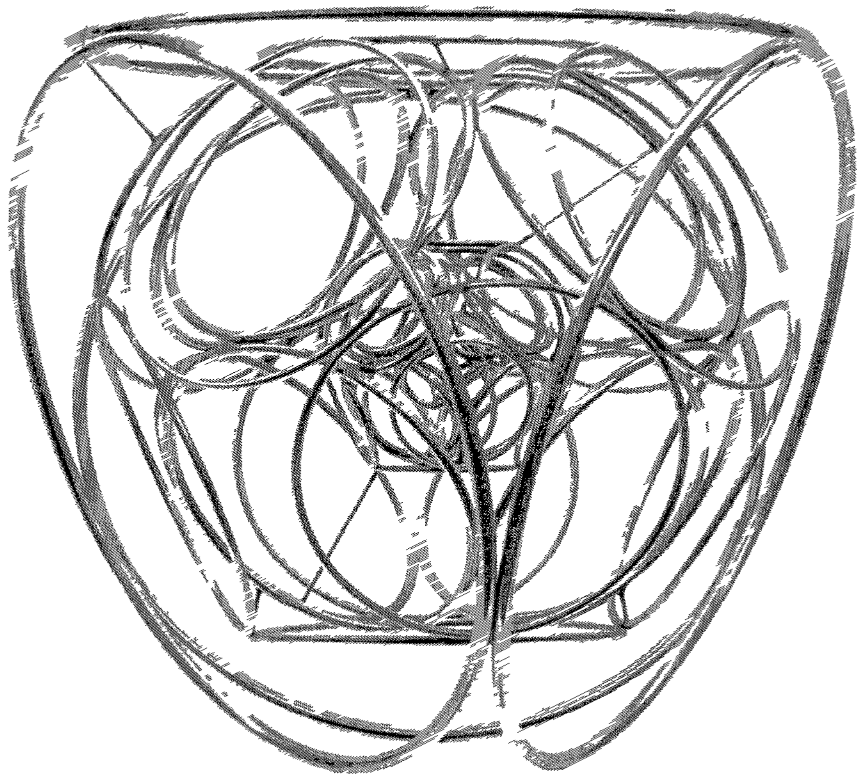


Figure 95 Snelson, *Portrait of an Atom*, 1965-2009 (Snelson Archive)

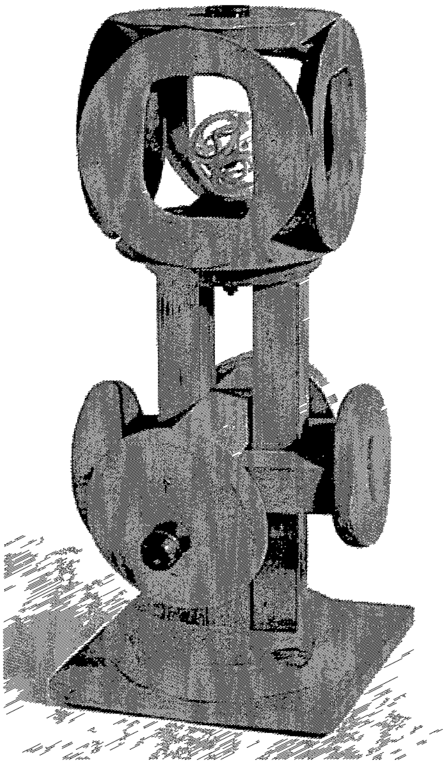


Figure 96 Snelson, *Homage to the Uncertainty Principle A Device to Aid Locating Electrons in an Atom if There were a Means to Look for them*, 1964 (Snelson Archive)

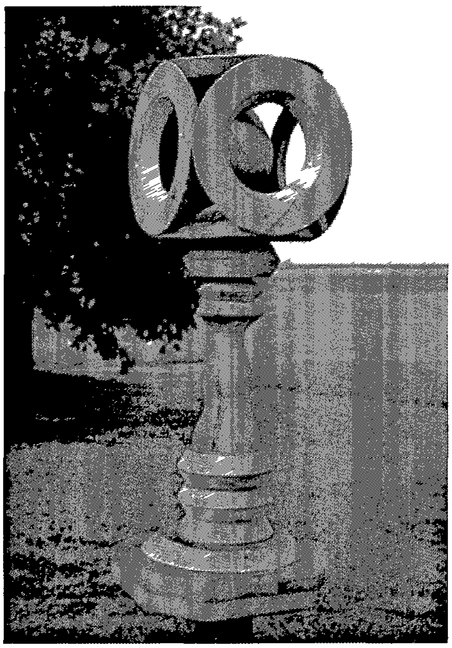


Figure 97 Snelson, *Wood Atom*, 1965 (Snelson Archive)

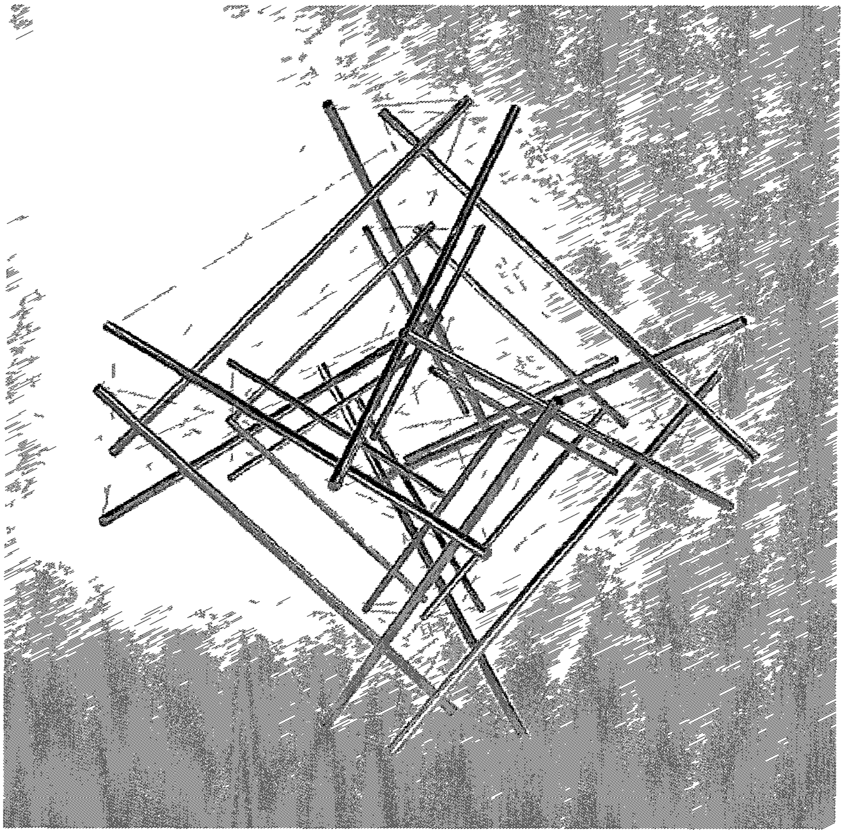


Figure 98 Snelson, *Double Shell Form 1*, 1979, Marlborough Gallery, New York

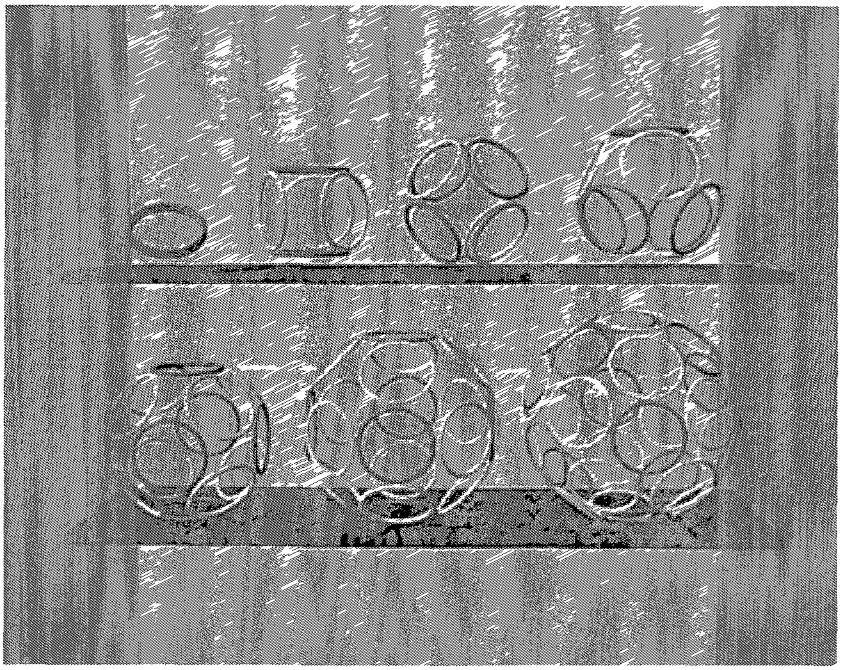


Figure 99 Snelson, digital atom image, n.d. (Snelson Archive)

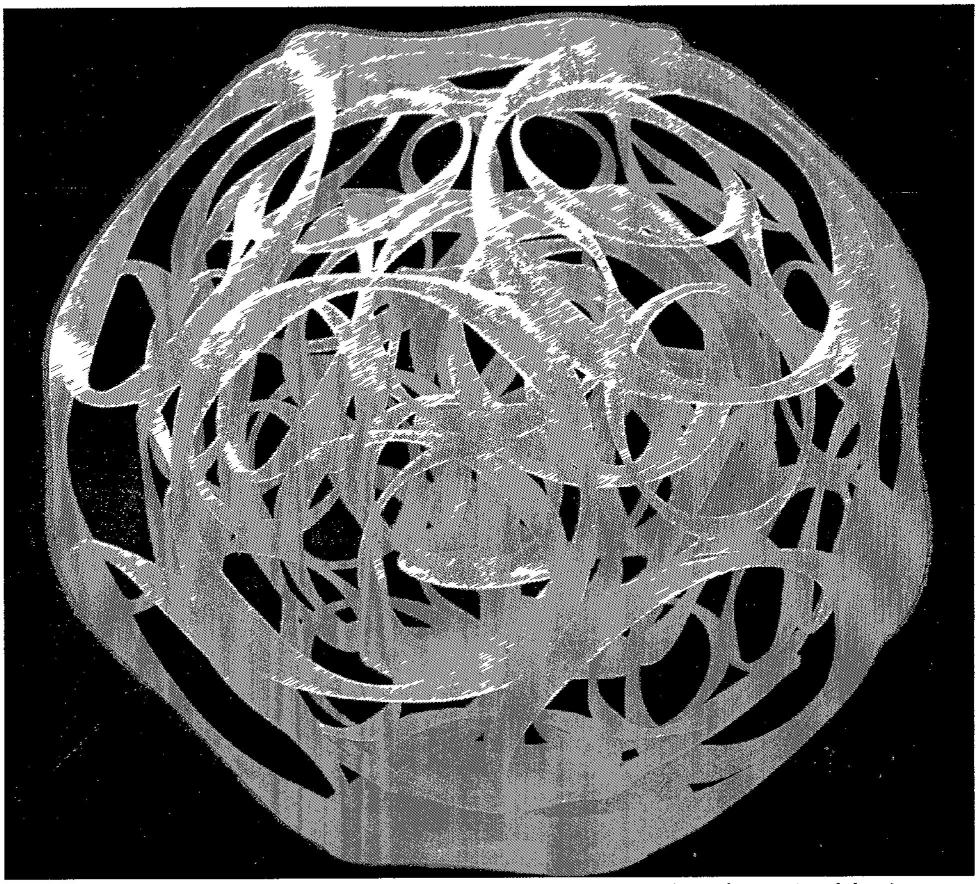
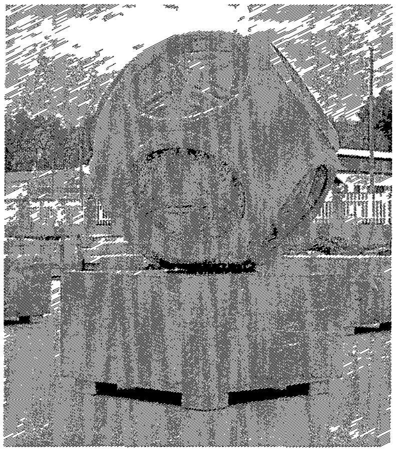
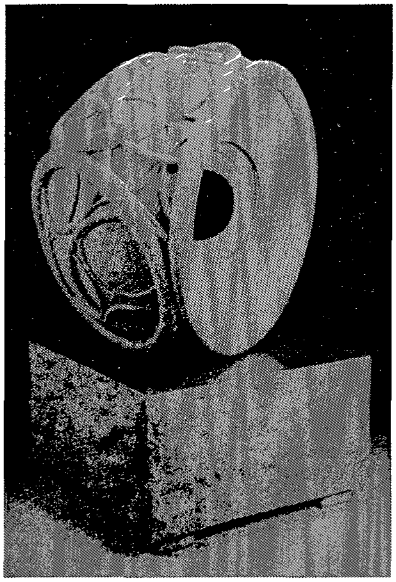
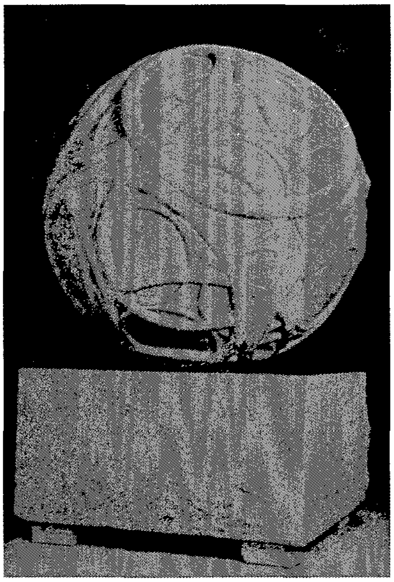


Figure 100 Snelson, Stereolithography atom, 2007 (Snelson Archive)







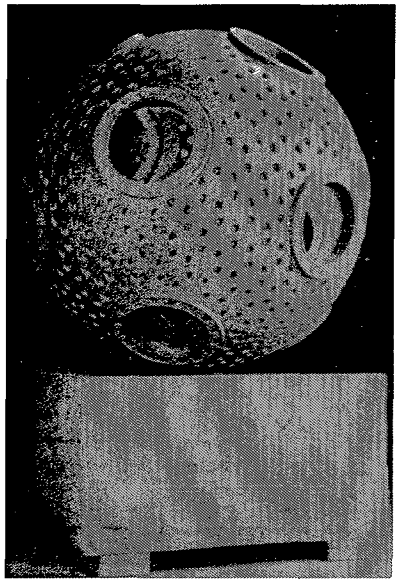


Figure 101
Snelson, Five granite spheres, 2008
(Snelson Archive)

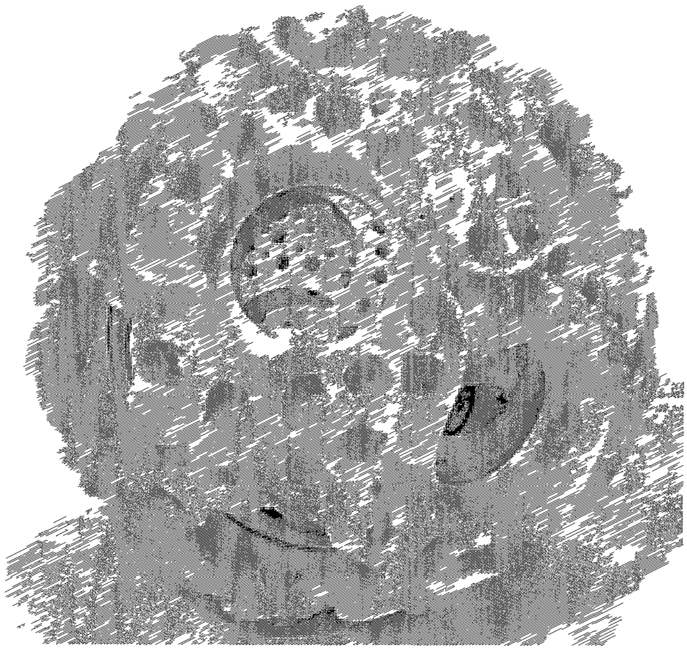


Figure 102 Chinese ivory ball, Nineteenth Century

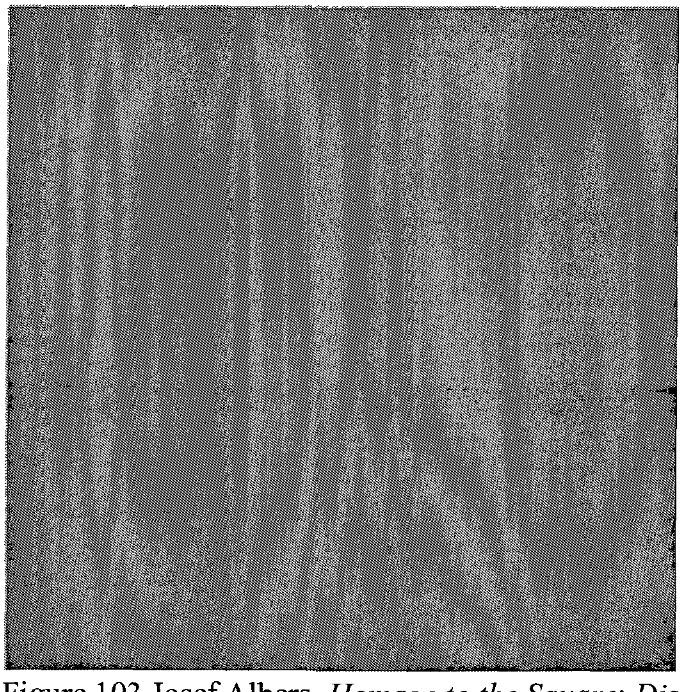


Figure 103 Josef Albers, *Homage to the Square: Dissolving/vanishing,* 1951 (Los Angeles County Museum, Los Angeles)

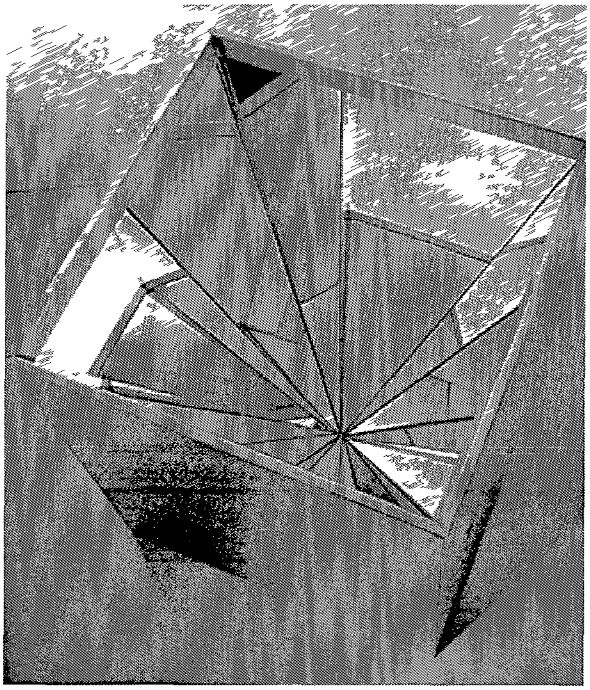


Figure 104 Robert Smithson, *Enantiomorphic Chambers*, 1965

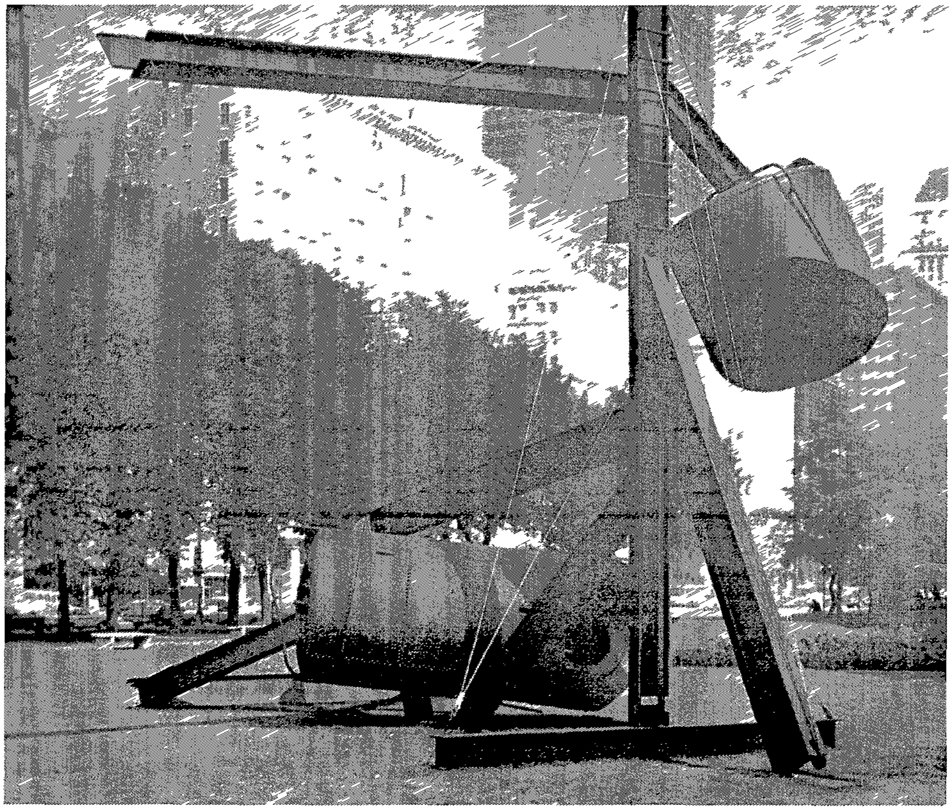


Figure 105 Marc di Suvero, *For Lady Day*, 1968-9 (*Sculpture in the Park*, Grant Park, Chicago, 1974)

Figure 106 Mark di Suvero, *Elohim Adonai*, 1966 (*American Sculpture of the Sixties*, Los Angeles County Museum, 1967, 99)

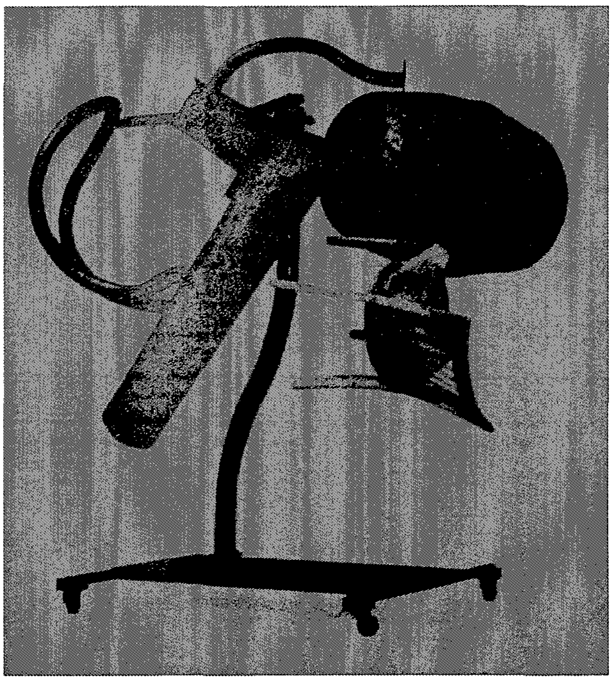


Figure 107 Mark Di Suvero, *Stuyvesantseye*, 1965 (Dalrymple Henderson, *Reimagining Space*, Blanton Museum of Art, The University of Texas at Austin, 2008)

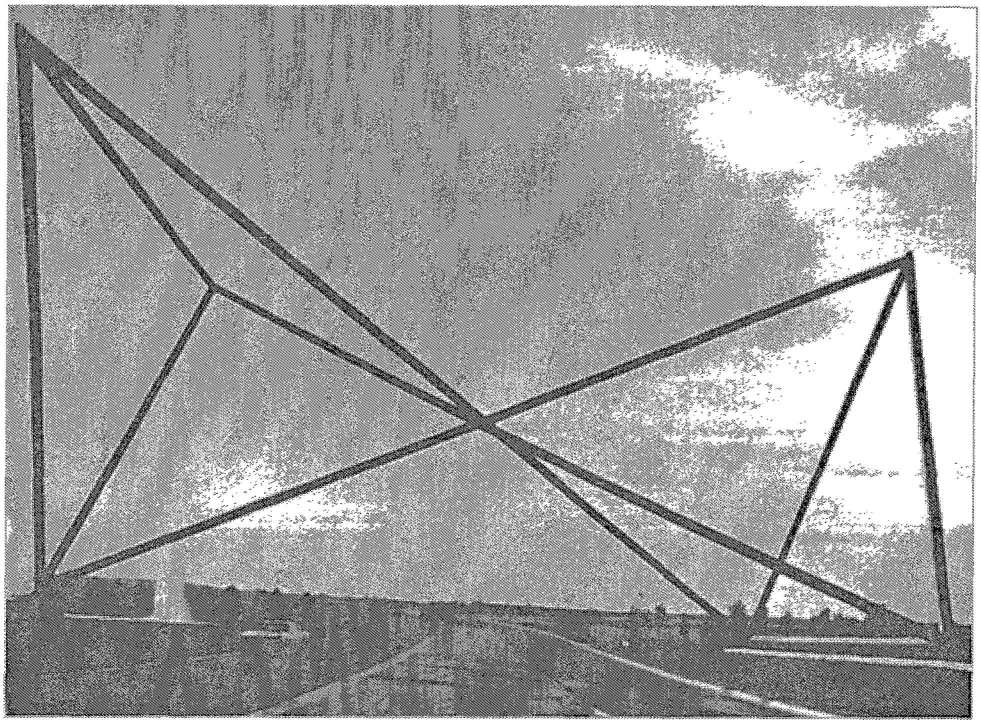


Figure 108 Peter Forakis, *Atlanta Gateway*, 1967

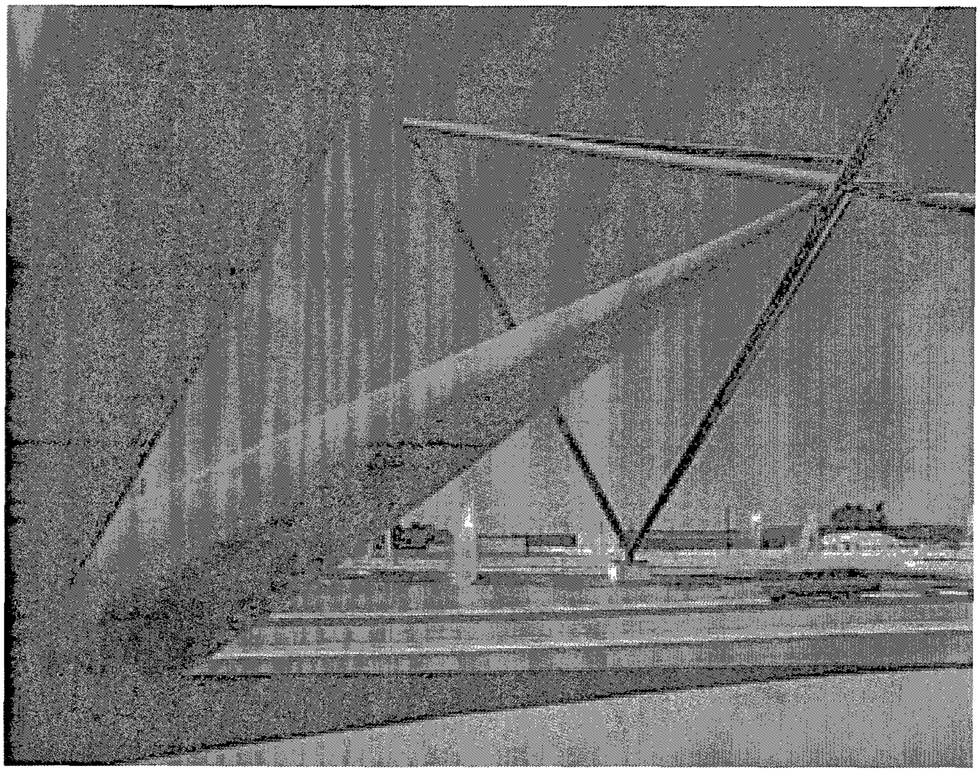


Figure 109 Peter Forakis, *Atlanta Gateway*, 1967

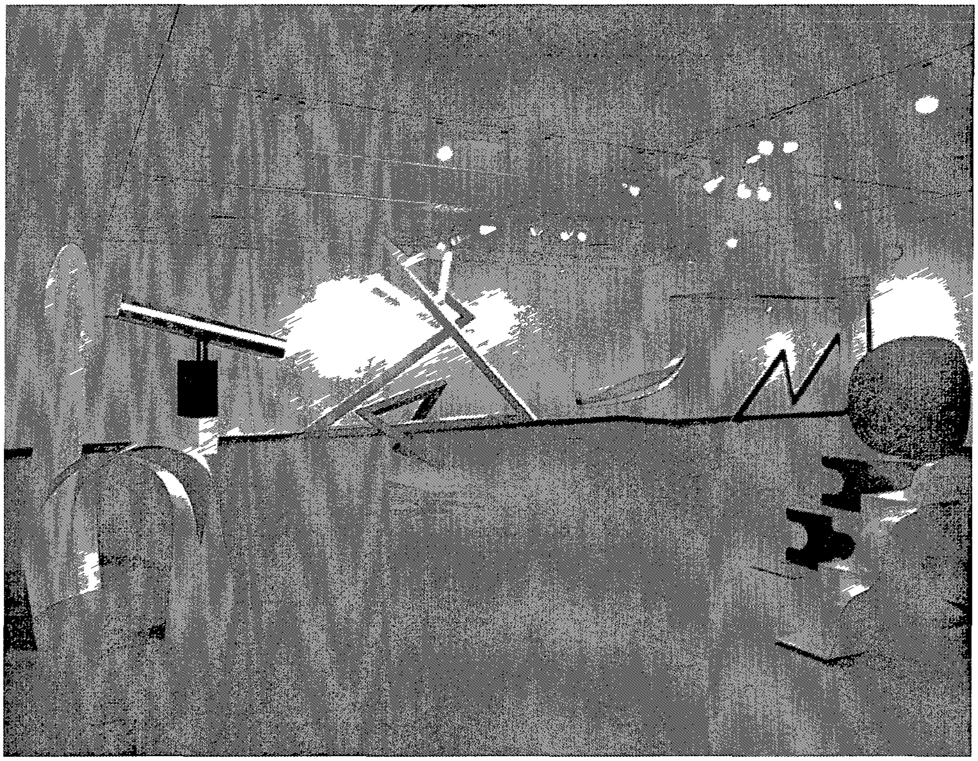


Figure 110 Gallery I, *Primary Structures*, The Jewish Museum, 1966, including work from left to right: Peter Forakis, *JFK*, 1963; Salvatore Romano, *Zeno II*, 1965; Forrest Myers, *Zigarat & W. & W.W.W.*, 1965; David von Schlegell, *Wave*, 1964; Ellsworth Kelly, *Blue Disc*, 1963; William Tucker, *Meru I, Meru II, Meru III,* 1964-65 (Meyer, *Minimalism: Art and Polemics in the Sixties*, 14)

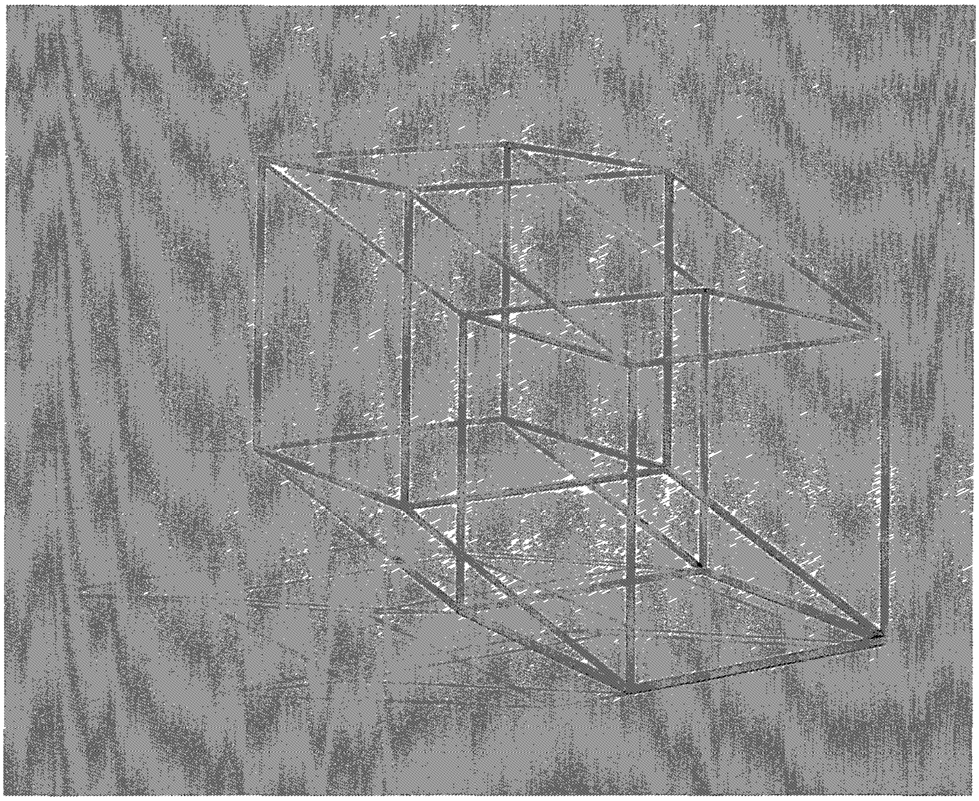


Figure 111 Peter Forakis, *Hyper-Cube*, 1967 (Walker Museum of Art, Minneapolis, Minnesota)

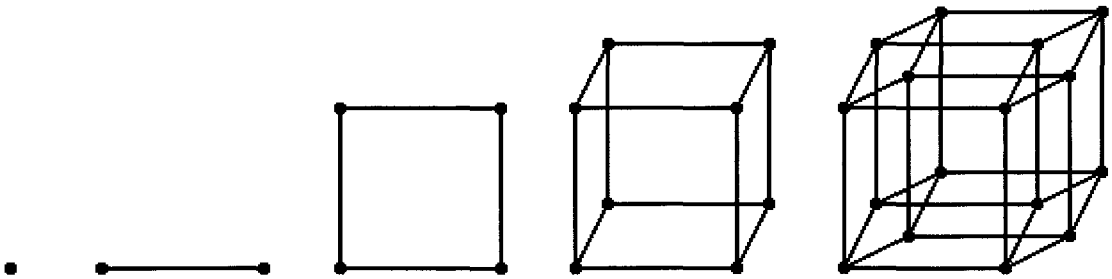


Figure 112 Forming a Tesseract or Hypercube (http://gerbonl.home.xs4all.nl/Tesseract.htm)

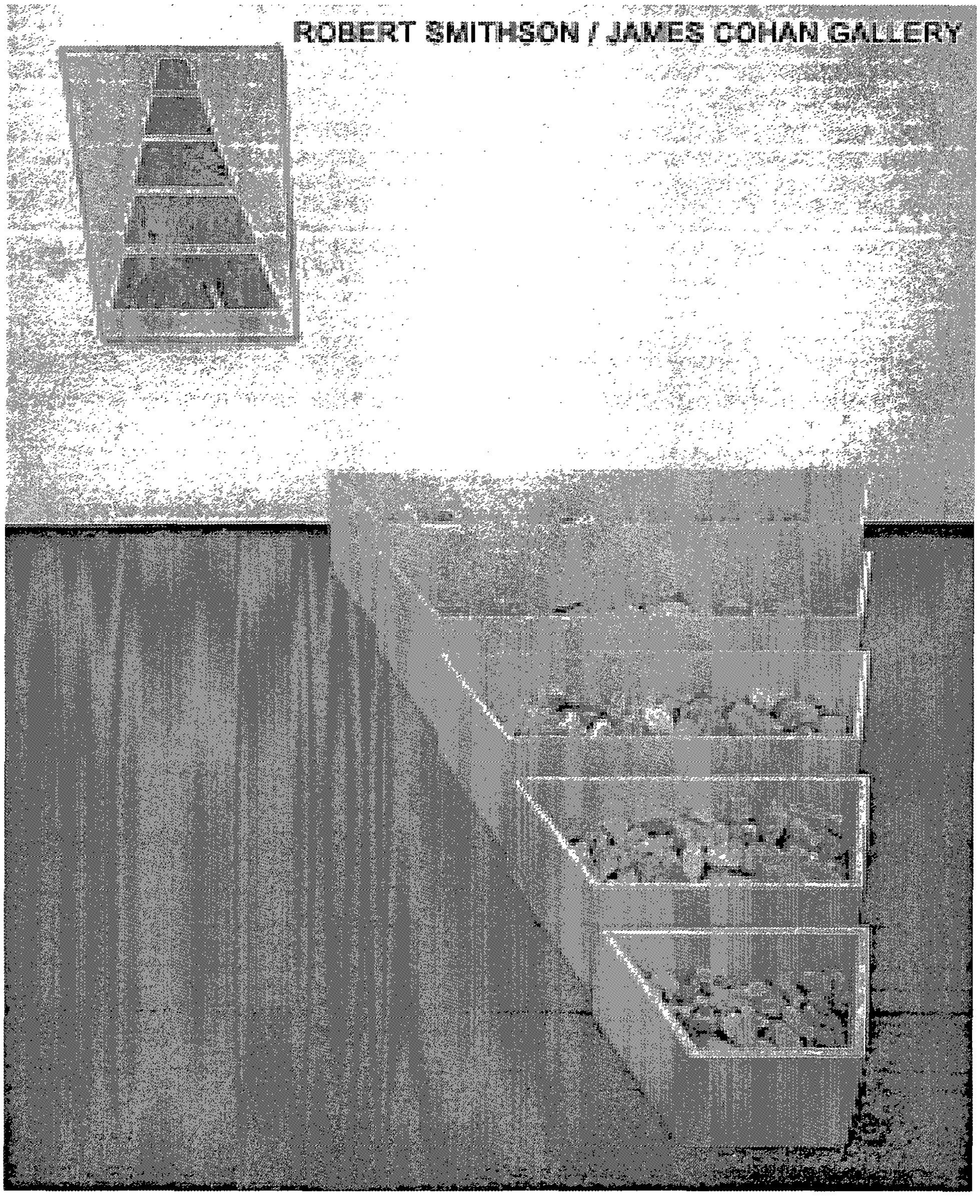


Figure 113 Robert Smithson, *A Nonsite, Franklin, New Jersey*, 1968
(James Cohan Gallery, New York)

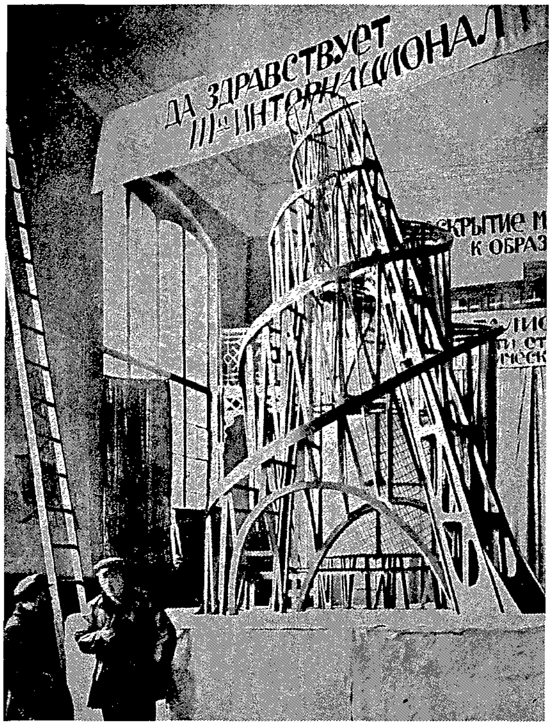


Figure 114 Vladimir Tatlin, *Monument to the Third International* (model), 1920

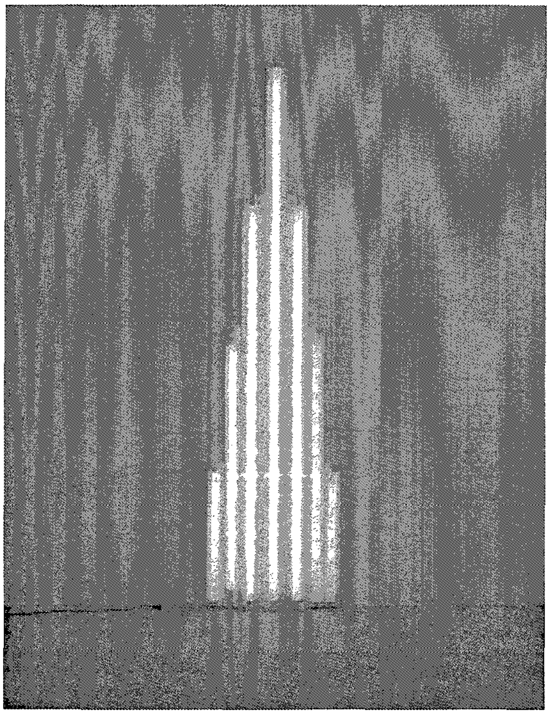


Figure 115 Dan Flavin, *"Monument" for V. Tatlin 1*, 1964 (The Museum of Modern Art, New York)

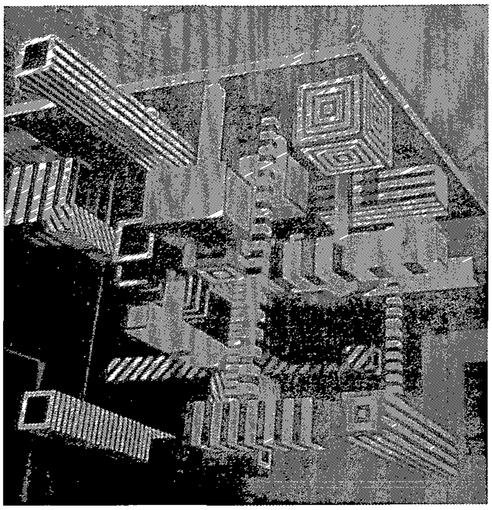


Figure 116 Sol LeWitt, *Hanging Sculpture with Stripes*, 1965

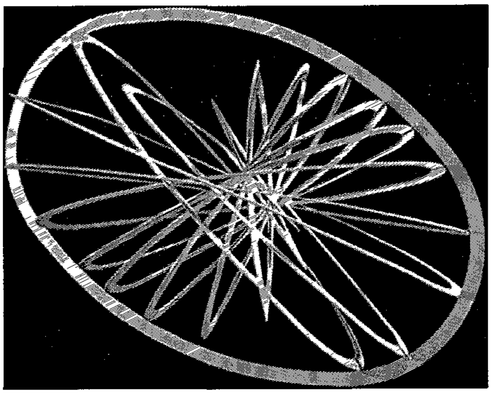


Figure 117 Alexander Rodchenko, *Spatial Construction 12*, 1920

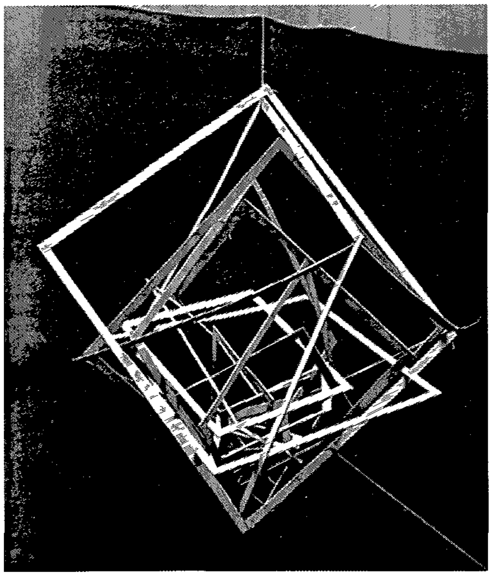


Figure 118 Alexander Rodchenko, *Spatial Constructions*, 1918-21

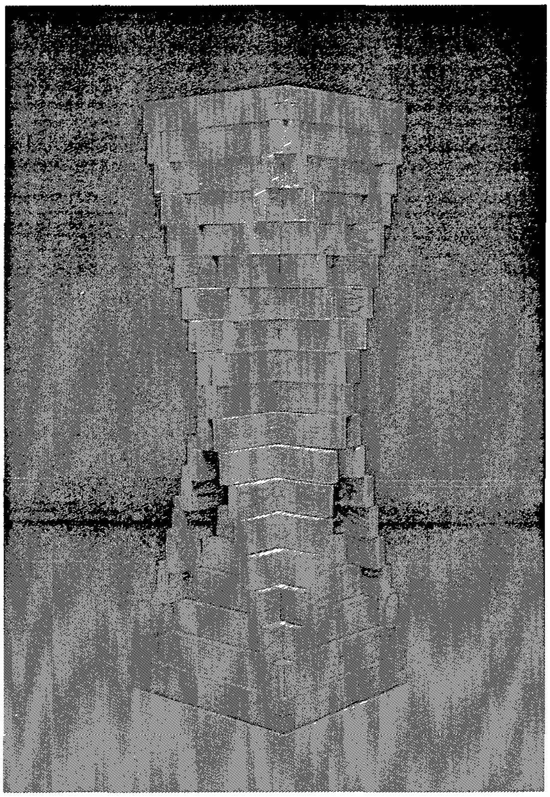


Figure 119 Carl Andre, *Pyramid (Square Plan)*, 1959 (1970 reconstruction)

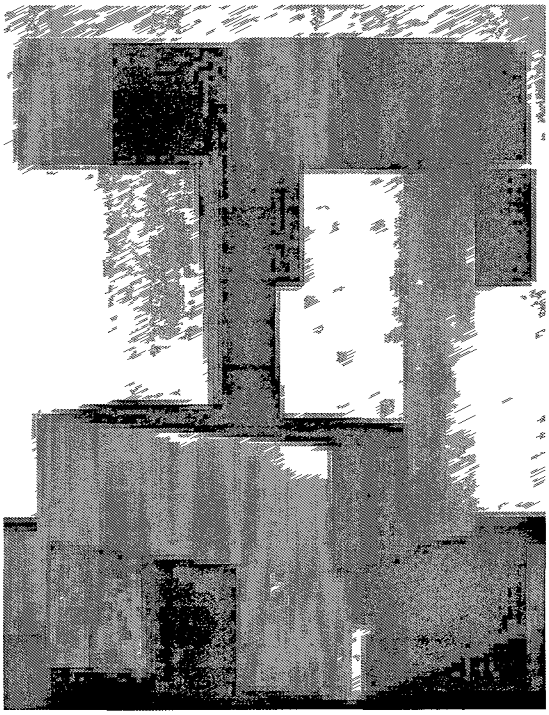


Figure 120 Alexander Rodchenko, *Construction of Distance*, 1920

Figure 121 Naum Gabo, *Linear Construction No. 4*, 1959-6 (The Hirshhorn Museum and Sculpture Garden, Washington, D.C.)

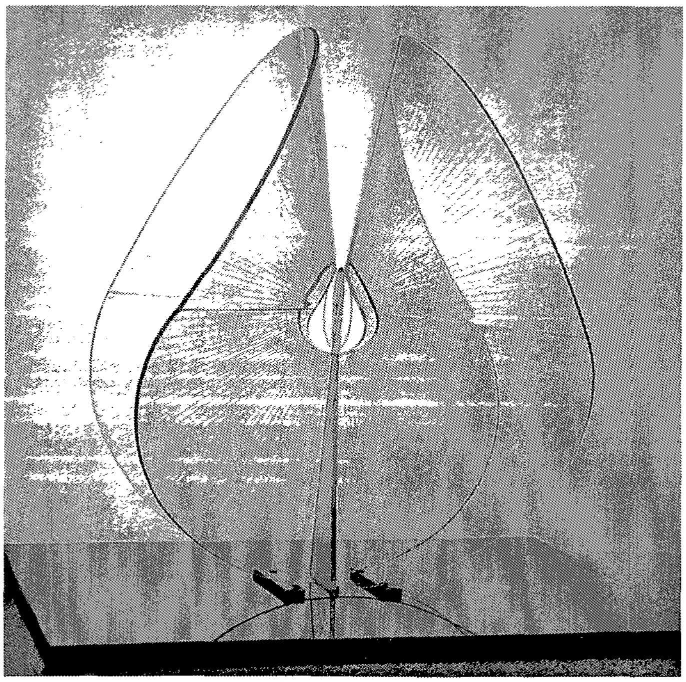


Figure 122 Naum Gabo, *Translucent Variation on a Spheric Theme*, 1937/51 (Tate Modern Museum, London)

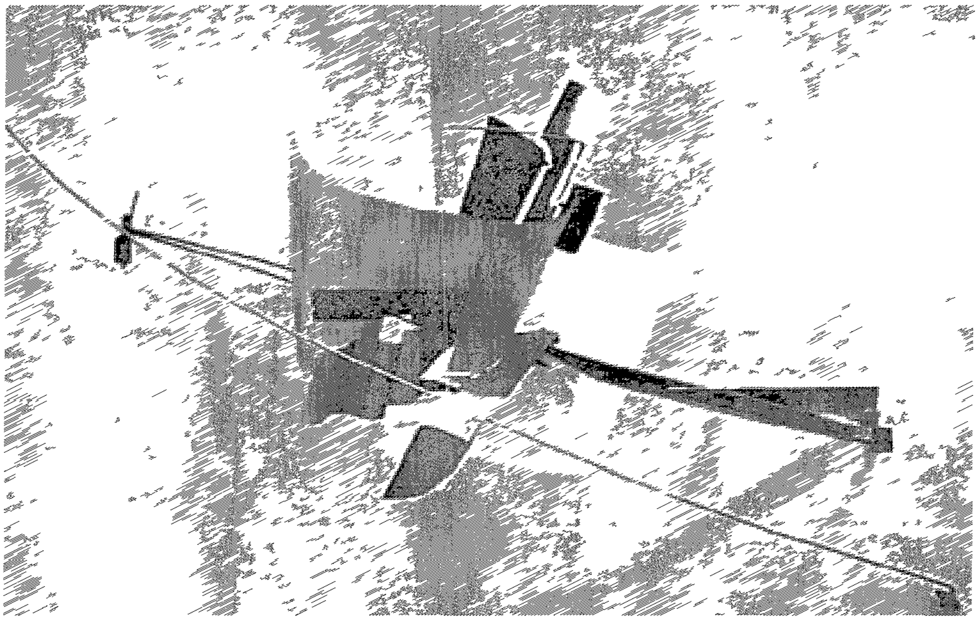


Figure 123 Vladimir Tatlin, *Corner Relief*, 1915 (1966-70 reconstruction) (George Rickey, *Constructivism: Origins and Evolution*, 1967)

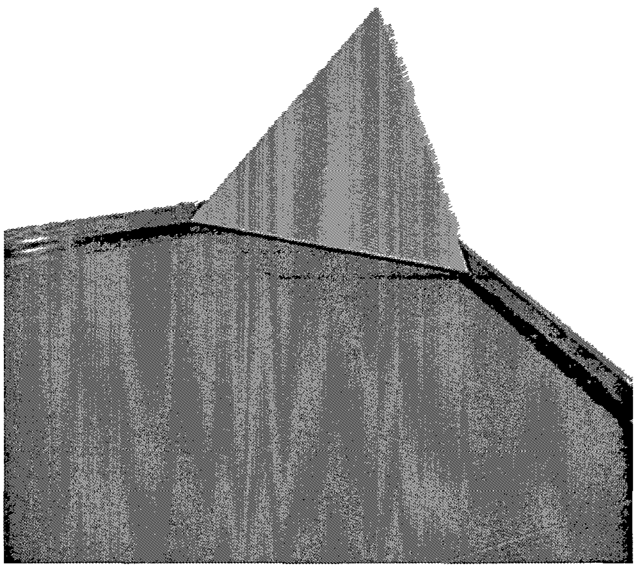


Figure 124 Robert Morris, *Untitled* (*Corner Piece*), 1964

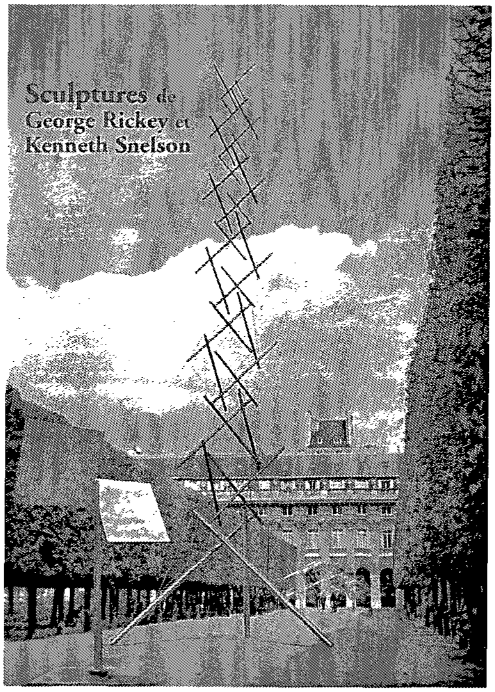


Figure 125 *Deux Américains à Paris: Sculptures de George Rickey et Kenneth Snelson*, curated by Robert Hobbs, Jardins due Palais Royal, Paris, France, 2006, catalogue cover

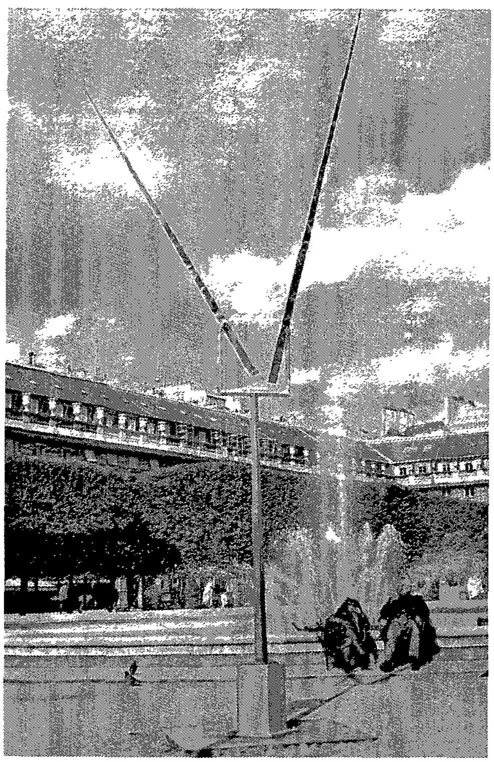


Figure 126 George Rickey, *Two Lines up Excentric Twelve Feet*, 1994 (*Deux Américains à Paris*, Jardins due Palais Royal, Paris, 2006)

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