KENNETH SNELSON

ART AND IDEAS

ESSAY BY ELEANOR HEARTNEY

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Essay by Eleanor Heartney
Additional text by Kenneth Snelson

KENNETH SNELSON
IN ASSOCIATION WITH
MARLBOROUGH GALLERY, N.Y., NY

For Katherine and Andrea

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by Kenneth Snelson

When I was a child growing up in Pendleton, Oregon, during the 1930s and 1940s I found a great delight and satisfaction in making things with my hands. In the years of the Great Depression, most children were accustomed to hearing those sad words: "We can't afford it." A good way for me not to take "no" for an answer was to try making a model, however rough, of the object of my dreams—a race car, a set of drums, a new bicycle or a dangerous Gee Bee racing plane. I especially enjoyed making model airplanes in those exciting years when we first saw the crop of sleek, experimental, streamlined beauties in the movie newsreels, in the comic strip "Smilin' Jack", or when Clark Gable sped around pylons or went down in flames.

Main Street in Pendleton, Oregon, September, 1934, decorated for the Roundup

Building flying model airplanes with balsa sticks and tissue put us as close as we could get to the excitement of flying during what's been called the "golden age of aviation." My rubber-powered airplanes were stand-ins for the magic of the real machine and we learned how to get them to perform in flight. The simple but painstaking technology—constructing glued-together balsa stick frames and very carefully covering the framework drum-tight with Japanese tissue, finishing it off with intoxicating paint—gave them a special, unclassifiable, tactile aesthetic, a form that is uncannily light and strong.

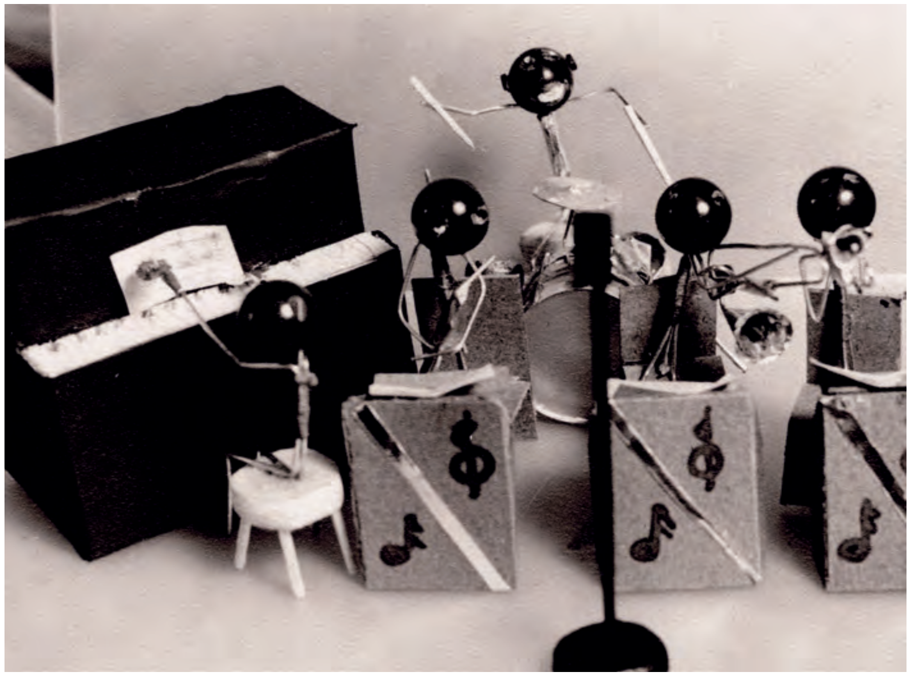

Kenneth, age 5, photographed by his father on a pony at the Pendleton Roundup

From building things I developed skills that convinced me, even as a boy, that I could create a model of anything I might imagine. Sculptures and atoms were yet to come.

Looking back I can see the connection between my love for making model airplanes and playing drums in a band during my teens to making sculptures with steel pipes and cables in my adult years. All three involve internally stored-up energy: tension pulling against solid resistance; the airplane's skin shrink-stretched over the frame for strength; drumheads stretched for tuning; and steel cables pulling against the struts to make the

Kenneth, 1942, looking to become the next Gene Krupa

Kenneth, age 8, discovered the joy of building stick-and-tissue model airplanes



Model of Jimmy Foster’s band, 1938
black beads, film can, cardboard, balsa wood, paper clips

sculpture firm. All possess what is called *prestressing*—materials under internal pressure and external tension—a natural principle that seems to hold a universal attraction for people. It is what urges men to kick the tires in an auto showroom and what makes playing with soap bubbles and balloons forever fun.

Jack Snelson on his Flying Merkel motorcycle, 1912

Photography became part of making things because my father opened The Snelson Camera Shop when I was six years old. The 1930s were especially the time when a remarkable assortment of classy innovative cameras were being made in Germany: Leica, Contax, Rolleiflex, Voigtländer, Plaubel Makina and the rest. Dad allowed me to shoot a trial roll of film in each new model that arrived in the store. (There was no such thing yet as a camera from Japan.) The camera shop, and all that it made available to me, was Dad's most valuable gift to me as it became my school of photography including movies, panoramas and working in the darkroom. It also sustained me as a freelance cinematographer in my early years.

My father, Jack Snelson, son of a building contractor, was born in 1884 in Rolla, Missouri. At age thirteen, he ran away from home to become a teenage hobo, riding the rails around the U.S. wherever the train might take him. He told my brother and me colorful and thrilling stories about adventures and daring far from anything I could experience living safely in our small town of Pendleton. He told of being in the great 1906 San Francisco earthquake, living in a hotel that crumbled as guests escaped into the street; how everyone camped in tents in the parks because the great city was in flames. For a year he served as cabin boy on a ship sailing out of Seattle. He told of crashing his Flying Merkel motorcycle; breaking his arm in three places. Then, at nineteen, he decided "to make something of himself," as he said, and got a job in a laundry in Jacksonville. So began his life's work in the laundry business: working in laundries, selling laundry machinery on the road and, in 1926, buying the Troy Laundry in Pendleton, Oregon.

Jack Snelson with the laundry truck, Pendleton, Oregon, 1929

Of all my father's adventures the one that affected me most happened in 1920, long before I was born, while he was living in New York City, managing the Morgan Steam Laundry in The

Kenneth Snelson, photographer, 1937

Jack Snelson at the Snelson Camera Shop, 1940

Jack Snelson and his Elgin, 1919

Bronx. One lovely spring morning Jack was driving his shiny black Elgin down the Grand Concourse to work. When he came to a momentary traffic stop he saw, standing but a few feet away, waiting for her street car to work at the offices of the American Split Steel Pulley Company, the attractive young Mildred Unger. Jack and Mildred caught one another's eyes and he offered her a ride.

My mother, Mildred Unger, daughter of Hungarian Jewish immigrants, grew up in one of New York's harsh neighborhoods. She spoke wistfully of wishing as a girl to be a dress designer but coming from a poor family she hadn't a clue how an inexperienced girl with a tenth grade education might find her way into New York's world of fashion. Grocery shopping or wherever, mother was always meticulous in her dress, even though Dad's income from the ever-struggling laundry and camera shop never allowed her to own the fashionable wardrobe she longed for, in order to be part of a chic world she imagined; one that, in any case, never existed in Pendleton.

The stories Mother told about her youth made New York sound like the most exciting, yet dangerous, place in the universe. Those stories and her complaints about living in the boring confinement of a small town, along with my father's stories of his adventures, no doubt, contributed to my choice to live in the *Big Apple*. I moved to New York at about the same age Mildred Unger had been when she married Jack Snelson and left New York for Pendleton, Oregon.

Pendleton, in the northeastern corner of Oregon, was a remote small town of 7,000 in the 1930s and 1940s, obviously far from any center of culture except for what we saw in *Life* and *Time* magazines and heard on the radio. I never knew or heard about a real living artist in our town, home of the Pendleton Roundup. In those times in towns across America, to be an artist was something "far off"; a phenomenon from somewhere, but not from here. In people's imagination an artist emerged from the womb as a child Raphael of storybook legend or a Joan of Arc whose voices tell her to pick up pallet, paints and brushes. In any case,

Mildred Unger in sheep country wearing a fox fur, 1920, Pendleton, Oregon

Jack, photographed by Mildred, Rockaway Beach, New York
Beside him, sitting in the sand is his fine professional Graflex camera.

Jack, Kenneth (seated), and his older brother Everett,1928, by the family's Lincoln.The day's hunt included two bucks and a black bear.

Mildred, 1922, Canon Beach, Oregon

no such spirit had ever appeared in Pendleton. So, when a grownup asked, “What do you want to do when you grow up?” my most reasonable answer was, “I’m going to be building model airplanes.”

In May 1945 when I graduated from high school, World War II in the Pacific was still going on and so was the military draft. Considering I would turn eighteen in the next month I signed up for for training as a radio technician in the Navy. After two months of training, the war with Japan ended with the horror of Hiroshima and Nagasaki. I was transferred to a Naval Intelligence Office in Washington D.C. At the end of a year the military began discharging all of us who were no longer needed. According to the G.I. Bill, men or women who had served a year or more were entitled to four years of college. Good fortune had kept me in for just thirteen months. The education grant was the jewel of the G.I. Bill and by 1947 half the college students nationwide were veterans. Without that advantage I might today be somewhere else but surely I wouldn’t be where I am.

As a nineteen-year-old starting out in a world that had ended the great drama of World War II, I now agonized over the question whether Kenneth Snelson was born with the aura of an artist. To declare to myself, let alone to my parents and friends, that I had selected to major in art was bold in the extreme and I chose to not even try to explain.

In May, 1948, at the end of my sophomore year at the University of Oregon, I was beginning to believe that it might be possible to become a real painter—with study and work and faith that I had talent. It also began to occur to me that there might be places even more interesting to study art than in my native state of Oregon. Moreover, since I was on the G.I. Bill, the government did not care where they sent my tuition and subsistence checks. It was then, in the University library, that I first read about Black Mountain College in North Carolina.

Kenneth, May 1945, graduation day, Pendleton High

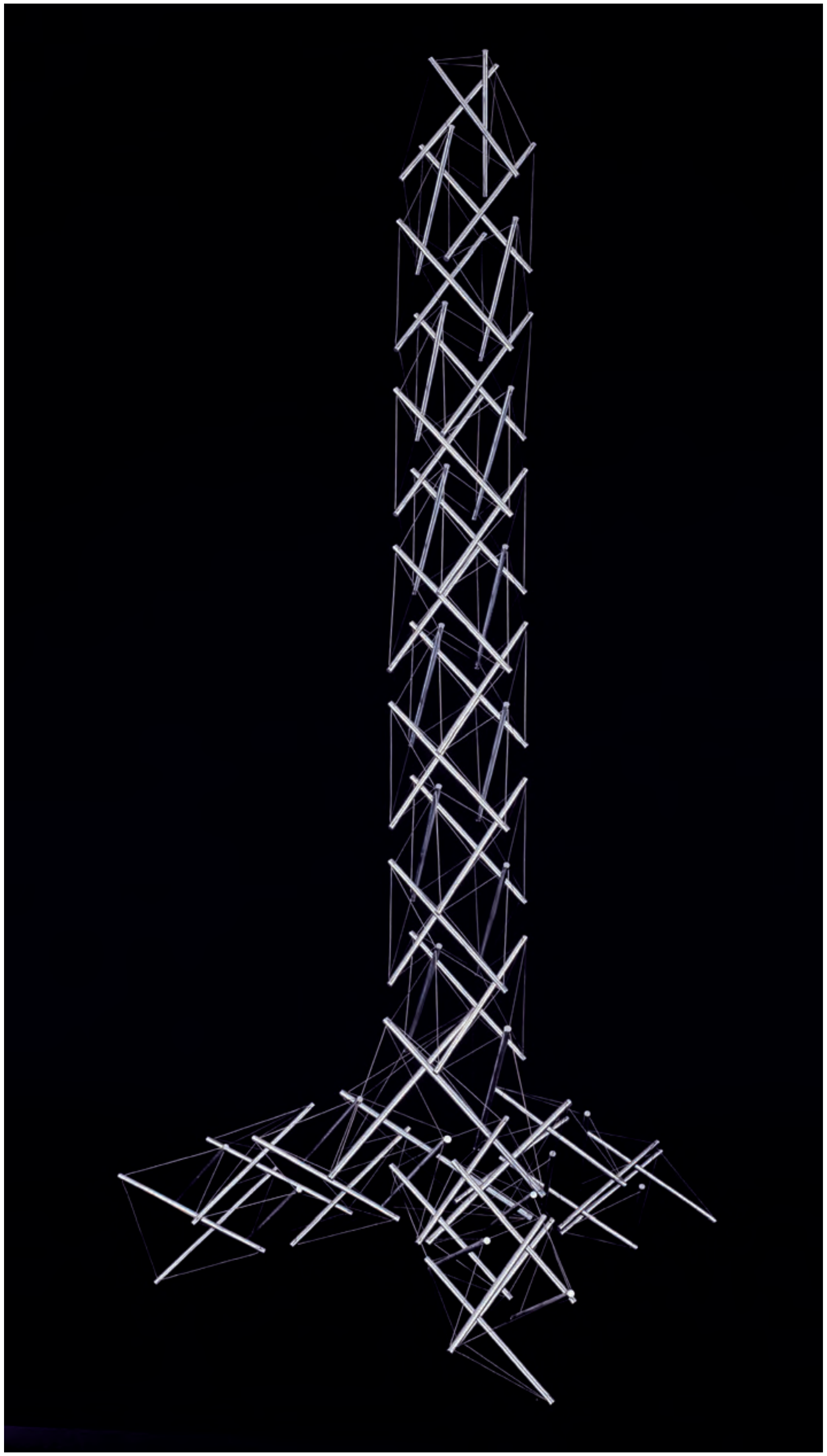
Kenneth, 1946, Washington, D.C., a sailor on his Harley Davidson

Kenneth Snelson, self-portrait, December, 1948, Pendleton, Oregon

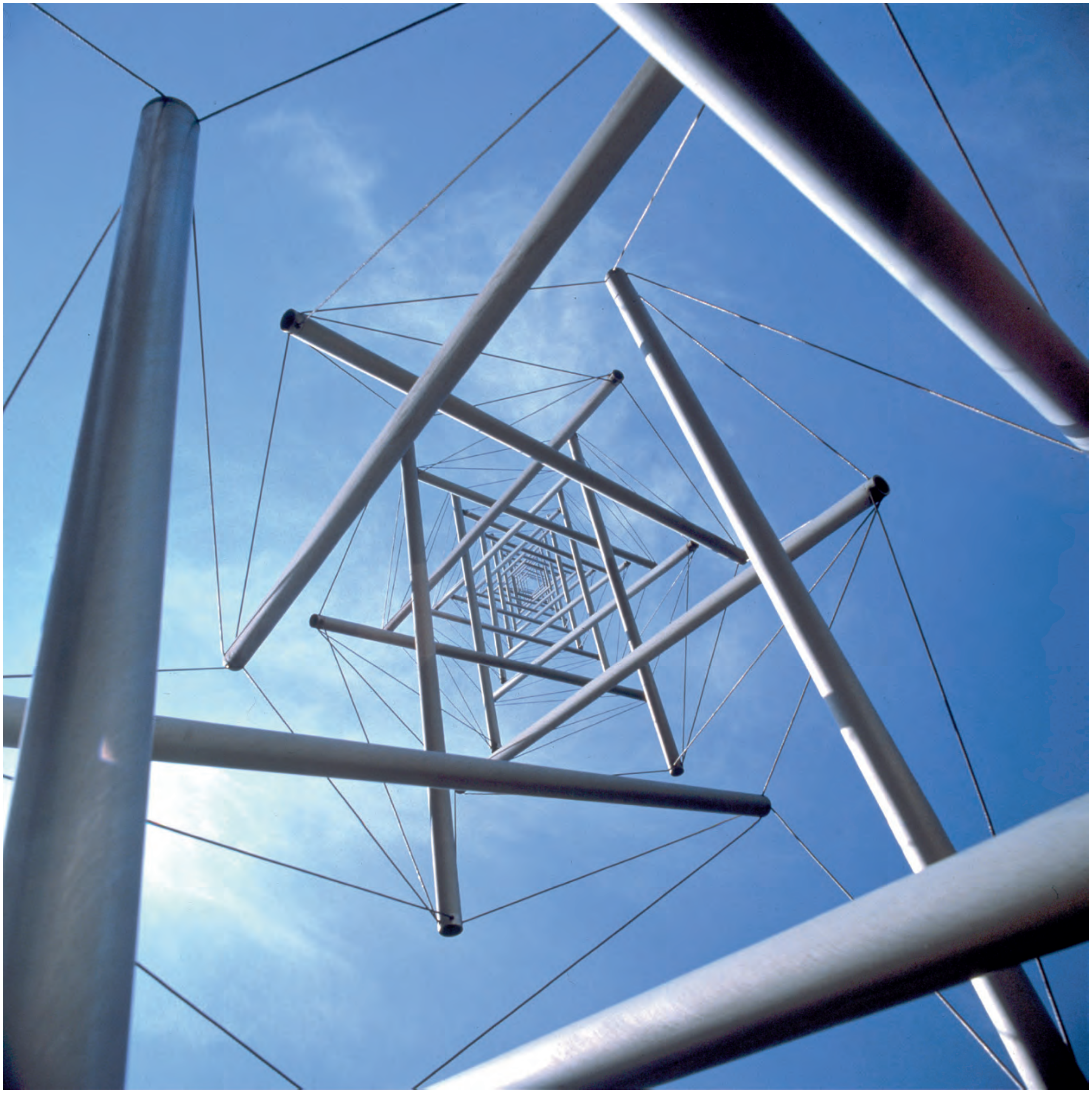
FORCES MADE VISIBLE
by Eleanor Heartney

In the dawn of the modern era, words like “purity,” “simplicity” and “truth” carried a moral force. Early abstractionists like Piet Mondrian, Wassily Kandinsky and Kasimer Malevich as well as pioneers of modern architecture like Louis Sullivan and Frank Lloyd Wright believed that art was part of a more general inquiry into the underlying structures of the universe. The pursuit of art and architecture became a quasi-religious quest for hidden truths that would enhance human life at a moment of tremendous change. The heart of the universe was open to those who approached it properly. Simplicity, transparency and intelligibility were tools in this search. In this spirit, Kandinsky declared, “All methods are sacred if they are internally necessary. All methods are sins if they are not justified by internal necessity.” Sullivan, condemning architectural ornament that obscured a building’s structure, argued that “Form follows function.” This statement was amended by Wright to “Form and function should be one, joined in a spiritual union.”

Today, the myriad of artists producing abstract paintings and sculptures in a highly decorative mode have largely discarded such thinking. However, the intellectual urgency that inspired the early modernists can still be felt in the work of Kenneth Snelson who, for the last five decades, has been engaged in a series of investigations into the structures of nature, the points of convergence between science, mathematics and art, and the continuity between the micro and macroscopic realms. He pursues this inquiry in a variety of formats. He is perhaps best known as the creator of elegant metal sculptures composed of complex structures held in place through the forces created by combining metal rods and flexible cables. He has also been engaged for many years in a dialogue with physicists and mathematicians over the structure of the atom and has used his own elegant solution to the problems posed by quantum mechanics to create sculptural models and beautiful digital images. And,



Trigonal Tower, 1962-63
aluminum and stainless steel
65 x 31.5 x 28 in
165.1 x 80 x 71.1 cm



Needle Tower, 1968
aluminum and stainless steel
60 x 20 x 20 ft
18.2 x 6 x 6 m
Collection: Hirshhorn Museum and Sculpture Garden, Washington, D.C.

he has explored the shape of visual space with sweeping photographic panoramas of urban landscapes.

While Snelson is loath to adopt the mystical language of Kandinsky or Wright, there is a Platonic imperative behind his thinking. His work is governed by a sense of the connection between the visible and invisible worlds. He describes the principle behind his sculptures as “forces made visible.” His atom presents his effort to give tangible visual form to the invisible building block of the universe. And, in an affirmation of the Platonic equation of truth and beauty, all of his artworks are imbued with an aesthetic whose pleasure derives in good part from their revelation of the structures in reality.

Needle Tower II, 1969
aluminum and stainless steel
90 x 18 x 18 ft
30 x 6 x 6 m
Collection: Kröller-Müller Museum
Otterlo, Netherlands

Snelson's interest in such matters can be traced to his childhood in Pendleton, Oregon, where, as a boy, he became fascinated with making models, and creating airplanes, boats and race cars out of cardboard, balsa wood, and rice paper. Building models offered him a feeling of mastery over the world and a sense that he might be able to construct an alternate universe. The models were also a way to work out abstract principles of balance and tension through objects that could be experienced with the senses. Thus, from an early age, it was clear that Snelson's interest in structure, mathematics and physics would be grounded in physical materials and that he would be a "builder," rather than a theoretician or physicist.

However, for a young boy in Oregon, the option of a career in art did not immediately present itself. As Snelson notes, "The discovery that art was approachable at all was somewhat astonishing since I grew up with the commonly held belief that artists, somehow, of all human beings, are not made, but born with a mystical aura, which, if you had it, should be visible to all, though none of us had known such a spirit in Pendleton." Snelson made this discovery when, after a stint in the U.S. Navy at the end of the Second World War, the G.I. Bill allowed him to enroll at the University of Oregon. Along with courses in accounting and pre-law, he began to study architectural drawing and design, which eventually led him to art. His most memorable teacher at the University was Jack Wilkinson, whose Basic Design Course introduced him to the notion of art as an intellectual exercise, with discussions of semantics, Gestalt psychology and mathematics. Wilkinson's teaching methods drew on techniques from the educational program of the Bauhaus, the innovative industrial design school which operated in Germany from 1919 until it was shut down by the Nazis in 1933, at which point many of its prominent practitioners fled to the United States. Bauhaus education was based on the notion that mass production was reconcilable with the individual artistic spirit and centered around workshops in which students learned the principles behind

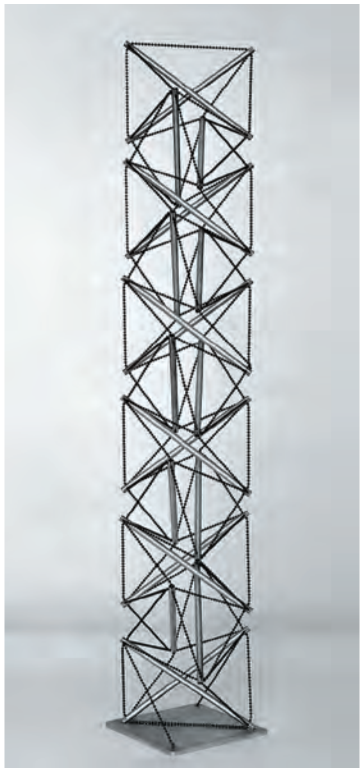

Kenneth, 1936, with Spee-Dee model airplane

disciplines like metal, wood sculpture, glass painting, weaving, pottery, furniture, cabinet-making, typography, and wall painting. In practice, as Snelson discovered, this involved practical exercises in the creation of objects out of cardboard, wire, balsa wood paint and construction paper, activities which resonated with his childhood pursuits.

But despite his longstanding interest in model making, Snelson initially pursued painting, a field which in the late 1940s was dominated by debates over the meaning and direction of abstraction. Snelson was particularly enamored of figures like Josef Albers, Lyonel Feininger, Wassily Kandinsky and Paul Klee, and when he discovered that Albers, a former Bauhaus instructor, was Dean of Black Mountain College in North Carolina, he and a friend decided to apply for admission to the summer session.

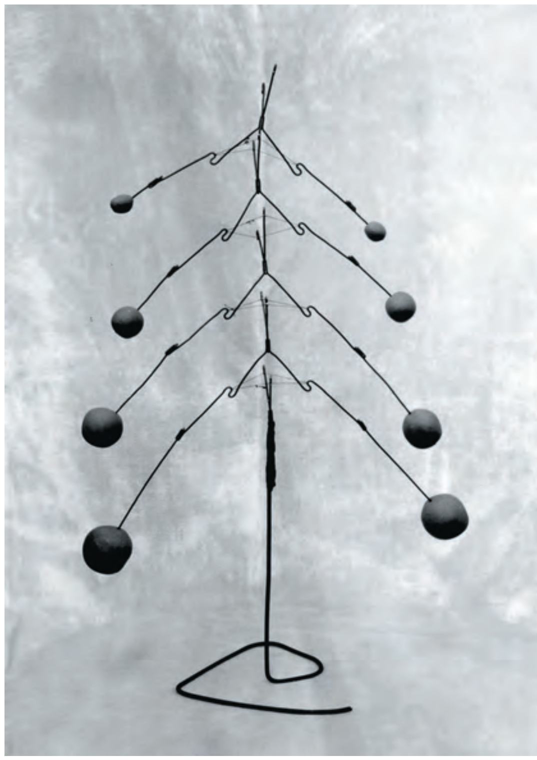
Black Mountain College founded in 1933 was an exemplar of the progressive educational principles of John Dewey and the Bauhaus. Unlike other educational institutions, the college was faculty owned and operated, and devoted to the idea that the arts are central to any real education. It was also structured in a radically democratic way, and both faculty and students participated in day-to-day operations like farm work, construction projects and kitchen duty.

The two summers Snelson spent at Black Mountain College in the years 1948 and 1949 turned out to be pivotal in his career, turning him from painting to sculpture and sealing the future direction of his art. During Snelson's first summer at Black Mountain, the faculty included Albers and his wife Anni, Willem de Kooning, John Cage, Merce Cunningham and Richard Lippold, as well as a last minute replacement teacher named Buckminister Fuller. Not yet a celebrity, Fuller nevertheless became a kind of guru for many of the students, and, fortuitously, Snelson was picked to help him create the models of geometric structures that he used in his lectures. Fuller, who would later become known as the master of the geodesic dome, was a mesmerizing lecturer who enlisted the students in realizing his elaborate visionary projects.



X-Column, 1959
aluminum and bead chain
35.5 x 6 x 6 in
90 x 15 x 15 cm

Moving Column,1st Study, 1948
mixed media
23.75 x 11 x 4.5 in
60 x 28 x 11.5 cm



Moving Column, 2nd Study, 1948
mixed media
17.5 x 12.5 x 5.375 in
44.5 x 32 x 14.5 cm

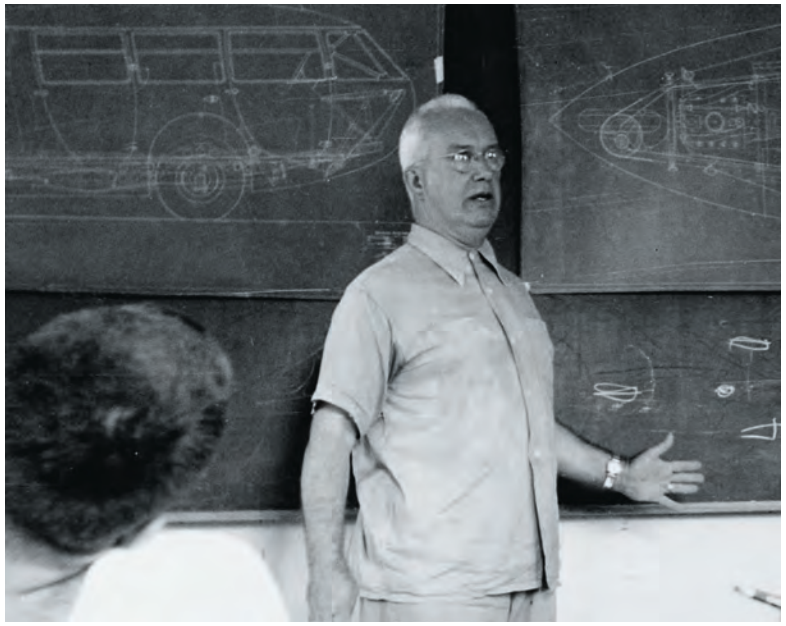
At Canon Beach, 1946
casein on masonite
24 x 24 x 24 in
61 x 37.5 cm

Upon his return to the University of Oregon that fall, Snelson began working with wire sculpture that consisted of stacked elements and moved on swivel points. He achieved a major breakthrough with a work he titled *Early X Piece* (1948), in which two wooden X forms were held together without touching by a matrix of nylon tension lines much in the way a kite frame is constructed with sticks held together by taut strings. This work was a rudimentary example of a principle for which Fuller later coined the word “tensegrity” (a combination of the words tension and integrity). Essentially, it refers to structures composed of bars or tubes that do not touch and are held in place by tension cables. Simple as this pioneering work was, it pointed ahead to the possibility of structures in which form and function truly are, in Frank Lloyd Wright’s formulation, one, and the visible configuration of the sculpture is simply the revelation of otherwise invisible forces. The essence of tensegrity is flexibility—things maintain their form through the outward push of the compression tubes and the inward pull of the tension cables. As a result, the tubes, which in a more conventional sculpture would form a rigid armature, here never touch one another. The resulting structures will bend, rather than snap, when subjected to pressure. And they will hold together independent of gravity. As Snelson describes it, “The sculpture could be put into orbit in outer space and it would maintain its form. Its forces are internally locked. These mechanical forces, compression and tension or push and pull are invisible—just pure energy—in the same way that magnetic or electric fields are invisible.”

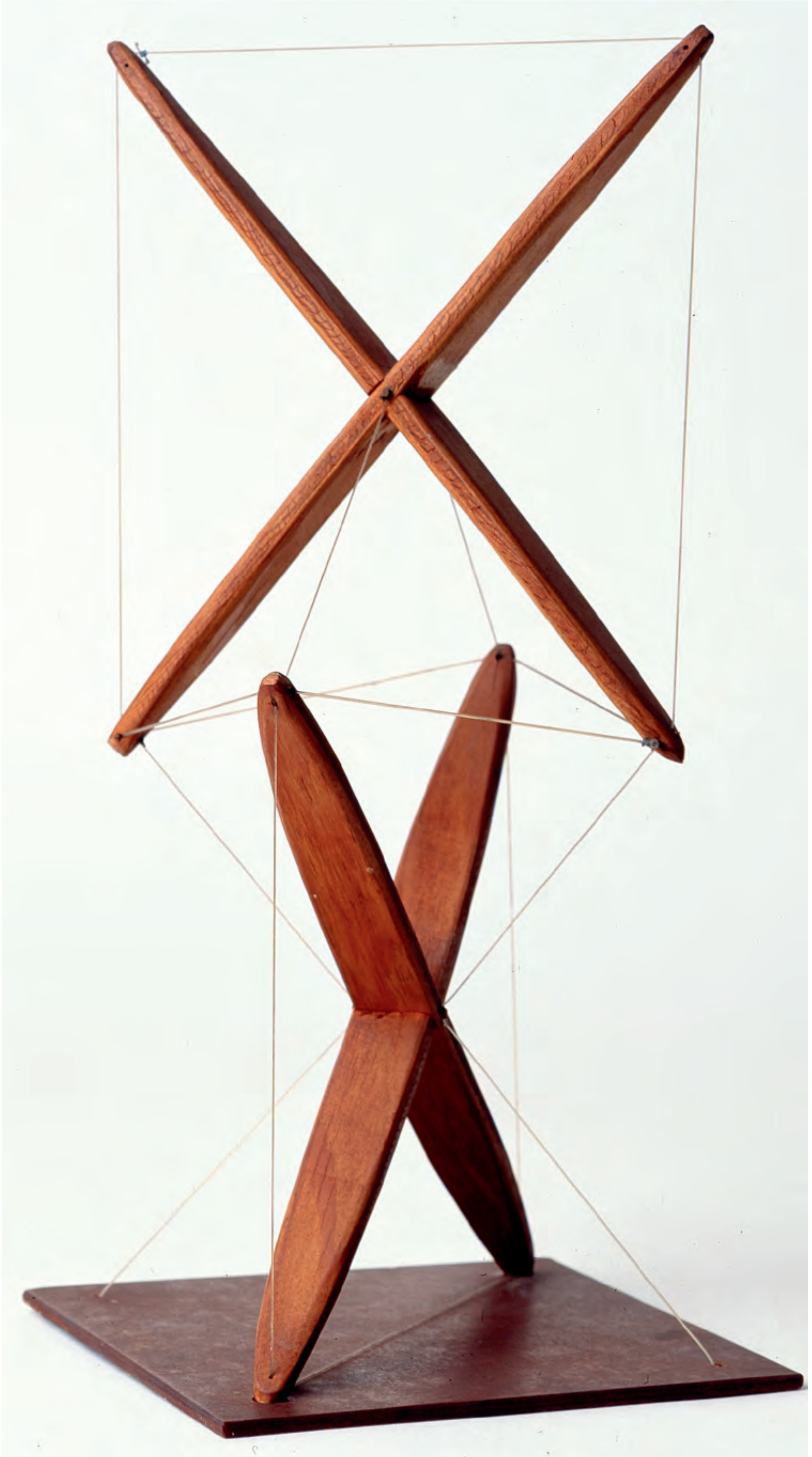
The next summer, Snelson returned to Black Mountain and showed his new sculptures to Fuller, who immediately recognized their potential, and, Snelson feels, adapted them into his own work without credit to Snelson.

photograph by Jim Lehman

Jack Wilkinson, 1948, University of Oregon



Buckminster Fuller lecture, 1948, Black Mountain College, Asheville, NC

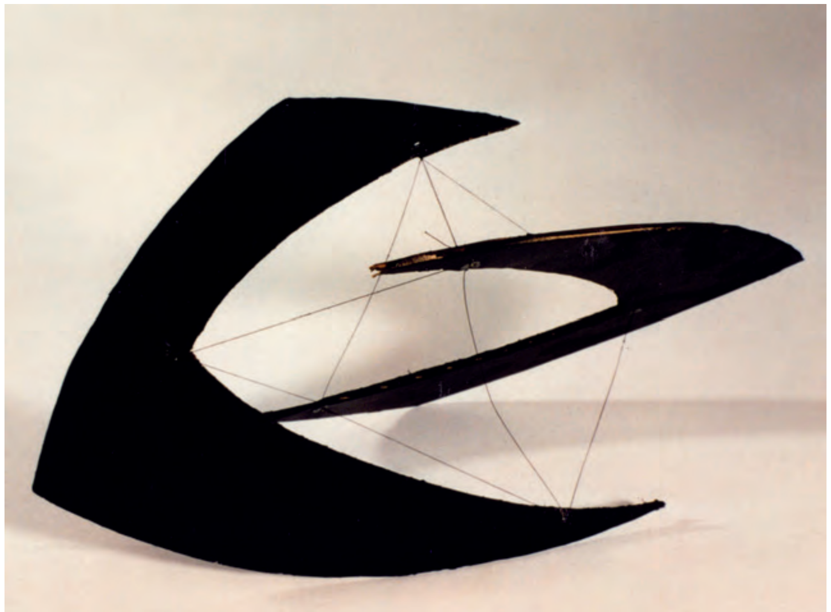


Early X-Piece, 1948
wood and nylon
11.5 x 5.375 x 5.375 in
29 x 4.5 x 4.5 cm

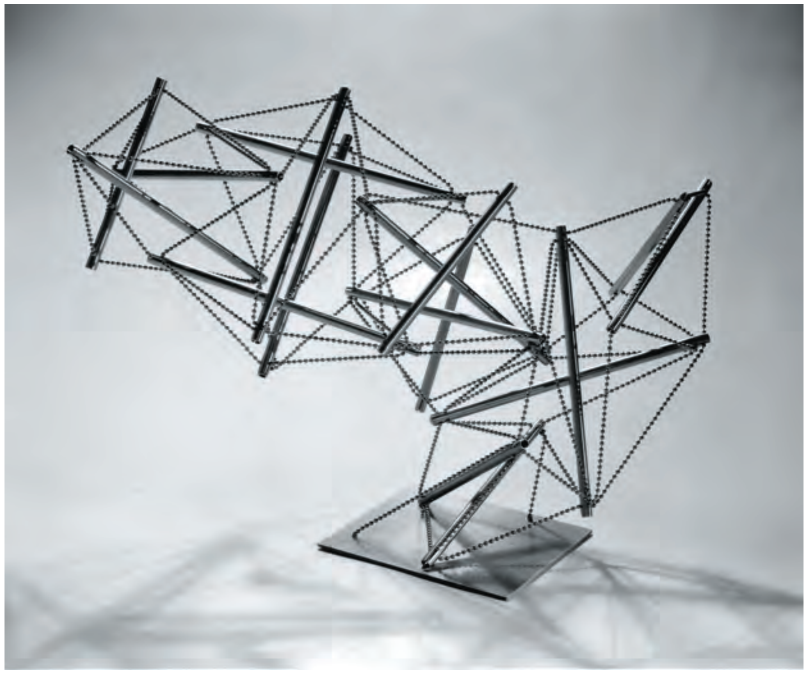
EXPLORING TENSEGRITY

The principle of tensegrity would become a central theme in Snelson's mature work, which he began to create after a rather winding course that took him through further studies at the Chicago Institute of Design, a move to New York City, a sojourn in Paris at Fernand Leger's studio and an extended period as a cinematographer for documentary films. Snelson's return to serious art making in the late 1950s plunged him into the midst of the New York art world. It was a time of great ferment when new ideas were spinning through the air. Artists who saw it as the new establishment were challenging the once revolutionary aesthetic of Abstract Expressionism. The fetishization of the painterly gesture and the handmade object was giving way to a new interest in technology, mass production and media, soon to manifest itself in movements as diverse as Pop, Minimalism, and Conceptual art. It was also during this period that the stage was being set for the emergence of Experiments in Art and Technology (also known as E.A.T.), a non-profit organization founded by artists Robert Rauschenberg and Robert Whitman and engineers Billy Klüver and Fred Waldhauer that catalyzed collaborations between hundreds of artists and engineers.

Snelson, who has always maintained a position which is both inside and outside the mainstream art world, threw himself into work that elaborated on his tension-compression models, experimenting with materials like wood dowels, fishing line, aluminum tubes and bead chain to create structures that were held together by their own internal tension. The works in this vein took many forms, resembling at times, crystalline structures, suspension bridges, snowflakes and three-dimensional spider webs. However, they were united by the delicate dance of tension and compression in which the cables served, in a sense, as musculature and the cylinders as bones, held together in configurations that often were as miraculous as they were beautiful. Snelson applied for and received a patent for his discoveries, which he dubbed "Continuous Tension, Discontinuous Compression Structures." (The publication of patents keeps these discoveries in circulation, and they are now available free on



Bat Wing Piece, 1948
cardboard and thread
10 x 13 x 10 in
25.5 x 33 x 25.5 cm



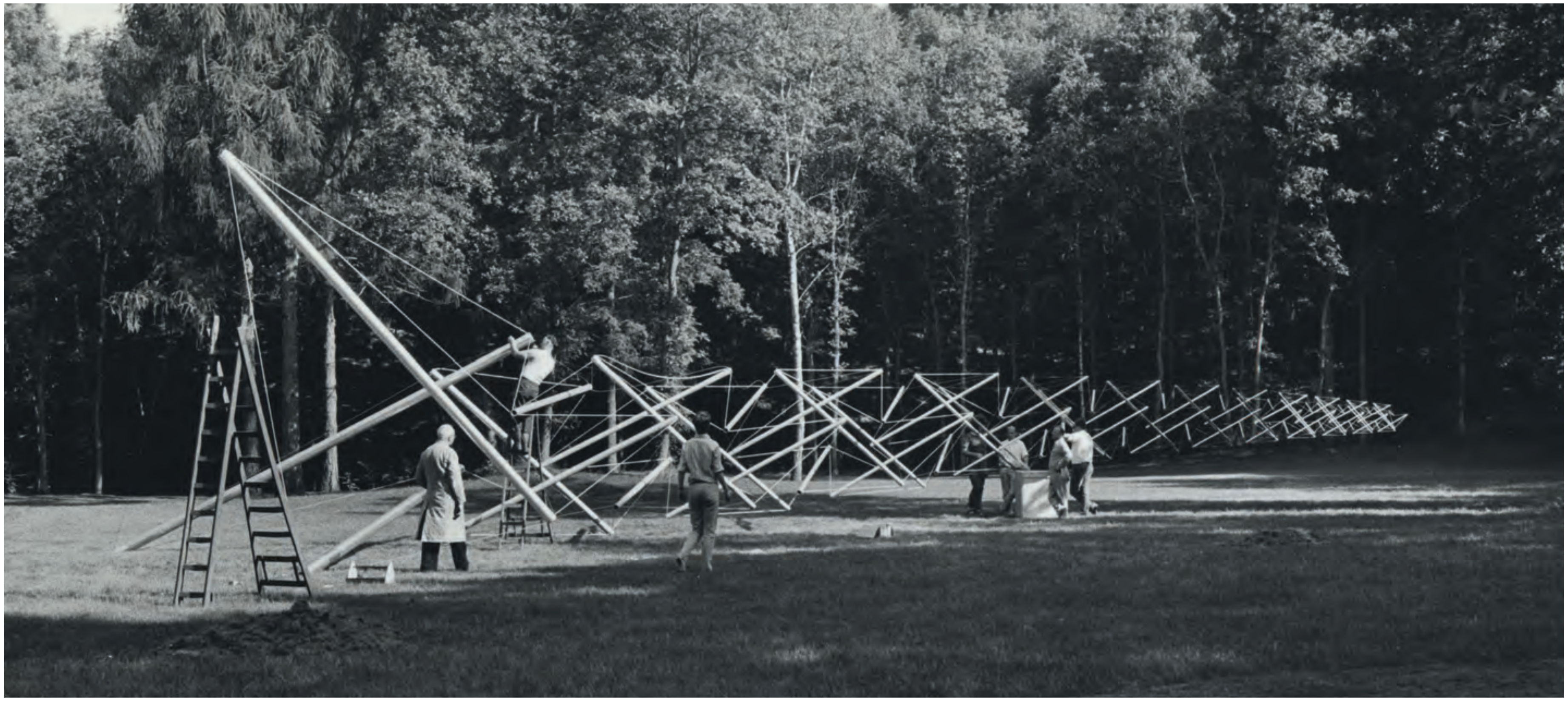
Harry's Hen, 1960
aluminum and bead chain
14 x 18 x 10 in
35.5 x 46 x 25.5 cm


Snelson in studio with Arcuate Lip Superstar, 1960, Spring Street, New York, NY

the web.) He also began to experiment with "circlespheres," sculptures composed of plastic rings connected with nylon line, which would become the basis for his explorations of the atom.

By the mid 1960s, Snelson's work was beginning to appear in gallery and museum exhibitions and he was discovering how to translate his small models into large-scale sculptures. These works bore a superficial resemblance to minimalism, and in fact in 1966 he joined the influential Dwan Gallery, which also represented more clearly minimalist artists like Carl Andre, Dan Flavin, Michael Heizer, Sol LeWitt and Robert Smithson. Minimalism is generally concerned with the placement of real materials in real space, and often consists of configurations of identical parts, which can be interchanged with machine-like consistency. (In fact none of the artists associated with this term was ever comfortable with it.) Nothing could be further from Snelson's approach. While he shares these artists' interest in geometry and visual clarity, he is interested in balance, equilibrium and tension, not in the reduction of matter to its most inexpressive form. Minimalism is often associated with a resolute rejection of individual subjectivity, the spiritual dimensions of art, and the romantic ethos that characterized the preceding generations of abstractionists. Snelson retains what one headline writer referred to as "designs on the universe," is comfortable with poetry and metaphor as tools for furthering the appreciation of his work, and he also believes that the articulation of structure is a form of beauty.

The difference in attitude is clear from two statements made by Snelson in reference to supposedly "structural works" by other artists. Commenting on *Primary Structures,* a 1966 show which celebrated the new reductive art which would come to be known as minimalism, Snelson commented, "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



Installation of ***Needle Tower II*** for Kenneth Snelson Exhibition, 1969, Kröller-Müller Museum, Otterlo, Netherlands bridge, for example. It is a definition of what is going on to cause that space to exist."

He was similarly trenchant in his reaction to a 1977 exhibition of the work of Sol LeWitt: "I noticed in the publicity blurb he 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."

Despite the apparent simplicity of the principle, Snelson discovered that tensegrity could yield sculptures with a wide degree of variation. His sculptures take the form of towers, cantilevers, arches, as well as more irregular, less immediately referential forms. They thrust upward in a series of diminishing modules as if straining toward infinity and they meander horizontally above the ground in defiance of gravity. Sometimes they suggest collections of pick-up sticks thrown up into the air and suspended there. They conjure associations with architecture, constellations, sailing vessels, elementary particles, crystals, and creatures. Often titles point to certain interpretations, as in *Sagg Harbor I,* which sits on a single mast-like leg and evokes the image of a sailboat turning into the wind. *B Tree* (1981) rises from a stable three-point base to expand outward in all directions like the branches of a tree seeking light. Taking a cue from the title of a work called *Mozart 1* (1982) an observer might imagine this interwoven structure as a visual equivalent of a contrapuntal piece of music in which several independent voices are layered over each other to create a complex interplay of harmonics.

Snelson notes impishly that his titles, which generally come after the fact, are drawn from some very unorthodox sources. A number of them are named after discontinued race horse names that he found in a handbook put out by the Jockey Club. These often were very suggestive of the sense of movement and force that characterize his works. Thus, a sculpture titled *Free Ride Home,* Snelson notes, zooms down and comes back like a bucking horse, an image he recalls from the Pendleton Roundup of his childhood. *Triple Crown* received its name because it was to be placed in Crown Plaza. *Easy Landing* sits delicately on three

Photo by Katherine Snelson

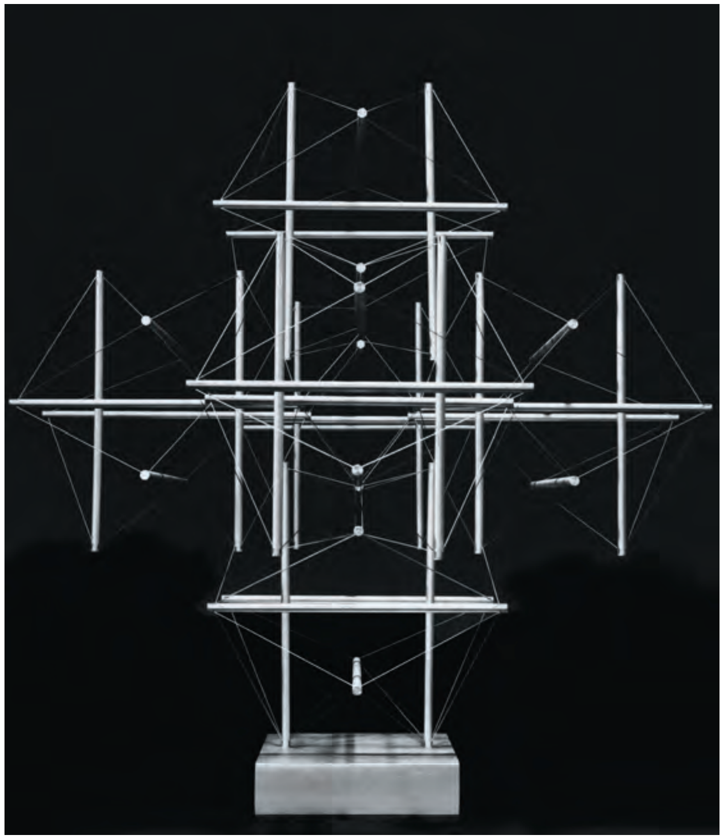
Snelson making adjustments, ***Needle Tower II,*** 1971, Kröller-Müller Museum, Otterlo, Netherlands points like something which has just settled on earth from another planet.

From a formal perspective, Snelson's sculptures can be grouped into categories based on the structural principles they express. What he refers to as his Trigonal sculptures are works that have been built from the inside out. These works suggest explosions of energy, as force vectors created by cables and rods press outward in multiple directions. In some ways, they bear a kinship with the cubist principle of fractured space, taking the expression of multiple perspectives and planes into three dimensions. They express a sense of contained chaos that contrasts strongly with the elegant regularity of some of his other sculptures. This can be seen, for example, in *Forest Devil,* in which one vertical leg and two angled ones seem barely able to hold the exploding vectors in place.

In what Snelson calls his Module translation pieces, by contrast, the same form is repeated in one direction or another. This can be seen in *Four Module Piece,* in which the repeated modules spread out horizontally, creating a structure, which seems to hug the ground. It has a sense of rootedness that is rare in his works.

Other sculptures wrestle with natural forces. For instance the Cantilevers hover horizontally over the ground in a way that defies gravity. These works, which are built of repeated modules, require careful planning. Snelson notes that *Cantilever,* 1967, which has one of the longest extension of these works, was created out of aircraft aluminum and weighs only fifty pounds. This allowed him to stretch it out an amazing thirty feet. *Dragon* (2000-2003) and its counterpart, *Sleeping Dragon* (2002-2003) animate the cantilever arrangement, rearing up or slumping down in homage to the creature honored by their titles.

By contrast, for Snelson's towers, the enemy is wind, not gravity. The question here becomes: "how high can you go?" With their open structure and stacks of modules of ever diminishing size, they become metaphors for human aspiration and the ancient desire to touch the heavens. Snelson's 60-foot-high *Needle*



Spring Street, 1964
aluminum and Steelon
30 x 30 x 30 in
76 x 76 x 76 cm

Forest Devil, 1975
stainless steel
34.5 x 68 x 51 in
87.5 x 173 x 130 cm

Assembling ***Free Ride Home*** at Waterside Plaza, 1974, New York, NY

Photo by Reinhard Friedrich

Assembling ***New Dimension,*** 1977, Nationalgalerie, Berlin, Germany

Installing ***Easy Landing,*** 1977, Baltimore, MD

Tower (1968) at the Hirshhorn Museum and Sculpture Garden in Washington, D.C., is a stack of hexagonal gridded forms that have been given a spiral twist. Looking up into the tower from below, this creates a remarkable pattern of twisting stars working their way skyward. From outside, the rotation creates a subtle dynamism. Reflecting on this work, Snelson has remarked "The tapered towers presented the difficult problem of diminishing the size of the piece while maintaining the appropriate stresses at each reduction, module by module. Out of this, though, has resulted the snail-like spiral, or proportional growth principle which has become the spatial musical scale with which I now work." Even higher is *Needle Tower II* at the Kröller-Müller Museum, in Otterlo, Netherlands, whose delicate filigree rises a full 90 feet. Reflecting on this work, Snelson remarks, "When I look at that sculpture today, I wonder how I had the audacity to do that."

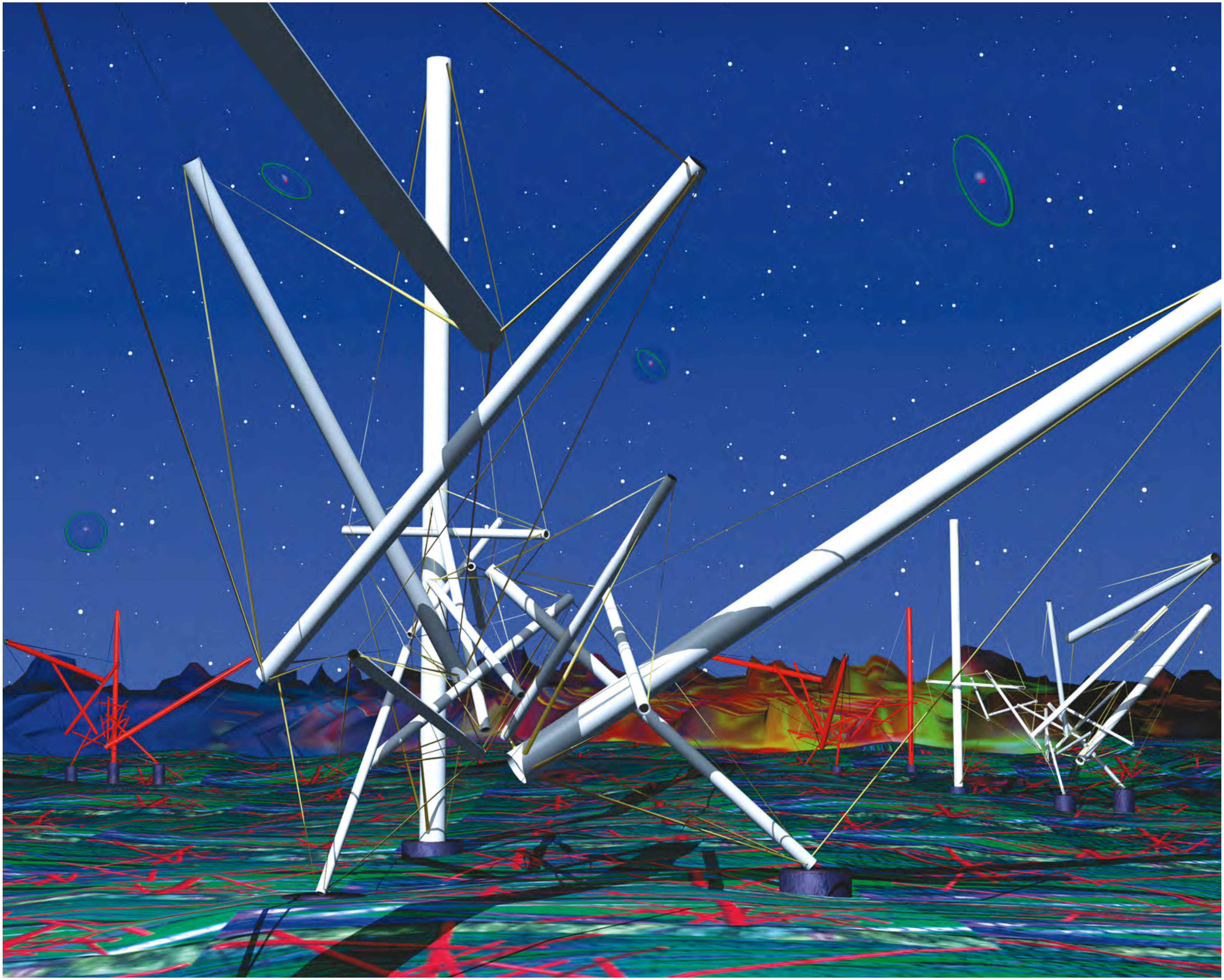
Snelson has also created sculptures that bend in graceful arches. Sometimes, as in *Rainbow Arch* (2001), these offer a smooth seamless curve while in other works, like *Free Ride Home* (1974) the modules seem to spill across the expanse between the work's three legs like a shattered arch.

Today Snelson's work generally takes the form of unpainted steel or aluminum, materials he values for their durability, strength and, in the case of aluminum, lightness. The metallic sheen gives the works a clean industrial look that does not distract from their structural complexities. And when the works are placed outside, the metal often picks up surrounding colors of grass or sky, making the works blend into their natural settings.

However, he has also experimented with other materials. An early work, *Audrey 1* (1966) employs a configuration of porcelanized aluminum pipes in three different colors which seem to have burst free of the confines of gravity and are held in place by tiny steel wires. This work was created shortly after his wife's death from breast cancer and it is titled in commemoration of her. It represents a short-lived excursion into the use of color, which was aborted when the porcelain veneers fell off. In 1971, making a virtue of necessity during a summer on the Spanish Island of Ibiza, he used locally available materials to create a series of sculptures which employ bamboo, fishing line and nylon rope. These works, which resemble kite armatures, have a more handcrafted feel than his metal work, but did not signal a major change of direction.

In recent years, Snelson has also realized some of his sculptures as digital images, where they inhabit a virtual world where the forces of gravity, wind and inner tension do not apply. An outgrowth of his exploration of the atom, these virtual sculptures enhance the odd alien quality of Snelson's structures, though he notes ruefully that creating a single digital image actually takes many more hours than creating a model of its three-dimensional counterpart.

For George, 1970
black bamboo and nylon line
50 x 24 x 33 in
127 x 61 x 84 cm



Forest Devils' Moon Night, 1990
computer picture

THE AESTHETICS OF STRUCTURE

While Snelson's materials and forms seem far from traditional sculpture, leading some to identify his work with engineering rather than art, in fact his approach to the act of *making* is very much in keeping with the history of sculpture. As the realization of a three-dimensional form in space, sculpture is always concerned with the constraints of the physical world. Stone, wood and clay, no less than aluminum and steel, must be fashioned in such a way that they stand up and hold together. What places Snelson firmly in the camp of the artist rather than the engineer is his interest in exploring the potential of his materials for their own sake. He did not develop the concept of tensegrity to create buildings or to offer a model for the interconnections of cellular structures, though it has been used in such ways. Instead, he has been impelled by the dictates of his materials to ask how high can a tower be made to stand? How far can a cantilever extend over the ground? How few vectors can a sculpture contain, while maintaining its structural integrity? As he puts it, "Engineers make structures for specific uses, to support something, to hold something, to do something. My sculptures serve only to stand up by themselves and to reveal a particular form such as a tower or a cantilever or a geometrical order probably never seen before; all of this because of a desire to unveil, in whatever ways I can, the wondrous essence of elementary structure."

The limitations of materials can become sources of beauty. In the case of Snelson's sculptures, this beauty is expressed through the creation of structures whose form offers a visible manifestation of internal forces. The elegance of these sculptures rests on the principle of non-redundancy—that there is nothing extraneous—no element that can be removed without affecting the integrity of the whole. The notion of beauty as an expression of structural clarity is an aesthetic that also drove some of the most remarkable architectural innovations of the modern era. One thinks, for instance of the Crystal Palace, created in London for the Great Exposition of 1851. This glass and iron structure, reminiscent of a green house, provided a striking contrast to the more typical gaudy and over decorated Victorian era industrial products contained within. As such, it served as a clarion call to artists and architects interested in discovering a form of beauty appropriate to an industrial age. The Eiffel Tower, completed in 1887, offered a similar revelation about the beauty of revealed structure. More recently, Richard Rogers and Renzo Piano's 1976 Pompidou Center in Paris gained notoriety and praise for its audacious configuration, in which the building's internal functions were displaced to the outside of the building, again making the case that architectural structure in itself is beautiful.

Snelson takes this notion of the beauty of structure out of the realm of architecture and into the world of physics, chemistry and biology. It is no accident that Snelson's works evoke comparisons with constellations, cellular organisms, and crystalline structures. Like the systems studied by the physical and life sciences, Snelson's sculptures create a dynamic equilibrium in which all parts are necessary for the structure to hold. Snelson likes to think of his works as analogues of the larger cosmos where everything is in motion and, in a telling metaphor, he sees the steel or aluminum rods that cross without touching as akin to planets which pass by each other in their orbits without making contact.

For this reason, Snelson distinguishes his work from the modular sculptures of Sol LeWitt whose grids are created simply by addition of one square upon another. LeWitt's basic unit in these works is the cube, a static form, while Snelson's is the tetrahedron, which is the ultimate model of a compression structure. Snelson has more kinship with the work of Agnes Denes, whose twisting open fretted pyramids, though not realized in three dimensions, explore the dynamism of structure as a metaphor for the dynamism of society. Snelson expresses no such intentions, but it is hard not to see in his sculptures a model for human connectivity in which the removal of any element destroys the whole.

Rainbow Arch, 2001
aluminum and stainless steel
84 x 152 x 32 in
213.4 x 386.1 x 81.3 cm

INSTALLING A SCULPTURE IN BERLIN
by Kenneth Snelson

Every piece starts with a model. The model must encompass all the necessary considerations for constructing the sculpture in its full size. In my mind, the piece becomes a kind of being, a creature of a sort. I imagine it in its full proportion as if I were standing near it, under it; walking around it.

The general idea of *New Dimension* was the outgrowth of a piece called *Free Ride Home*, 1974. It too had a trigonal development but was arch-like instead of a system of cantilevers as in this new sculpture. I started to imagine a sculpture raised overhead, cloud-like, to stand on three points.

The work was named *New Dimension* because, while I was working on it, I was trying to evolve a system of measurement that would be dependable. 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 that 8-meter ceiling and a space 50 meters by 50 meters. I felt challenged to do a piece that would relate to such a space.

After all the parts have been measured and cut and the drawings, photographs, papers and lists made, the crates are built, the container filled, the boat sails, and here I am, in Berlin, ready to put the sculpture together for the first time anywhere. This is an exciting moment. Will it actually go together as I have imagined through all of this?

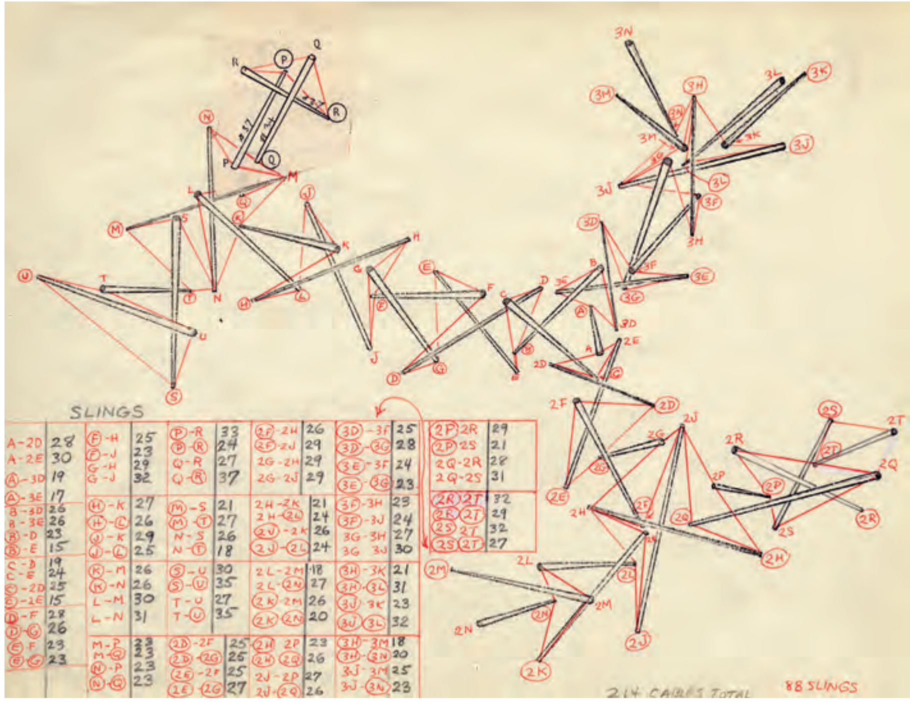
The assembly starts by laying out the network of cables and hubs that connect them in a flat pattern on the floor where we have a guide for assembling them. It's a bit like laying out the lights for a Christmas tree.

We start assembling wherever we can, which is usually outward from the center. It takes a lot of brawn. Three of us, sometimes

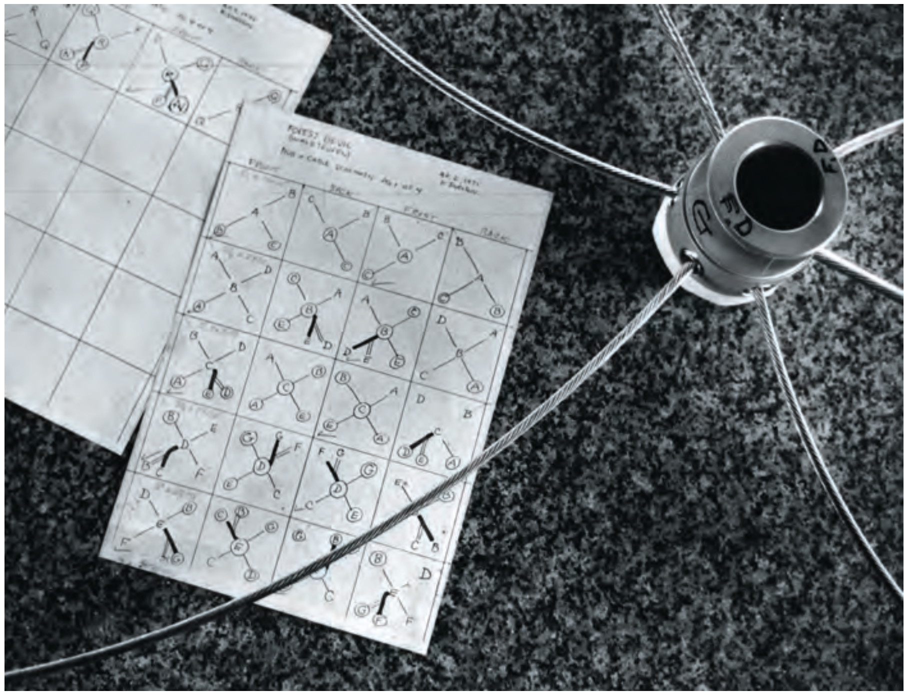
Photos on pages 32-37 by Reinhard Friedrich

Kenneth, 1977

Kenneth, 1974



Spec Drawings for ***New Dimension,*** 1976

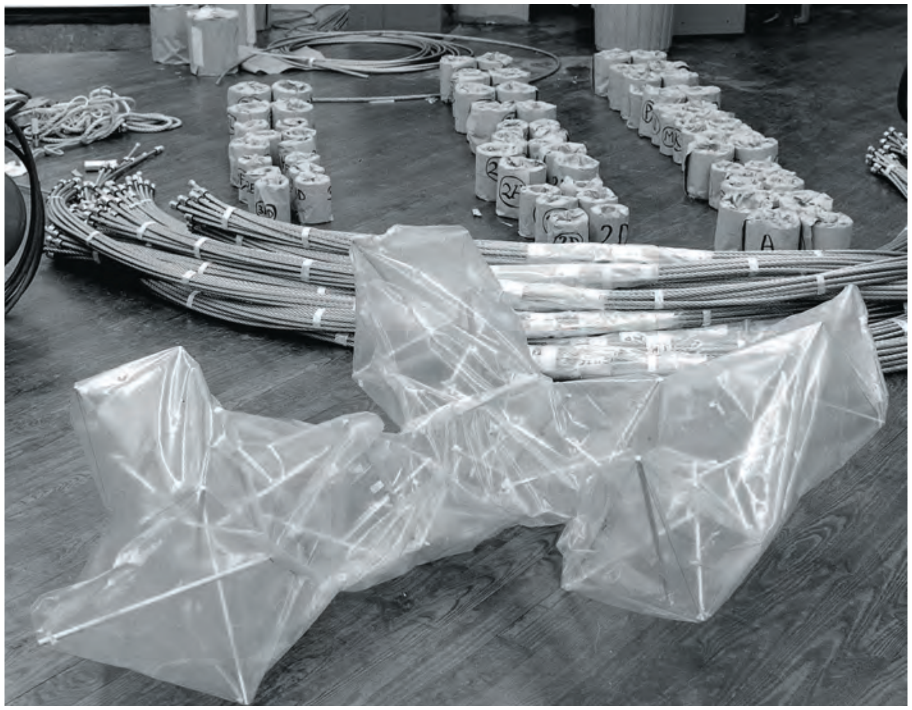


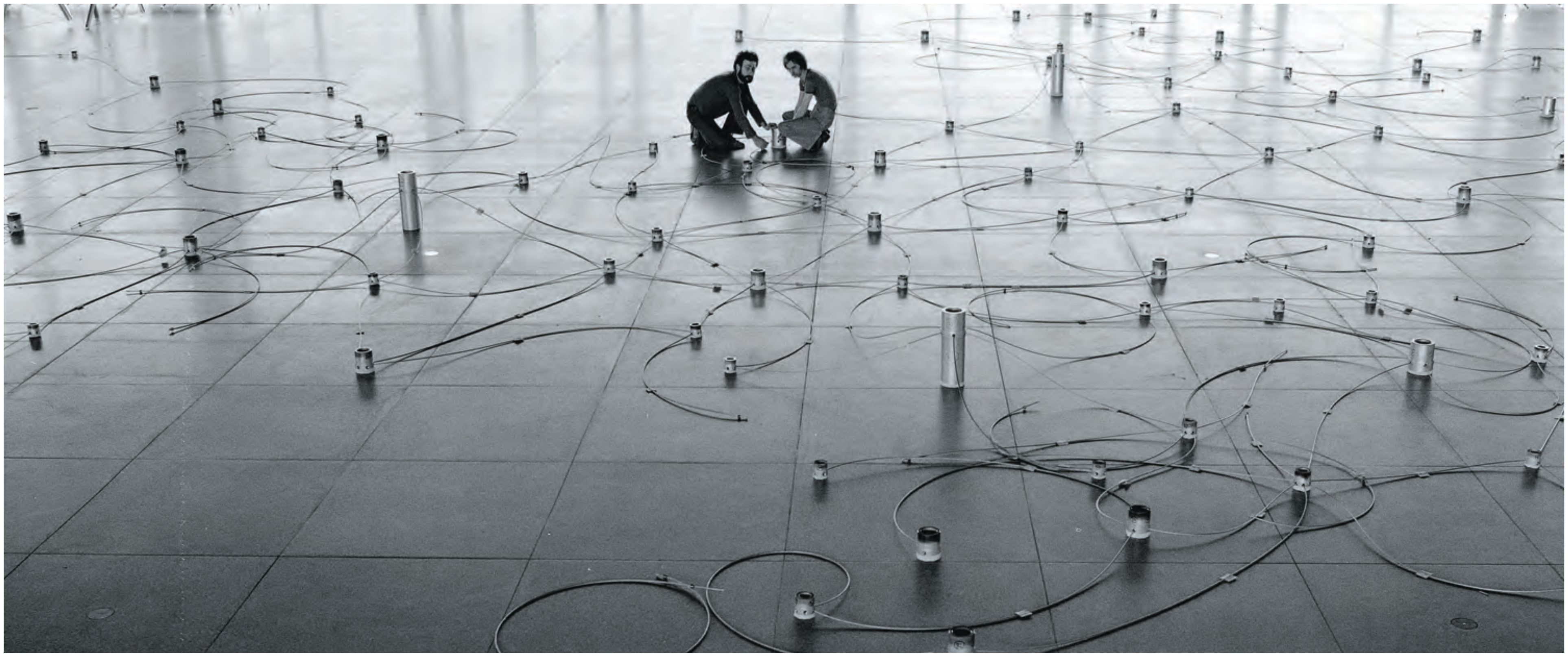
as many as six men fought with the forces in *New Dimension* while it was going up. It is like taking on a colossal, dead weight wrestler or an enormous mind-bending jigsaw puzzle constructed of a series of booby-traps.

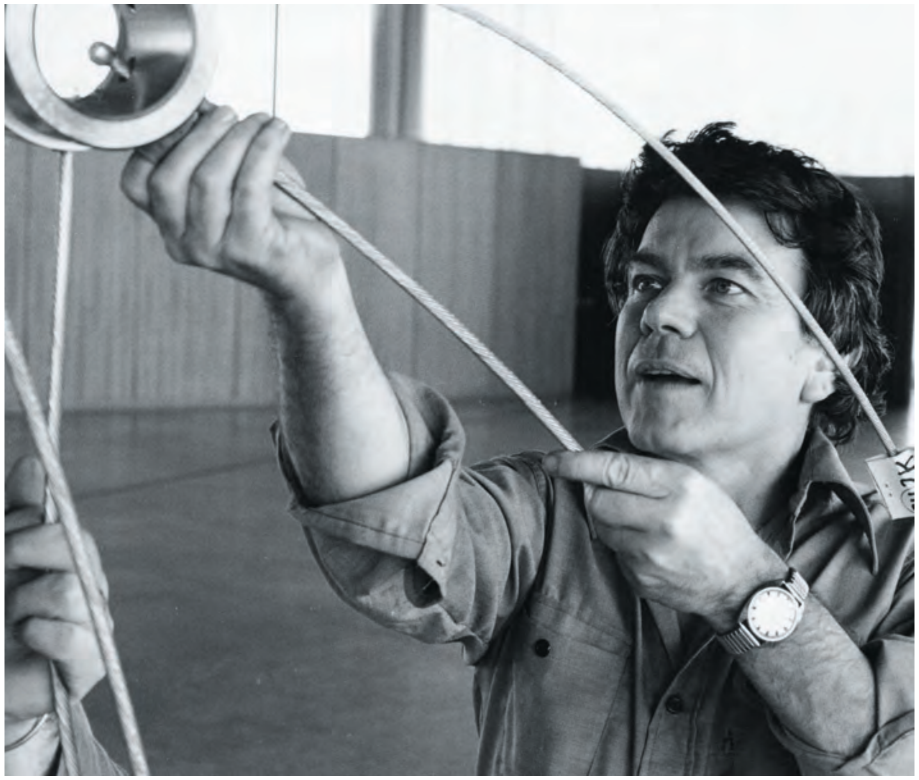
Sometimes it takes an hour or so just to arrange for the introduction of a single pipe. After finally overwhelming the monster with our brave determination and strength we see that we have won. Only then does someone discover that a cable is twisted over something in the wrong way and we must do the whole act once again.

These works are first and last organizations of forces in space. Until the piece is put together the forces are not there. The forces are introduced as things are added, piece-by-piece. Finally, when the last cable is attached, the closed system of forces is complete.

It took eight days to put together *New Dimension.* That final moment is always an amazement to the people who are working on the assembly. Most of them have never done anything like this before. Suddenly all these scattered parts have been transformed into something completely steady. The intact piece is a set of closed forces that doesn't depend on gravity. Like all my sculptures, *New Dimension* presents forces made visible. I am showing you what structural space really looks like.



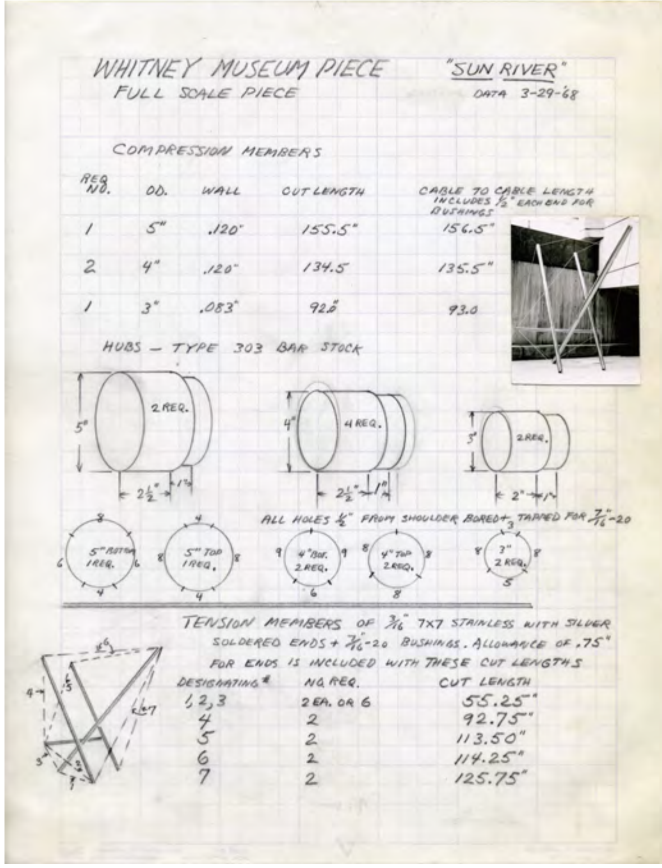




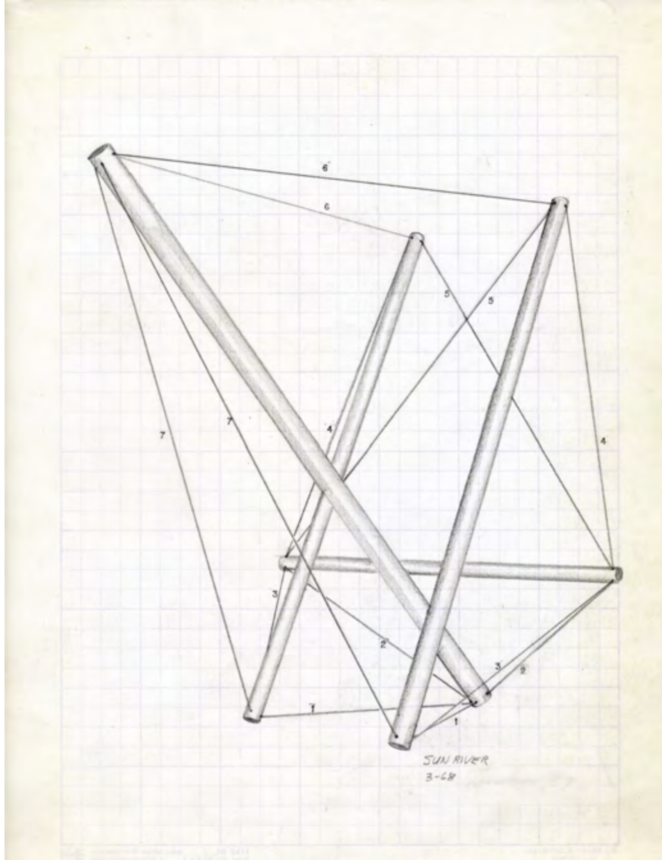

2K 2N
2J 2K

New Dimension, 1977
(***Soft Landing,*** 1975-77)
aluminum and stainless steel
17 x 63 x 45 ft
5.2 x 19.2 x 13.7 m
Kenneth Snelson Exhibition, Nationalgalerie, Berlin, Germany

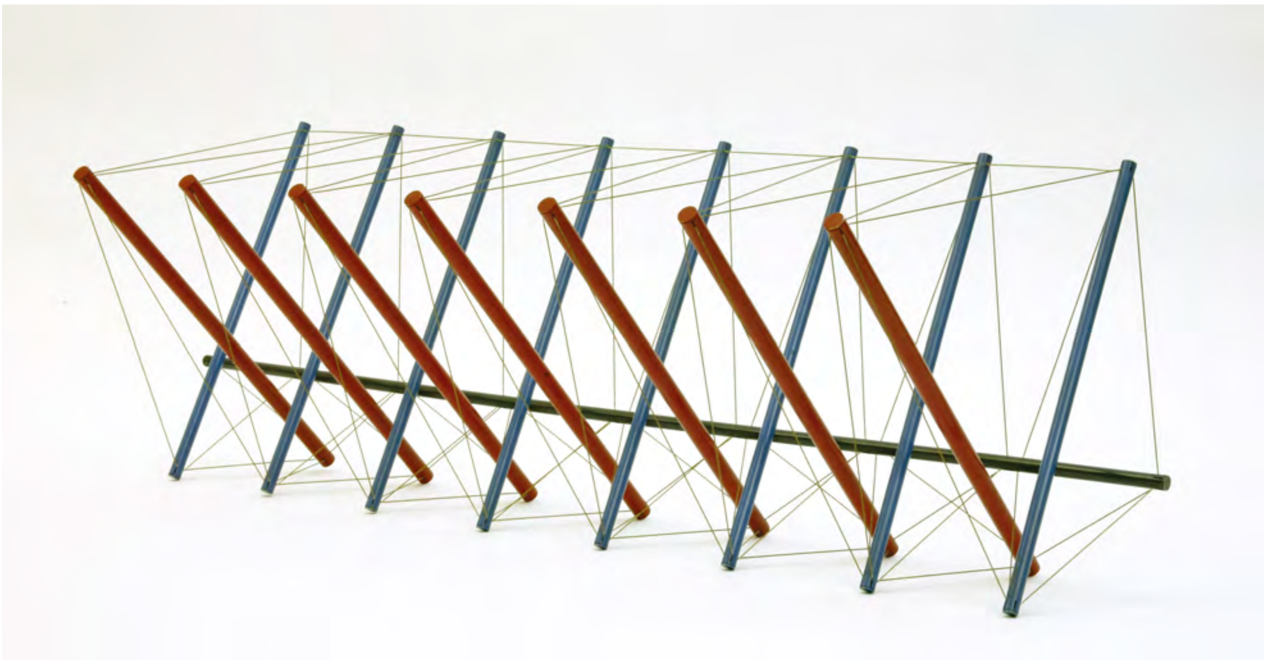
SCULPTURE PLATES



Sun River mechanical drawing, 1967
pencil on paper with photograph
8.5 x 11 in
21.5 x 28 cm

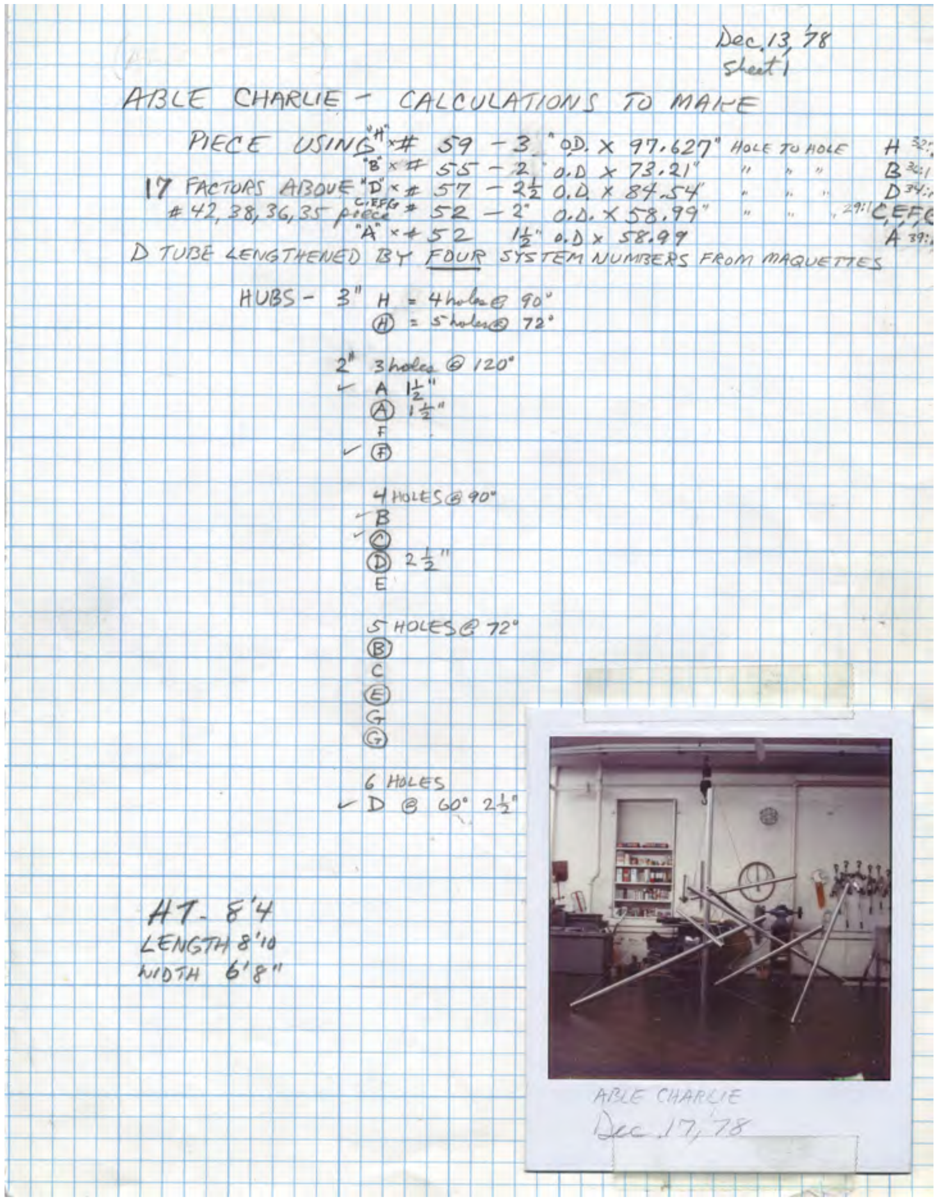


Sun River drawing, 1967
pencil on paper
8.5 x 11 in
21.5 x 28 cm



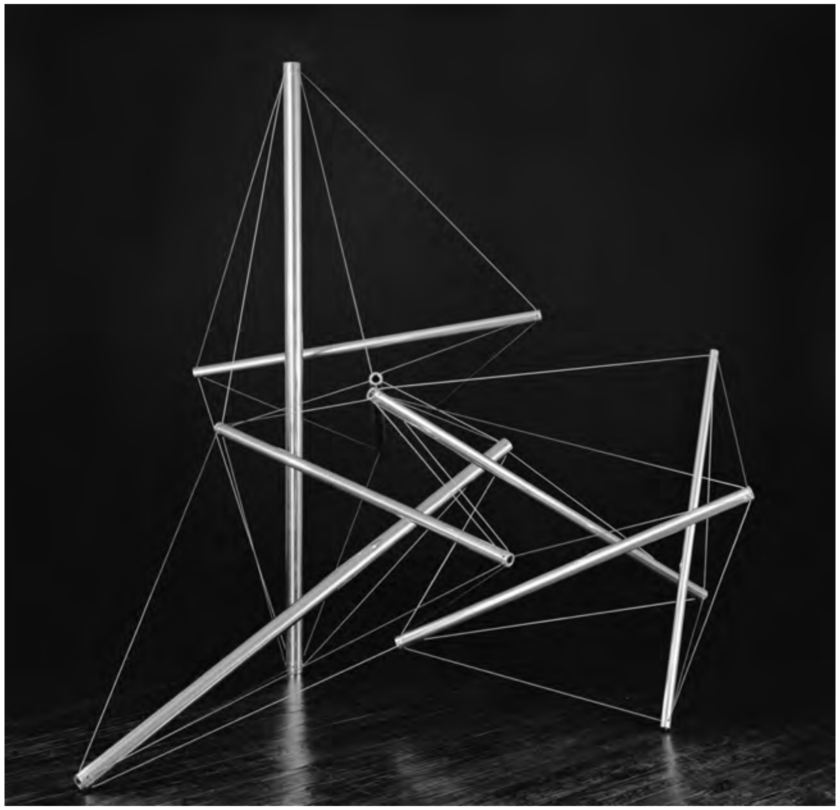
Sun Run, 1967
painted aluminum and Steelon
11 x 33.25 x 10.75 in
28 x 84.5 x 27.5 cm

Sun River, 1967
stainless steel
10.5 x 8 x 9.75 ft
3.2 x 2.4 x 3 m
Collection: Whitney Museum of American Art, New York, NY

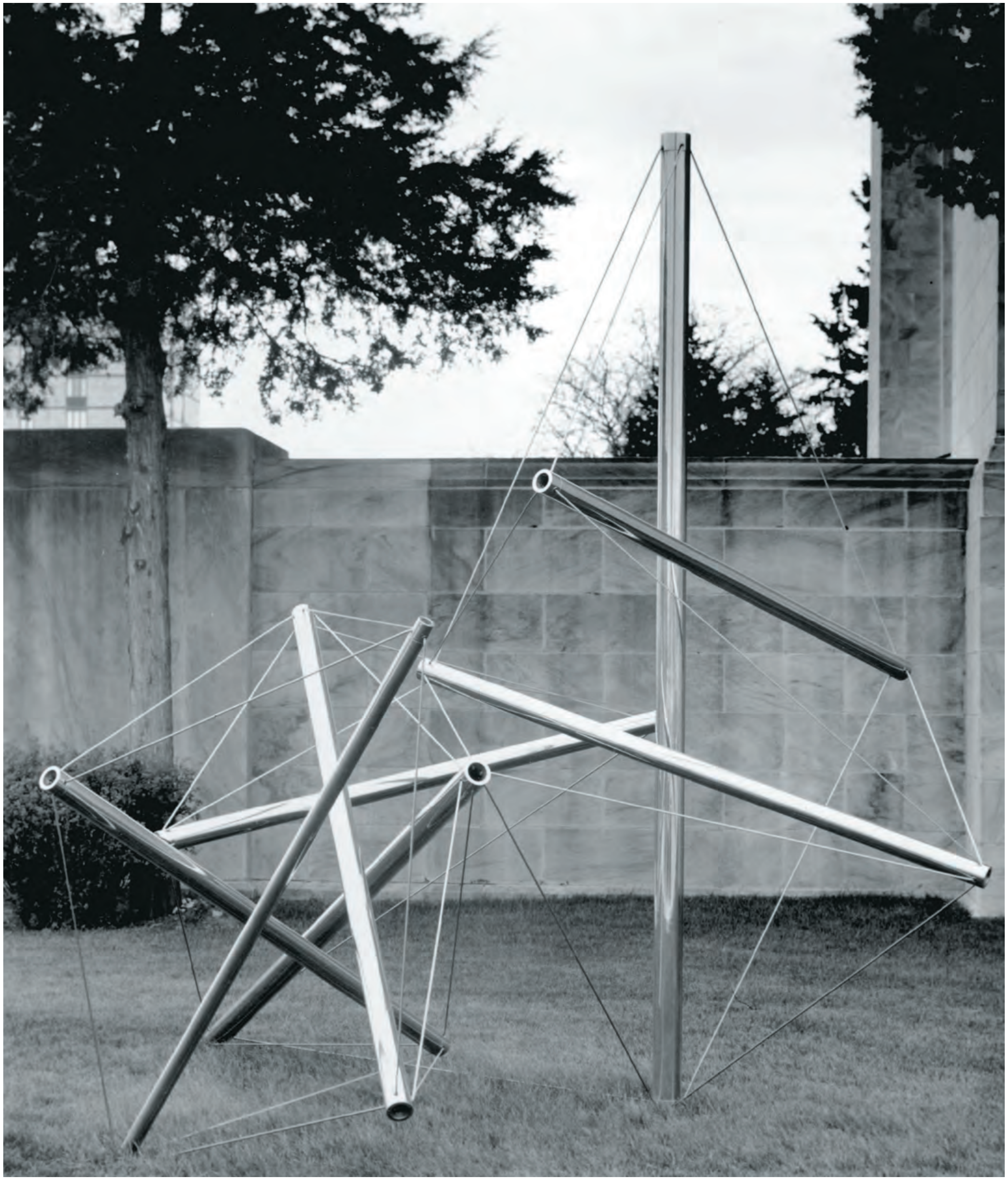


Able Charlie collage specification drawing, 1978
pencil on paper and Polaroid photo
8.5 x 11 in
21.5 x 28 cm

Snelson with ***Able Charlie*** in studio, 1978



Study for Able Charlie, 1978
aluminum and stainless steel
8.3 x 8.9 x 6.7 ft
2.5 x 2.7 x 2.04 m



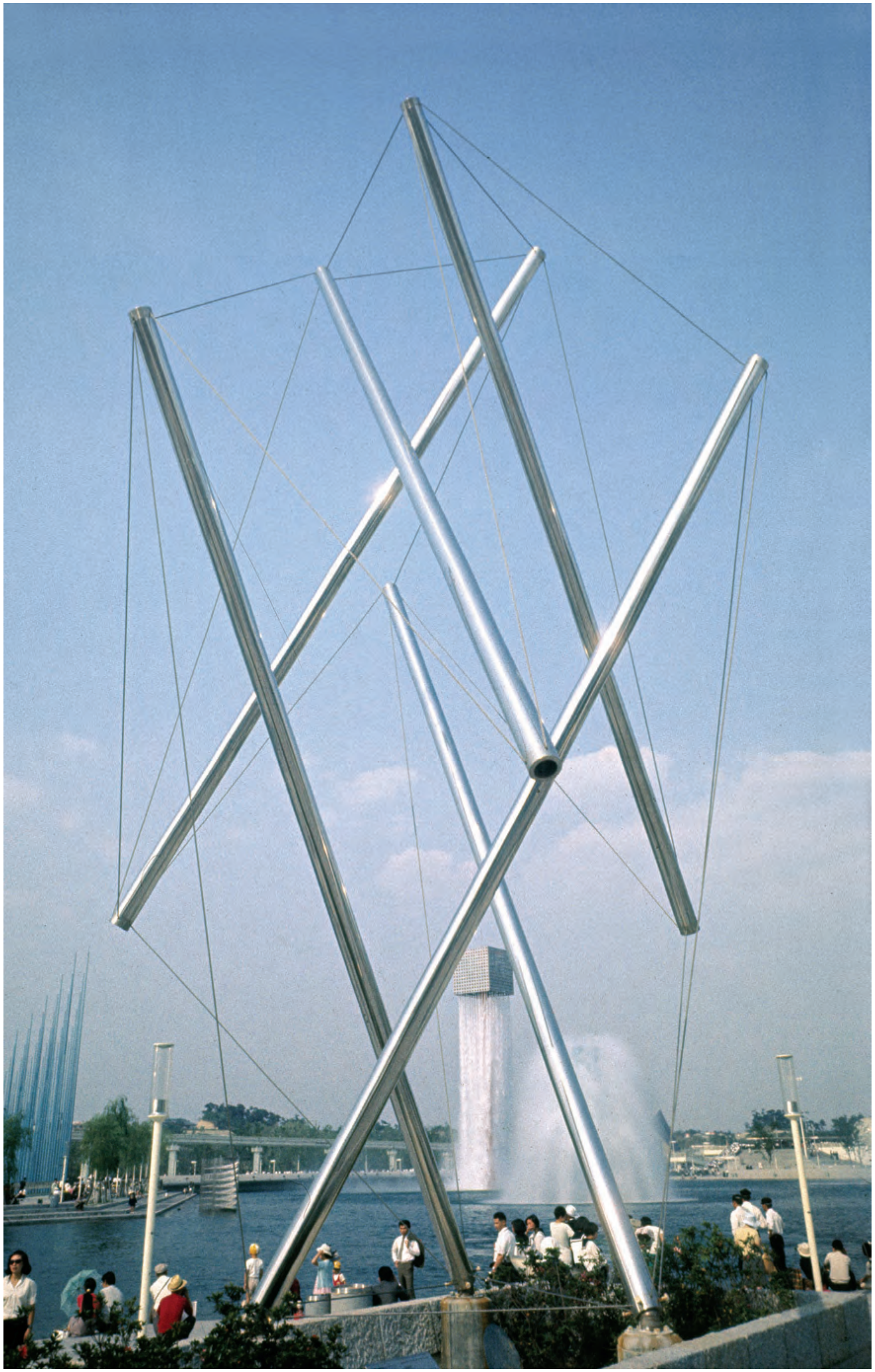
Able Charlie, 1978
stainless steel
11.3 x 12 x 10.8 ft
3.5 x 3.7 x 3.3 m
Joslyn Art Museum, Omaha, NE

Photo by Katherine Snelson

Kenneth Snelson and George Rickey, 1969
International Sculpture Symposium, Osaka, Japan

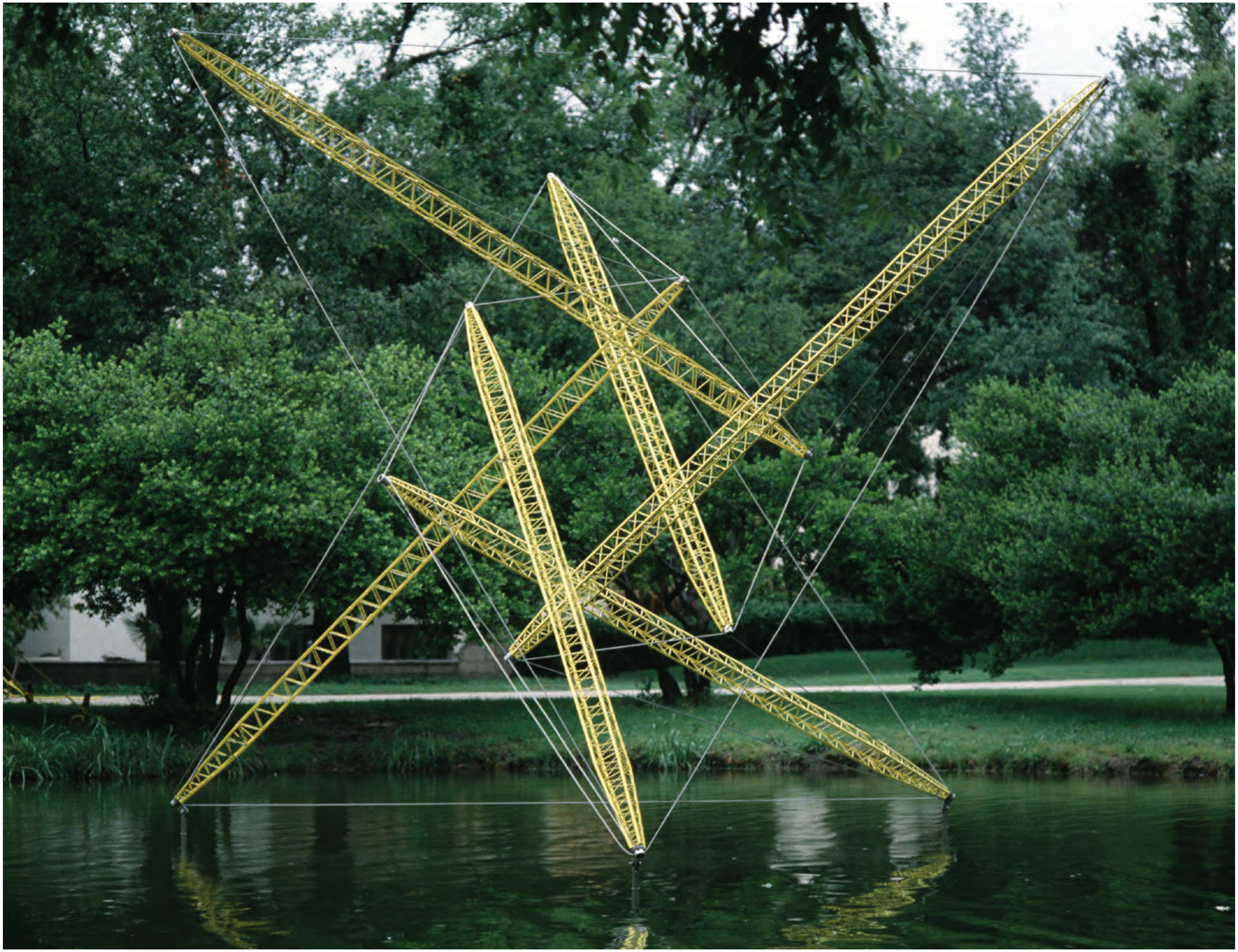
Heinrich Brummack, Kenneth Snelson, Jean Tinguely, 1969
International Sculpture Symposium, Osaka, Japan

Kenneth Snelson with sculpture, ***Osaka,*** made originally during the Osaka World Fair
“Osaka ‘70,” Osaka, Japan

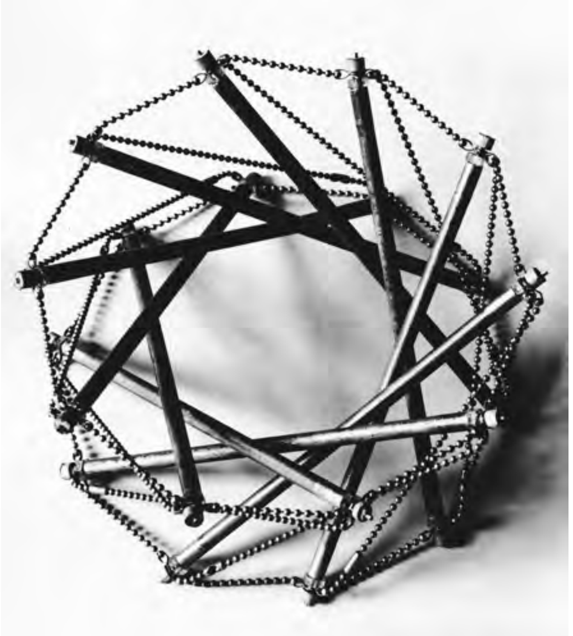


Osaka, 1970
stainless steel
33 x 16 x 16 ft
10 x 5 x 5 m
Japan Iron and Steel Federation
Kobe, Japan

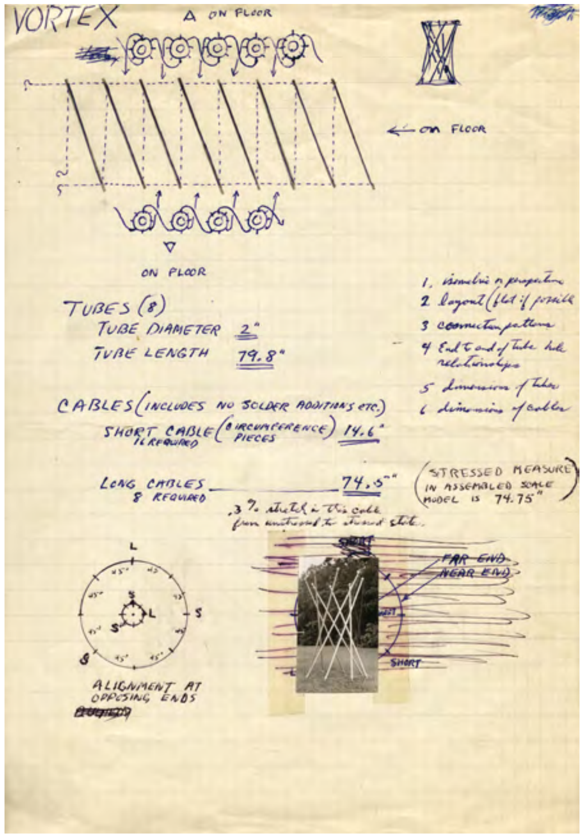
INDEXER 2000
stainless steel
10.8 x 8 x 7 ft
3.30 x 2.43 x 2.13 m
2006: Jardins du
Palais Royal, Paris



Northwood I, 1969
painted steel and stainless steel
12 x 12 x 12 ft
3.65 x 3.65 x 3.65 m
Collection: Northwood Institute, Dallas, TX



Bead Chain Helix, 1959
Aluminum and bead chain
5 x 11 x 11 in
12.5 x 28 x 28 cm

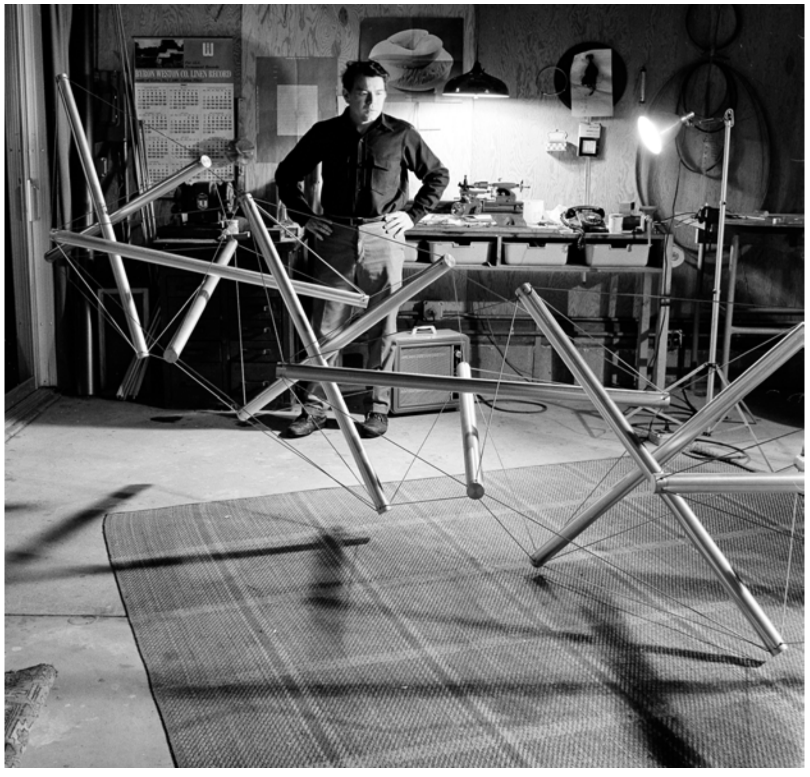


Drawing for first ***Vortex*** study, 1967
ink and collage on paper
8.26 x 11.69 in
20.9 x 29.7 cm

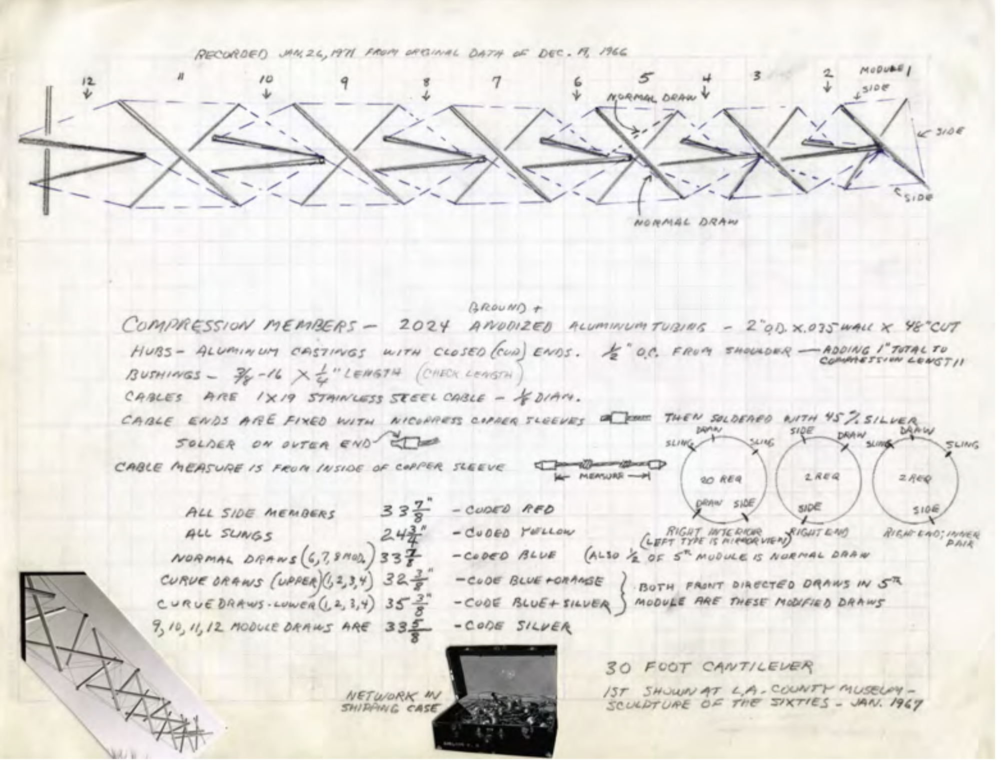
Vortex III, 2002
Stainless steel
23.5 x 13 x 13 in
59.6 x 33 x 33 cm

V-X, 1968
stainless steel
72 x 120 x 120 in
182.9 x 304.8 x 304.8 cm

Cantilever, 1967
Aluminum & Stainless Steel
4 X 4 X 30 ft
1.2 x 1.2 x 9.14 m
Los Angeles County Museum
Los Angeles, CA



Cantilever assembled in
Snelson's studio, 1967
Sapaponack, NY



Drawing for ***30' Cantilever***
pencil on paper with photographs
8.5 x 11 in
21.5 x 28 cm

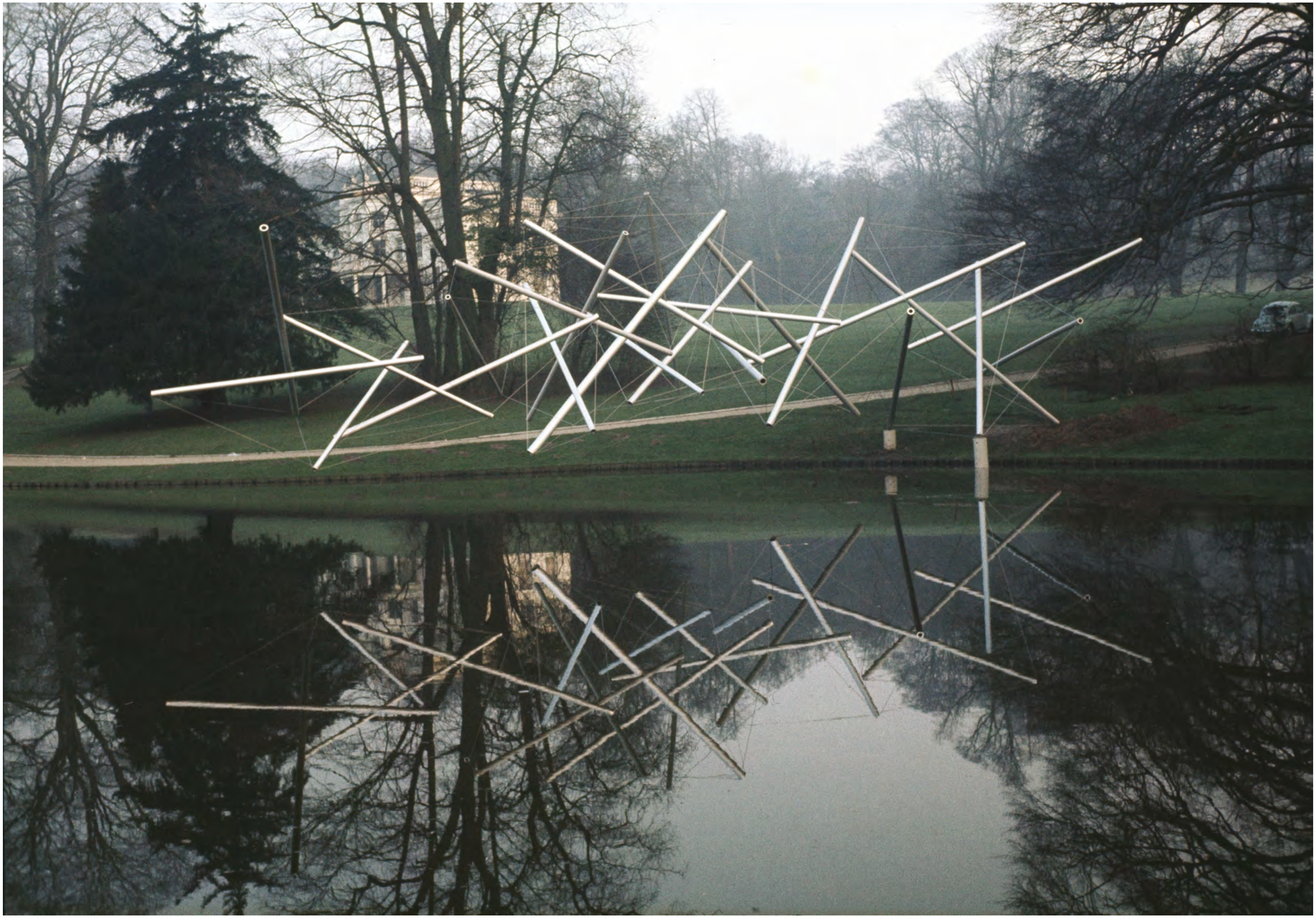
Cantilever, 1967
aluminum and stainless steel
4 x 4 x 30 ft
1.2 x 1.2 x 9.14 m

Easy-K, Park Sonsbeek, unpacking crates, sorting parts

1970, Installing Snelson’s 100′ long cantilever sculpture, *Easy-K*, at Park Sonsbeek, Arnhem, Netherlands for “Sonsbeek 71” exhibition

Volunteers carrying ***Easy-K*** from the assembly field to its installation site, Park Sonsbeek, Arnhem, Netherlands, 1970

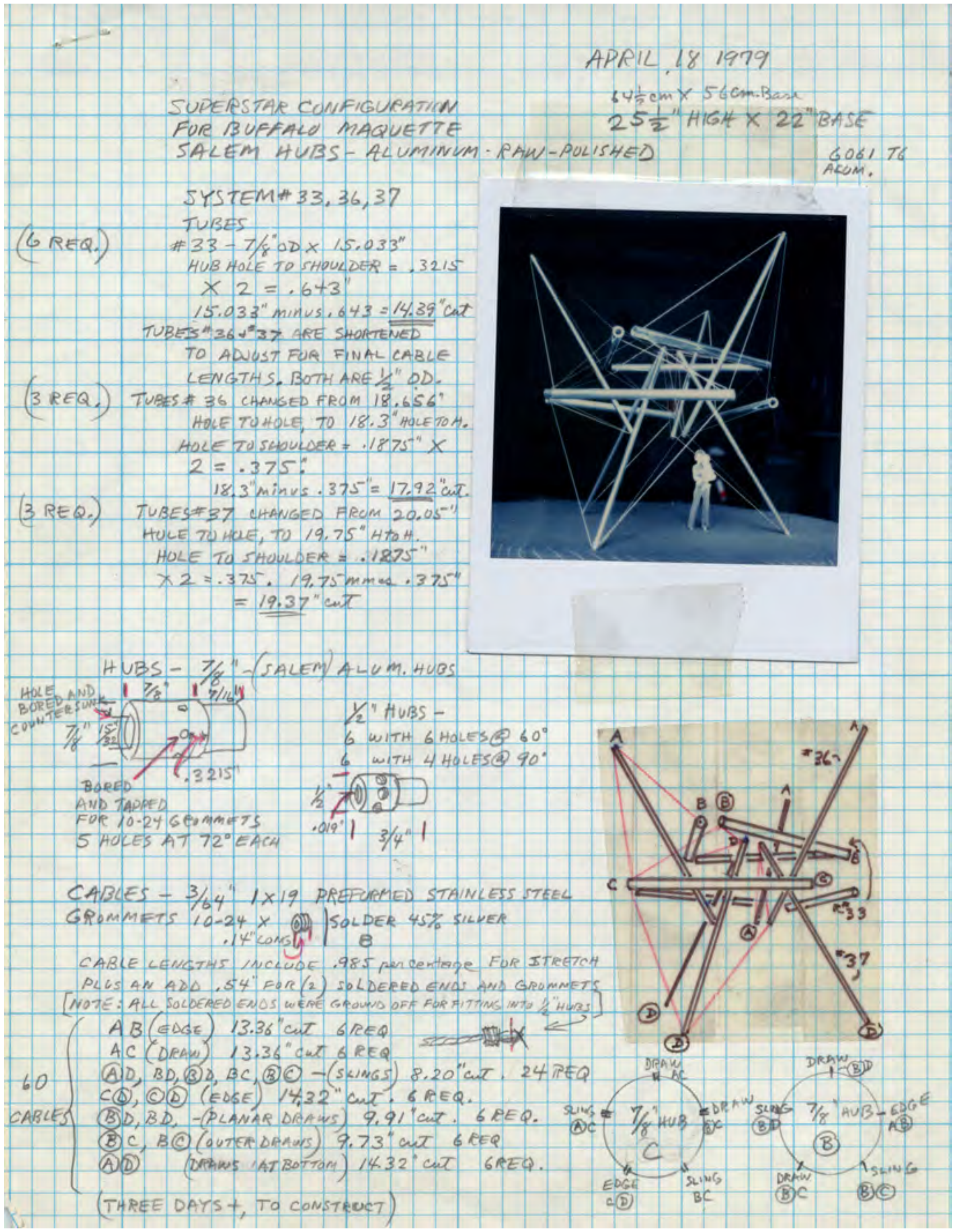
Assembling and installing ***Easy-K***, Park Sonsbeek



Easy-K, 1970
aluminum and stainless steel
20 x 20 x 100 ft
6.5 x 6.5 x 32 m
Exhibition, Sonsbeek '71, Arnhem, Netherlands

Photo by Jan Cook

Dragon, 1999-2000
stainless steel
30.5 x 31 x 12 ft
9.29 x 9.44 x 3.65 m



Drawing for ***Coronation Day***
Collage on paper
8.5 x 11 in
21.5 x 28 cm

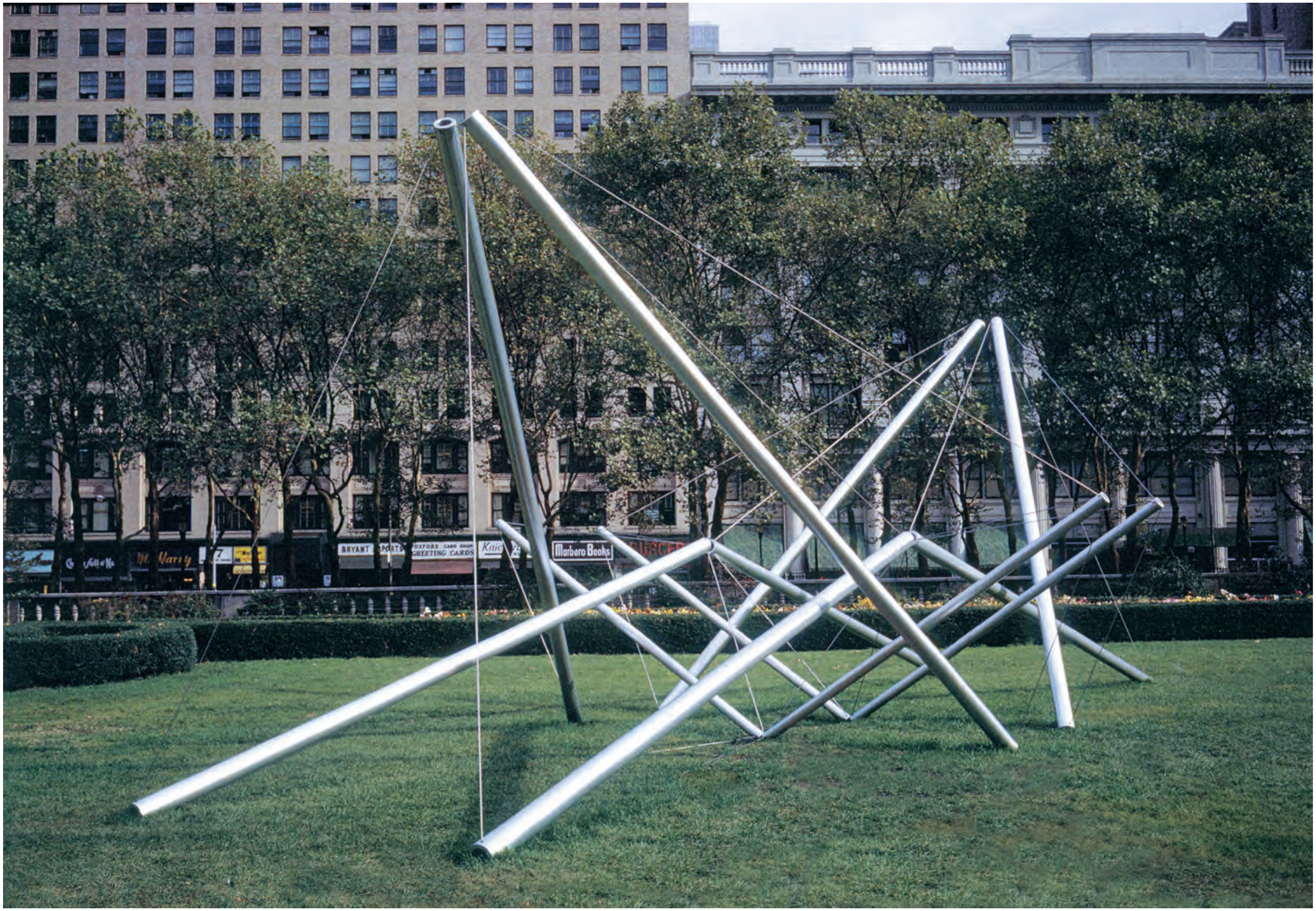
Tall Star, 1979
brass and stainless steel
53 x 40 x 37 in
135 x 102 x 93 cm

Coronation Day, 1980
stainless steel
20 x 20 x 20 ft
6.5 x 6.5 x 6.5 m
Collection: City of Buffalo, Buffalo, NY

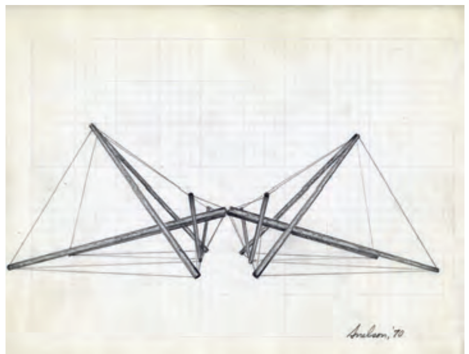
Avenue K, 1968
Snelson exhibition
Bryant Park, N.Y., NY

Installing ***Avenue K***, Snelson Exhibition
Fort Worth, TX, 1968

Avenue K, 1968
aluminum and stainless steel
20 x 20 x 60 ft
6.1 x 6.1 x 18.3 m
Collection: City of Hannover, Germany
Photograph: Snelson Exhibition, Bryant Park, New York, NY



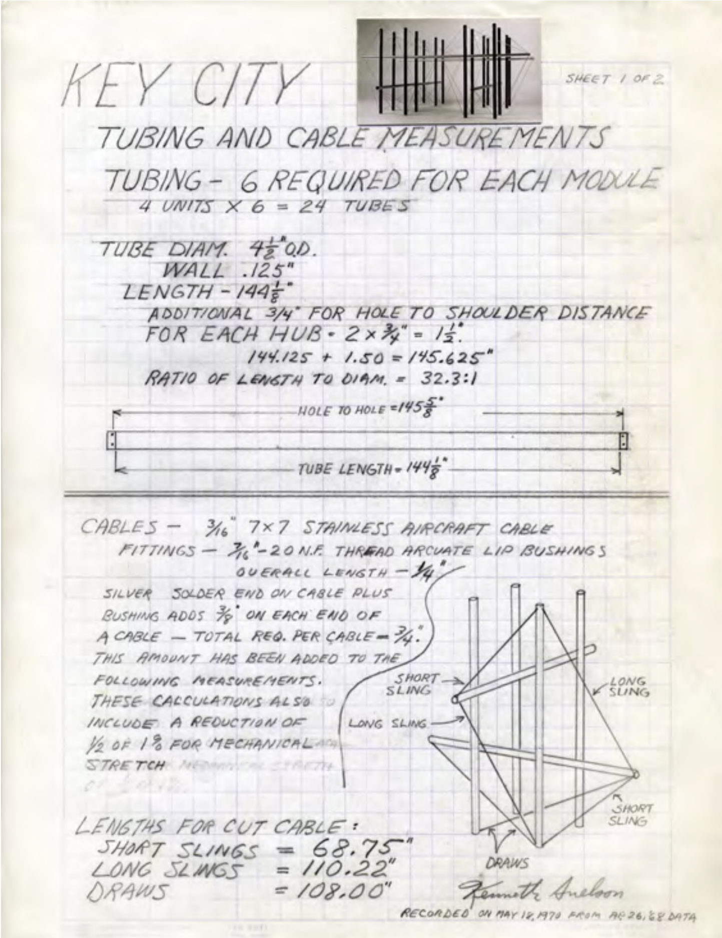
Four Module Piece, Form 1, 1968
aluminum and stainless steel
18 x 48 x 16 ft
5.48 x 14.6 x 4.87 m
Snelson Exhibition, Bryant Park, New York, NY



Four Module Piece drawing, 1970
pencil on paper
8.5 x 11 in

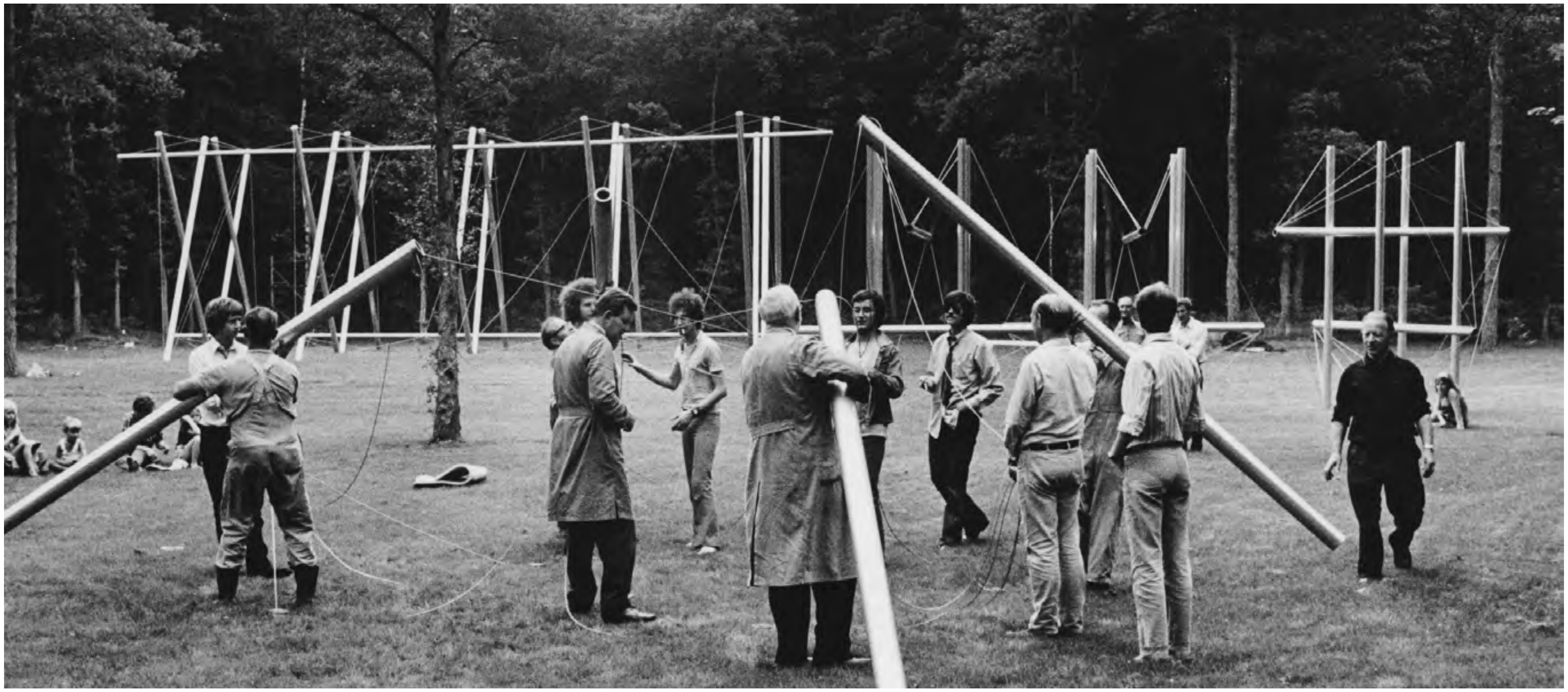
Four Module Piece, Form 2, 1968
aluminum and stainless steel
18 x 40 x 40 ft
5.48 x 5.48 x 12.2 m
Snelson Exhibition, Bryant Park, New York, NY

Four Module Piece at Jardin du Palais Royal
Paris, France, 2006

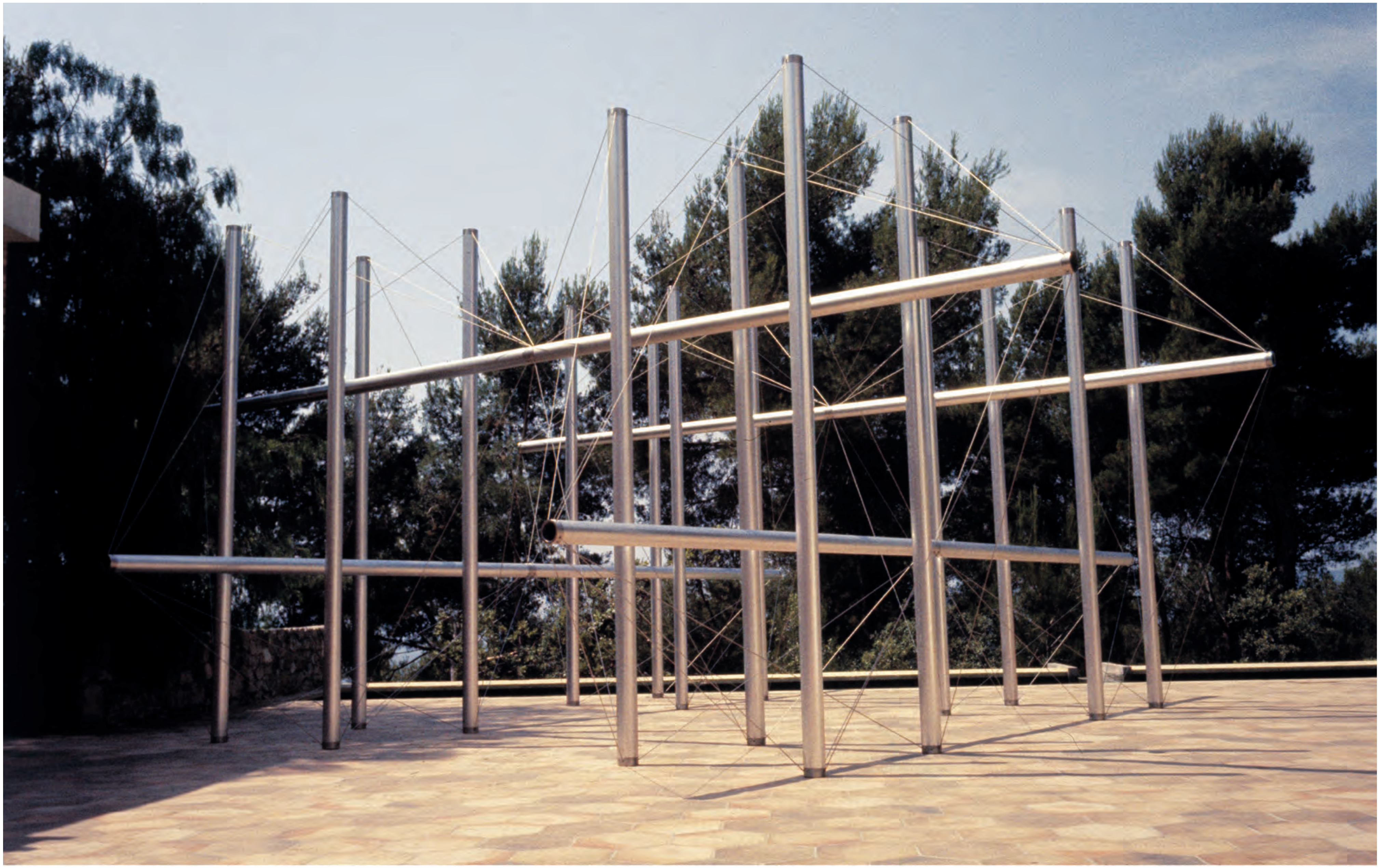


Key City drawing, 1968-70
pencil and photo on paper
8.5 x 11 in
21.5 x 28 cm

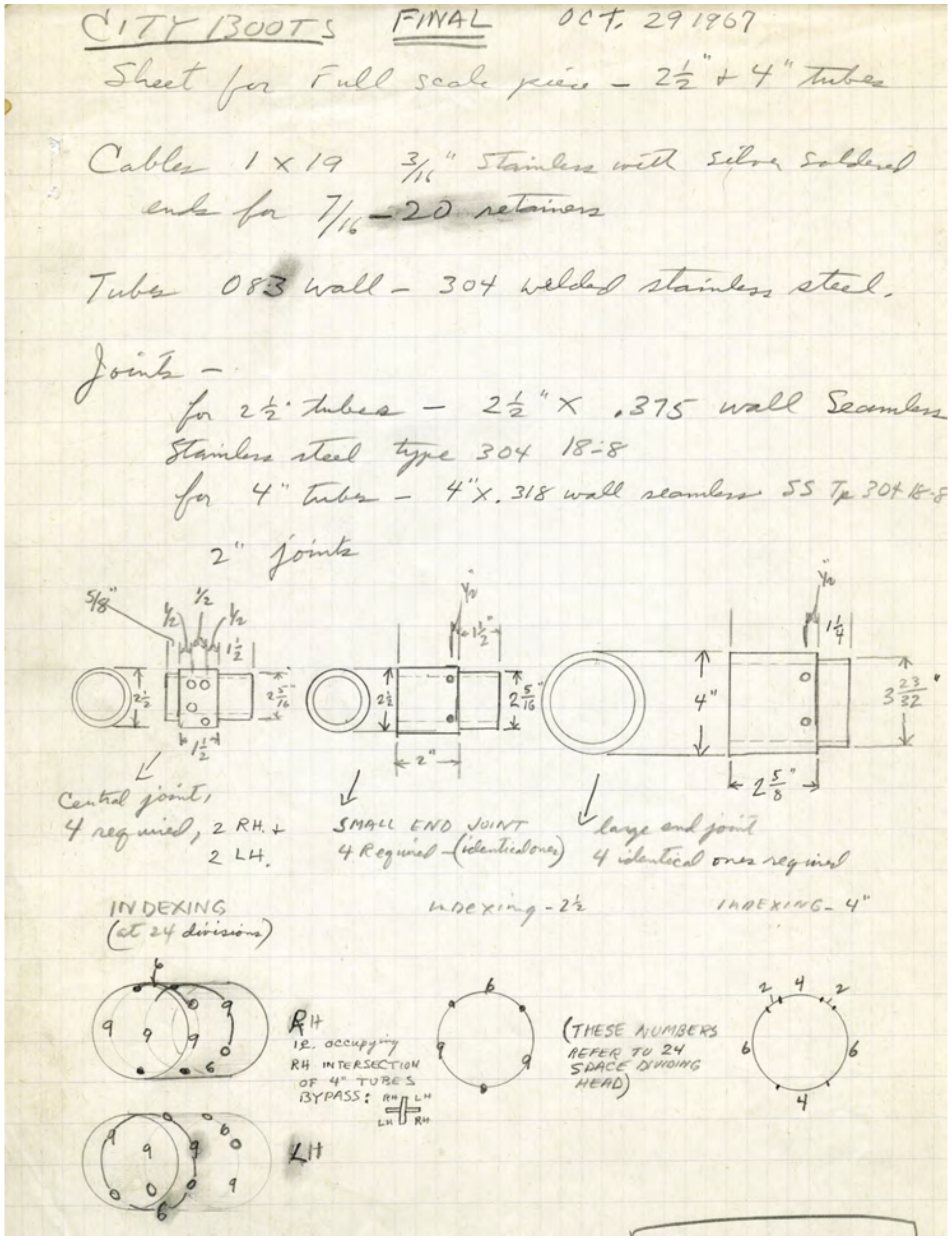
Key City assembly, Fondation Maeght
St. Paul de Vence, France, 1969



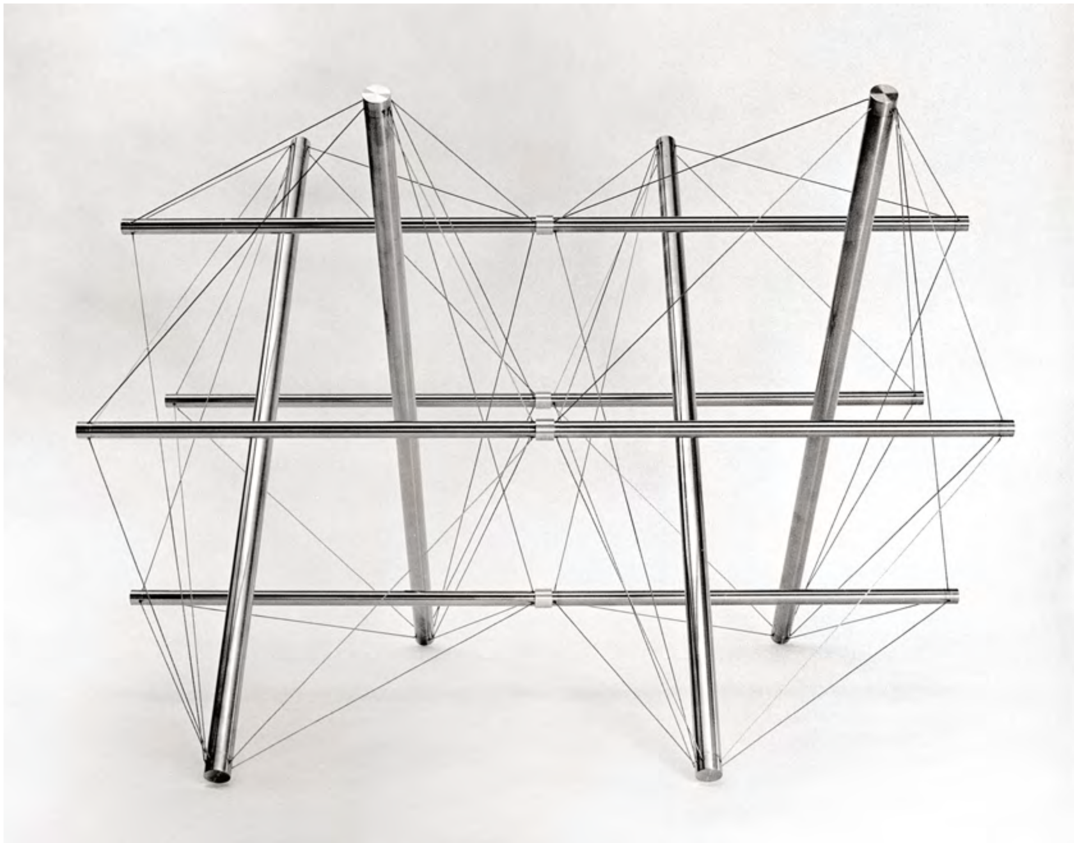
Installing ***Key City*** at Kröller-Müller, Otterlo, Netherlands, 1967



Key City, 1968
aluminum and stainless steel
12 x 24 x 24 ft
3.65 x 12.2 x 12.2 m
Photograph: Exhibition at Fondation Maeght,
St. Paul de Vence, France, 1969

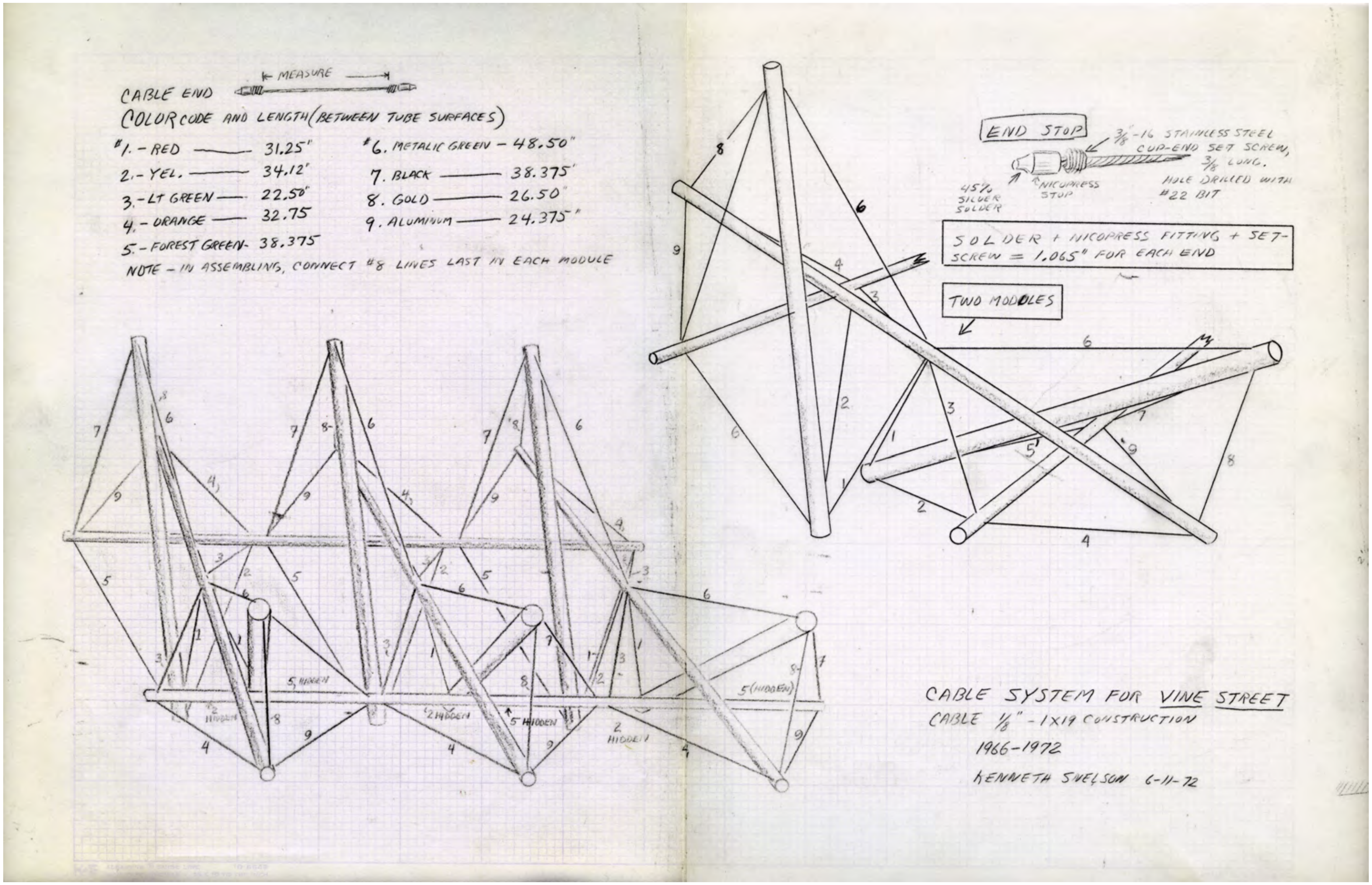


City Boots drawing
pencil and paper
8.5 x 11 in
21.5 x 28 cm

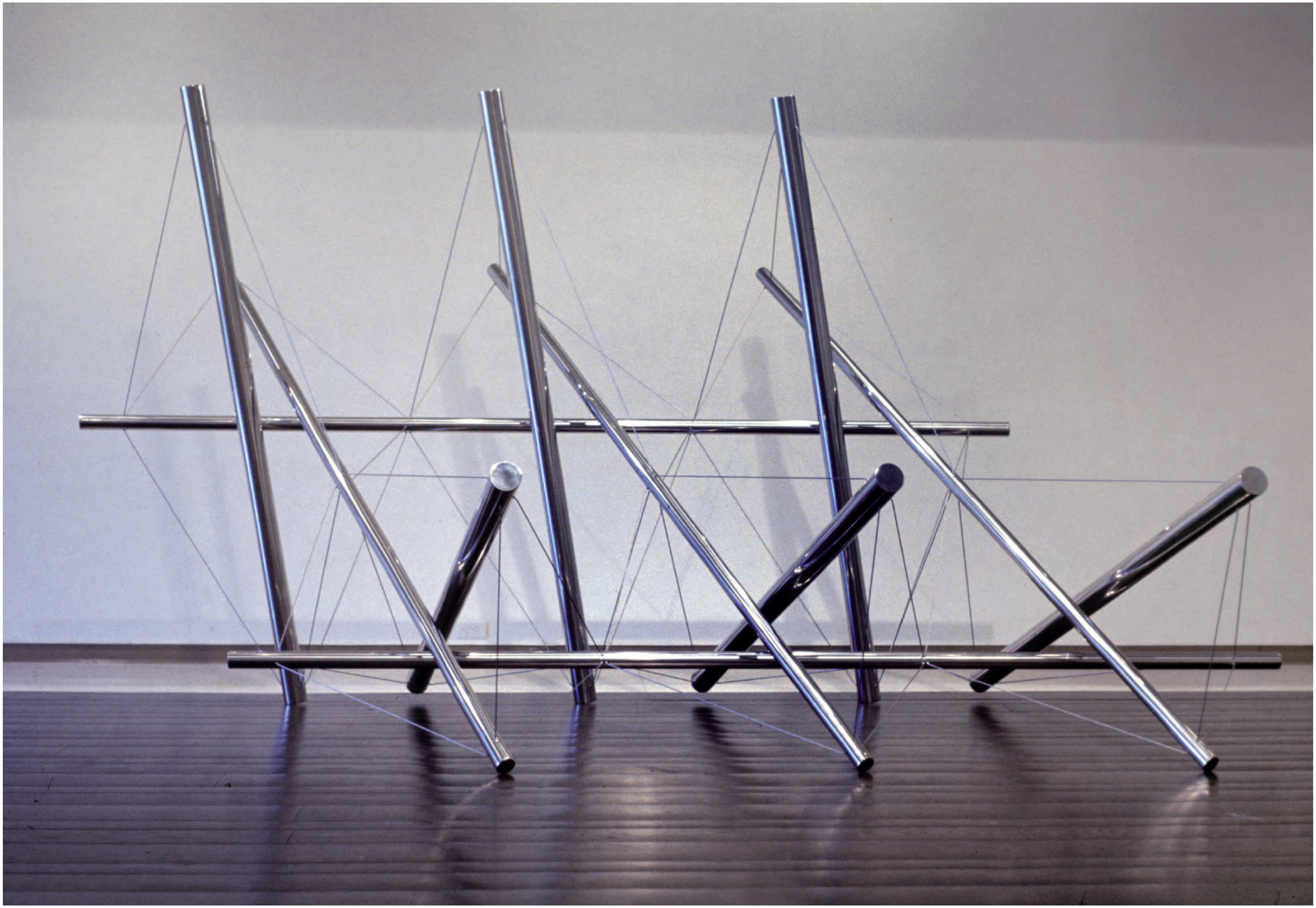


Double City Boots small sculpture, 1968
stainless steel
19 x 26 x 19 in
48 x 66 x 48 cm

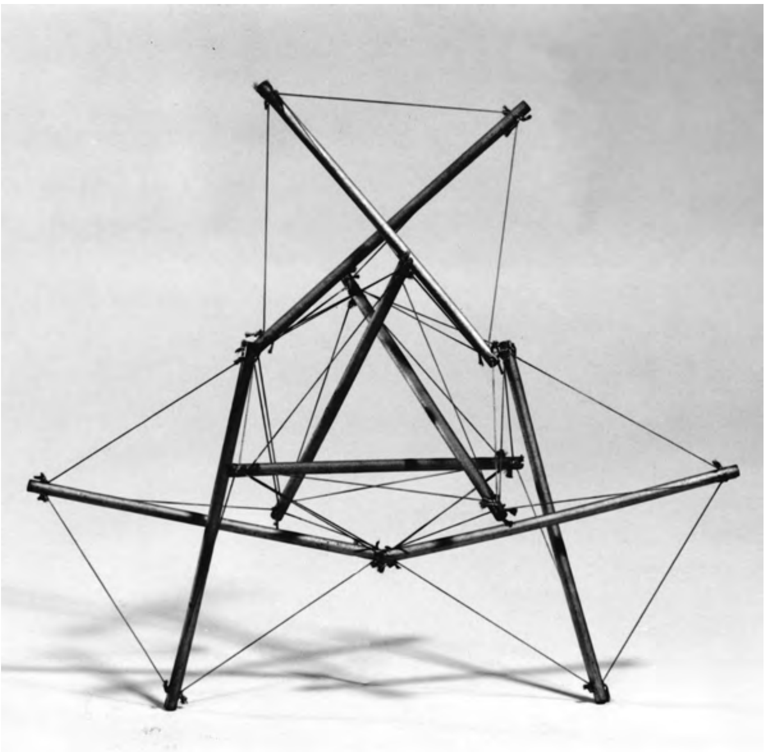
Double City Boots, 1968
stainless steel
9 x 9 x 12 ft
2.75 x 2.75 x 3.65 m
Collection: Miami-Dade Art in Public Places, Miami, FL



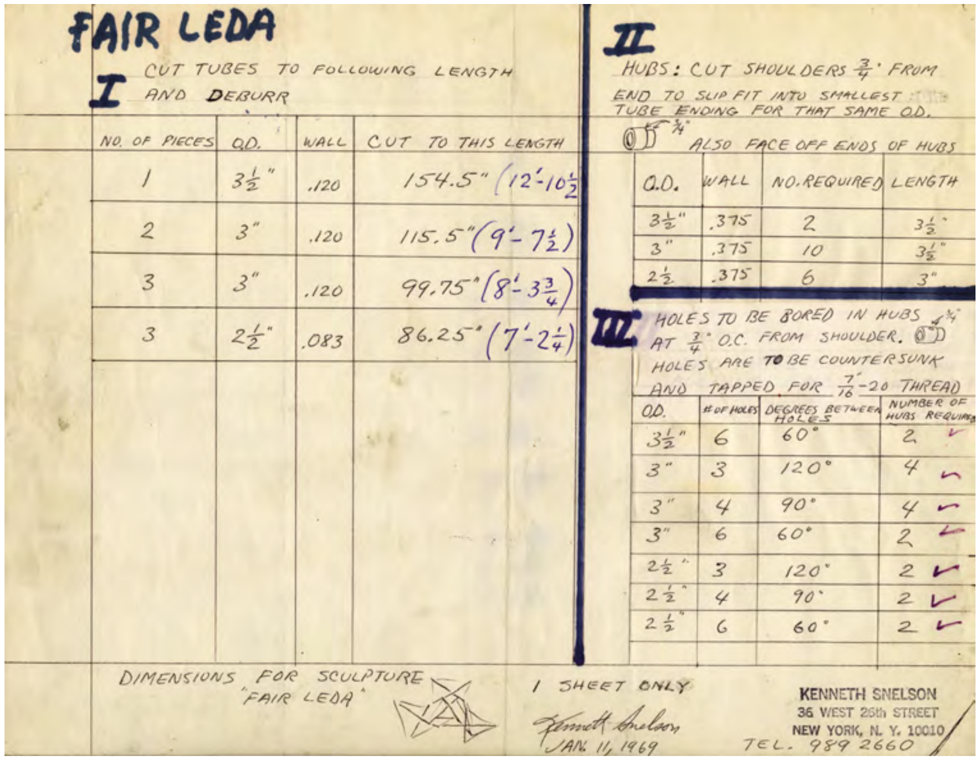
Vine Street drawing
pencil on paper
17 x 11 in
43 x 28 cm



Vine Street, 1966
stainless steel
6.4 x 11.8 x 7.5 ft
1.96 x 3.6 x 2.3 m



Fair Leda early study, 1960
wood and nylon line
8 x 9 x 5 in
20 x 23 x 13 cm



FAIR LEDA

I CUT TUBES TO FOLLOWING LENGTH AND DEBURR

NO. OF PIECES	O.D.	WALL	CUT TO THIS LENGTH
1	3½"	.120	154.5" (12'-10½)
2	3"	.120	115.5" (9'-7½)
3	3"	.120	99.75" (8'-3¾)
3	2½"	.083	86.25" (7'-2¼)

II HUBS: CUT SHOULDERS ¾" FROM END TO SLIP FIT INTO SMALLEST TUBE ENDING FOR THAT SAME O.D.
¾"
ALSO FACE OFF ENDS OF HUBS

O.D.	WALL	NO. REQUIRED	LENGTH
3½"	.375	2	3½"
3"	.375	10	3½"
2½	.375	6	3"

III HOLES TO BE BORED IN HUBS ¾" AT ¾" O.C. FROM SHOULDER. HOLES ARE TO BE COUNTERSUNK AND TAPPED FOR 7/16"-20 THREAD

O.D.	# OF HOLES	DEGREES BETWEEN HOLES	NUMBER OF HUBS REQUIRED
3½"	6	60°	2
3"	3	120°	4
3"	4	90°	4
3"	6	60°	2
2½"	3	120°	2
2½"	4	90°	2
2½"	6	60°	2

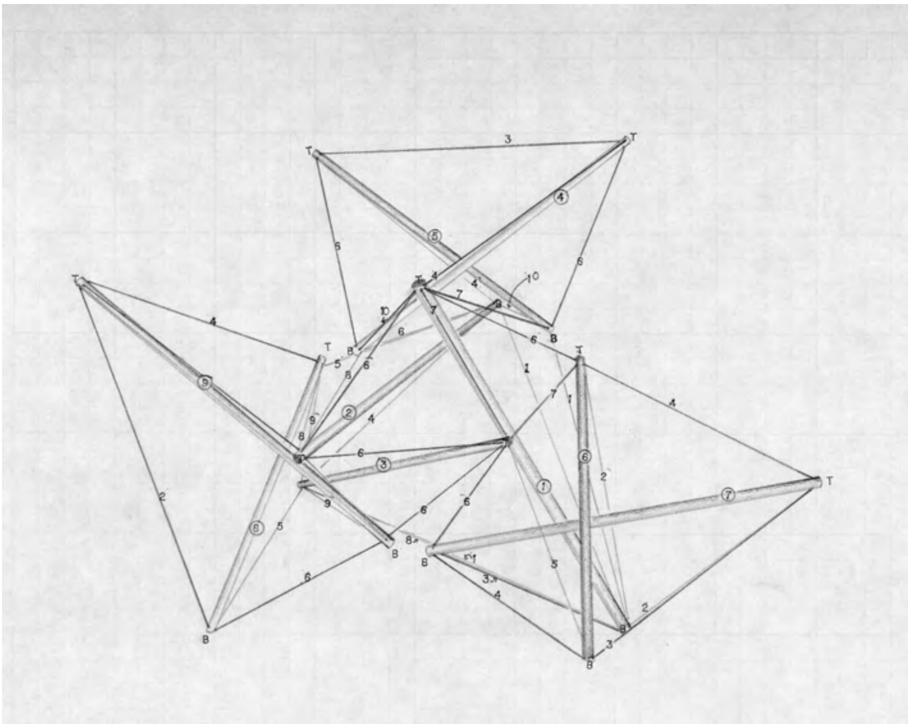
DIMENSIONS FOR SCULPTURE "FAIR LEDA"

1 SHEET ONLY

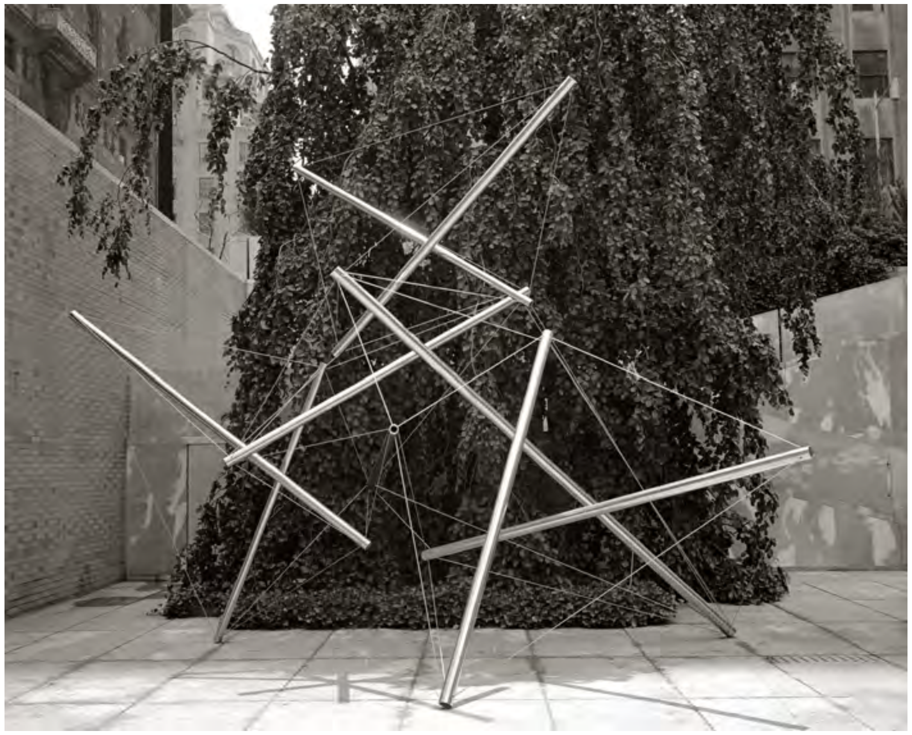
Kenneth Snelson
JAN. 11, 1969

KENNETH SNELSON
36 WEST 26th STREET
NEW YORK, N. Y. 10010
TEL. 989 2660

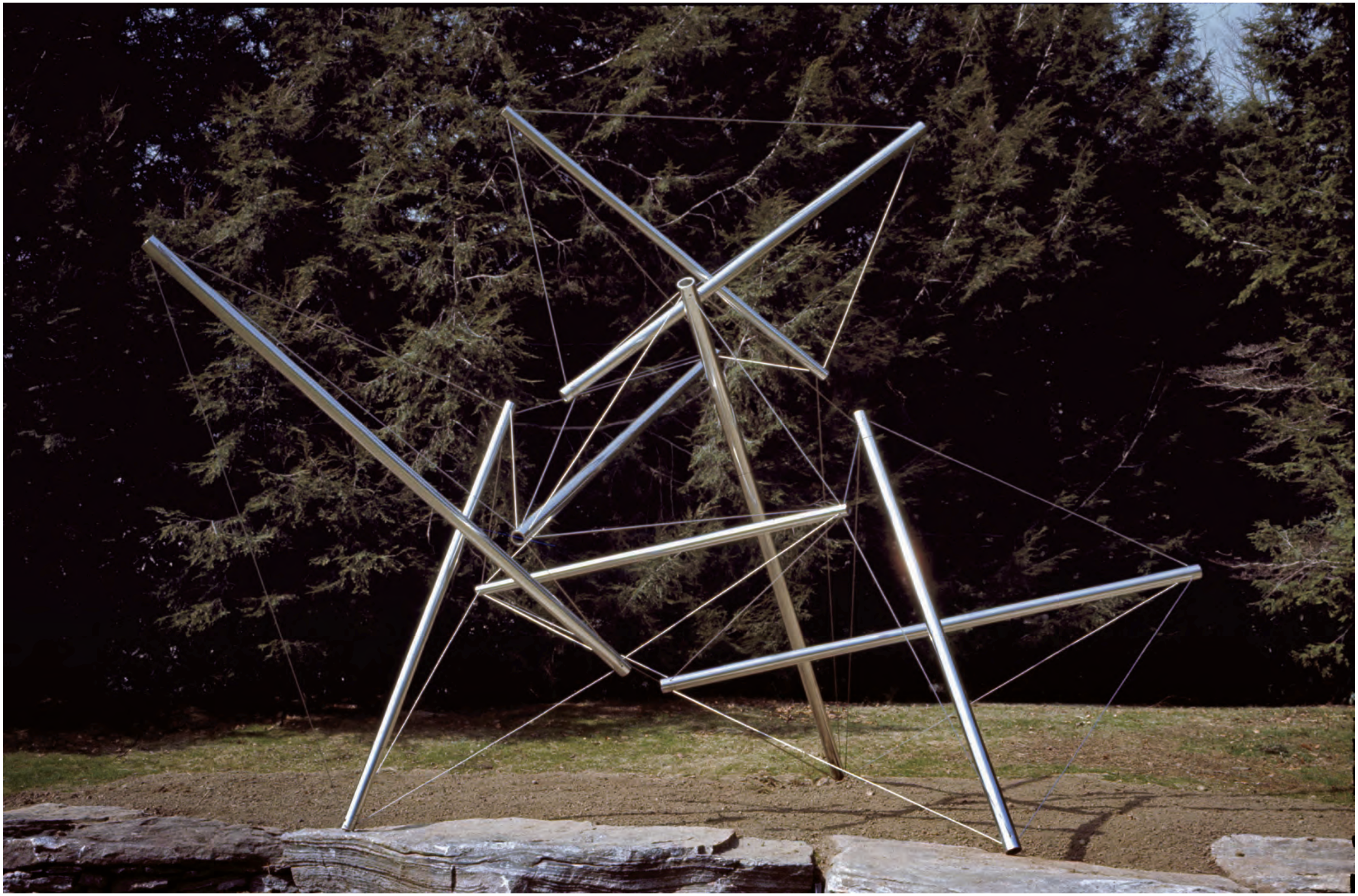
Fair Leda data sheet, 1969
ink and pencil on paper
8.5 x 11 in
21.5 x 28 cm



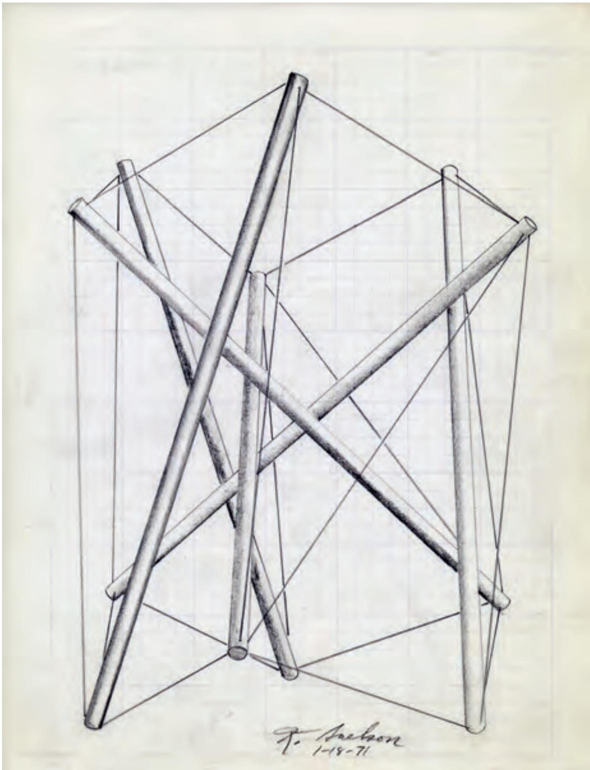
Fair Leda drawing, 1969
pencil on paper
8.5 x 11 in
21.5 x 28 cm



Fair Leda, 1969 Museum Modern Art, N.Y., NY



Fair Leda, 1969
stainless steel
12 x 10 x 18 ft
3.6 x 3 x 5.5 m
Collection: Rockefeller Estate, Pocantico Hills, NY

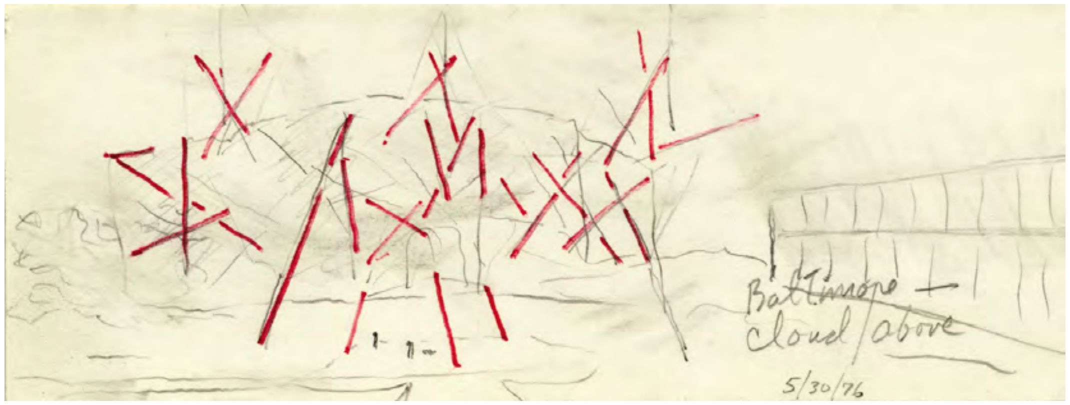


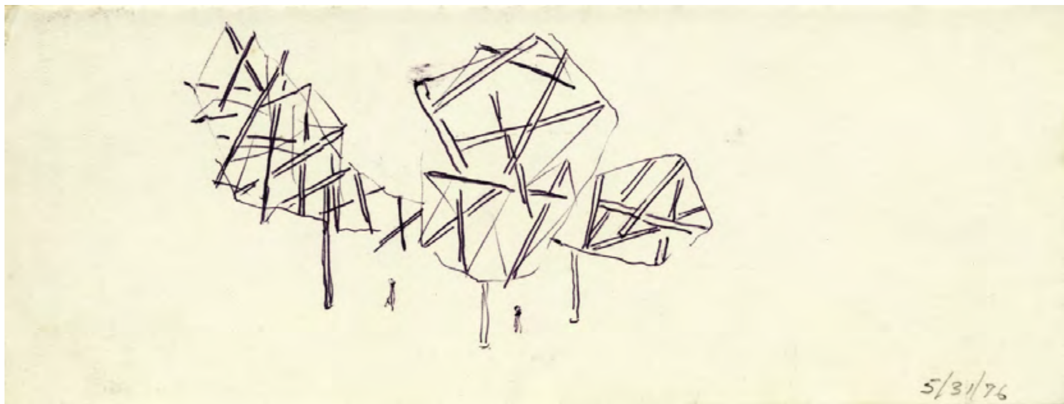
Newport drawing, 1971
pencil on paper
8.5 x 11 in
21.5 x 28 cm

First assembly of ***Newport,*** The Springs, Long Island, NY, 1967

Photos of Snelson with *Newport* by Dan Budnik

Newport, 1968
stainless steel
12 x 9 x 9 ft
3.65 x 3.65 x 2.74 m
Collection: M. Margulies, Coconut Grove, FL

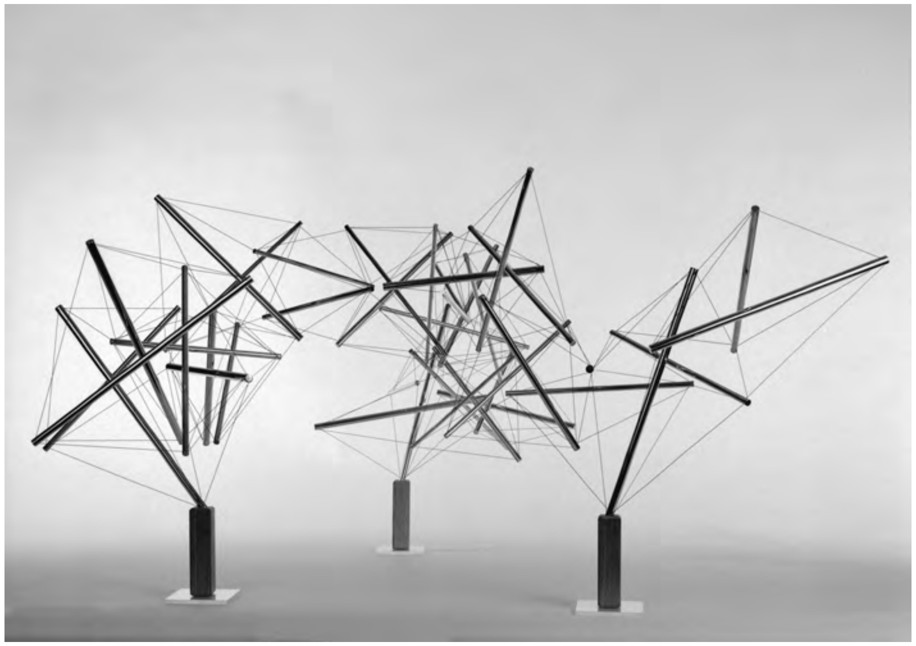




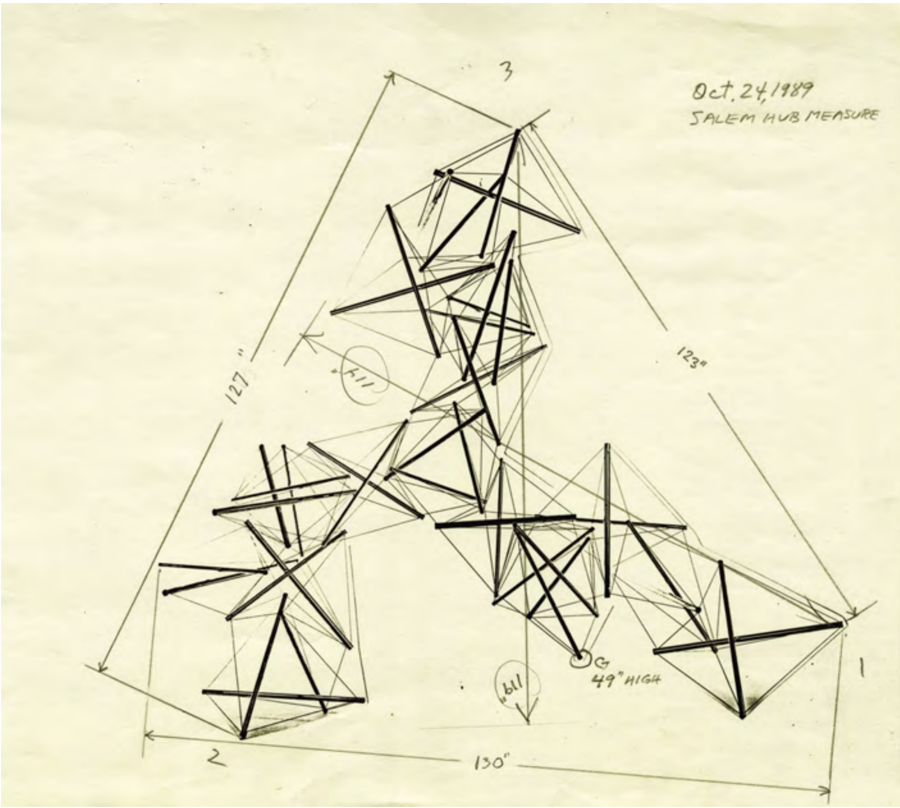
Sketches, first visit to Baltimore Inner Harbor, MD, 1976

Installation of ***Easy Landing***
Baltimore Inner Harbor, MD, 1977

Easy Landing, 1977
stainless steel
30 x 85 x 65 ft
10 x 25 x 20 m
Collection: City of Baltimore, Baltimore, MD



Triple Crown maquette, 1989
aluminum and stainless steel
22 x 42 x 38 in
56 x 106.5 x 96.5 cm

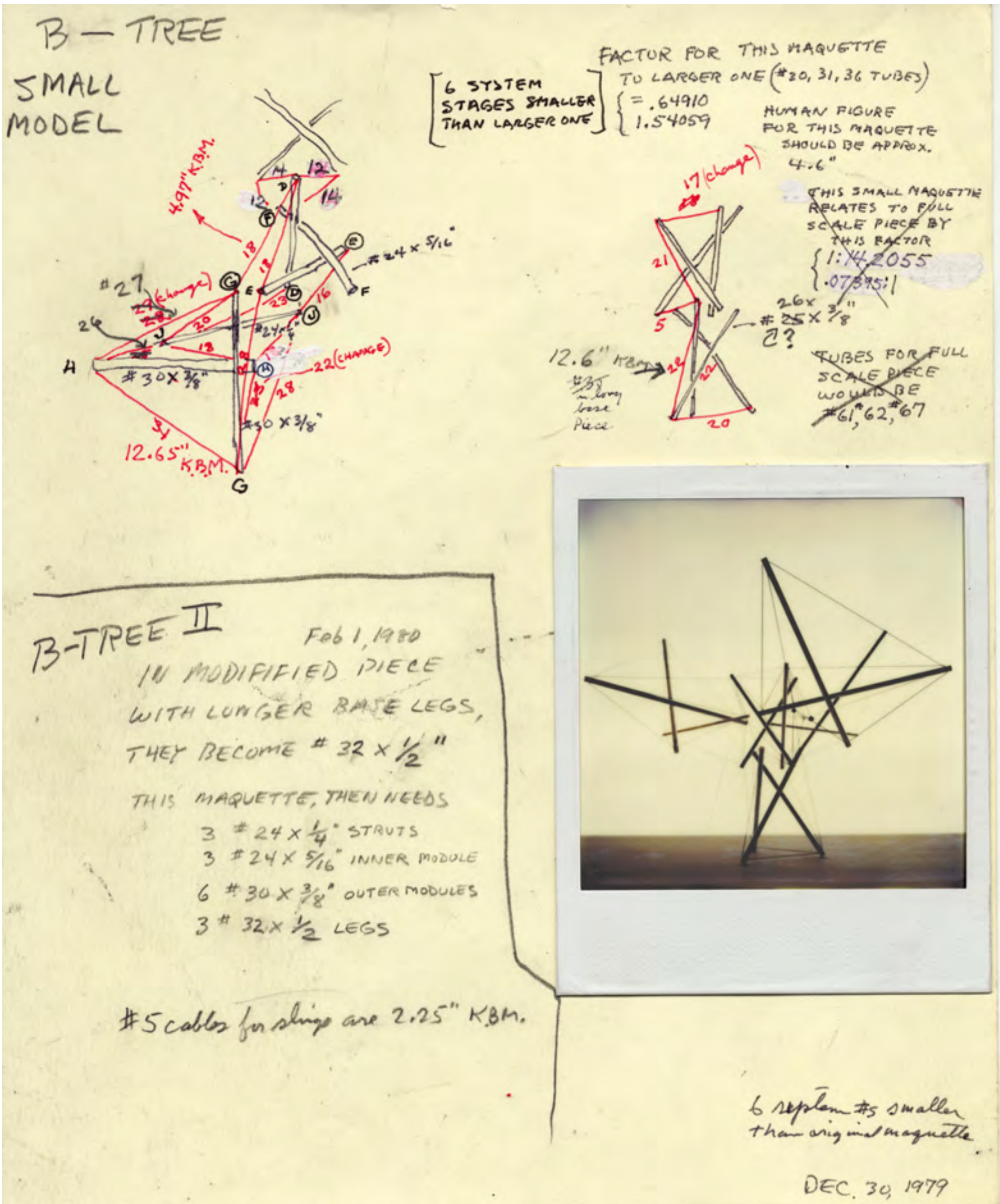


Triple Crown drawing, 1989
photo with pencil on paper
8.5 x 8 in
21.5 x 20 cm

Triple Crown Instsllation, Crown Center
Kansas City MO 1989

Triple Crown, 1991
stainless steel
43 x 85 x 78 ft
13 x 26 x 23 m
Collection: Hallmark, Inc., Kansas City, MO

Installing ***B-Tree I***
National Institutes of Health
Bethesda, MD, 1979



B-Tree I and II drawing, 1979
mixed media drawing on paper
8.5 x 11 in
21.5 x 28 cm

B-Tree II, 1981-2006
stainless steel
35 x 38 x 42 ft
10.6 x 11.6 x 12.8 m
Frederik Meijer Gardens and Sculpture Park, Grand Rapids, MI

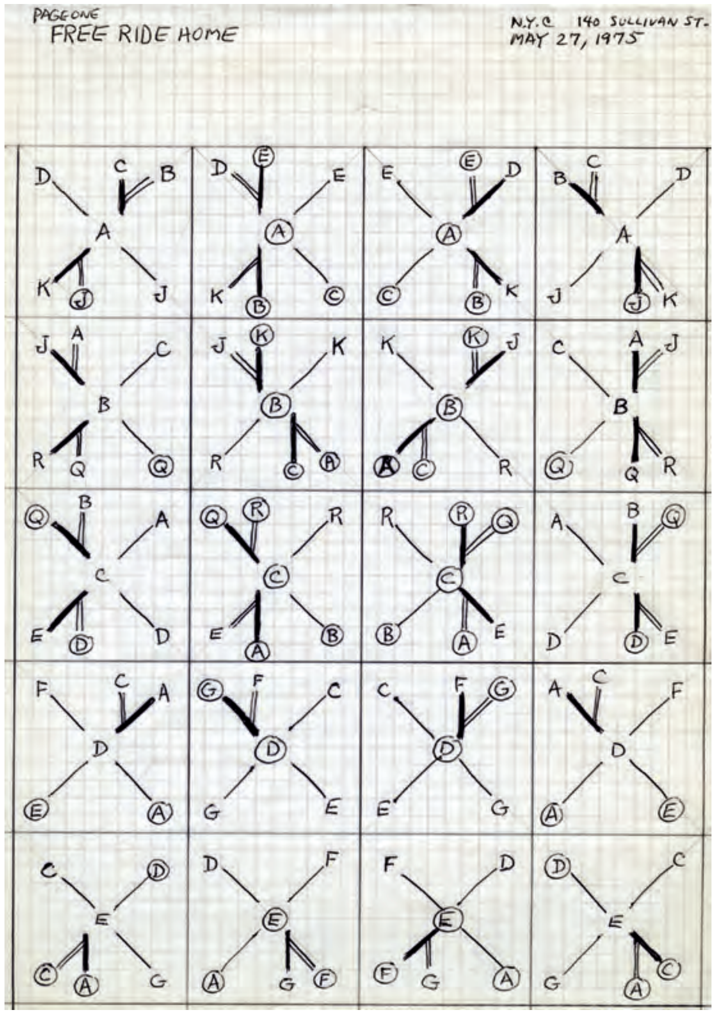


Diagram of cable connections for ***Free Ride Home***
ink on paper
8.5 x 11 in
21.5 x 28 cm

Free Ride Home original maquette with scale figures, 1974
aluminum and stainless steel
23.75 x 42 x 35 in
58.5 x 95 x 94 cm

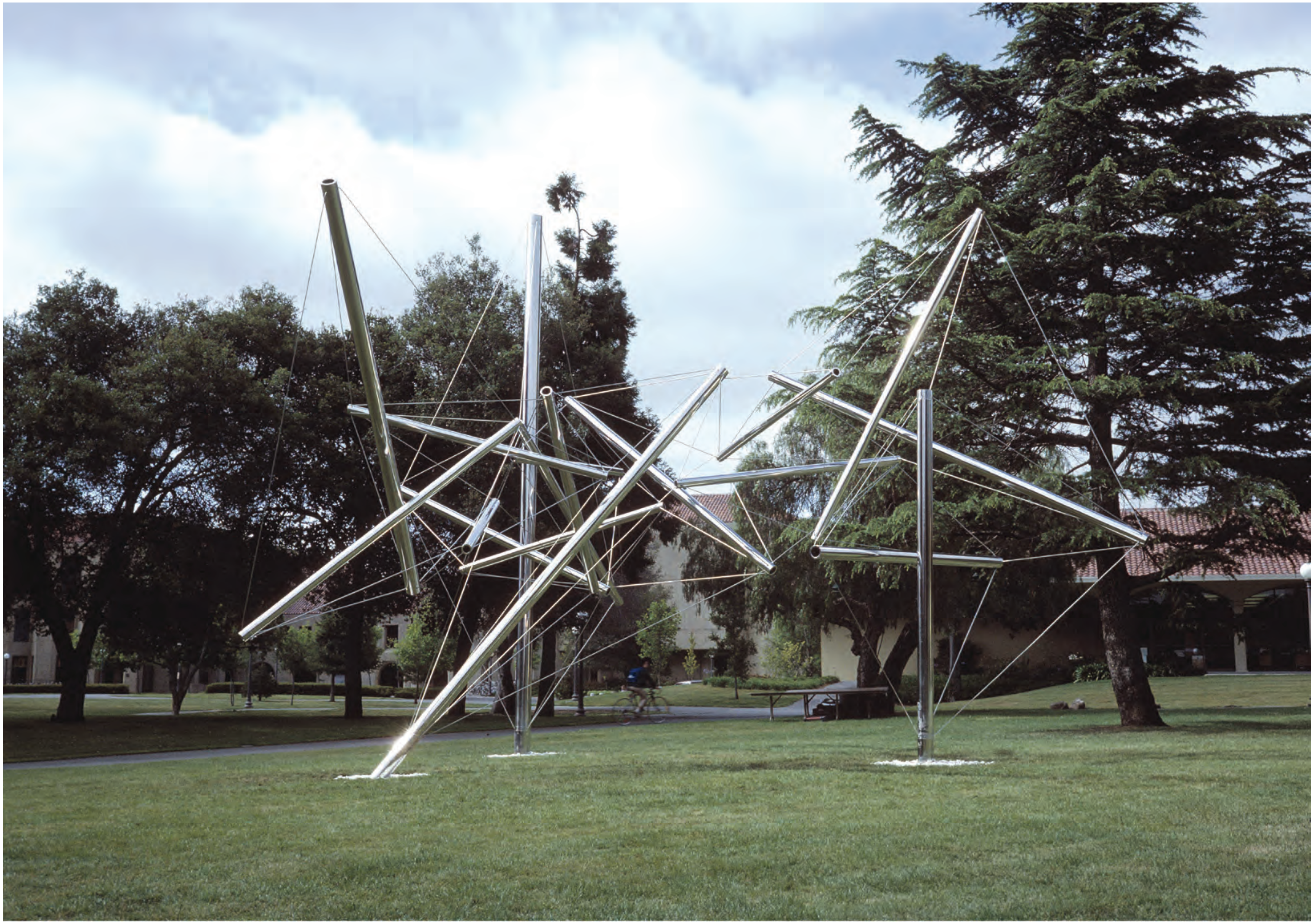
Installing ***Free Ride Home*** at Storm King Art Center
Mountainville, NY, 1974

Andrea Snelson, assistant

Free Ride Home, 1974
aluminum and stainless steel
30 x 60 x 60 ft
10 x 20 x 20 m
Collection: Storm King Art Center, Mountainville, NY

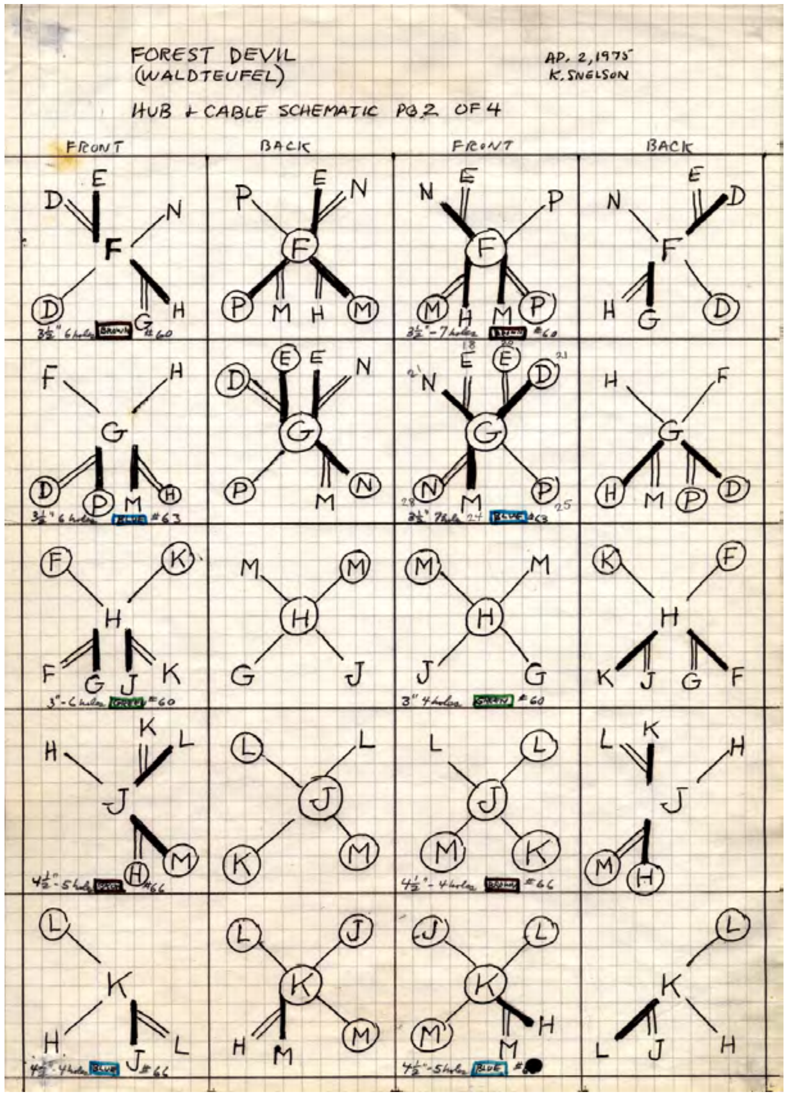
Installing *Mozart I*, at the Donald M. Kendall Sculpture Garden, Purchase, NY

Installing Mozart I at Stanford University, Stanford, CA, 1982



Mozart I, 1982
stainless steel
24 x 24 x 30 ft
7 x 9 x 9 m
Collection: Stanford University, Stanford, CA

Forest Devil model with i.d. tags 1975
aluminum and stainless steel
17.3 x 33.5 x 28.5 in
44 x 85 x 72 cm



Forest Devil cable-connection diagram, 1975
ink on paper
8.5 x 11 in
21.5 x 28 cm

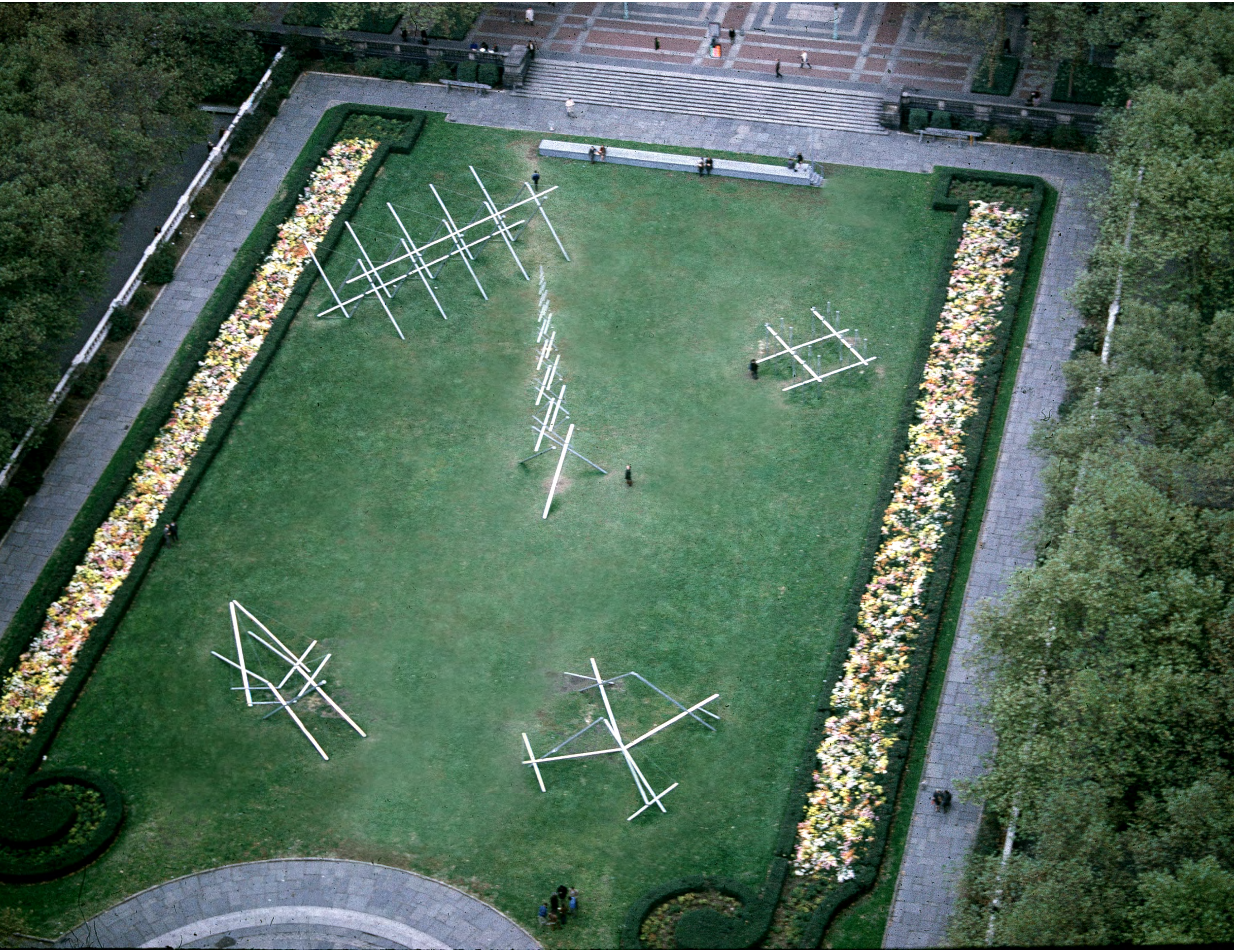
Forest Devil parts list, 1975
ink on paper with photograph
8.5 x 11 in
21.5 x 28 cm

Forest Devil 1977
Dedication Day
Pittsburgh, PA, 1977

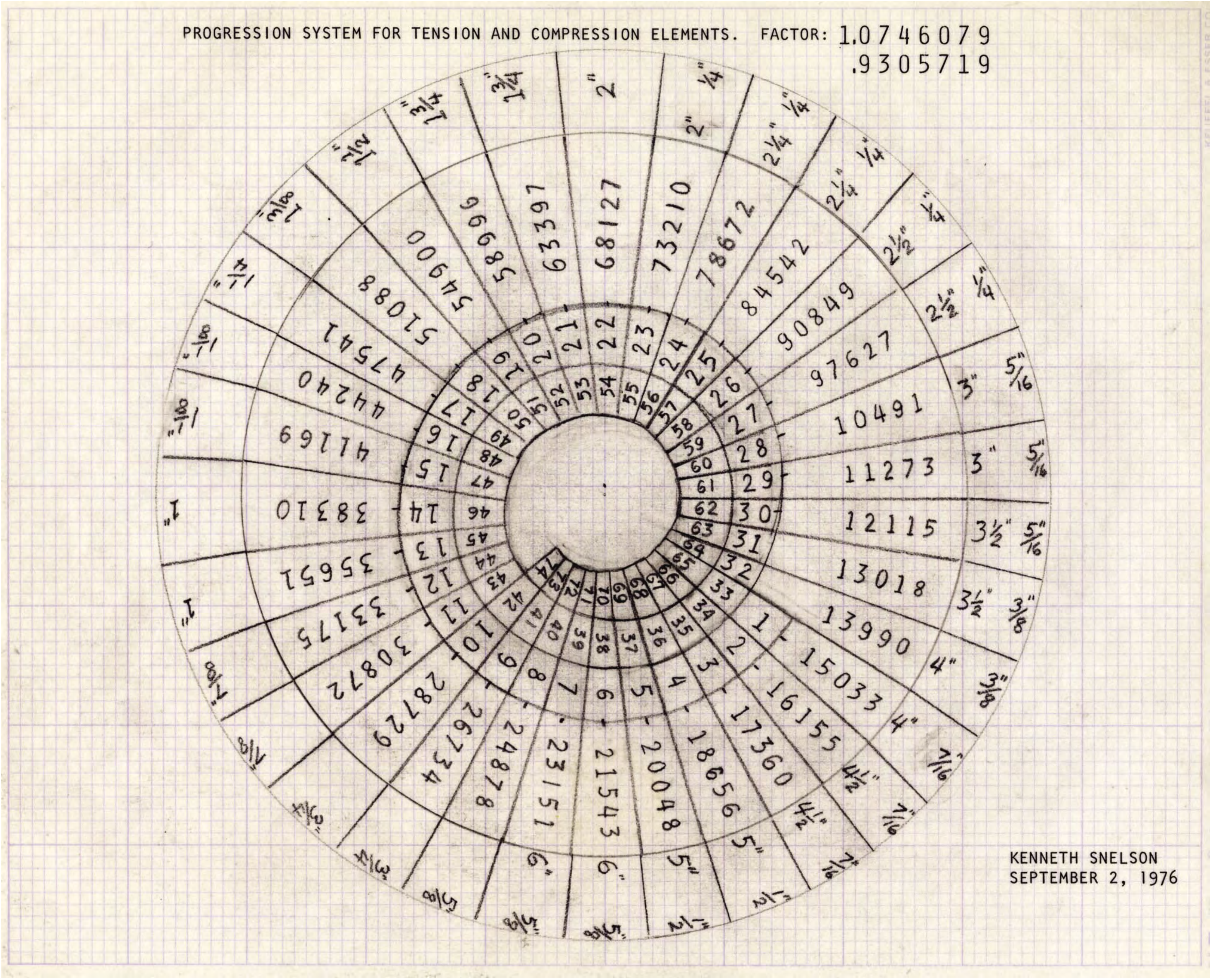
Forest Devil, 1975-1977
stainless steel
17 x 35 x 25 ft
5 x 10.5 x 7.5 m
Collection: Museum of Art, Carnegie Institute, Pittsburgh, PA

Audrey II, 1966
porcelainized aluminum and stainless steel
9 x 18 x 9 ft
2.75 x 5.4 x 3 m

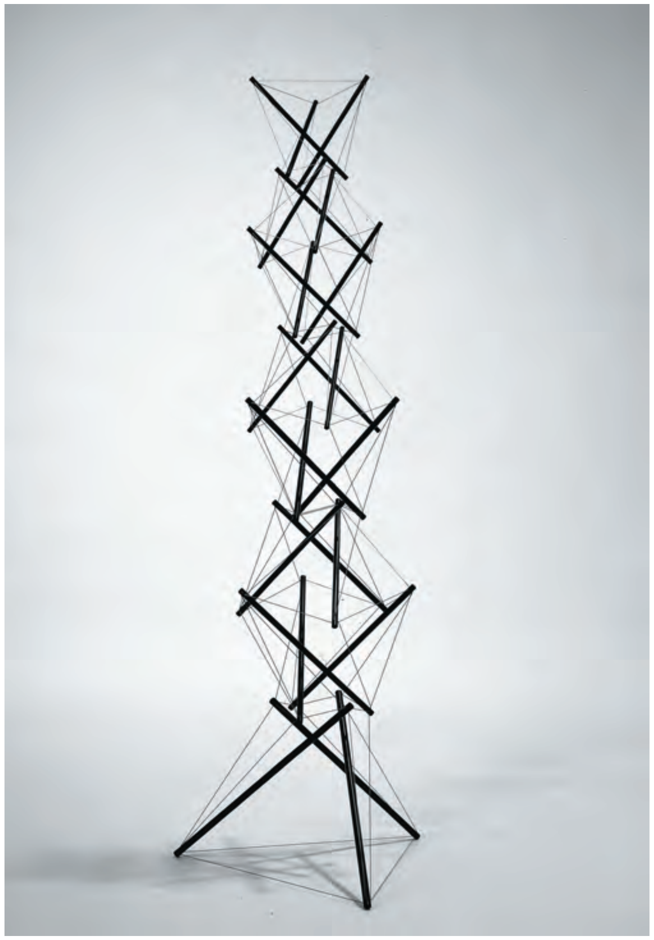
Tall Tale, 1975-1976
stainless steel
21 x 21 x 10 ft
6.4 x 6.4 x 3.08 m
San Diego Community College, San Diego, CA



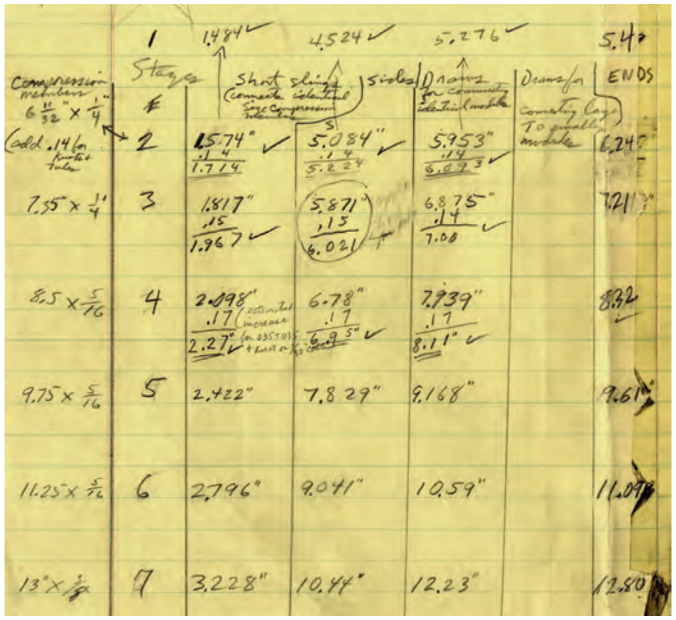
Five Sculptures by Snelson Exhibition 1968, Bryant Park, New York, NY



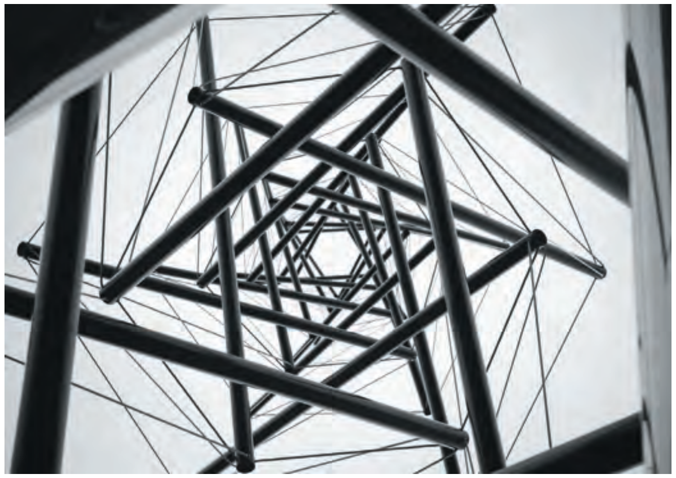
Snail-spiral Graph 1976 the size-relationships, module-to-module, for *Needle Tower II*



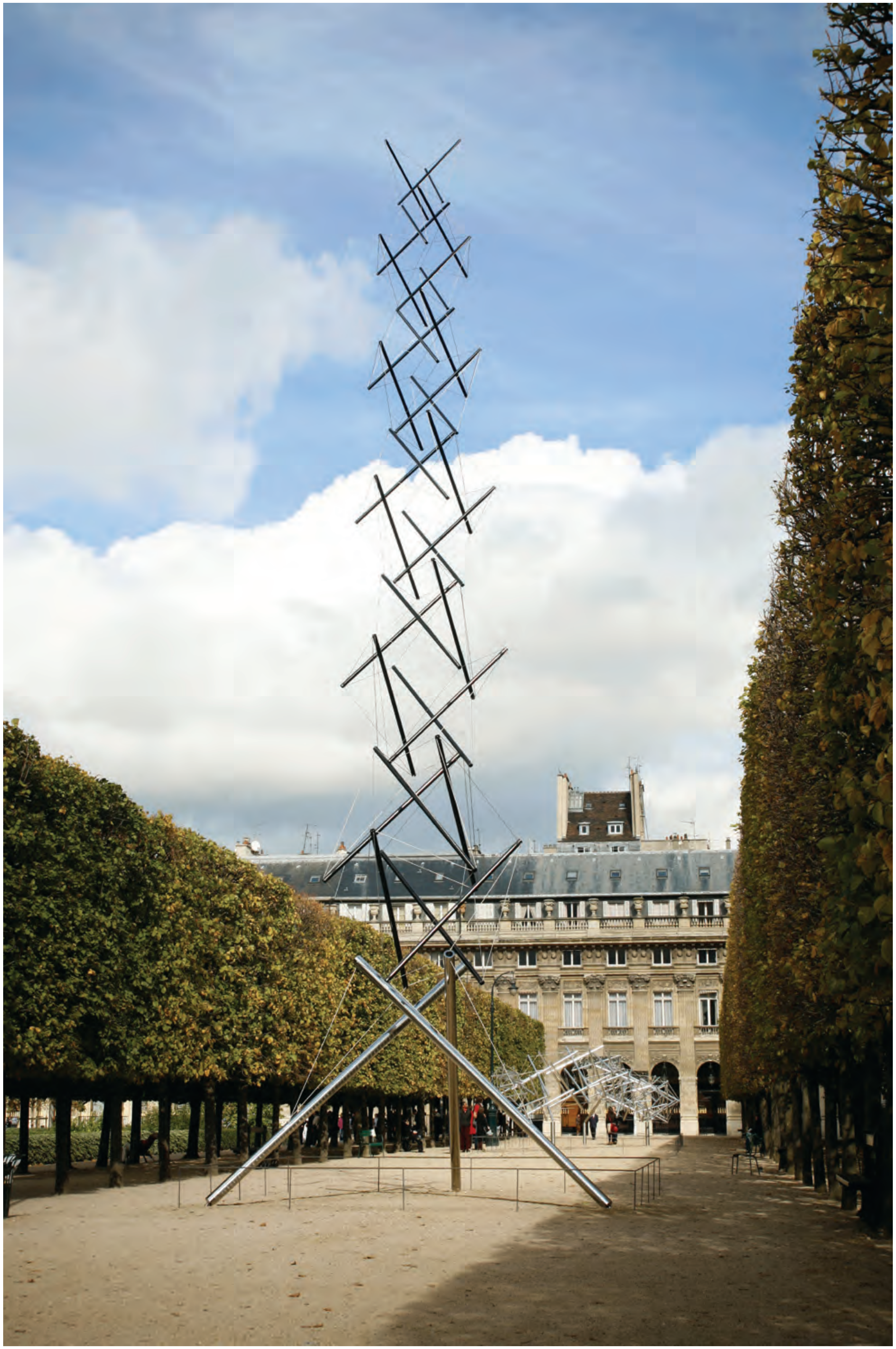
Black E.C. Tower, original maquette, 1969
black anodized aluminum and stainless steel
41 x 14.5 x 12.5 in
104 x 36 x 32 cm



E.C. Tower, first calculations for tension lines, 1969



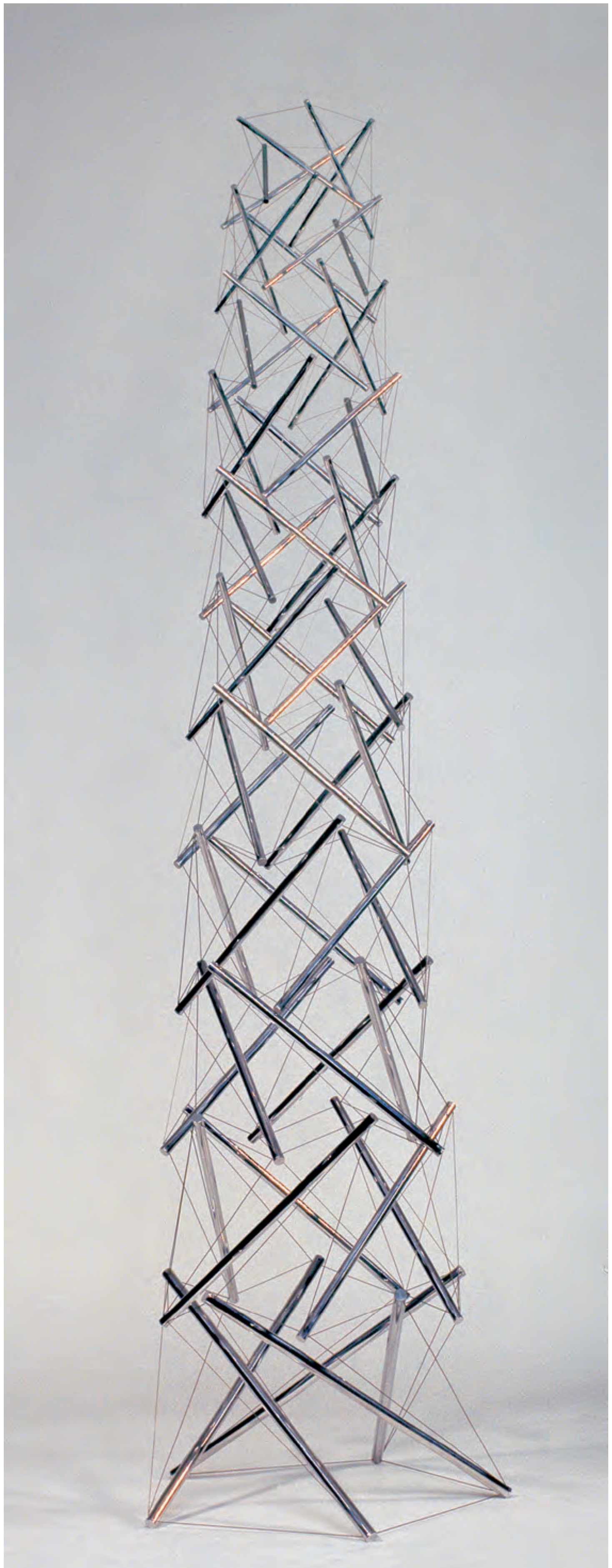
Installing ***Black E.C. Tower***
George Rickey and Kenneth Snelson Exhibition
Jardin du Palais Royal, Paris, France 2006



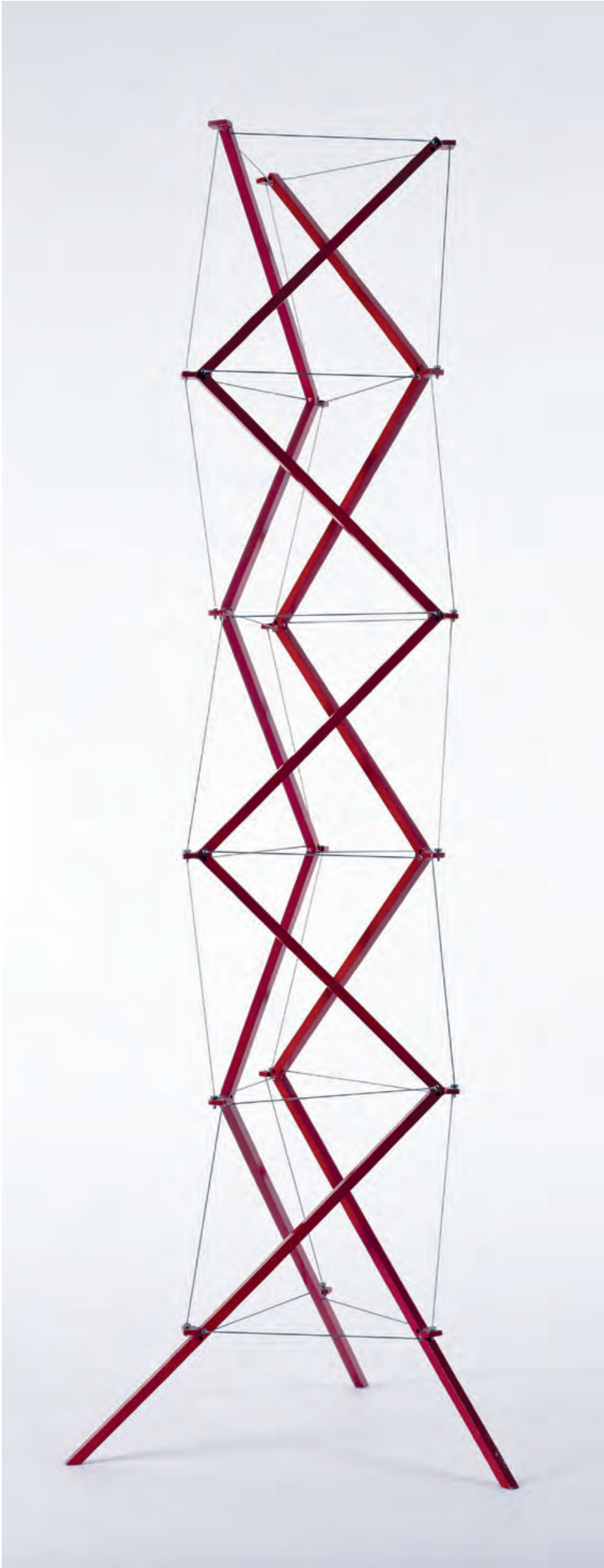
Black E.C. Tower, 2006
aluminum and stainless steel
50 x 11 x 9.5 ft
15 x 4 x 4 m
George Rickey and Kenneth Snelson Exhibition
Jardin du Palais Royal, Paris, France

Sleeping Dragon, 2003
aluminum and stainless steel
10 x 72.5 x 16 ft
3.04 x 22.1 x 4.87 m
George Rickey and Kenneth Snelson Exhibition, 2006
Jardin du Palais Royal, Paris, France

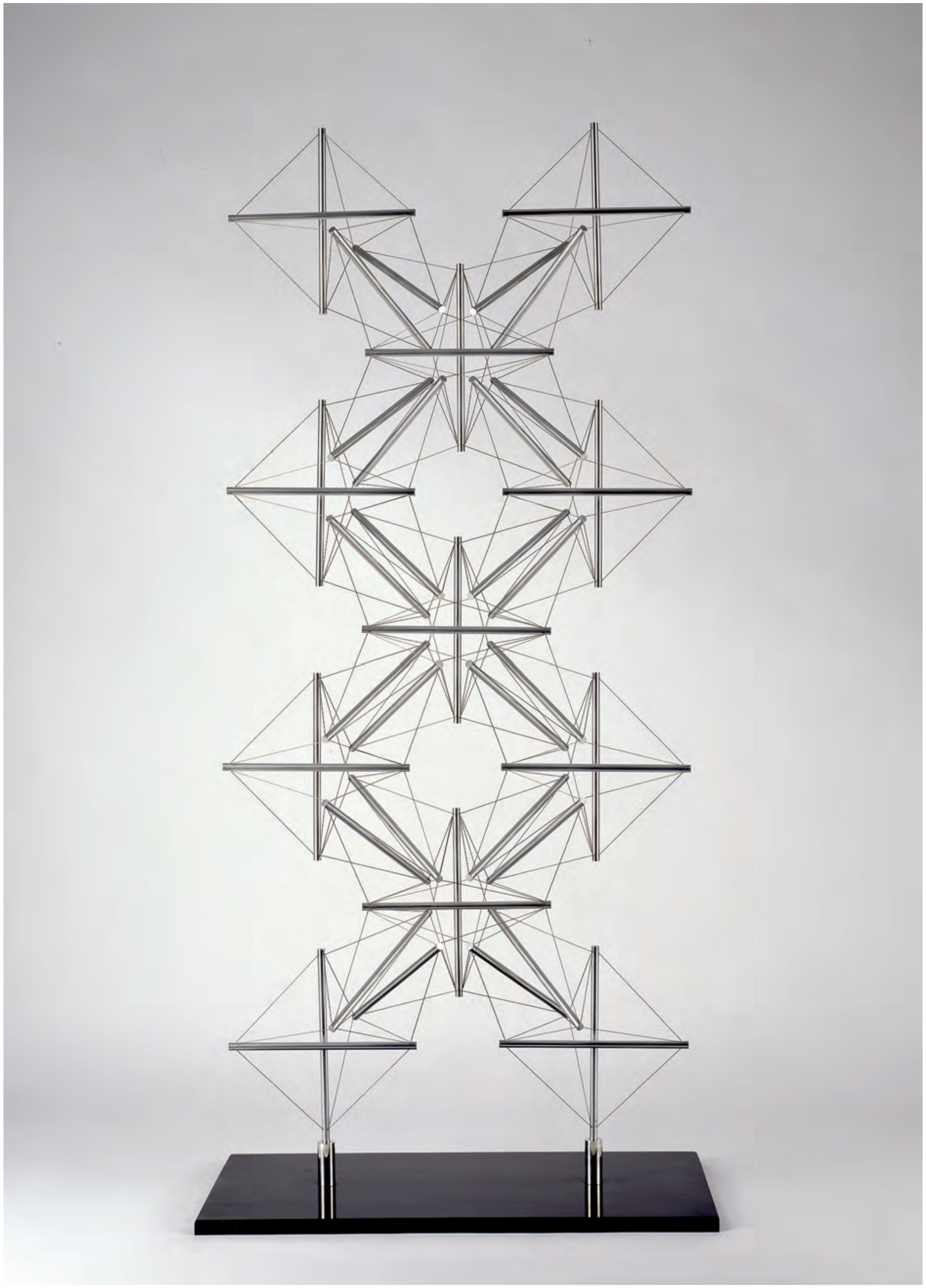
Sleeping Dragon



Penta Tower, 2001-2003
aluminum and stainless steel
57 x 14 x 15 in
145 x 35.5 x 35.5 cm



Zig-Zag Tower, 1997
painted stainless steel
45.5 x 9 x 7.75 in
115.6 x 22.9 x 19.7 cm

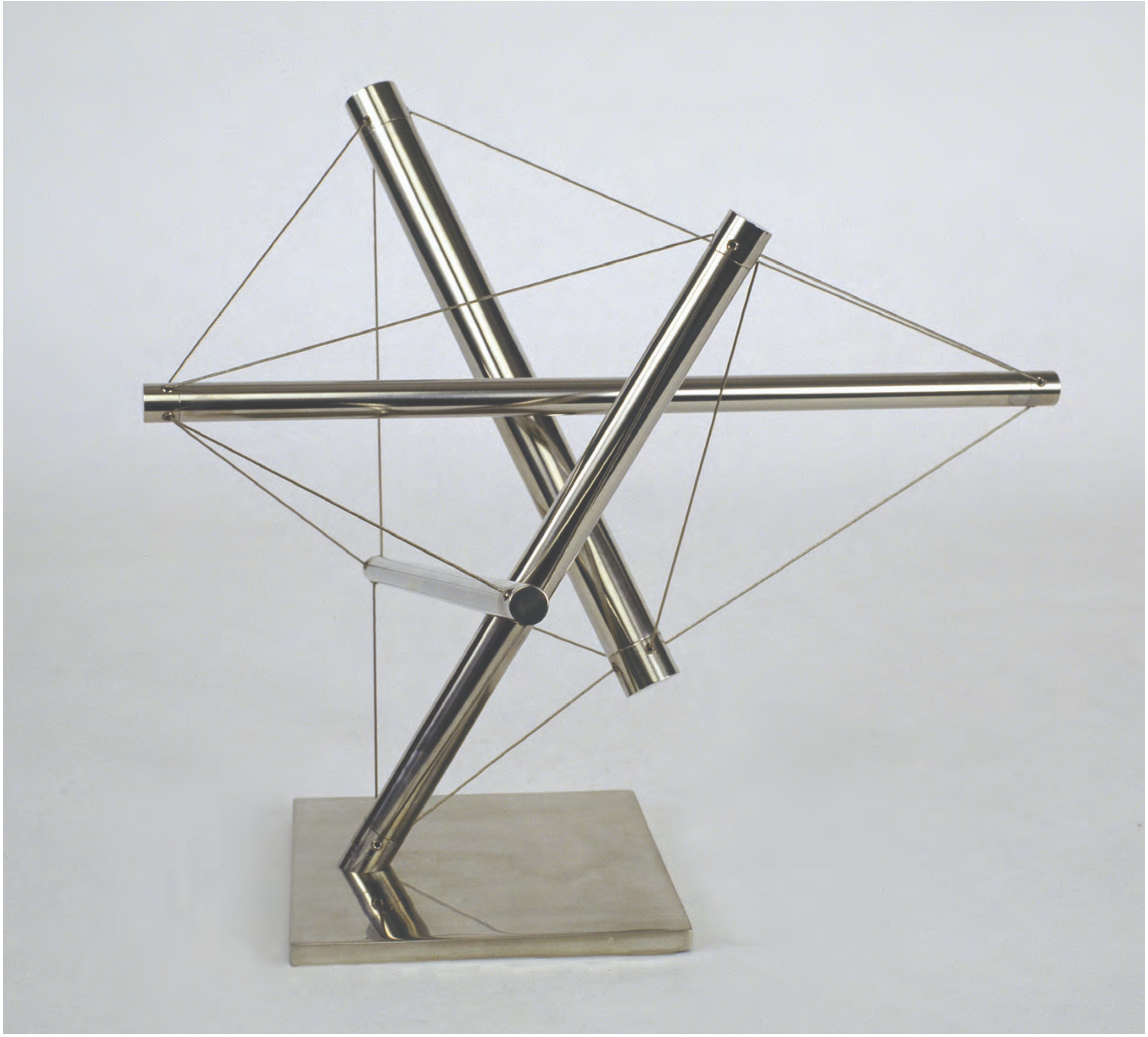


X-Planar Tower, 1962-1988
aluminum and stainless steel
51 x 22 x 6.75 in
129.5 x 55.9 x 17.1 cm

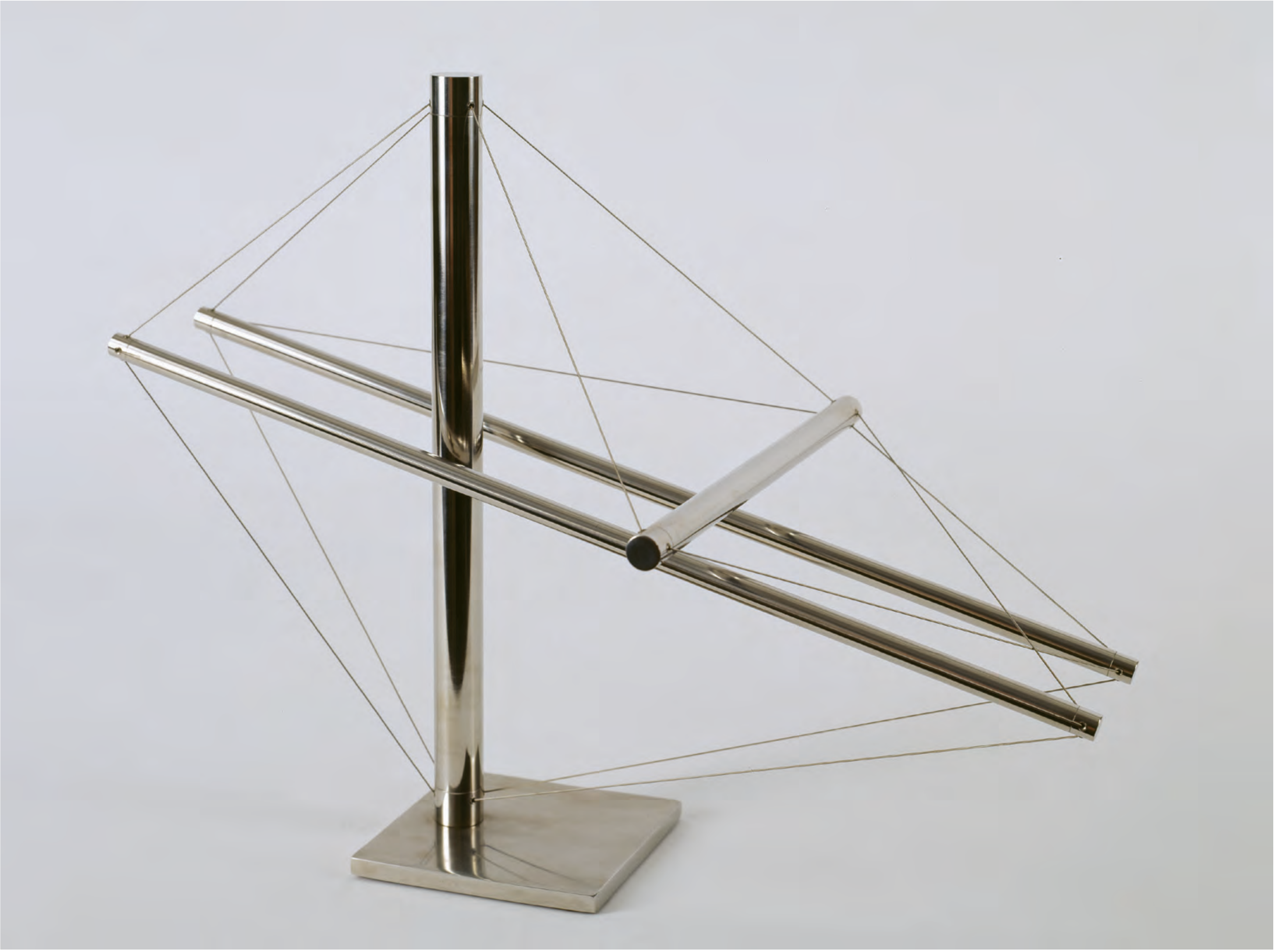
Sagg Main Street II, 2006
stainless steel
27.5 x 22.5 x 15.5 in
70 x 57 x 39 cm

Fat Rador, 1975-1978
brass and stainless steel
20 x 17 x 6 in
50.8 x 43.2 x15.2 cm

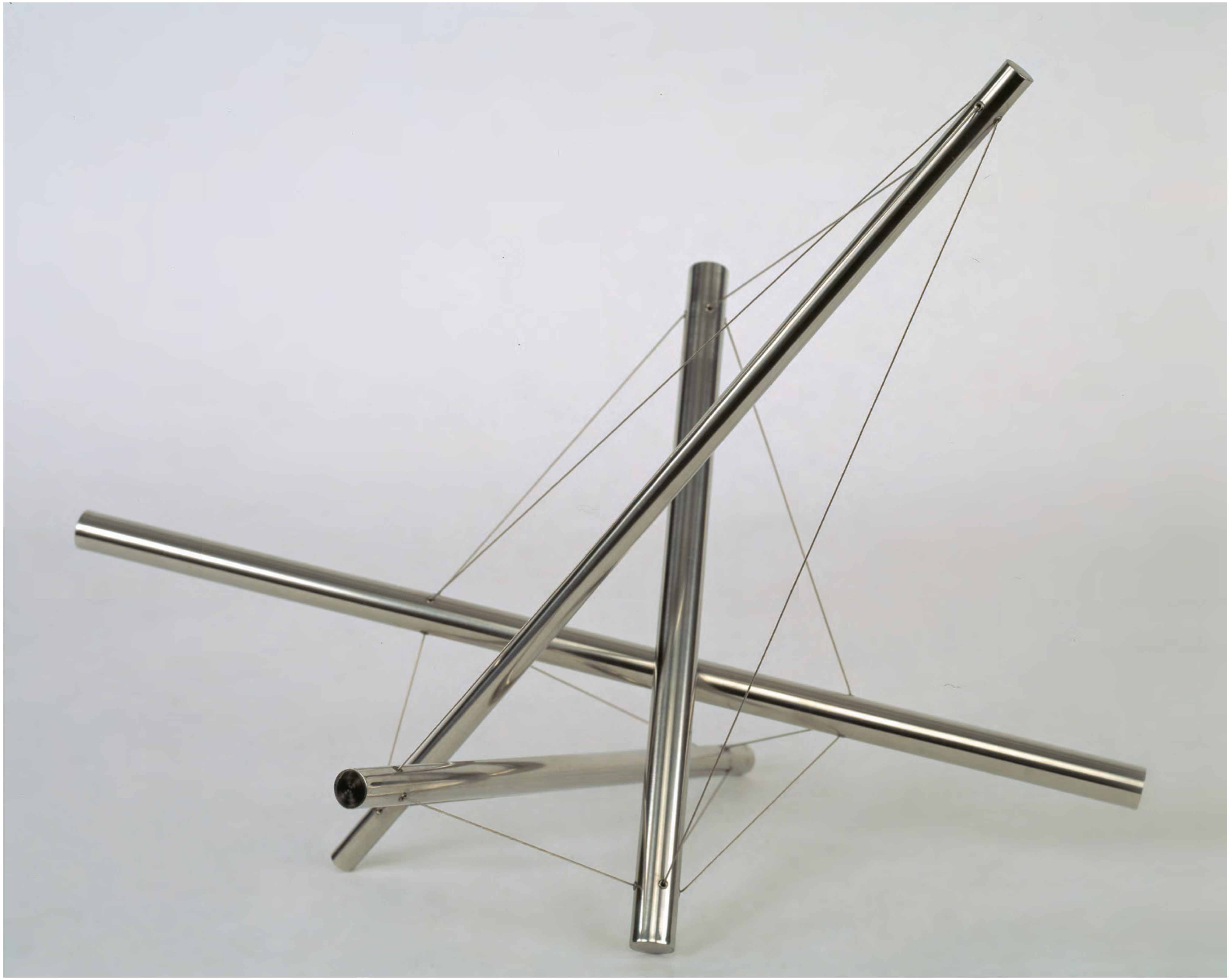
Sigma Data II, 1975-1993
stainless steel
29.25 x 35 x 21 in
76 x 90 x 51 cm



60.5 Degrees, 1992
stainless steel
13 x 15.5 x 13 in
34 x 39 x 34 cm



Flat Out, 1979
stainless steel
16 x 20 x 11 in
40 x 51 x 28 cm

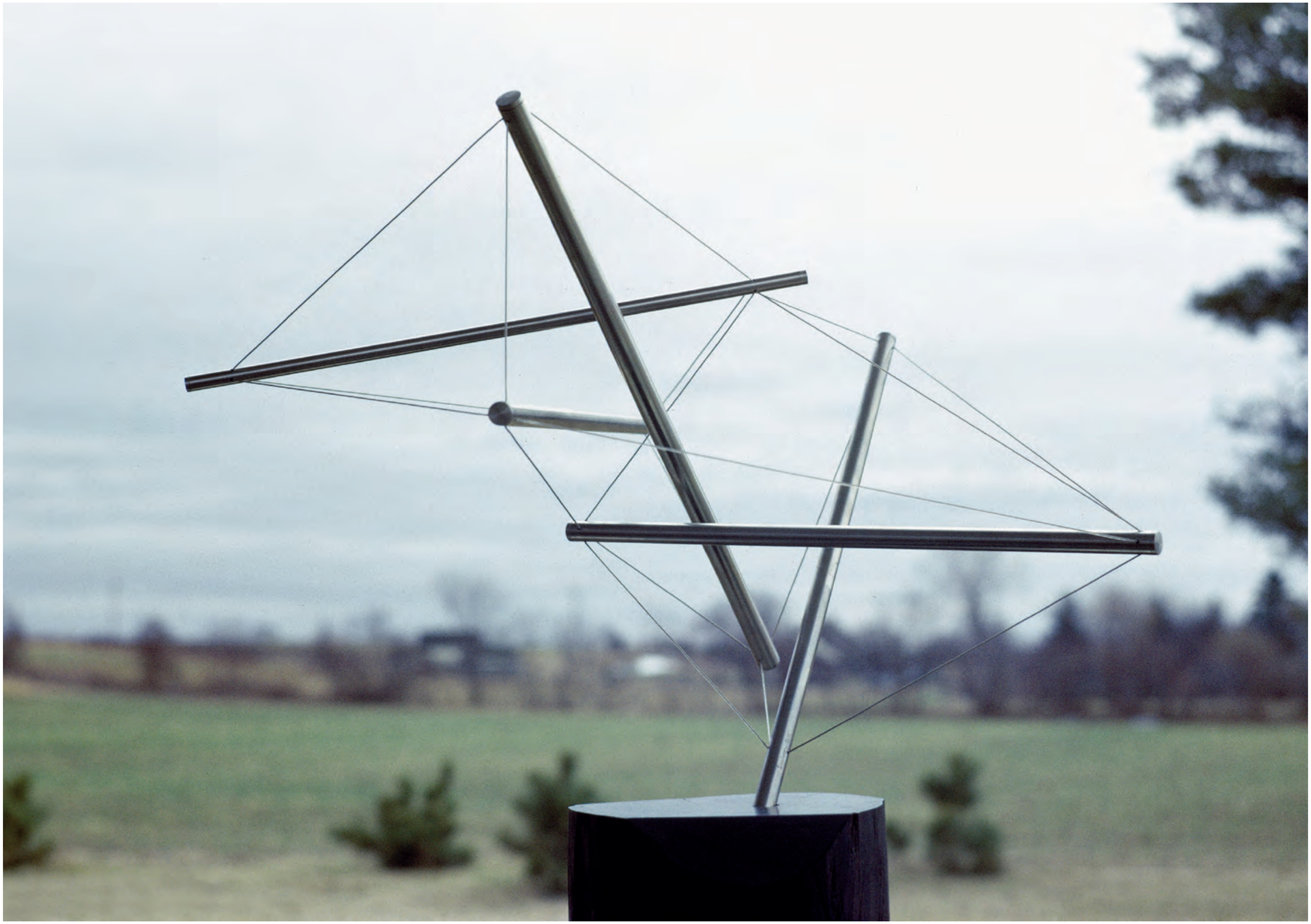


Omega, 1972-1993
stainless steel
14.5 x 19.75 x 11 in
37 x 50 x 28 cm

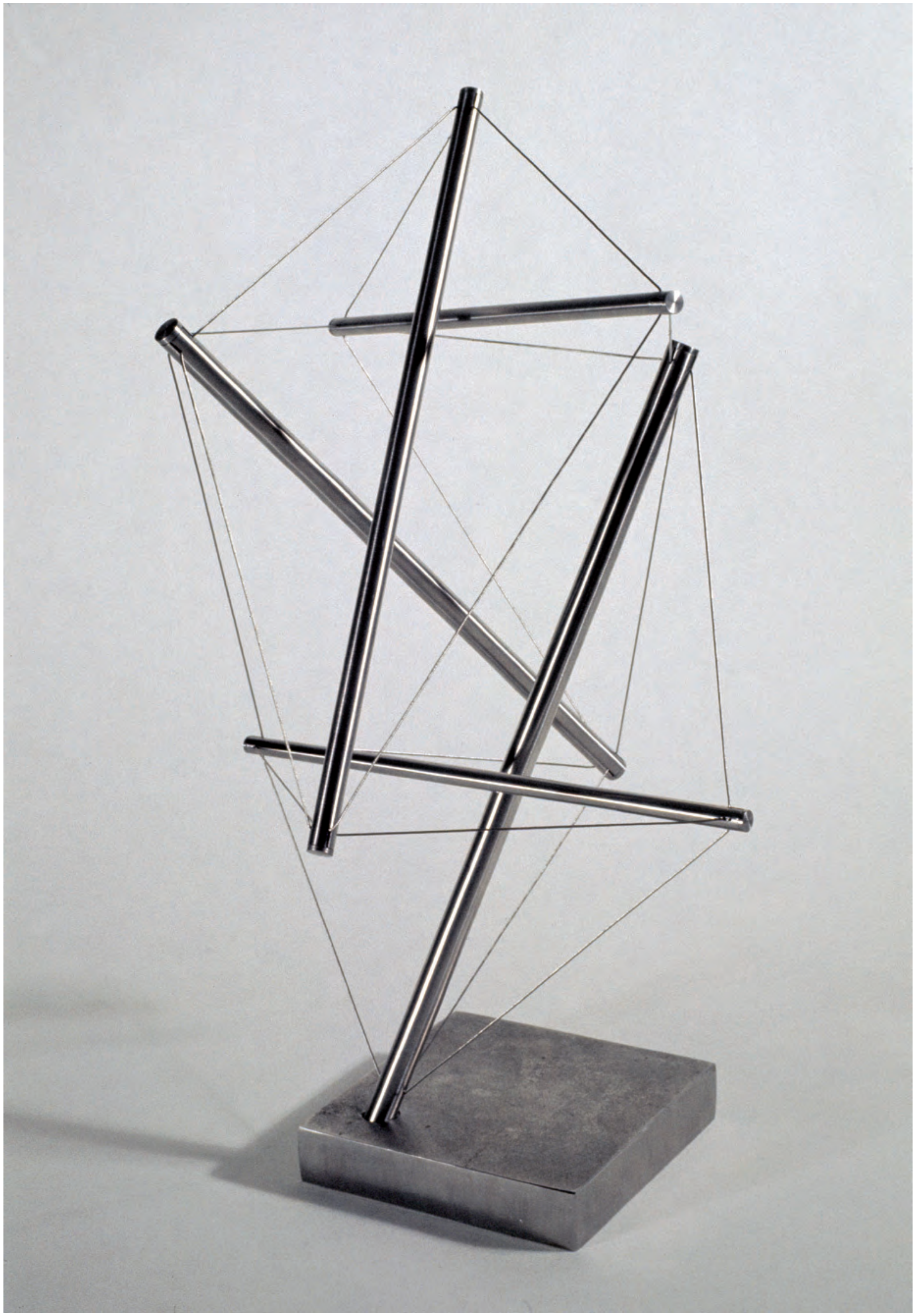
Four Chances, 1979
aluminum and stainless steel
35 x 41 x 31 in
86 x 107 x 84 cm

Mirror Mirror II, 1999
aluminum and stainless steel
22 x 17 x 14 in
55.88 x 43.18 x 35.56 cm

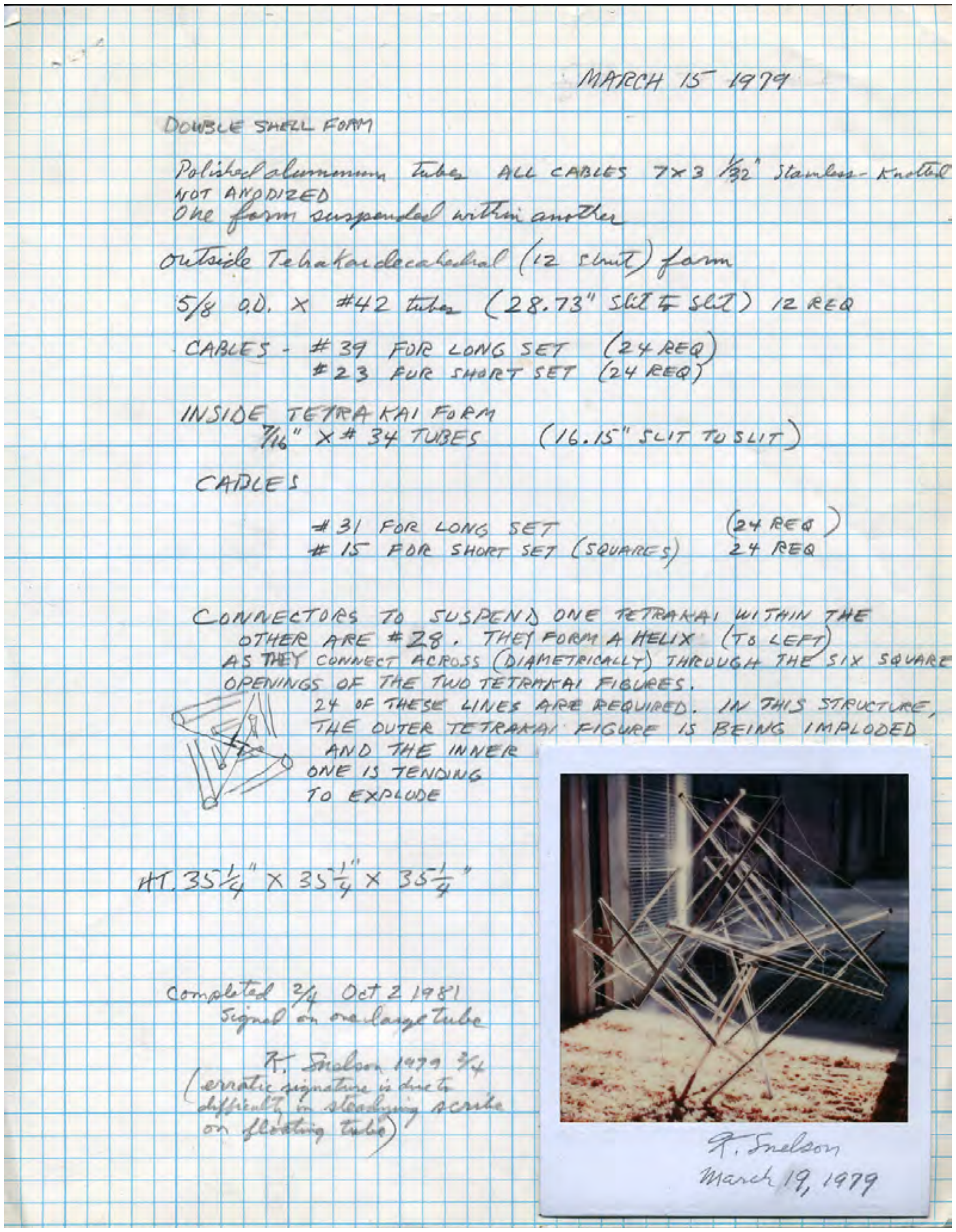
Andrea's Day, 1974
aluminum and stainless steel
27 x 15 x 14 in
69 x 38 x 36 cm



Sag Harbor I, 1965
stainless steel with iron-wood base
13 x 10 x 10 in
33 x 25.5 x 25.5 cm



Sag Harbor II, 1965
stainless steel
17 x 9 x 9 in
43 x 23 x 23 cm



MARCH 15 1979

DOUBLE SHELL FORM

Polished aluminum tubes ALL CABLES 7x3 1/32" Stainless - Knotted
NOT ANODIZED
One form suspended within another

outside Tetrakaidecahedral (12 strut) form

5/8 O.D. x #42 tubes (28.73" slit to slit) 12 REQ

CABLES - #39 FOR LONG SET (24 REQ)
#23 FOR SHORT SET (24 REQ)

INSIDE TETRAKAI FORM
7/16" x #34 TUBES (16.15" SLIT TO SLIT)

CABLES

#31 FOR LONG SET (24 REQ)
#15 FOR SHORT SET (SQUARES) 24 REQ

CONNECTORS TO SUSPEND ONE TETRAKAI WITHIN THE OTHER ARE #28. THEY FORM A HELIX (TO LEFT) AS THEY CONNECT ACROSS (DIAMETRICALLY) THROUGH THE SIX SQUARE OPENINGS OF THE TWO TETRAKAI FIGURES. 24 OF THESE LINES ARE REQUIRED. IN THIS STRUCTURE, THE OUTER TETRAKAI FIGURE IS BEING IMPLODED AND THE INNER ONE IS TENDING TO EXPLODE

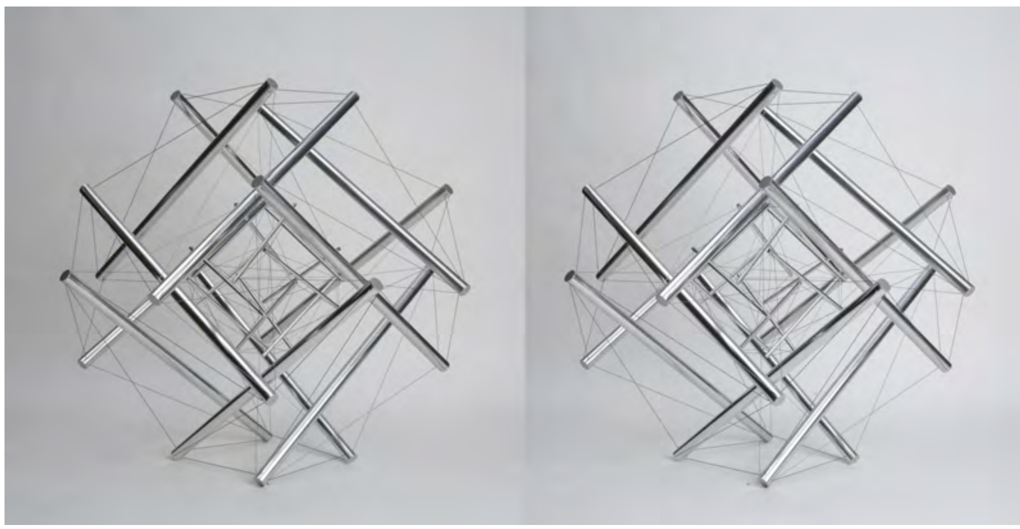
HT. 35 1/4" x 35 1/4" x 35 1/4"

Completed 2/4 Oct 2 1981
Signed on one large tube

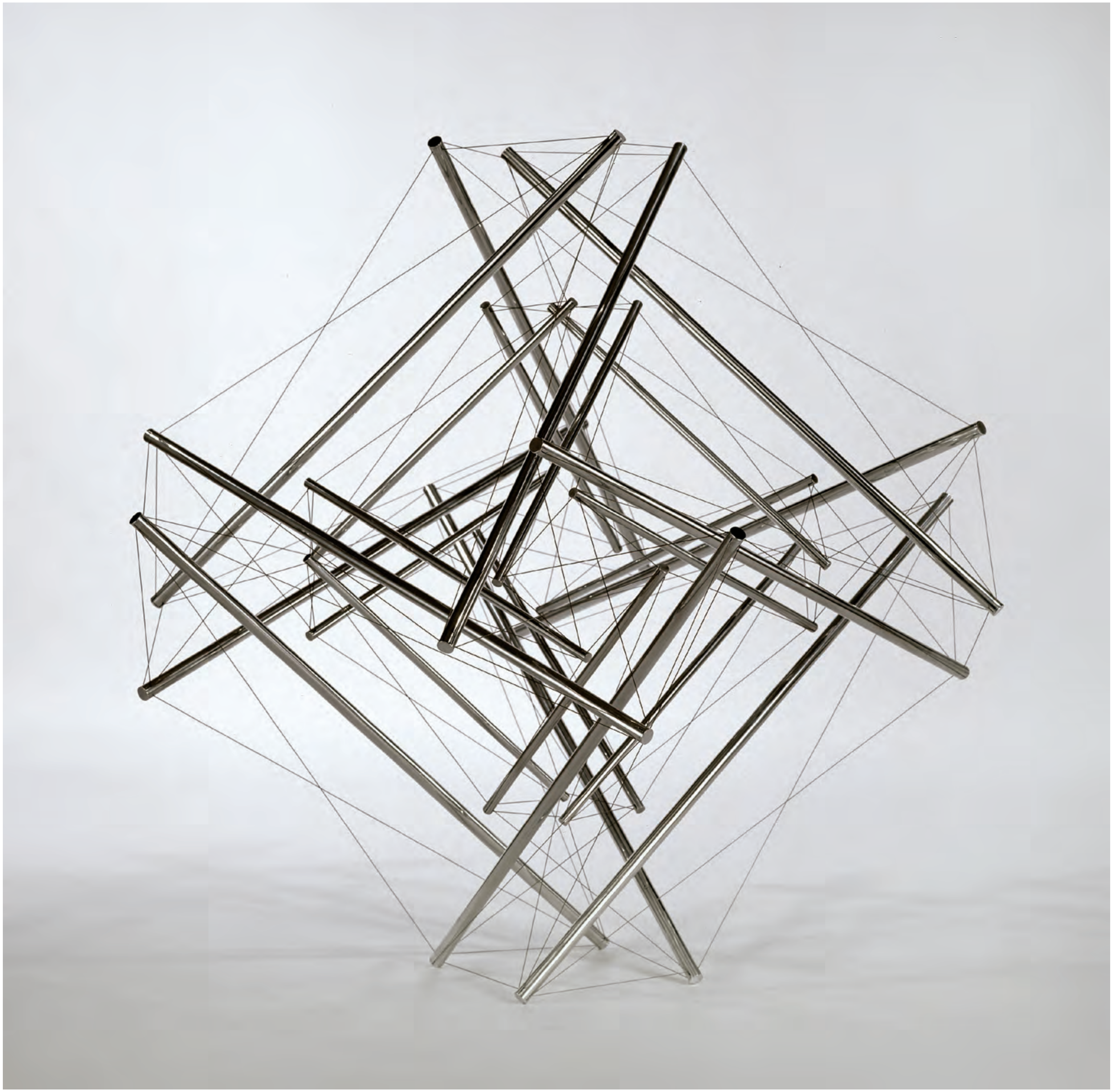
K. Snelson 1979 3/4
(erratic signature is due to difficulty in steadying scribe on floating tube)

K. Snelson
March 19, 1979

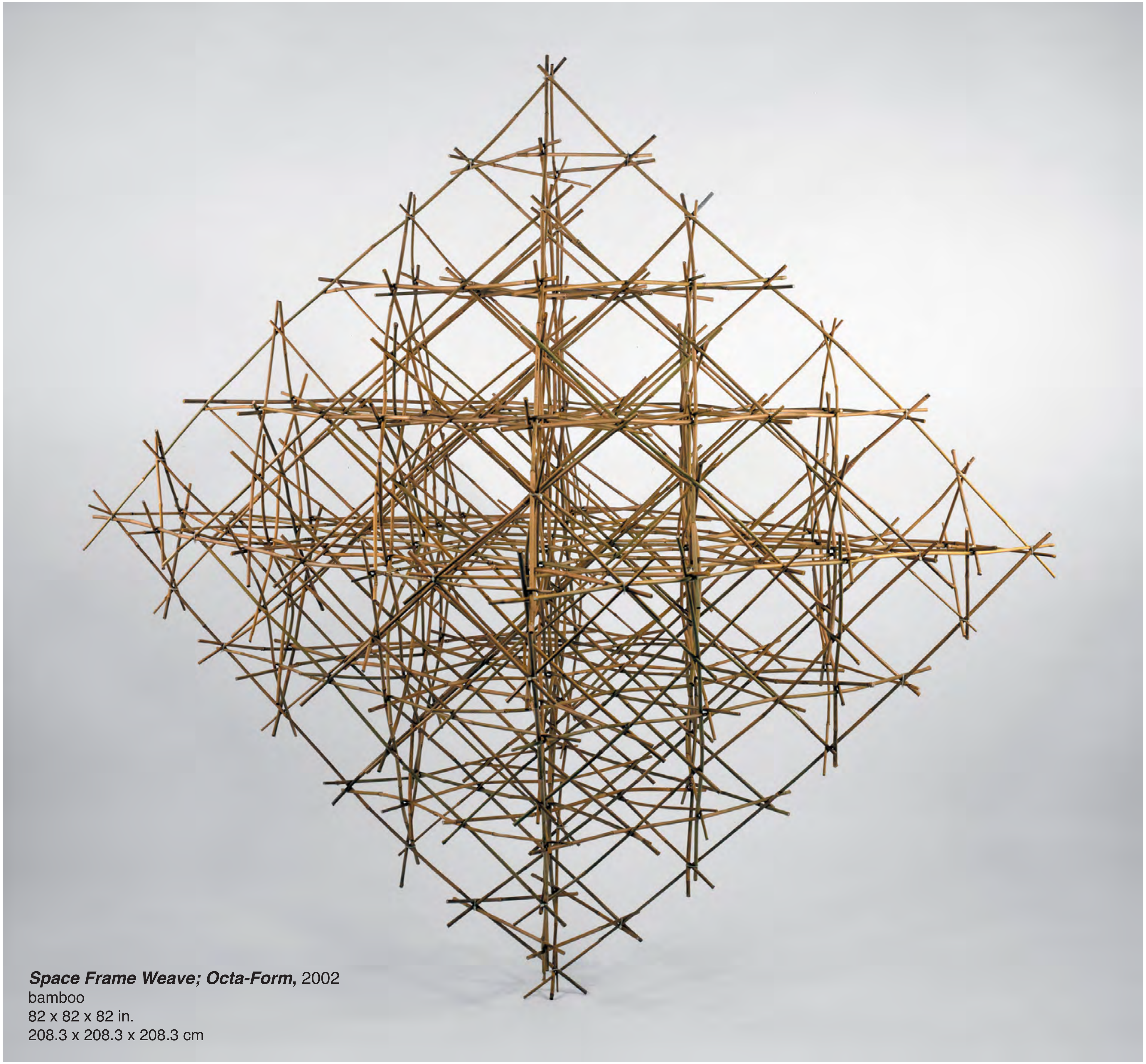
Double Shell Form, notes1979
pencil and photo on paper
8.5 x 11 in
21.5 x 28cm



Stereo (cross-eye)
Double Shell Form II, 1979
aluminum and stainless steel
23 x 23 x 23 in
58.5 x 585 x 58.5 cm

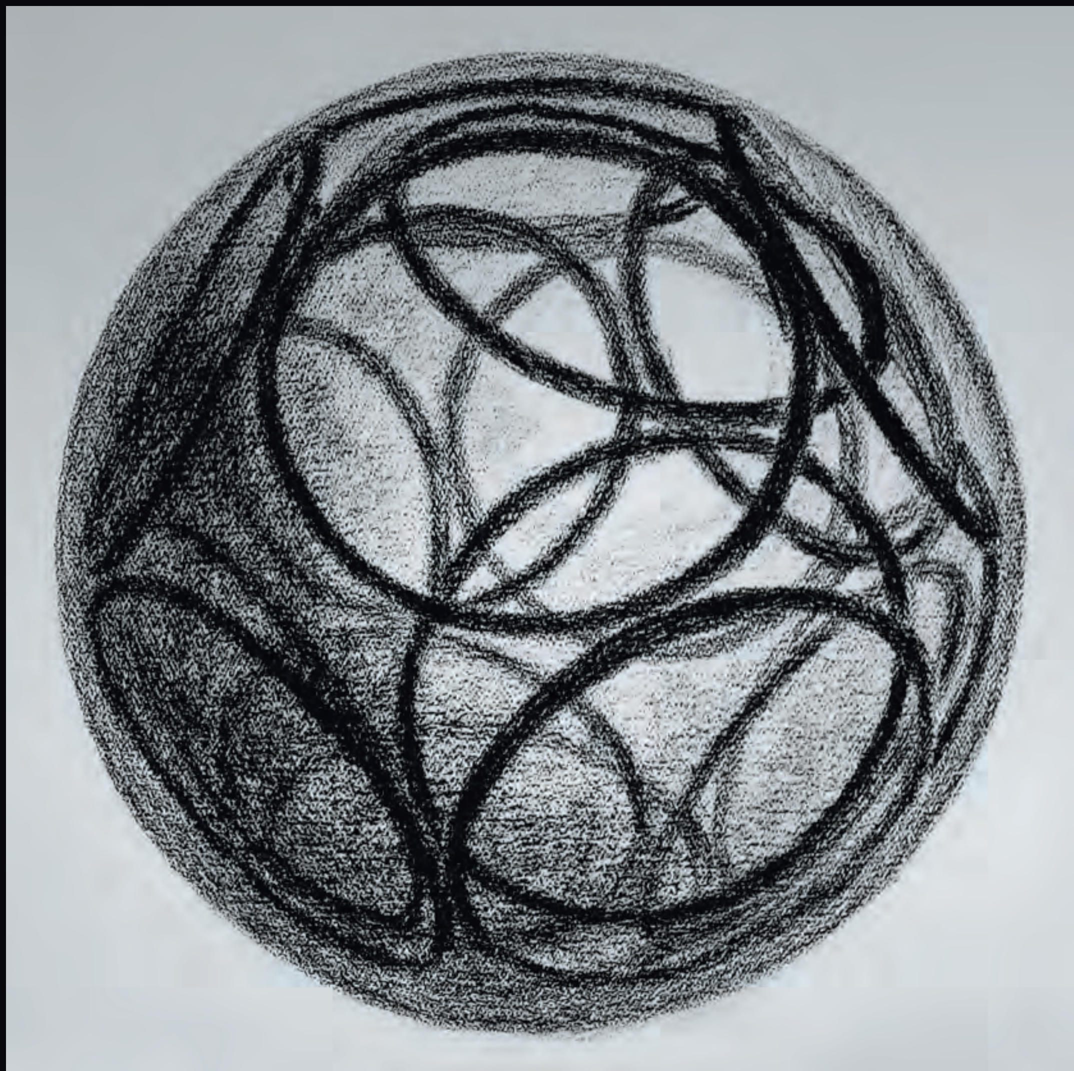


Double Shell Form, 1979
aluminum and stainless steel
35.25 x 35.25 x 35.25 in
89.5 x 89.5 x 89.5 cm



***Space Frame Weave; Octa-Form*, 2002**
bamboo
82 x 82 x 82 in.
208.3 x 208.3 x 208.3 cm

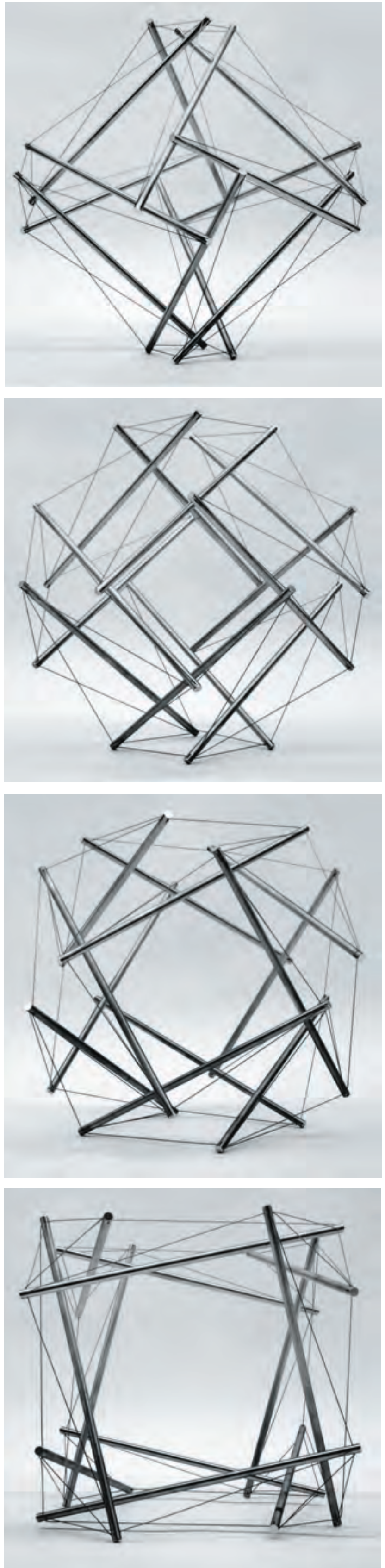
PORTRAIT OF AN ATOM



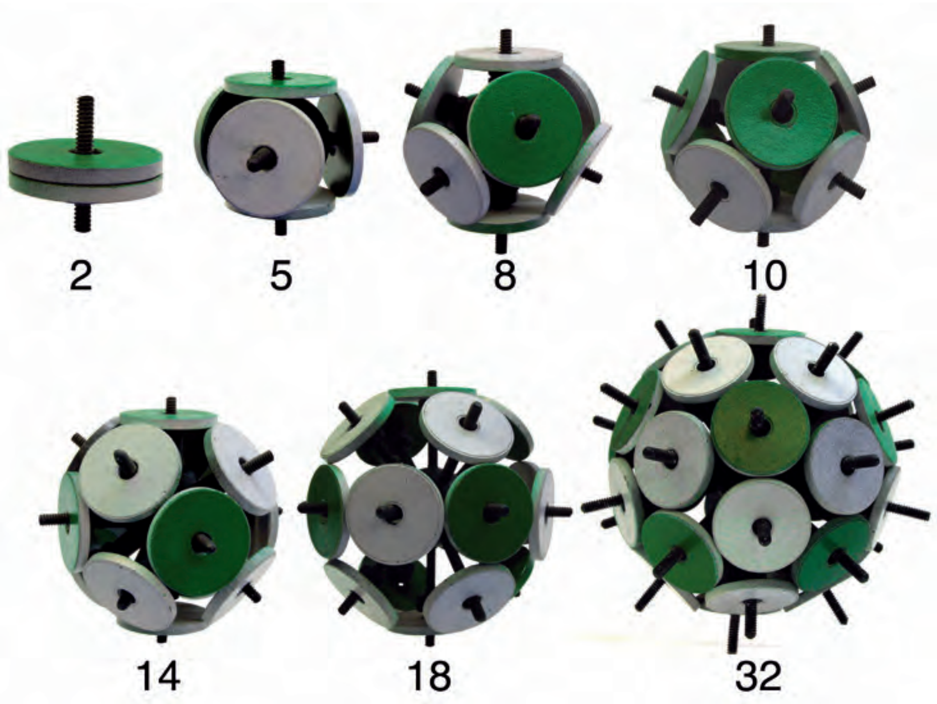
SNELSON'S ATOM
by Eleanor Heartney

During the fertile creative period in which Snelson was exploring the implications of tensegrity by creating increasingly complex sculptural forms, he began to introduce a rotational twist in the sculptures of the sort visible in works like *Needle Tower* and *VX*. He also began to play what he refers to as "what if" games. One of the most fertile of these was his "what if the units of his sculpture were set spinning?" He began to imagine structures that evoked spinning propellers. This in turn led to the creation of "circlespheres" which he describes as "an organization of identical, non-overlapping small circles on a sphere." Working with plastic rings he found in bulk in New York's Chinatown, he discovered that a special group of these structures have a strange property—that by using two different colors in alternation, no rings of the same color will touch one another, like the pattern of squares on a chessboard. Snelson found that there are seven unique sets: those with 2, 5, 8, 10, 14, 18 and 32 rings. He began to use these circlespheres as units in larger structures, creating complex open lattice networks of circles. Soon they were hanging from his ceiling and covering every available surface in his studio. In one of his expeditions to a hardware store, his eye lighted on a display of ceramic magnets that were round and flat like washers. He wondered if he could exploit the north south polarities of the magnets in his circlespheres. What followed was a new generation of circlespheres using magnets instead of plastic rings. Here spheres were created from these magnets by arranging them in such a way that one magnet would only be surrounded by magnets of an opposite north/south polarity. Thus, like the tensegrity sculptures, it became a manifestation of hidden forces—in this case, magnetism.

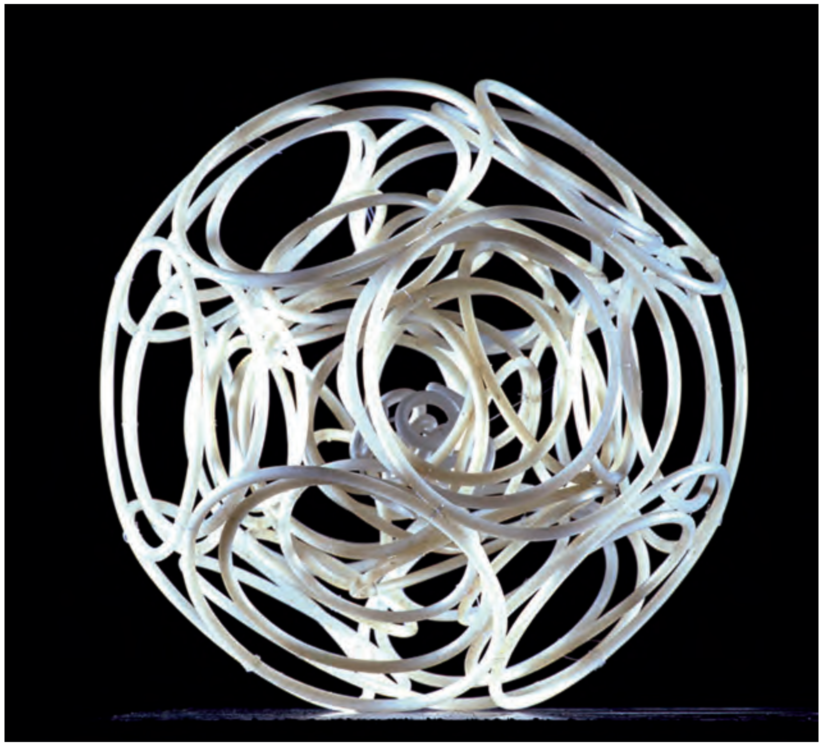
Up to this point Snelson had been exploring these structures simply to satisfy his own curiosity about how things hold together. However, once he became adept at creating and manipulating his circlespheres, Snelson began to wonder if he might have stumbled upon a structure with some sort of



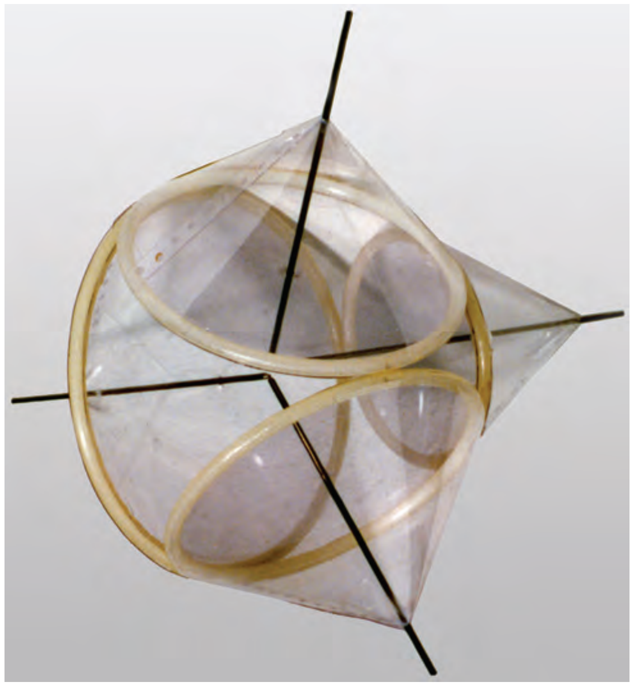
These four figures transform from tensegrity-octahedron to tensegrity-cube in four stages. In time-lapse of many stages the struts appear to spin. This virtual rotation in tensegrity stirred Snelson's interest in circlespheres which in turn led to his ***Portrait of an Atom.***



Seven magnet-circlespheres. In each set, when one magnet is turned by hand, the rest follow like a spherical chain of gears.



Atom Study With Seven Nested Circlespheres, 1960
plastic and monofil
10 x 10 x 10 in
15 x 15 x15 cm



Circlesphere With Four Centering Axes, 1974
plastic and steel
11 x 9 x 10 in
28 x 23 x 25.5 cm

Eight Rubber Wheels, 1948
model wheels, aluminum and steel
5 x 5 x 5 in
13 x 13 x 13 cm

analogy in nature. Realizing that his little models operated like building blocks that could be used to create ever more complex forms, he was struck by their resemblance to the atom.

Here follows a creative leap that seems to separate the artist from the scientist. (Though as we shall see, the distance between these two endeavors is in fact not so great.) Snelson began to devour information on the history of the atom and scientific debates over how its parts work and fit together. Despite huge changes in the understanding of the atom in the scientific world over the last century, most lay people hold on to the familiar model of the atom as a kind of solar system with the nucleus at the center and electrons revolving like planets in orbits around it. Snelson's investigations plunged him into an almost surreal world of quantum physics where the electron exists only as a mathematical equation, or probability function and its position and momentum cannot be determined simultaneously. The problem of the atom centers around the question of whether or not the universe works in ways that we can conceptualize. In the early part of the twentieth century scientists were able to transform the increasingly sophisticated discoveries about atomic behavior into visual models which took into account questions like: How do atoms bond to one another? Why do atoms fall into an orderly sequence in the periodic table? Why don't two atoms collapse into each other? The visual models that tried to answer such questions resembled everything from sausages to croquet balls attached by sticks, to raisin pudding. (In one visualization, suggested in 1897 by J. J. Thomson, electrons were envisioned as raisins randomly embedded in a ball of pudding.)

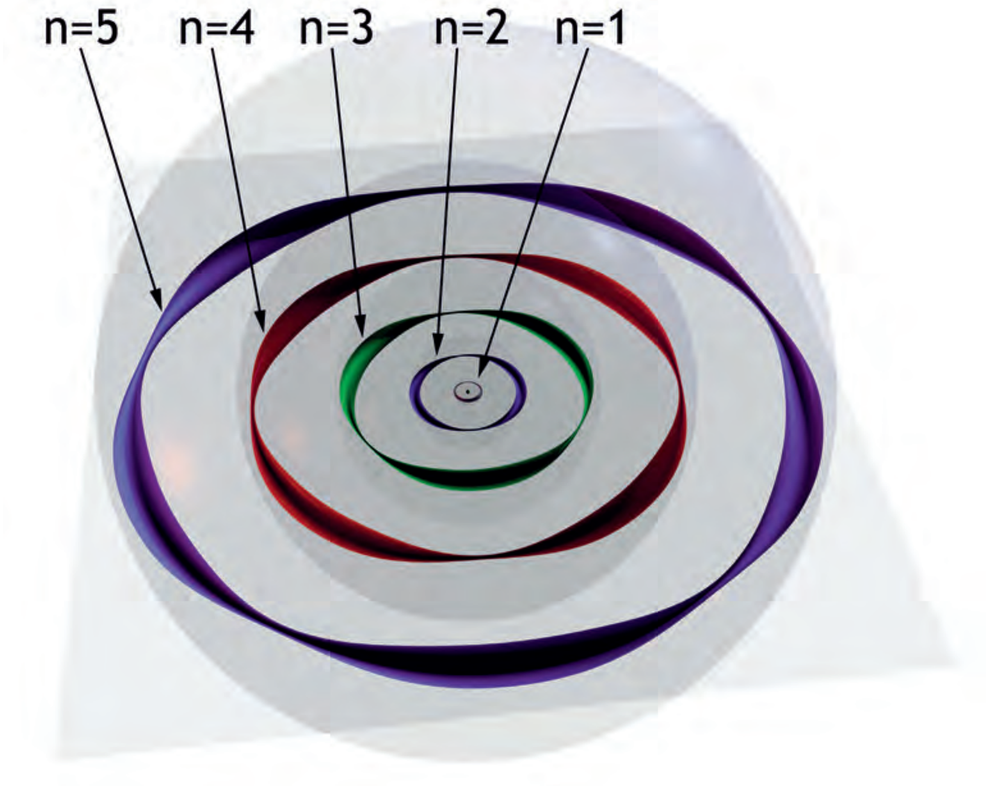
The last of the physicist's visual models was created in 1924 by Prince Louis de Broglie, a young French physicist. It was based on his theory that matter has a wave aspect, something like a wave of light, which, in the atom, causes the electron to take on the properties of a vibrating guitar string as it circulates in its orbit.

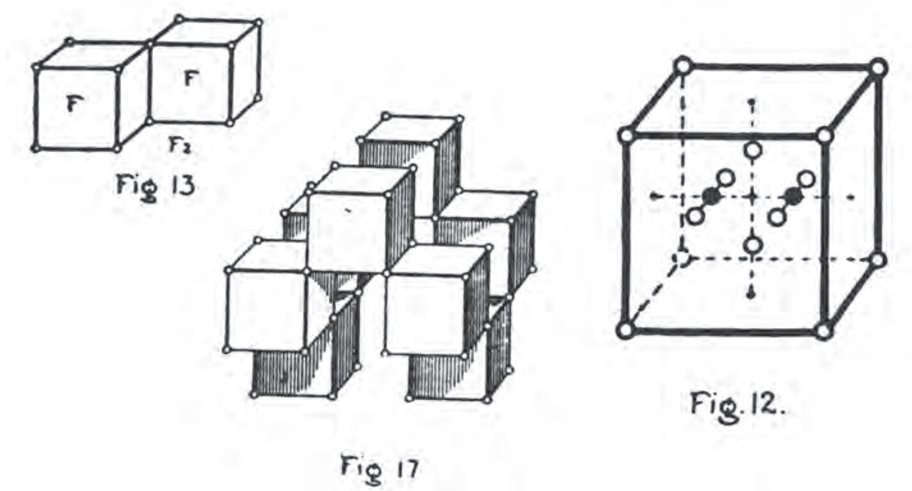
Three years later, in 1927, an event occurred that was to change atomic physics in a profound way. The German physicist Werner Heisenberg performed a "thought experiment." (Thought experiments are conducted only in the theoretician's mind via pencil and paper.) What came out of Heisenberg's mind exercise was a discovery about the limits of observation that greatly surprised the community of physicists who had been seeking a universally acceptable atomic model. Heisenberg's Uncertainty Principle, as it became known, proved that there is no physical means by which one might trace an electron's pathway in an atom. Because "following an electron in orbit" had been the accepted criterion for verification, it was now clear that any model purporting to describe such electronic choreography must amount only to speculation; an approach that atomic physics from now on would label as metaphysics or mysticism.

The Heisenberg discovery caused scientists to banish all physical models from atomic physics including de Broglie's matter wave atom. Instead, it was agreed that from that point forward the only acceptable approach to atomic problems would consist of abstract mathematics. Chief among these were Schroedinger's wave equation and Heisenberg's matrix mechanics. As Schroedinger wrote of this revolution, "it seemed to relieve us from the search for what I should call real understanding; it even rendered the endeavor suspect, as betraying an unphilosophical mind—the mind of a child who regretted the loss of its favorite toy (the picture or model) and would not realize that it was gone forever." But while this approach has proved fruitful to physicists, it offers little help to the non-specialist looking for insight into how the swarms of electrons in atoms perform their work.

To Snelson, it appeared that physicists had unnecessarily locked themselves out of the search for a genuinely visual model. He believed that neither Heisenberg nor anyone else had demonstrated that the atom's riddle was unsolvable, only that there is no absolute way to prove that any proposed model actually resembles nature's atom. Snelson's studies convinced him that there still is a need for a three-dimensional model for the public to whom quantum mechanical methods are inaccessible.

The key to such a picture, Snelson felt, lay in the atom's geometry. The blurry images from scanning microscopes show atoms



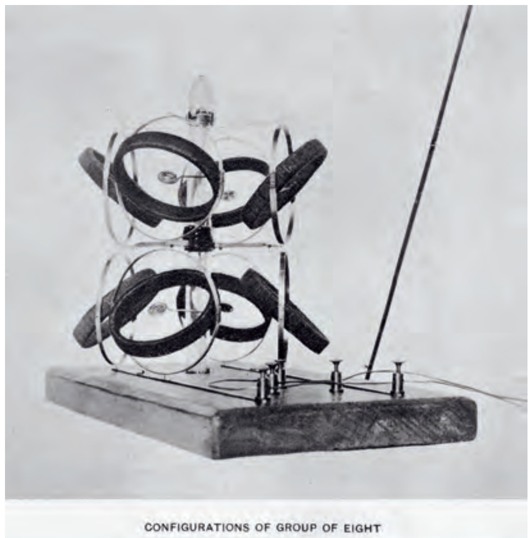


The 1916 G.N. Lewis and Irving Langmuir octet atom model with electrons positioned at the eight corners of a cube.

Louis de Broglie's 1923 model of the hydrogen atom replaced Niels Bohr's earlier circular electron paths with ring-guide matter-waves orbits, each level accommodating an additional whole wave.

$$i\hbar \frac{\partial}{\partial t}\psi(r,t) = -\frac{\hbar}{2m}\nabla^2\psi(r,t) + V(r,t)\psi(r,t)$$

Erwin Schrödinger's Wave Equation



Alfred Parson's 1915 demonstration device composed of electro-magnets to represent his "magneton electron," a hypothetical toroidal electron ring within the atom.

to be spherical in shape. A suitable model needed to explain why atoms can bond with their neighbors in endless geometric patterns, why they give off and absorb light in specific and predictable colors and why their electrons fill up the atomic sphere in exact numbers like eggs in a box. What kind of mechanism or design, he asked himself, would enable electrons, racing around the nucleus, to interact with one another and with their neighbors in these ways?

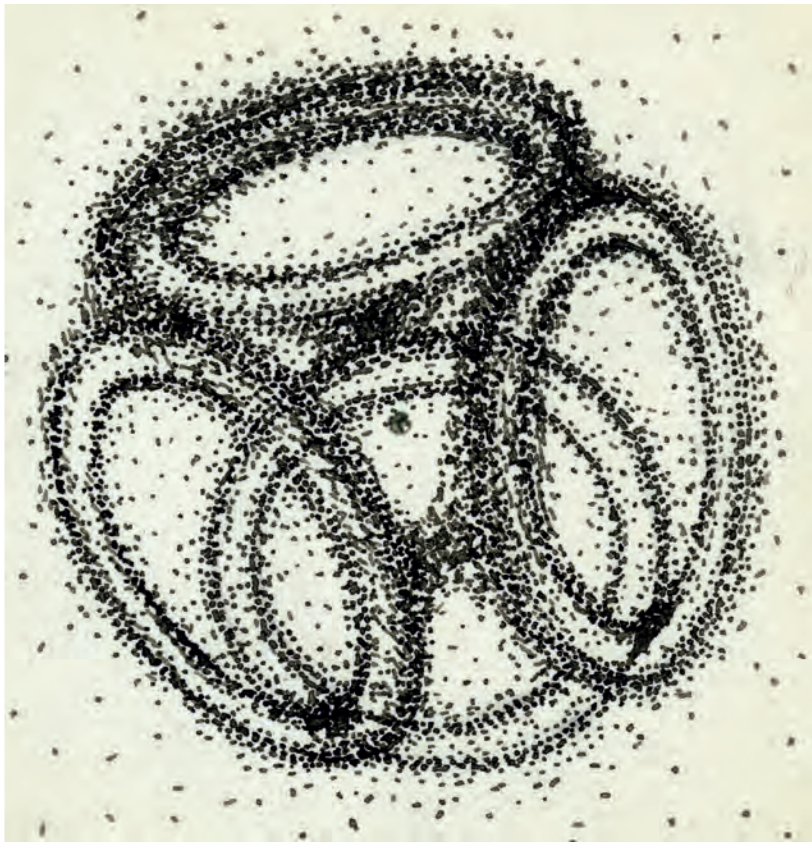
The previous model, in which the atom was seen as a tiny planet with undirected electron traffic careening around its dense nucleus, was completely unsuitable. Rather, Snelson realized, one needed a different analogy drawn from the macro, visible, world that could take into account the electron's space-filling quality. He found himself incorporating elements from earlier, long discarded atomic models, among them, a 1915 "magneton electron" envisioned by Alfred Lauck Parson, and an "octet" model created by chemists Gilbert N. Lewis and Irvin Langmuir in 1916. Of particular importance to Snelson was Louis de Broglie's long abandoned matter wave or waveguide principle. By combining parts of these theories with his remarkable circlesphere magnet assemblies, he began to envision an appropriate analogy.

Snelson observed that the numbers of magnets that can fully link together in circlespheres are uncannily close to the numerical sequences by which electrons fill "shells" or energy levels in atoms according to the periodic table of elements. The allowable numbers in successive shells are 2, 6, 8, 10, 14, 18 and 32 electrons. Snelson's magnet sequence, 2, 5, 8, 10, 14, 18 and 32 are off by only one digit.

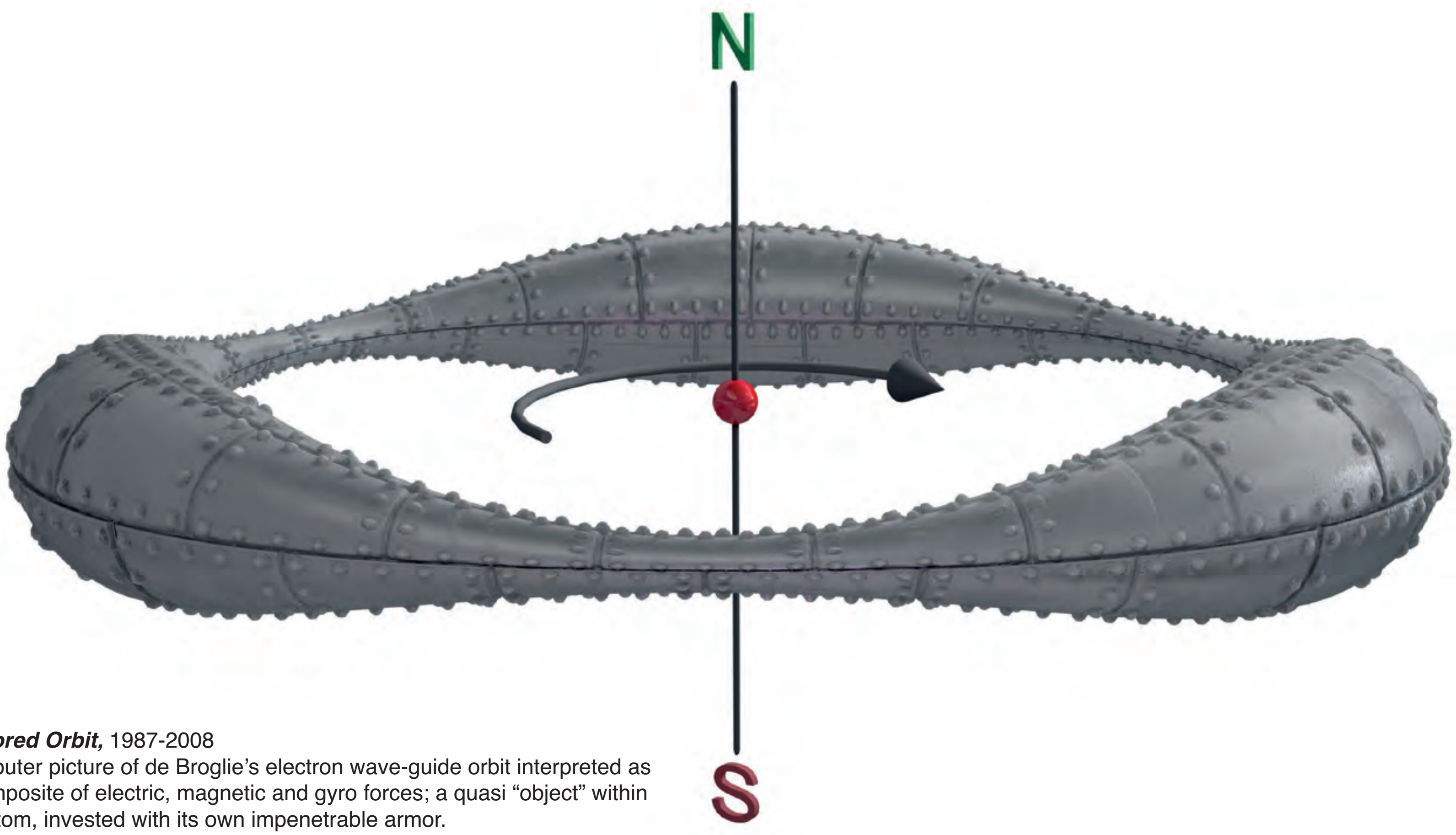
So Snelson began to think of his circlespheres as descriptions of the atom's building system. His magnets could be understood as circular electron pathways. Rather than orbiting like planets, the electrons in these pathways are contained in small-circle orbits rotating in little rings, like halos, on the atom's surface.

Linked magnetically to one another on concentric electrical globes around the nucleus, these orbits, like the magnets, are packed in and impermeable to one another. Thus, unlike the old solar system analogy, this model acknowledges the dual wave-particle nature of the electron as described by quantum mechanics. By proposing that these rings are in fact "matter waves," that actually fill up space, Snelson's analogy suggests how electrons keep one another out. In this they operate the same way as solid objects in the macro world in which things can't pass through one another or be in the same place at the same time. This, he believes, explains why the maximum number of electrons in each shell is fixed. They are required to move up to a higher shell, if they exceed that number.

It is also, Snelson argues, a visually compelling way to think about this most basic of physical structures. In a text titled *Portrait of an Atom,* he describes it in poetic terms: "All in all the atom of my fantasy is a finely designed, tiny, static-dynamic, electro-magnetic-mechanical device which, when disturbed, has the uncanny ability, unlike Humpty Dumpty, to revive itself in its pristine state



Atom Drawing, 1961
ink on paper
3 x 3.25 in
7.5 x 8 cm



Armored Orbit, 1987-2008
Computer picture of de Broglie's electron wave-guide orbit interpreted as a composite of electric, magnetic and gyro forces; a quasi "object" within the atom, invested with its own impenetrable armor.

Magnet Benzene, 1963
ceramic magnets and plastic
1.5 x 4.5 x 4.25 in
4 x 10.5 x 11 cm

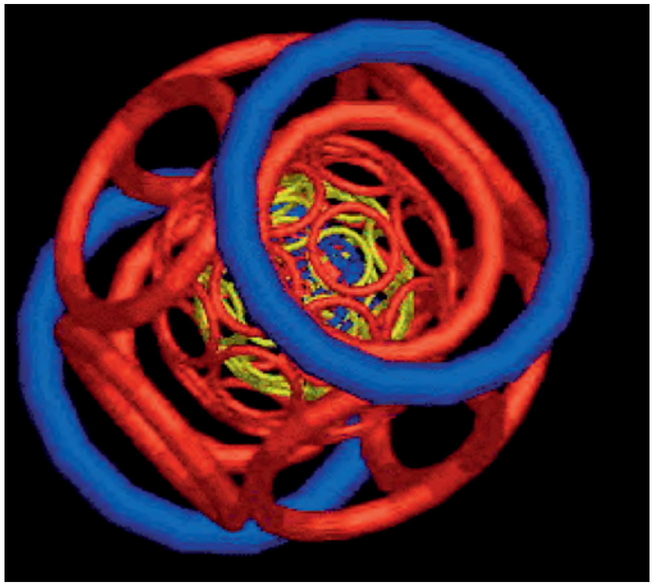
Magnet Cyclopropane, 1976
18 rubber magnets
2 x 4.25 x 4.25 in
5 x 11 x 11.5 cm

in a matter of nanoseconds. It is the kind of atom a thoughtful creator might have cast while granting basic matter the same reasoned beauty as the rest of the universe."

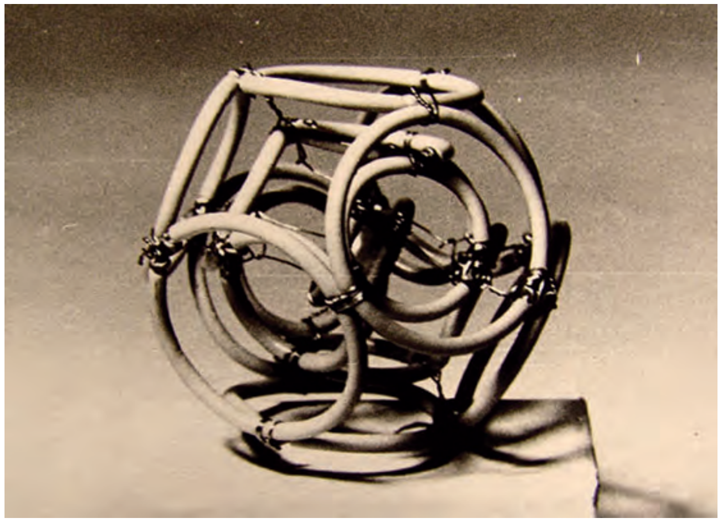
In the course of his investigations, Snelson began to contact scientists and initiate conversations with them about his atom. Predictably, he encountered resistance, exacerbated by his lack of professional credentials and by the now long ingrained disapproval of physicists to visual models of the atom. However, he also found support from surprising sources. A Russian engineer Alexander Kushelev began to correspond with Snelson about his own circular-wave-guide atom idea. Kushelev also alerted Snelson to the work of a Polish physicist Zbigniew I. Ogzhevalskovo, who published a scholarly paper on a related model in 1969.

In 1989, Snelson exhibited his materials related to his atom in an exhibition at the New York Academy of Sciences. The exhibition was accompanied by a publication that included essays by scientists as well as a conversation between Snelson and physicist Hans Christian von Baeyer. This fascinating document gives insight into both the points at which art and science are similar and those at which they diverge. In their conversation, Snelson and von Baeyer argue about the nature of science and the nature of art, and von Baeyer locates the difference between the two as the artist's need to pursue an idea of beauty and the scientist's need to create models which can be used to make further predictions. Further, von Baeyer argues that Snelson's atom doesn't really satisfy the mathematical requirements of the data, a point that is considerably less important to Snelson, who cheerfully admits that he doesn't really understand the mathematics of the accepted statistical model. However, he remains convinced that he has stumbled upon a structure that is too elegant not to have some kind of function in nature.

Robert Root-Bernstein, a professor of natural science and physiology, takes a more sanguine approach to Snelson's atom, acknowledging the importance of visual models in science. He notes, "One must be able to imagine a possible world before one can test it," and in fact he has written extensively on the process by which scientific discoveries are made. He suggests that scientists use a variety of tools in conceptualizing problems, and that, like lay people, some think visually, while others think aurally or kinesthetically. In particular, he suggests, the kind of purely mathematical models of the atom favored by physicists are far less useful to chemists, who need to understand what a molecule might look like in order to understand how it might bond or react to other stimuli.



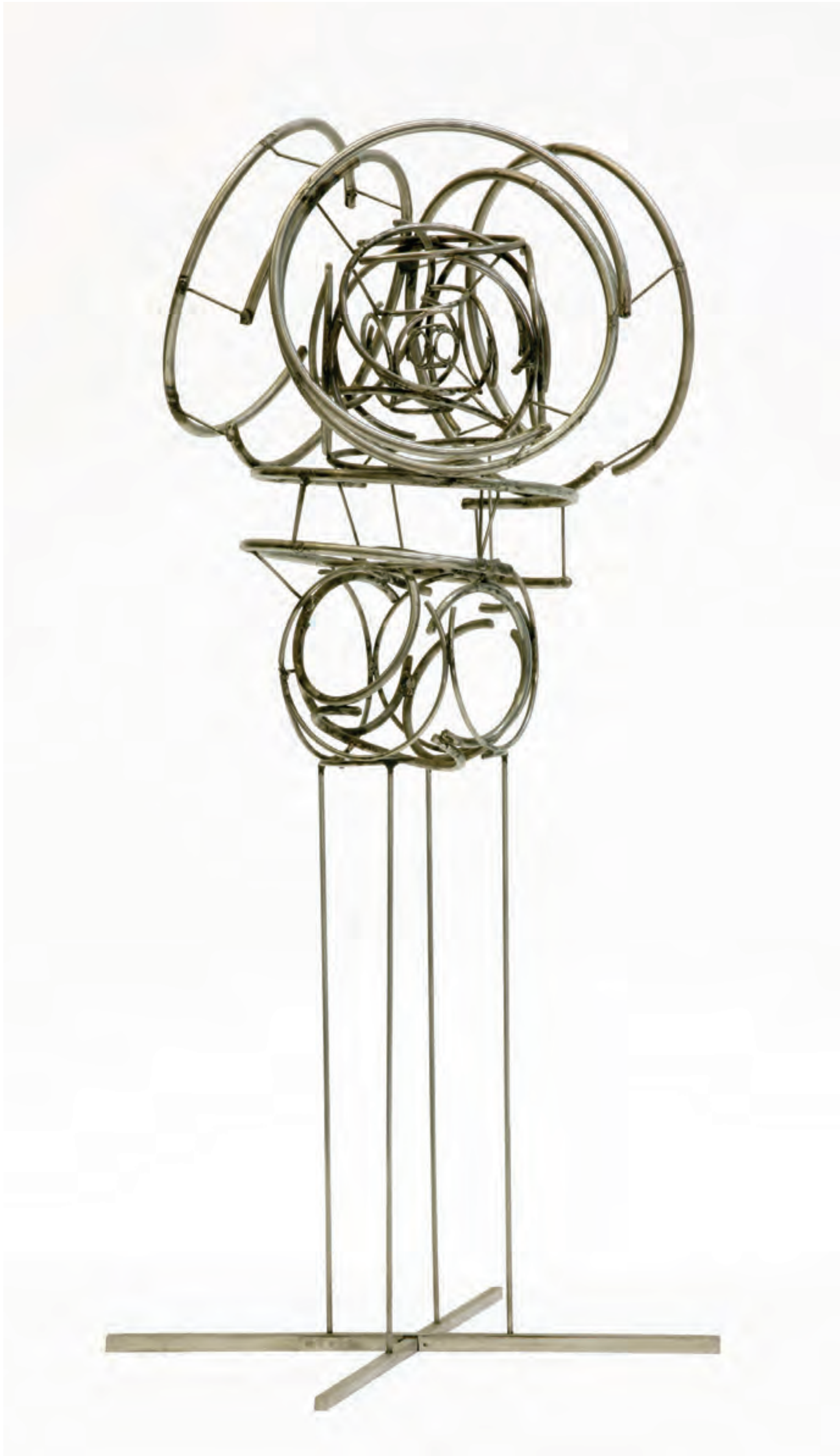
The atom model of Russian Engineer Alexander Kushelev, 1989



The atom model of Zbigniew I. Ogzhevalskovo, 1969

It may or may not be science, but is Snelson's atom art? This has also been a point of contention, and Snelson reports that he has encountered resistance to his atom from those in the art world. He notes that the director of a major museum once informed him, "You know, we like to keep these things separate." And indeed, Snelson's early efforts to model the atom with rings and magnets seemed at times to more closely resemble a boy's tinkerings than serious artistic productions. Eventually he moved to other materials, including arrangements of wood rings and dowels that conform in certain ways to traditional concepts of sculpture. They rest on pedestals; they are made of conventional sculptural materials, and have a distinctly mechanical and earthbound quality. An early wood piece has the cheeky title *Homage to the Uncertainty Principle: A Device to Aid in Locating Electrons in an Atom if There Were a Means to Look for Them* (1964) which, of course, the Uncertainty Principle insists there is not. Snelson also created lightweight stainless steel sculptures composed of semi-circular shapes rising from pedestals. In some ways, they resemble scribblings in space and seem to be spinning off into space, like an explosion of rings. Snelson remarks that they are rooted in a post-cubist mentality of the sort that pervaded art thinking during his formative years. He also began to describe his atom in writings that include two United States patents and a sixty-page unpublished manuscript.

However, Snelson was dissatisfied with these presentations, and the artist in him longed for something that more accurately reflected the inherent beauty of the structures he had discovered. It was at this point, in the mid 1980s, that CAD, or computer graphics programs capable of three-dimensional rendering became practical. Snelson purchased a state-of-the-art computer and began to create virtual versions of his atoms. Freed from the constraints of earthbound materials like wood and wire, and earthbound forces like gravity, they are fantastical looking structures that do indeed capture something of the magic of these elusive entities. Some, like *C60 Soccerball* (1991) which is a representation of C60 fullerene, also known as the soccer ball molecule, float free



Study for Atomic Space 3, 1964
stainless steel
19.5 x 8 x 8 in
49.5 x 20.3 x 20.3 cm

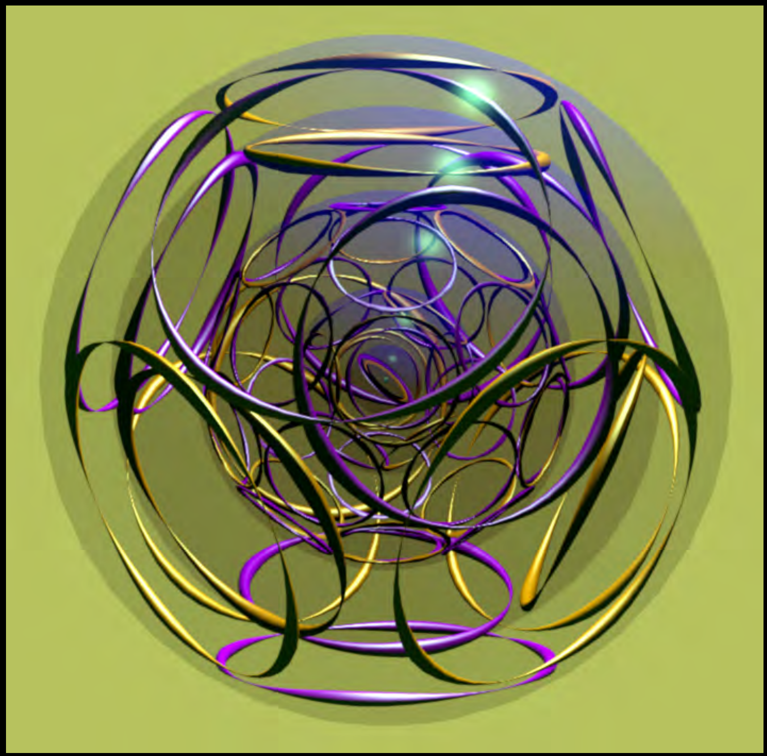
in a cosmic, star-studded space, which shows through the filigree arrangement of green, blue, red and purple rings that stake out the various electron shells. Others are rooted in futuristic-looking landscapes. *Atoms at an Exhibition* (1988) presents a selection of circlespheres composed of rings representing the various possible energy states of the atom. These rest on classical columns above a checkerboard ground that seems to curve slightly as if the whole scene was being viewed through a pinhole camera. In *Chain Bridge Bodies* (1991), the atom has become a formidable object composed of chains and studded metal rings. One looms in the foreground of a strange rippled landscape like some alien invader, while reinforcements can be glimpsed circling about in the sky beyond. Another set of rings with the ominous title *Invasion* (1989) floats over a grid which may also be a window frame. In *Kekule's Dream* (1996), the electron rings are realized as snakes in homage to Friedrich August von Kekule, the German chemist who discovered the structure of benzene through a dream about whirling snakes.

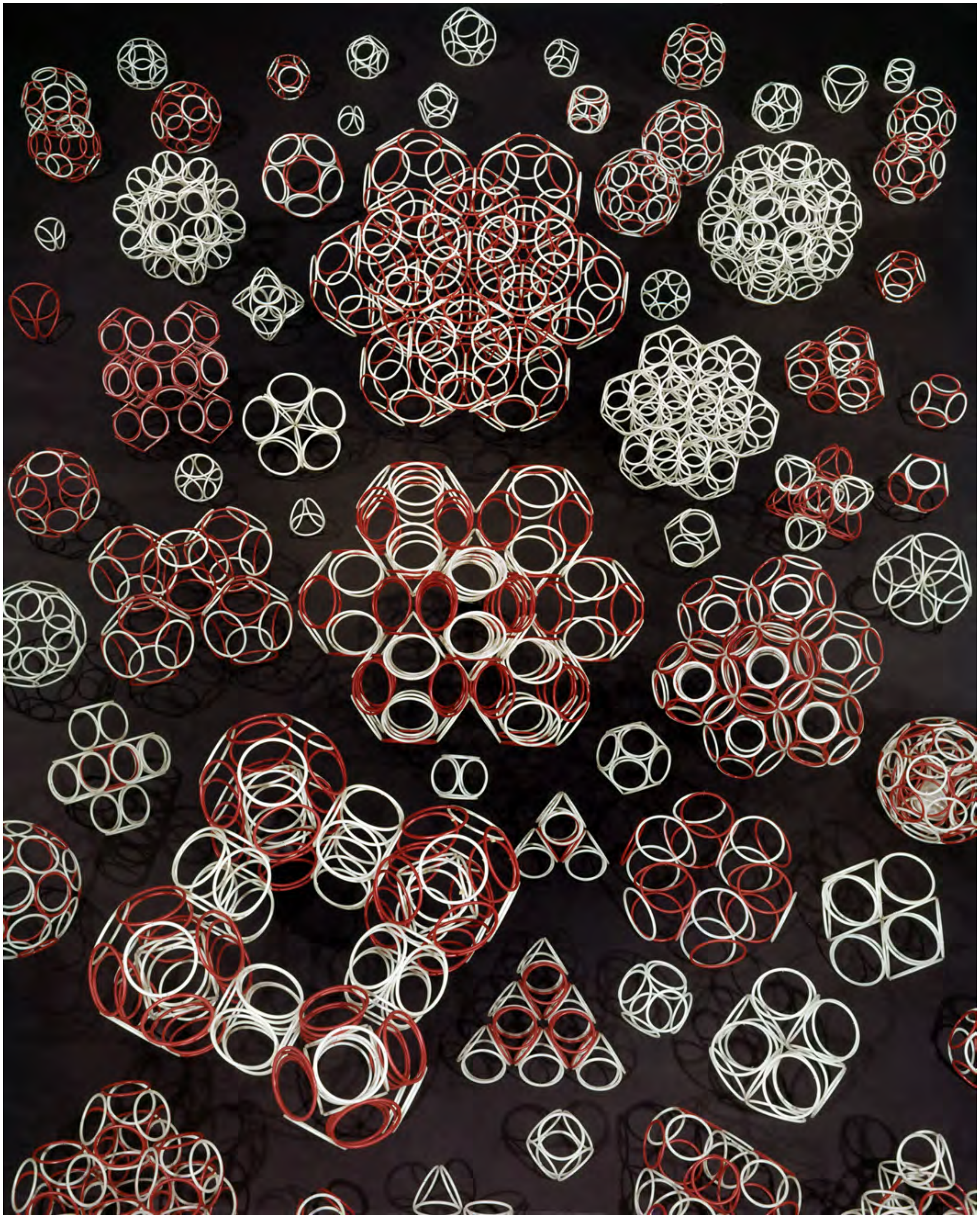
In his published conversation with Snelson, von Baeyer seems taken aback by the playful nature of these digital representations of the atom. He muses to Snelson that he had evidently misunderstood the artist's intentions, seeing him originally as a problem solver seeking a tangible model of the atom. Now, in his view, Snelson seems to have gone off on a tangent, creating virtual images full of beautiful flourishes that do nothing to advance the conceptual argument. Von Baeyer notes, "The computer images you've shown us are already very beautiful and they can become more and more persuasive, but that's a totally different thing from saying also that this is what the atom is." In a counter that highlights the divide between their thinking, Snelson maintains that the visual persuasiveness of the images is exactly their point: "With this elaborate new computer I can produce a really astonishing animation of this model without voice-over, just visuals, so that people could say 'Ah, yes, now I understand how an atom works!'"

And indeed, unlike Snelson's plastic rings and metal magnet constructions, his computer animations are undeniably art. They take his atom and use it to create a compelling and visually satisfying alternate world. But despite the artistry of these images, as Snelson ruefully acknowledges, the same people who admire his structural sculptures still often ignore his atom. Artists are not supposed to challenge accepted scientific dogma or spend years poring through the literature on developments in theoretical physics. However, Snelson sees a clear continuity between his tensegrity sculptures and his atom. Both grow out of his abiding interest in structure and reflect his compulsion to understand how things are connected. Like his sculptures, which will deform or collapse if a wire is snipped, Snelson's atom is a matrix of interdependent forces whose shape changes if any single element is removed or changed. Both hold their shape only through the push and pull of invisible forces. There is an irony here; Snelson's aluminum and steel works eschew the traditional solidity of sculpture in favor of structures that are open and flexible manifestations of compression and tension. His atom, meanwhile, is designed to explain the solidity of matter, why one atom or electron can't simply pass through another. Nevertheless, they are united by his lifelong need to create works through the manipulation of physical forces. For Snelson, the atom is the ultimate mystery of the physical universe, which may explain why he can't accept the idea that there can be no visual model of the atom's forces.

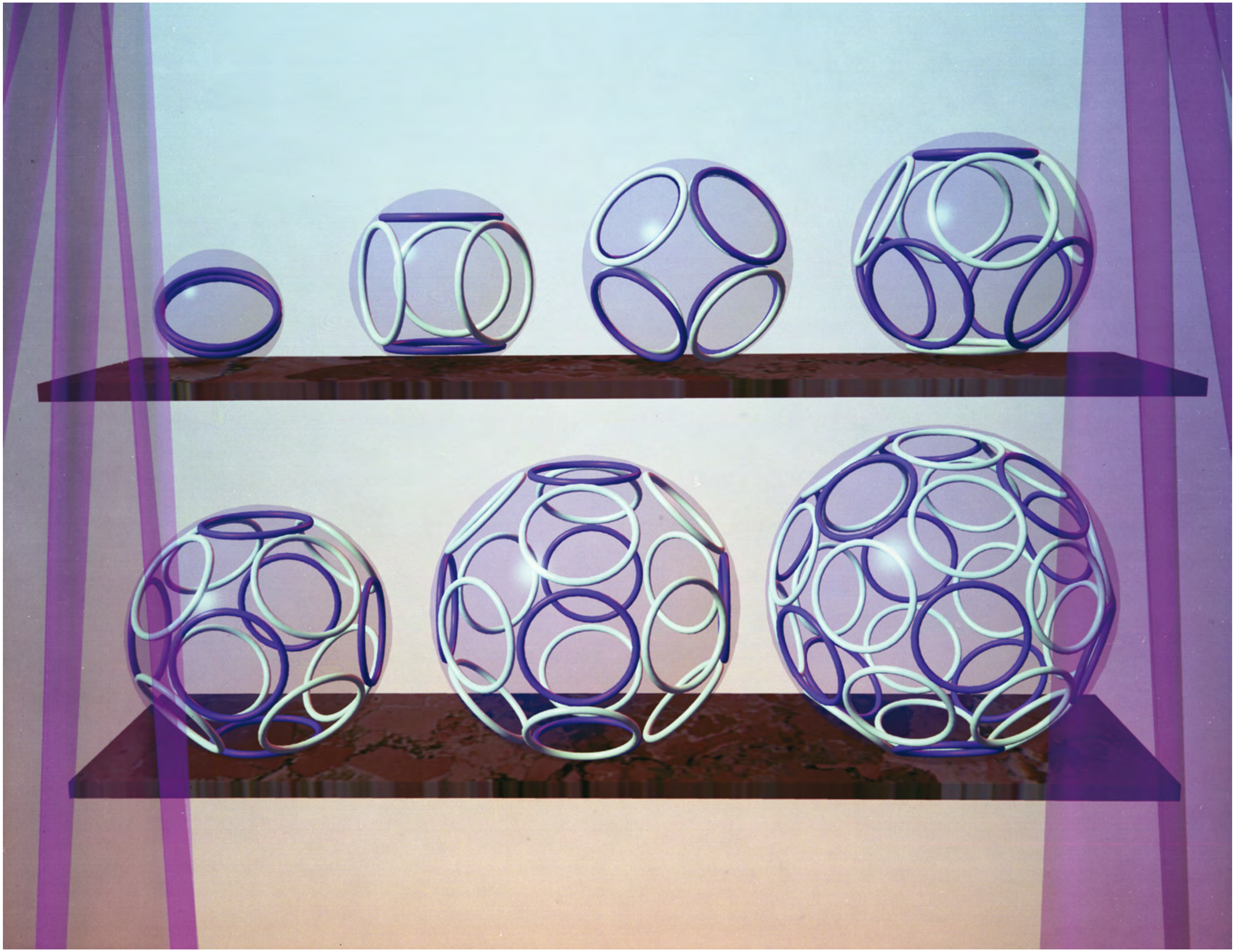
Study for Big Atom, 1965
stainless steel
46 x 52 x 55 in
117 x 132 x 140 cm

ATOM PLATES
With Comments by the Artist

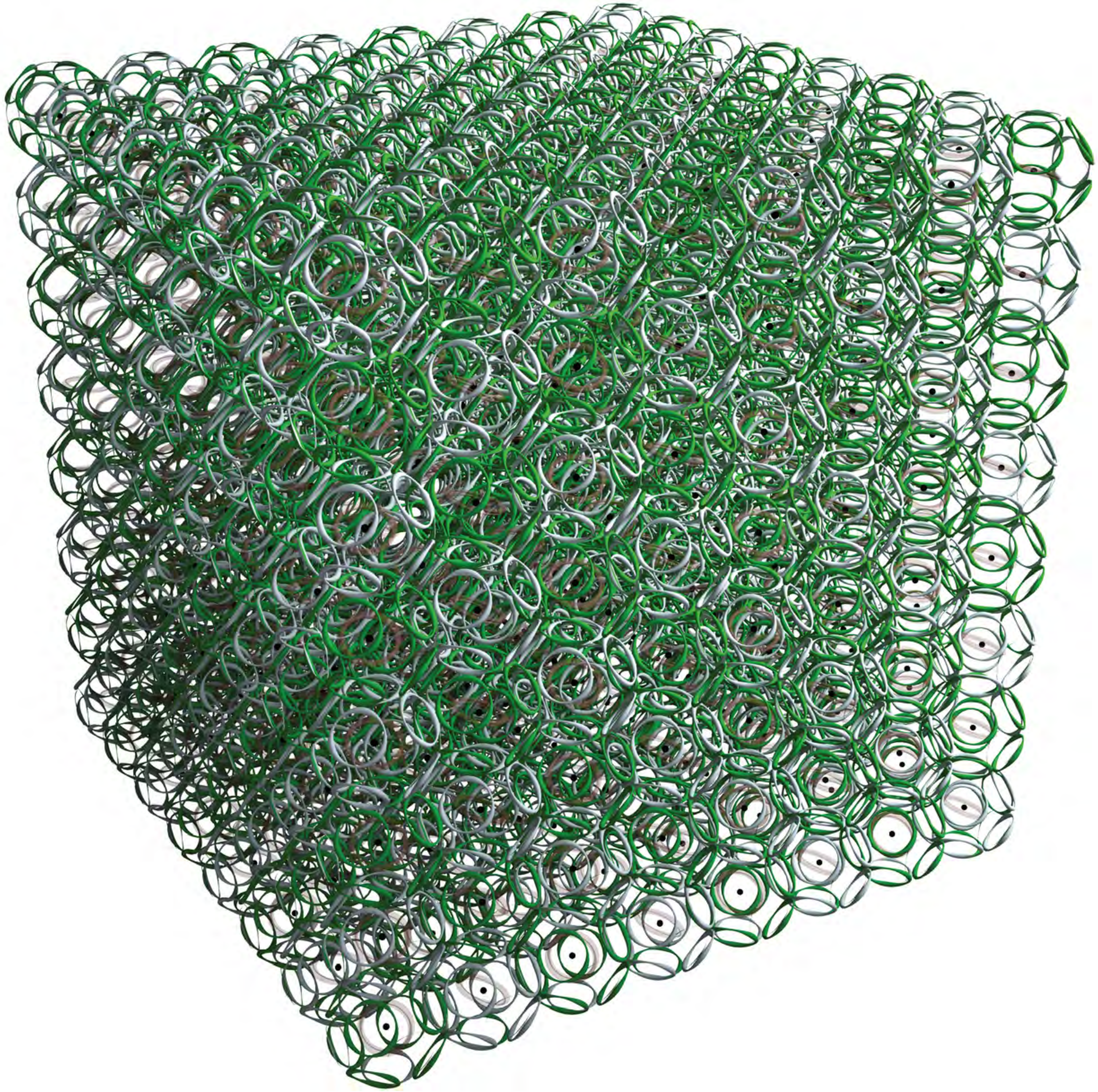




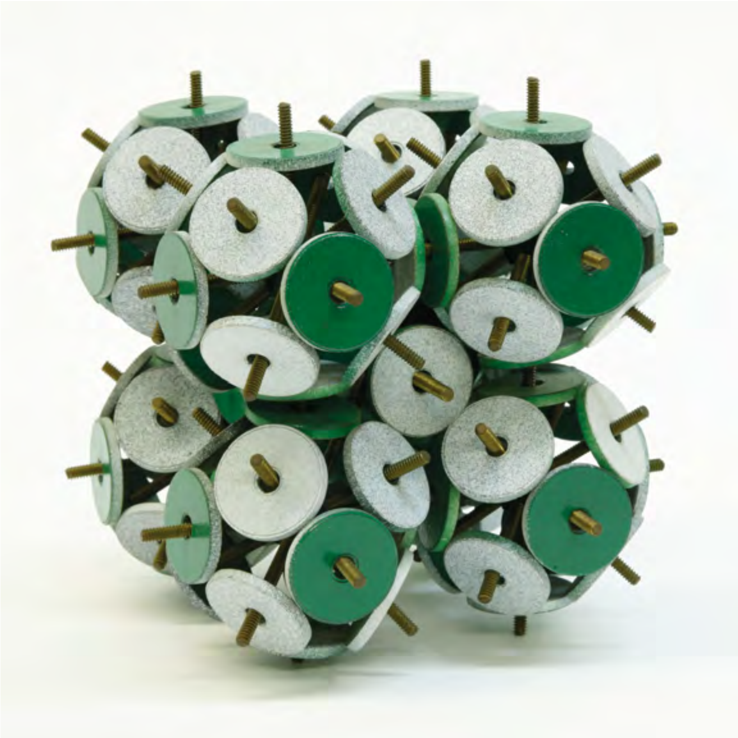
In 1960 I became curious about the many possible ways circles can fit onto spheres. I found a shop that was selling a factory overrun of plastic rings—hundreds of them. I bought the lot and began studying circles-on-spheres by drilling holes and sewing the rings together in every possible mosaic I could imagine. This photograph shows an assortment of those plastic ring cages: “circlespheres.”



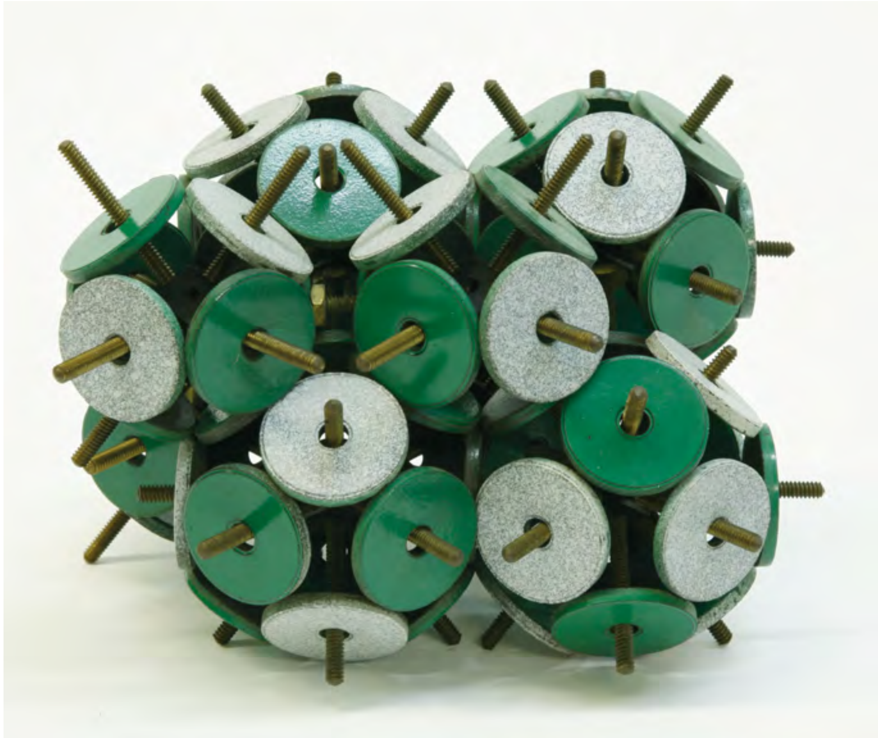
This computer-generated picture, ***Shelf Collection***, shows seven special circlesphere figures, composed of 2, 5, 8, 10, 14, 18 or 32 circles. This set is unique in that each sphere has rings of two colors wherein only rings of opposite colors touch one another: circlesphere checkerboarding.



Endless Magnetic Matrix, 1988-2008
computer picture



Magnet Fourteen Matrix BCC, 1962
ceramic magnets, brass and plastic
5.5 x 6.25 x 6.25 in
14 x 16 x 16 cm

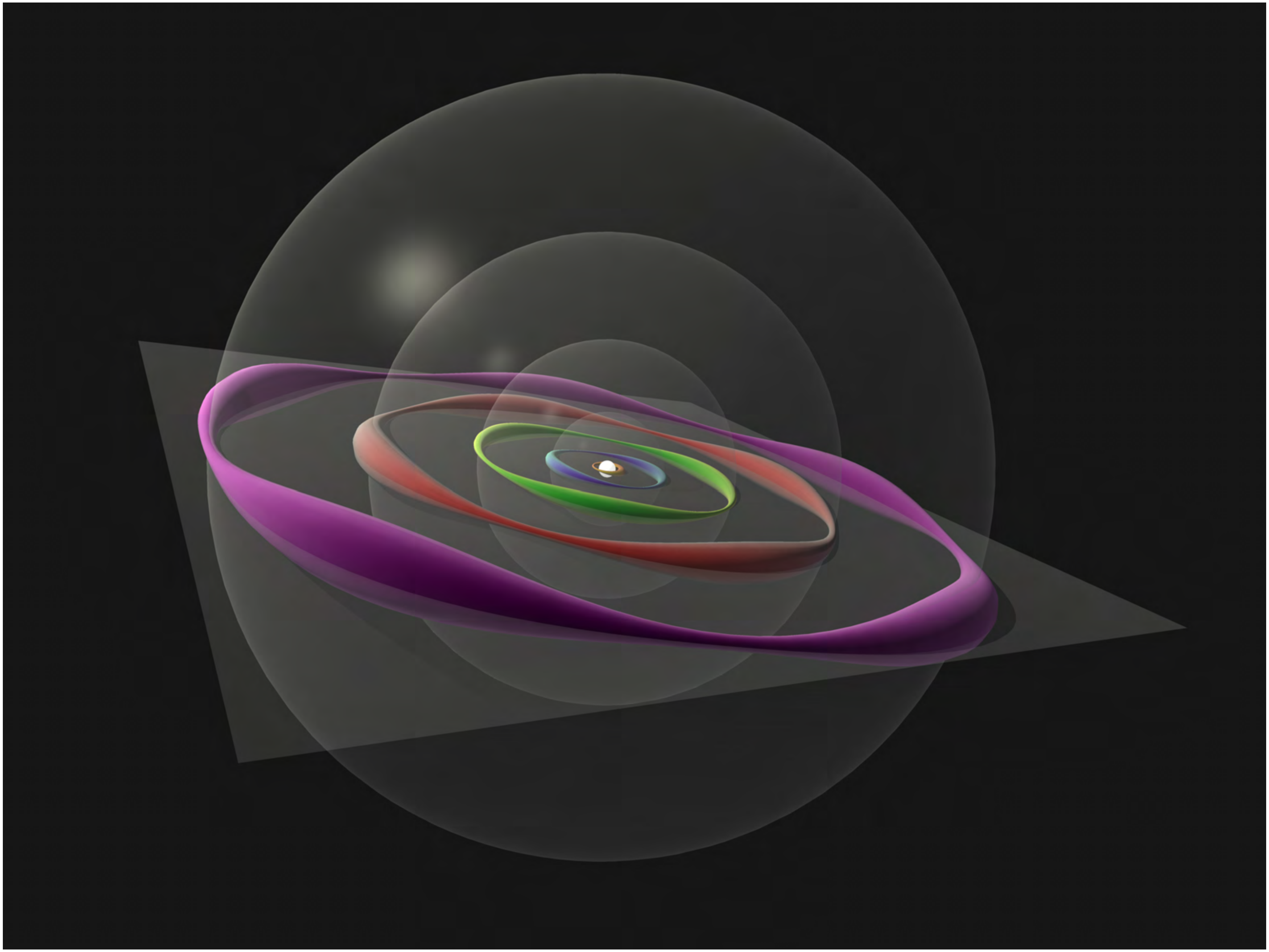


Magnet Eight and Fourteen Matrix BCC, 1962
ceramic magnets, brass and plastic
4 x 5.6 x 5 in
10 x 4.5 x 12.5 cm

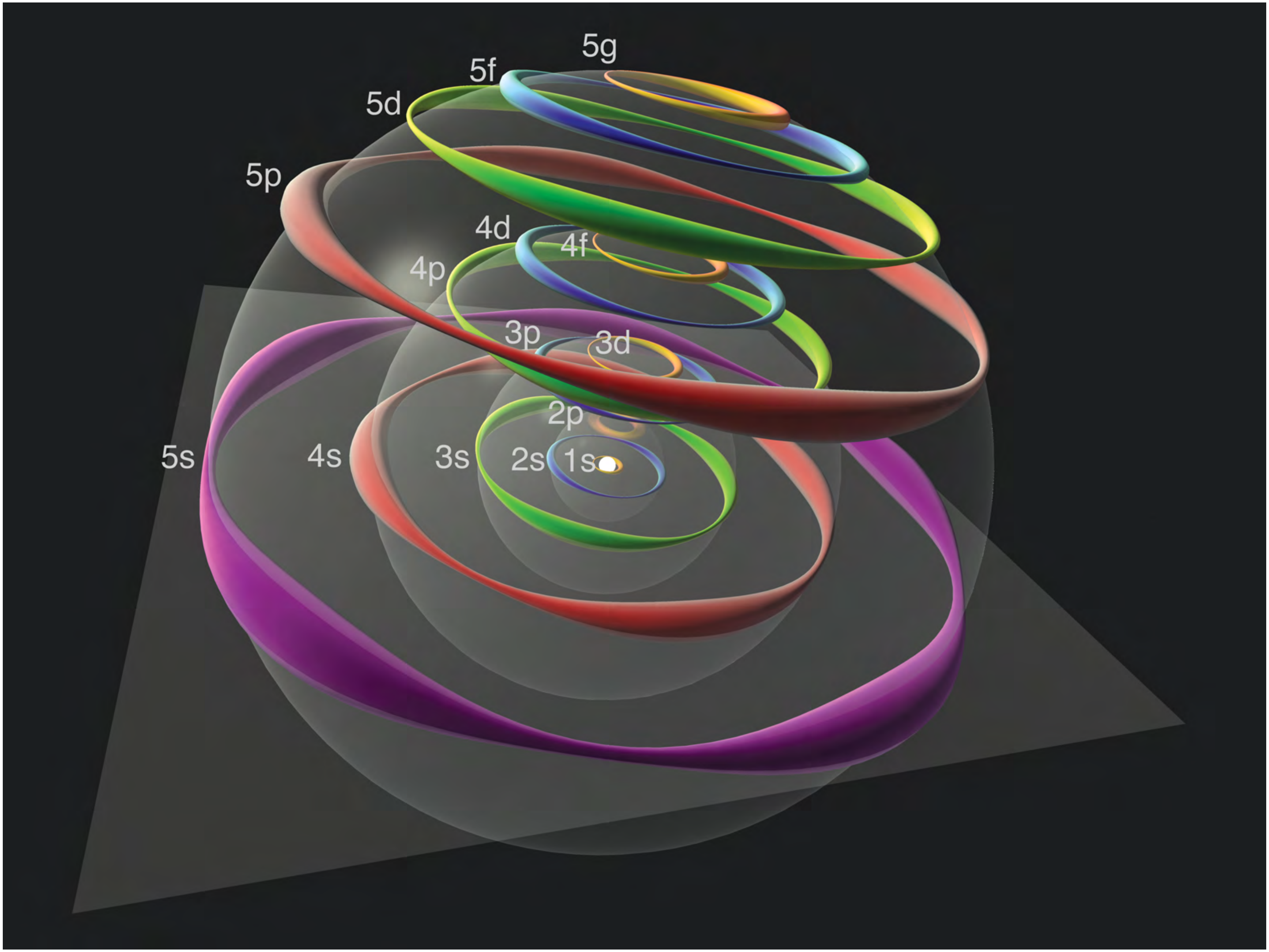
Magnet Graphene Plane, 1962
ceramic magnets and plastic
1.5 x 11 x 7.25 in
4 x 28 x 18.5 cm

Magnet Eight Matrix BCC, 1962
ceramic magnets, brass and plastic
3.75 x 5.25 x 5.25 in
9.5 x 13.5 x 13.5 cm

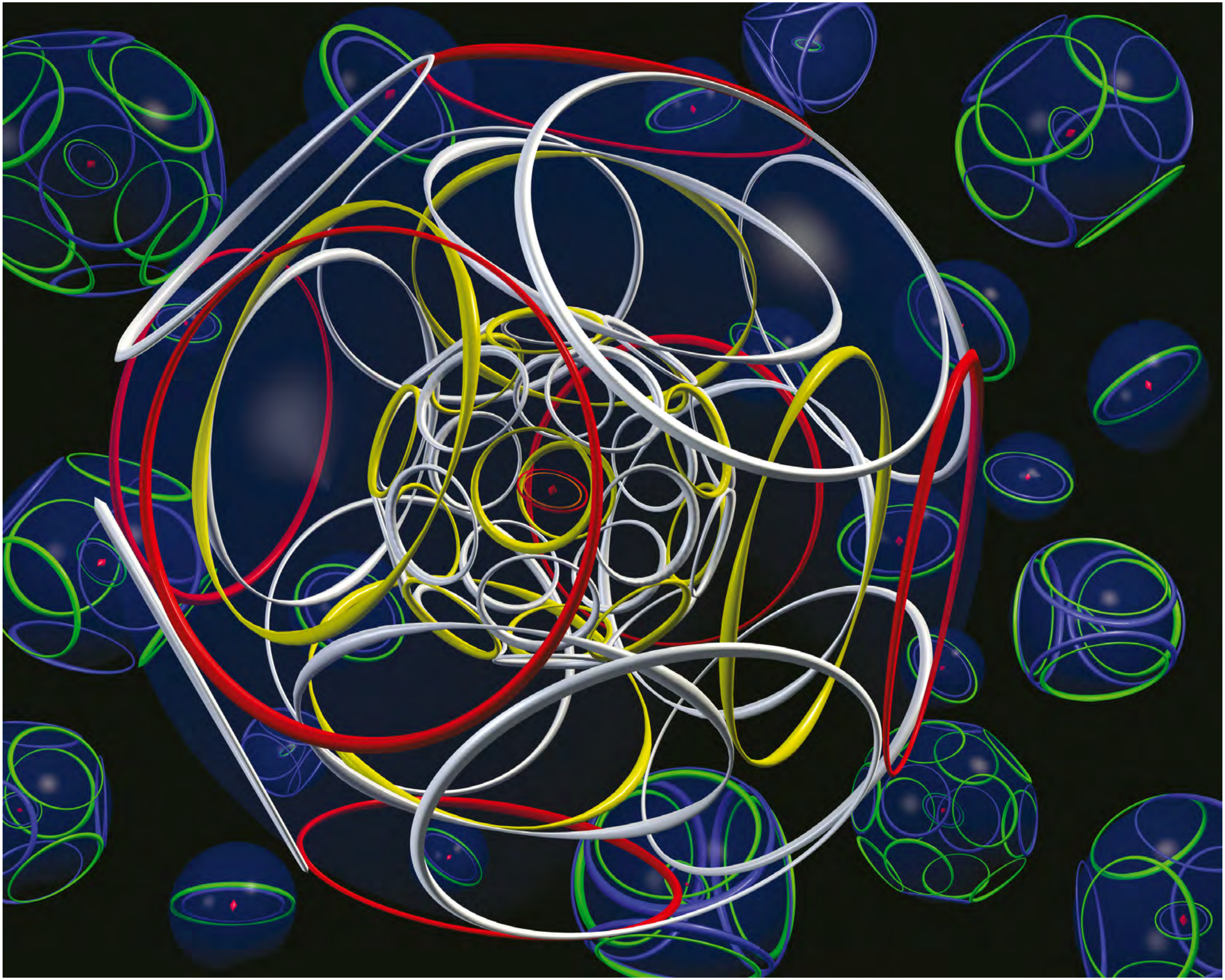
Three Shell Magnet Piece 1976
magnets, plastic, aluminum
8 x 8 x 8 in
20 x 20 x 20 cm



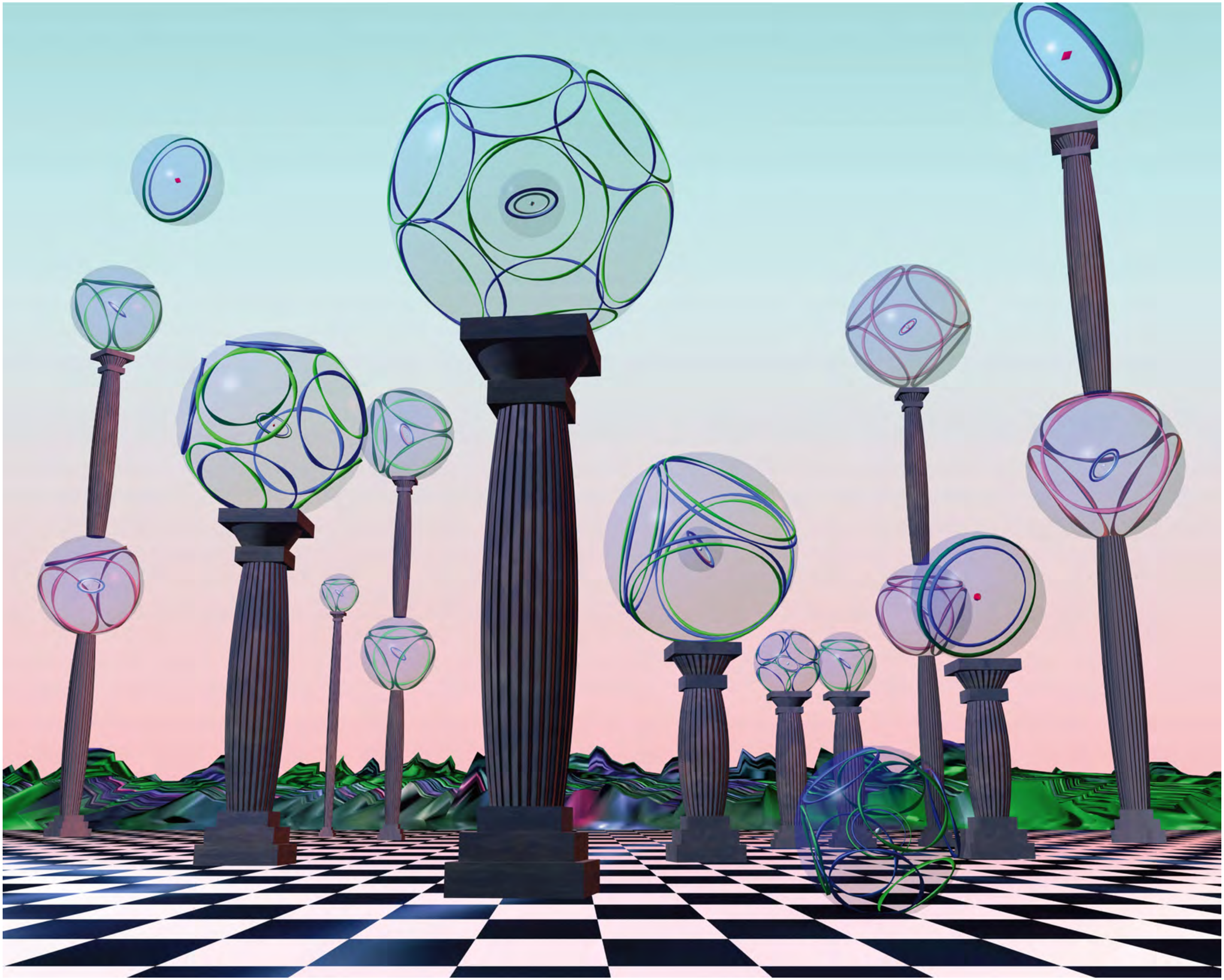
Count Louis de Broglie's Matter-Wave-Electron Atom. Computer picture
In 1923 a young French physics student, Count Louis de Broglie, proposed a model of the one-electron hydrogen atom. It was inspired by Niels Bohr's famous 1913 planetary-electron model but rather than Bohr's tiny planet circling the nucleus, De Broglie described the electron‘s pathway as a vibrating, continuous, “matter-wave” orbit. Each orbit contained a number of whole waves: One wave in the orbit nearest the nucleus, two in the second “shell”, three waves in the third, etc. De Broglie's matter-wave atom was a flat disk, not a three-dimensional spatial object.



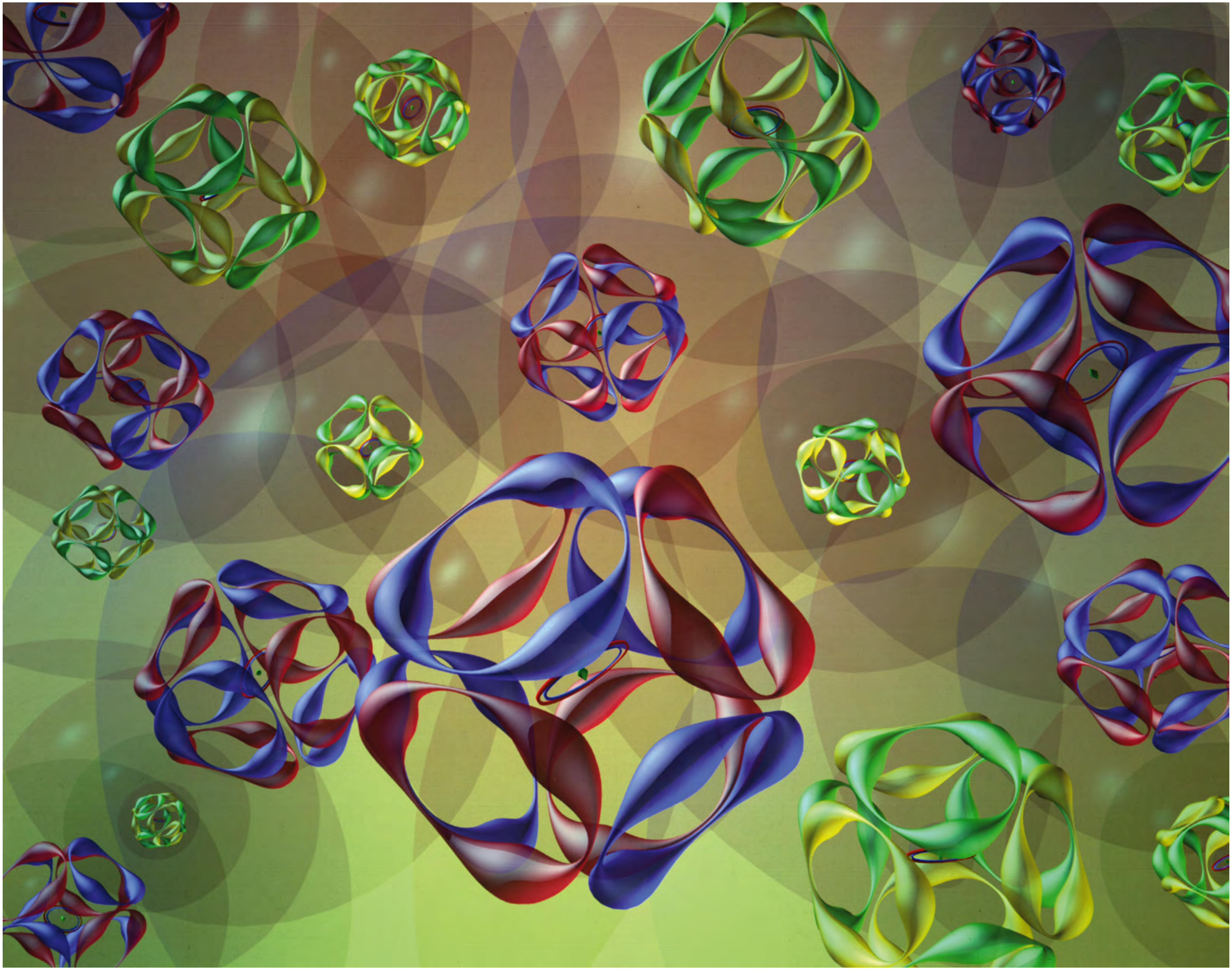
Snelson-de Broglie Hydrogen Atom's Auxiliary Orbits, 1987-2008
This computer picture shows the energy level alternatives for my model's hydrogen atom. Louis de Broglie's original (s) orbits for shells one through five are the same as those pictured on the previous page. Additional orbits, off-center from the nucleus, complete the required, p, d, f, g... auxiliary states. These are temporary levels the electron wave is transported to when the atom takes in or gives off light. They transform de Broglie's flat atom into a three-dimensional structure.



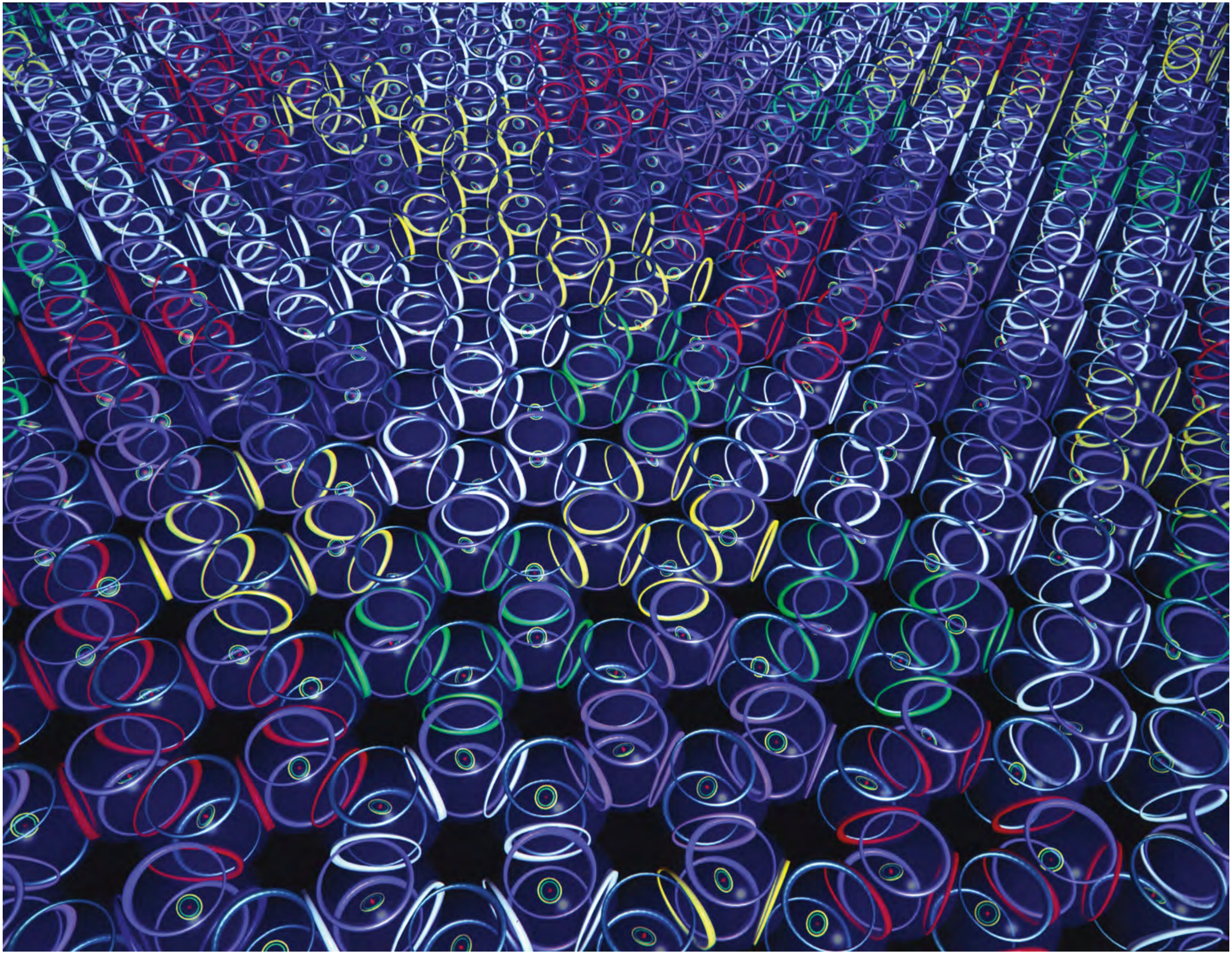
Midnight Variations, 1988
computer picture



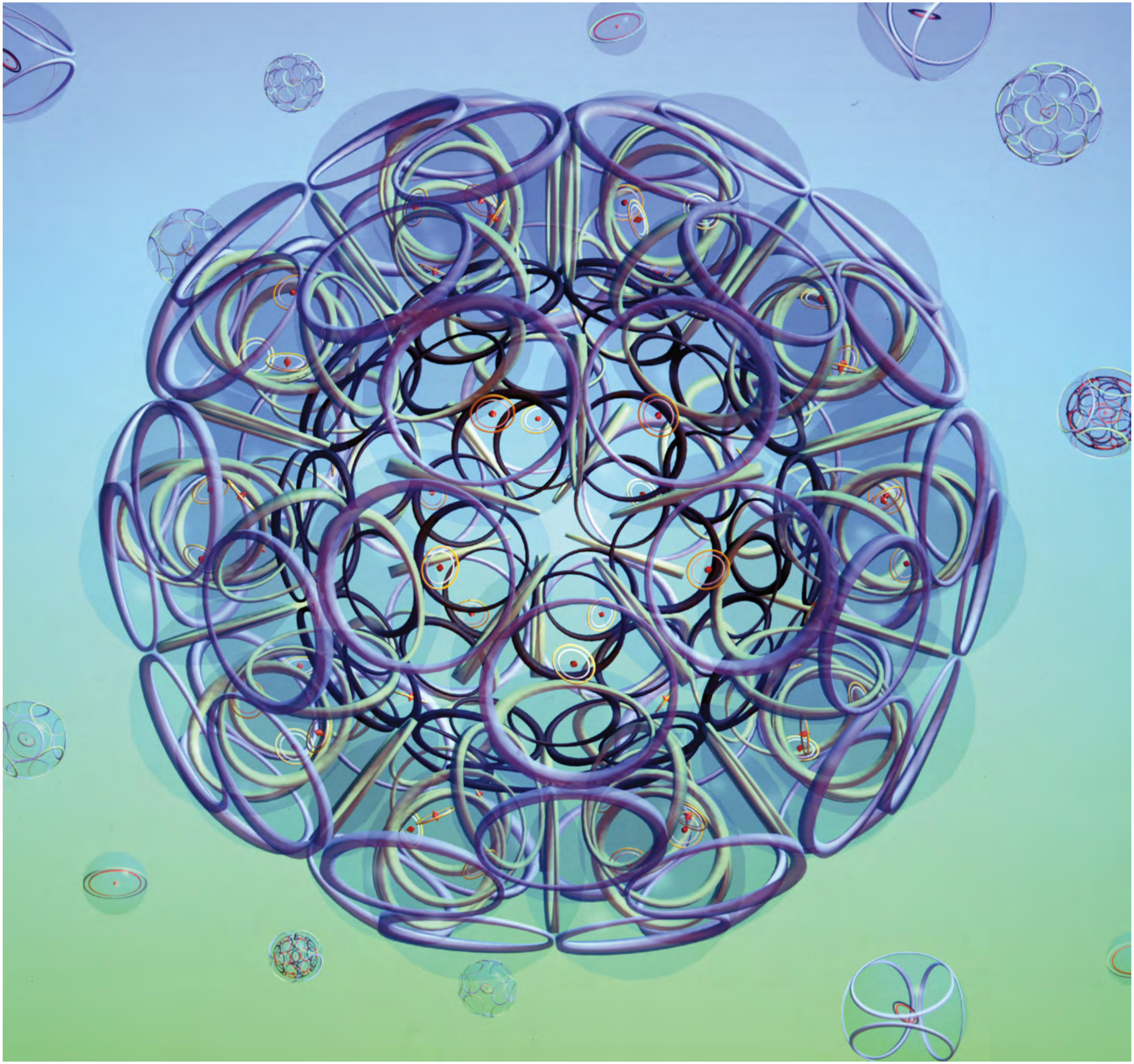
Atoms at An Exhibition 1988
computer picture



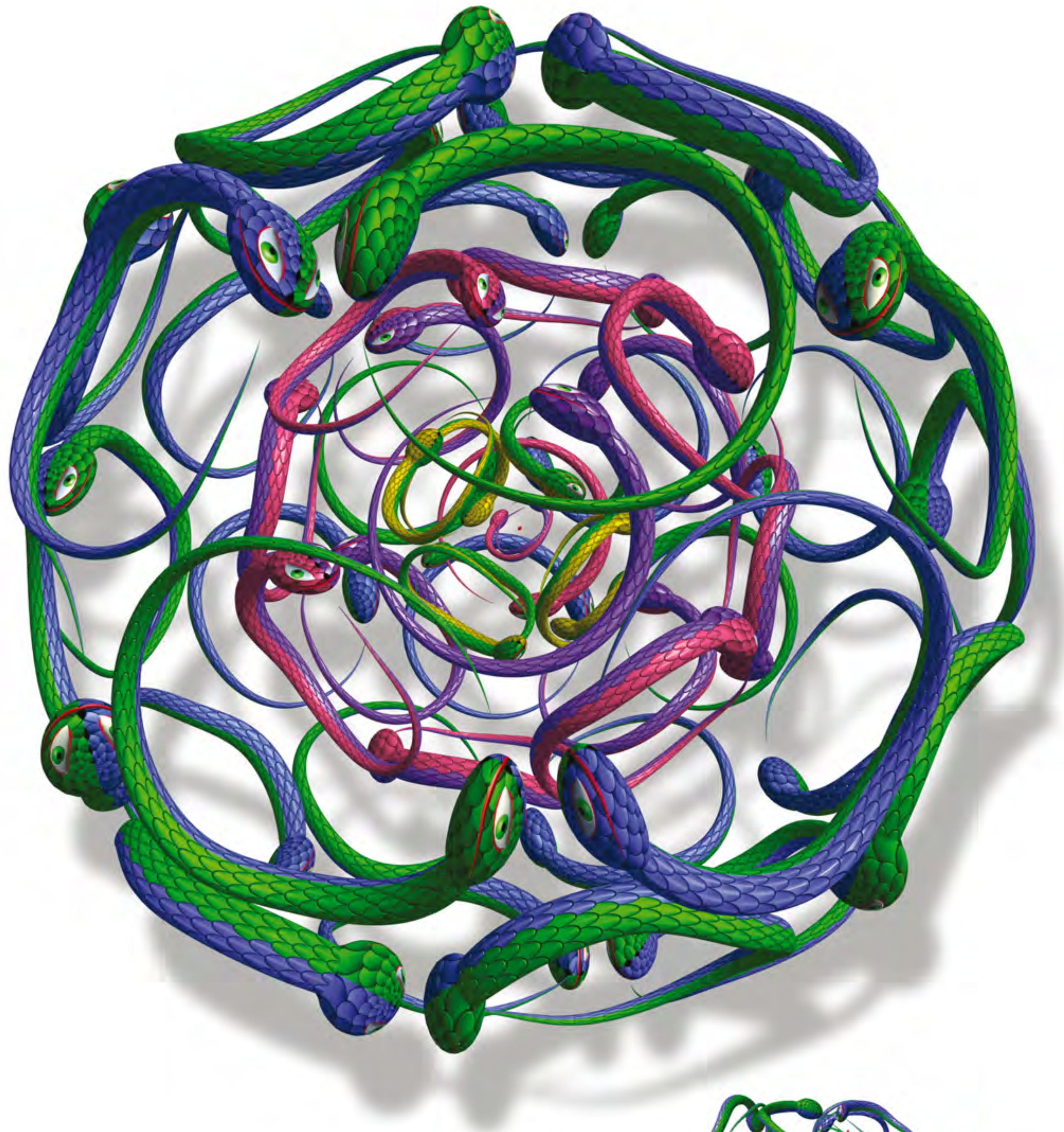
Sky Array, 1989
computer picture



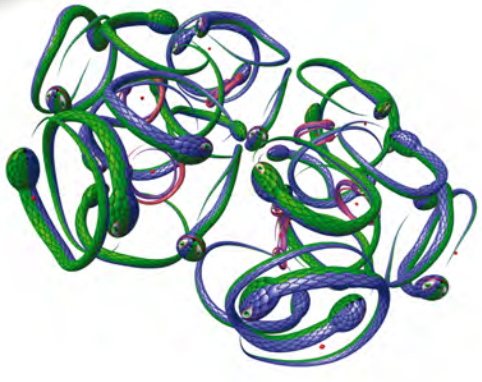
Graphene 1989
computer picture



Soccer Ball 1989
computer picture

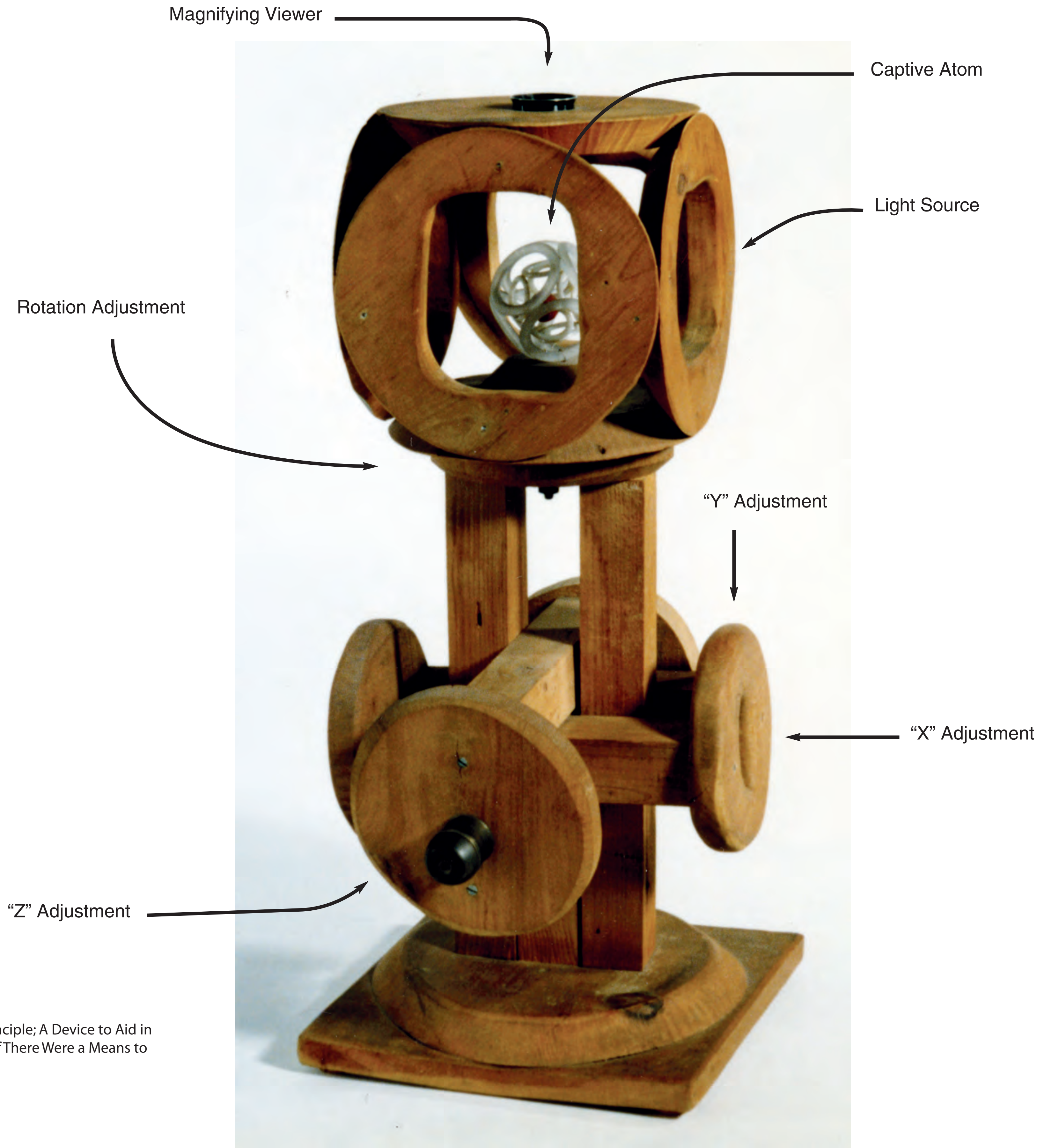


In 1865, August Kekulé dreamt of a whirling serpent seizing its own tail.



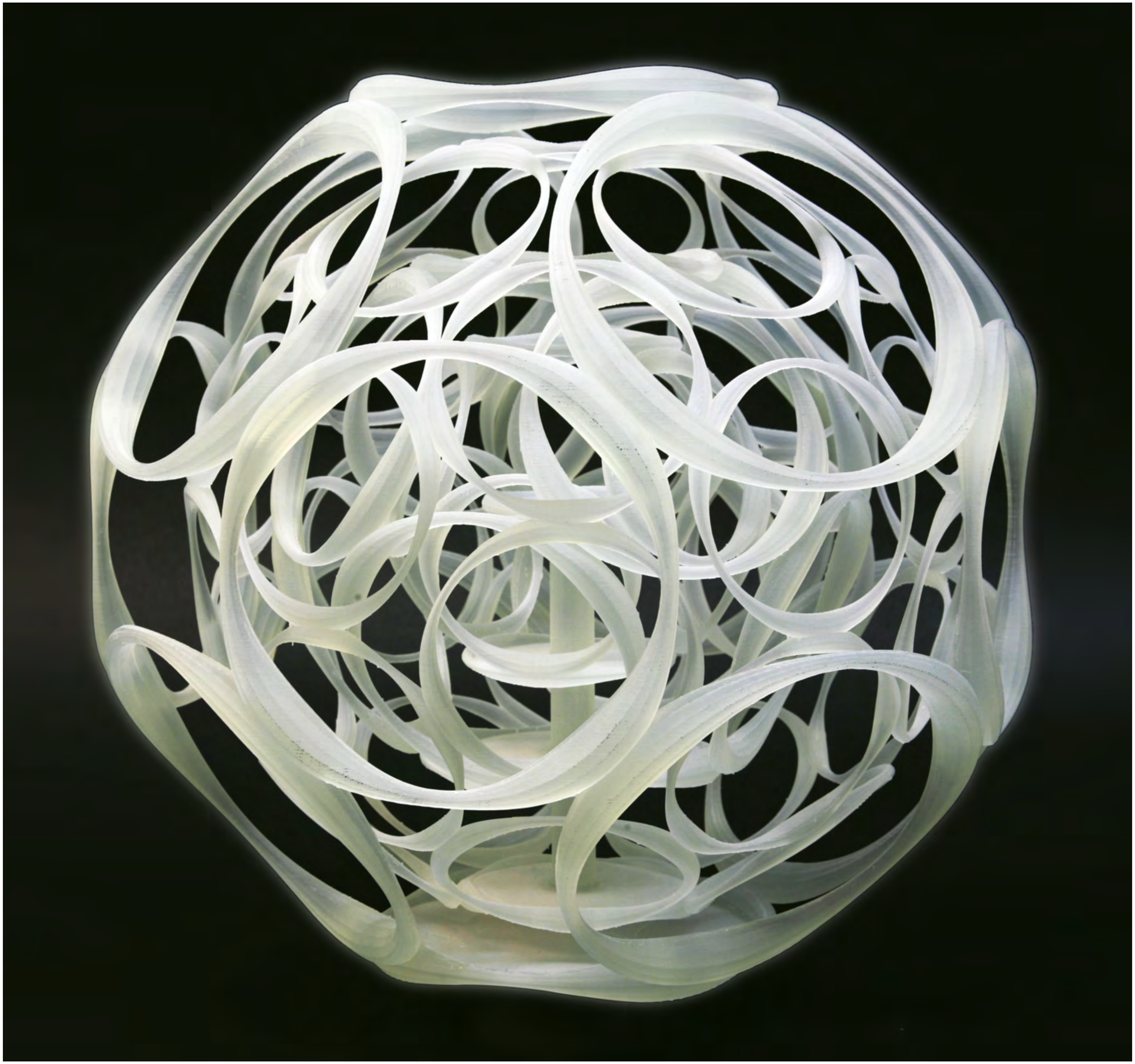
Kukele's Dream 1989
computer picture

Chain Bridge Bodies, 1989
computer picture



Homage to the Uncertainty Principle; A Device to Aid in Locating Electrons in an Atom If There Were a Means to Look for Them, 1964
mixed media
22 x 12.25 x 10 in
56 x 31 x 25.5 cm

Study for Atomic Space I 1964
stainless steel
13 x 10 x 11 in
33 x 25.4 x 27.9 cm



Stereo Lithography Atom 2007
12 x 12 x 12 in
30.5 x 30.5 x 30.5 cm

Dark Matter, rp model 2008

The raw granite at Dingli

Carved by machine into a sphere

Computer rapid prototyping technology for making three-dimensional models in industry has been used since the 1980s. Autodesk, largest maker of three-dimensional computer software, initiated its “Digital Stone” project in 2007. Four sculptors, Kenneth Snelson, Bruce Beasley, Jon Isherwood and Robert Michael Smith were commissioned to create rapid prototype works, five from each artist. The small models were sent to the Dingli Stone Carving Art Company in Fujian China to be enlarged and carved in granite. Snelson’s spherical sculptures are part of his multimedia “Portrait of an Atom”. Each is four feet in diameter and weighs over six-thousand pounds.

The photographs show the stages in making “Dark Matter” from the rapid prototype model to finished carving. The artists’ twenty works were exhibited at sites in China including Shanghai and the National Art Museum in Beijing. Autodesk’s Digital Stone project represents a unique marriage of cutting edge technology and traditional stone carving.

Holding Pattern, rp model; 8 x 8 x 8 in.

Shaping the granite sphere

Stone carver at Dingli factory using Snelson's RP reference-model to carve the 4' diameter, *Holding Pattern*, 2008

Robert Michael Smith photos

Kenneth Snelson, *Holding Pattern*, granite, 4 x 4 x 4 ft, 1.21 x 1.21 x 1.21 m, Exhibition "Digital Stone" Shanghai, China, 2009

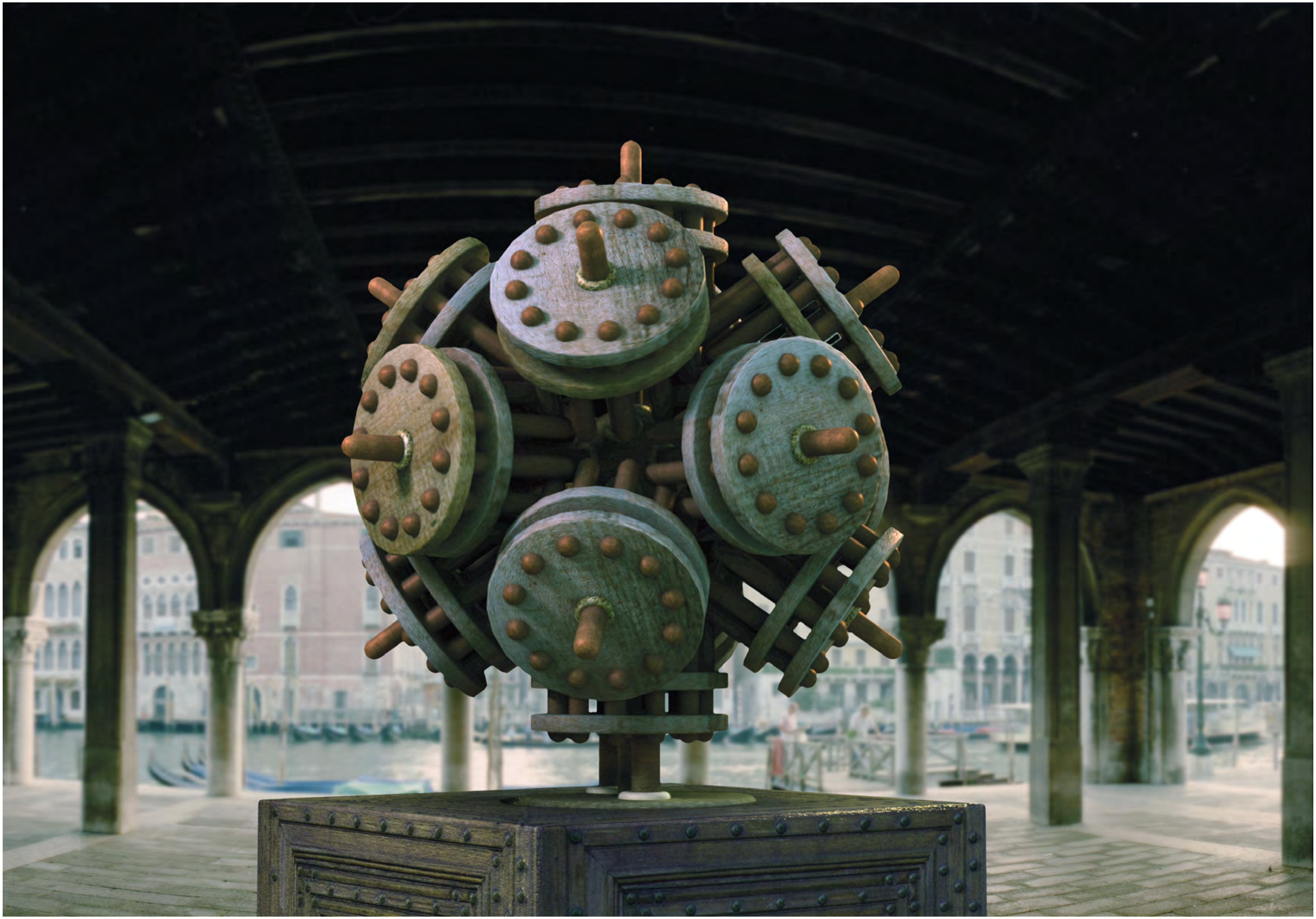
Base Station, 2008
granite
48 x 48 x 48 in
122 x 122 x 122 cm

Moon Shot, 2008
granite
48 x 48 x 48 in
122 x 122 x 122 cm

Hard Wired, 2008
granite
48 x 48 x 48 in
122 x 122 x 122 cm

Holding Pattern, 2008
granite
48 x 48 x 48 in
122 x 122 x 122 cm

Dark Matter 2008
granite
48 x 48 x 48 in
122 x 122 x 122 cm
private collection



Leonardo's Atom, 1991-2008
computer image with photograph

1

Portrait of an Atom —
A most didactic work of art.

Is the atom's electronic structure a reasonable subject for an artwork? Of course! Artists have often explored the invisible, the ghosts of the mind.

The atom's inner workings are not visible. They must be reconstructed from fragments of information. Though this task seems to lie in science's territory, it has largely been set aside in favor of digital rather than visual portrayals. Werner Heisenberg's uncertainty principle has abolished for the past half century any portrayals of how electrons may or may not <u>move</u> about the atom.

Because of this, I believe the atomic world can best be explored visually by the eye of an artist — with the use of data from the literature of science.

The atom is formed of circular orbits on spheres. Electrons race in circular vibrations — waves on the seeming non-substance of spheres of electrical energy surrounding each atomic nucleus like onion layers. Electrons race — their traces, like ski trails. The scar they leave — negative electricity searing over a constant strata of spherical positive field — is indeed primordial matter.

The particle, usually imagined, is dissolved — lost in the blur of its rapid motion. Electrons in atoms see one another only as standing-wave, circular rings — negative electrical donuts — not as bullets or flying objects. They respect one another's territorial rights. "I carve this orbital ring. This space is mine"

They prefer the special equatorial orbital but when more than one electron wave appear on the same shell none can monopolize it. They herd to opposite corners forcing one another to form off-center orbits in small-circle domains.

This is the fundamental shell formation for electrons: several on the same electrical sphere, all competing for a share of the space. They are electrically drawn toward the nucleus. They would fall toward it if nothing were to interfere. Fortunately, there is an exquisite set of deterents:

The primary one, in a many-electron atom is the barrier property of each of the electrons' matter-waves. Matter waves created in the electron's wake are matter-like. They take up space — fully occupying it. They exclude one another wherever they occur. They hold off one another within the atom (Pauli's Principle) and they barricade their space when separate atoms collide in a gas. They resiliantly maintain their spacing in a molecule or crystal.

Though electrons repel one another electrostatically, the <u>wall-like</u> property owned by electron matter-waves is a separate but concomitant phenomenon.

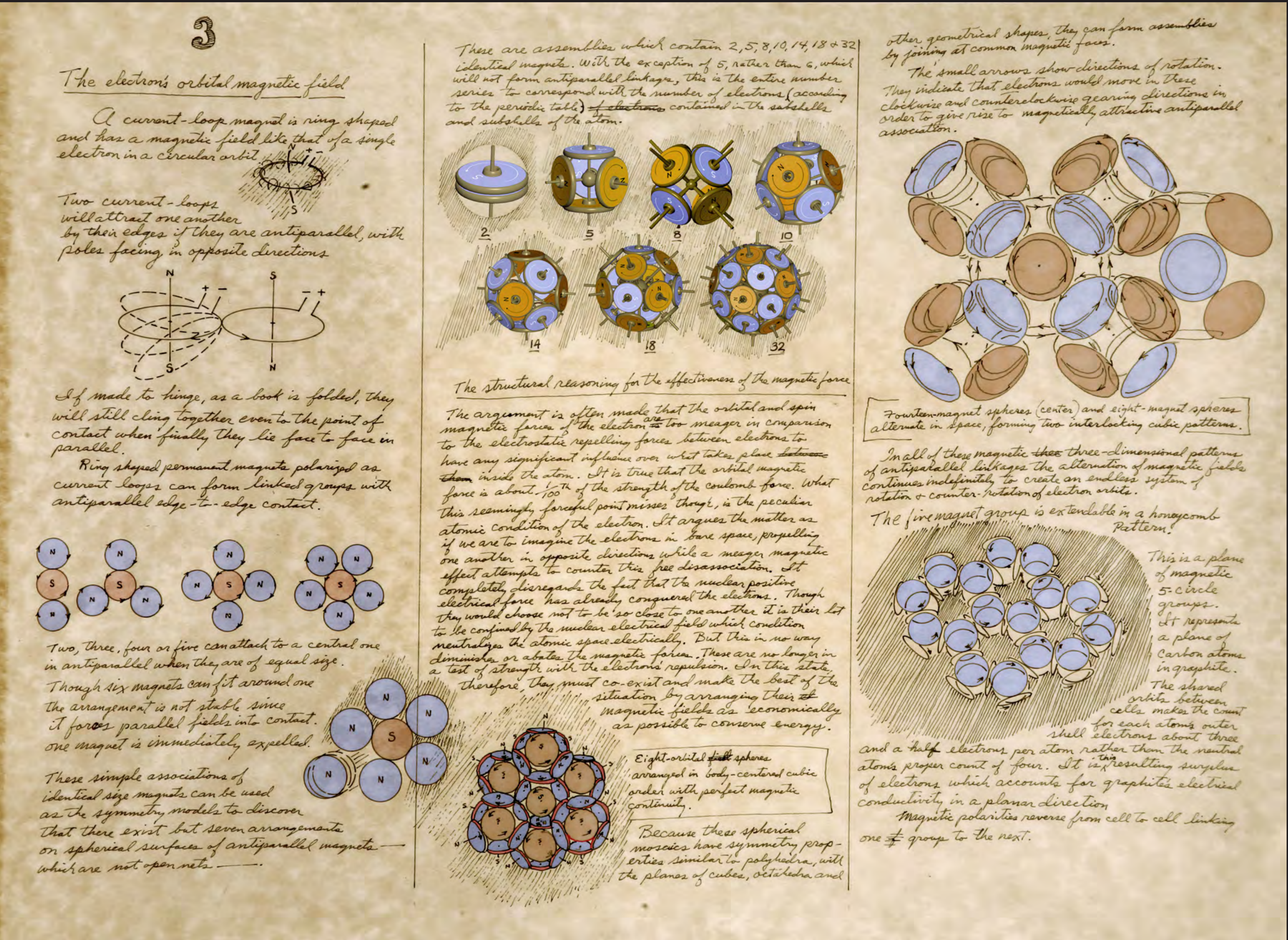
Because electrons thus separate themselves as items, each of their additional force characteristics — electrostatic, magnetic and gyroscopic — all act orbit to orbit to contribute structurally to the atom.

This forms a quite different picture from that of the long asserted physicists' view that electrons in the atom are to be seen as tiny electrostatic points which bustle about, randomly colliding millions of times a second; yet somehow managing to hold, statistically, to their assigned balloon-like orbitals. The orbitals in this accepted model are capable of interpenetrating one another like vapors or ghosts. Waves of probability are not matter-like.

The best justification for the lobe-like charge clouds always shown reaching out from the atom's center is more likely an anthropomorphic reason rather than a physical one. Arms and hands are thereby provided to grasp one another when one atom must bond to another.

Atom Codex Drawing, Page 1, 1980-2008
ink on paper and graphic collage
20 x 16 in
51 x 40.5 cm

Atom Codex Drawing, Page 2, 1980-2008
ink on paper and graphic collage
20 x 16 in
51 x 40.5 cm



3

The electron's orbital magnetic field

A current-loop magnet is ring shaped and has a magnetic field like that of a single electron in a circular orbit.

Two current-loops will attract one another by their edges if they are antiparallel, with poles facing in opposite directions

If made to hinge, as a book is folded, they will still cling together even to the point of contact when finally they lie face to face in parallel.

Ring shaped permanent magnets polarized as current loops can form linked groups with antiparallel edge-to-edge contact.

Two, three, four or five can attach to a central one in antiparallel when they are of equal size.

Though six magnets can fit around one the arrangement is not stable since it forces parallel fields into contact. One magnet is immediately expelled.

These simple associations of identical size magnets can be used as the symmetry models to discover that there exist but seven arrangements on spherical surfaces of antiparallel magnets — which are not open nets —.

These are assemblies which contain 2, 5, 8, 10, 14, 18 & 32 identical magnets. With the exception of 5, rather than 6, which will not form antiparallel linkages, this is the entire number series to correspond with the number of electrons (according to the periodic table) ~~of electrons~~ contained in the subshells and subshells of the atom.

2 5 8 10 14 18 32

The structural reasoning for the effectiveness of the magnetic force

The argument is often made that the orbital and spin magnetic forces of the electron are too meager in comparison to the electrostatic repelling forces between electrons to have any significant influence over what takes place ~~between them~~ inside the atom. It is true that the orbital magnetic force is about 1/100th of the strength of the coulomb force. What this seemingly forceful point misses though, is the peculiar atomic condition of the electron. It argues the matter as if we are to imagine the electrons in bare space, propelling one another in opposite directions while a meager magnetic effect attempts to counter this free disassociation. It completely disregards the fact that the nuclear positive electrical force has already conquered the electrons. Though they would choose not to be so close to one another it is their lot to be confined by the nuclear electrical field which condition neutralizes the atomic space electrically. But this in no way diminishes or abates the magnetic forces. These are no longer in a test of strength with the electrons' repulsion. In this state, therefore, they must co-exist and make the best of the situation by arranging their ~~st~~ magnetic fields as economically as possible to conserve energy.

Eight-orbital ~~field~~ spheres arranged in body-centered cubic order with perfect magnetic continuity.

Because these spherical mosaics have symmetry properties similar to polyhedra, with the planes of cubes, octahedra and other geometrical shapes, they can form assemblies by joining at common magnetic faces.

The small arrows show directions of rotation. They indicate that electrons would move in these clockwise and counterclockwise gearing directions in order to give rise to magnetically attractive antiparallel association.

Fourteen-magnet spheres (center) and eight-magnet spheres alternate in space, forming two interlocking cubic patterns.

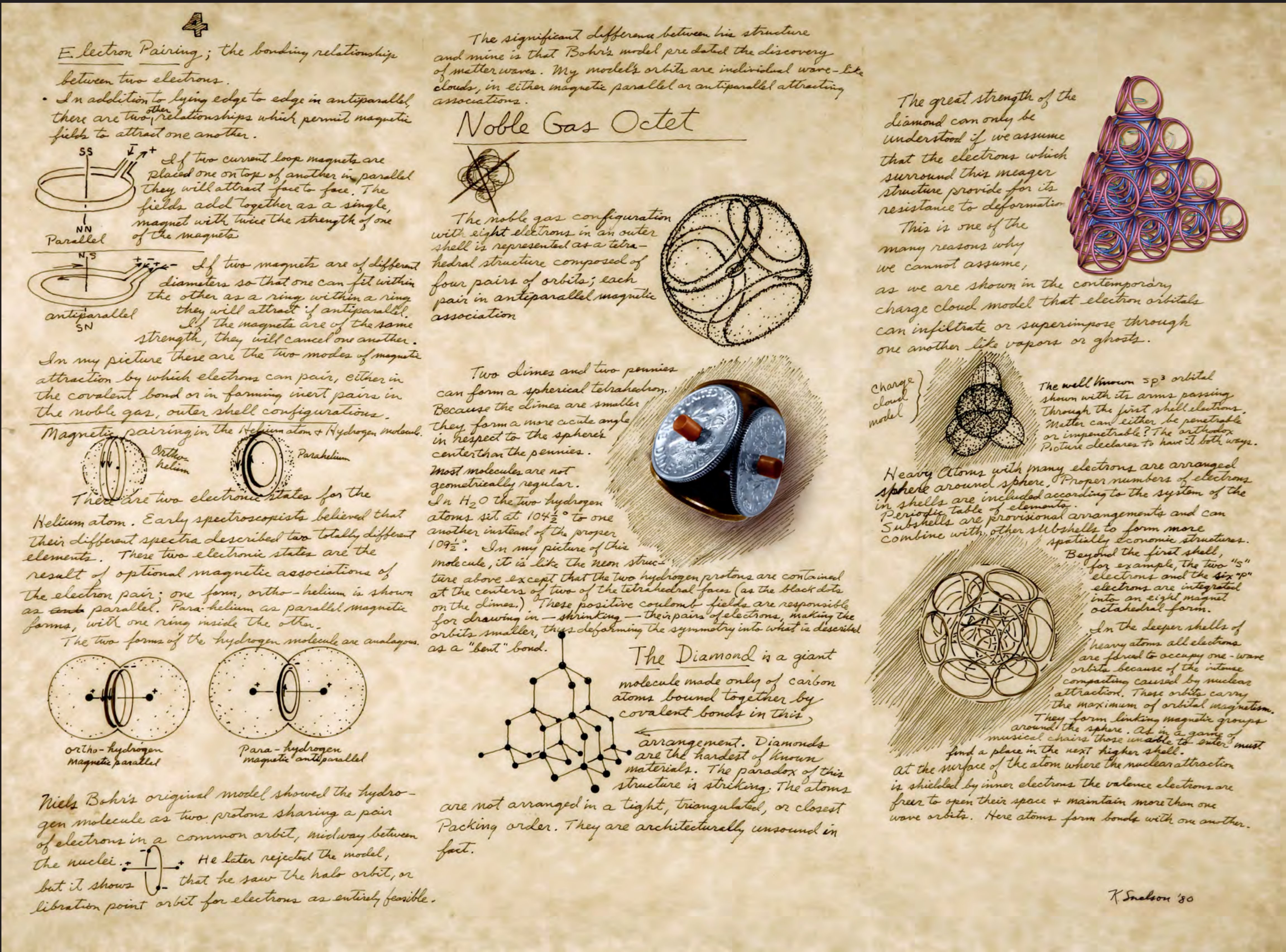
In all of these magnetic ~~thee~~ three-dimensional patterns of antiparallel linkages the alternation of magnetic fields continues indefinitely to create an endless system of rotation & counter-rotation of electron orbits.

The five magnet group is extendable in a honeycomb Pattern!

This is a plane of magnetic 5-circle groups. It represents a plane of Carbon atoms in graphite. The shared orbits between cells makes the count for each atom's outer shell electrons about three and a half electrons per atom rather than the neutral atom's proper count of four. It is this resulting surplus of electrons which accounts for graphite's electrical conductivity in a planar direction.

Magnetic polarities reverse from cell to cell linking one ~~f~~ group to the next.

Atom Codex Drawing, Page 3, 1980-2008
ink on paper and graphic collage
20 x 16 in
51 x 40.5 cm



Atom Codex Drawing, Page 4, 1980-2008
ink on paper and graphic collage
20 x 16 in
51 x 40.5 cm

THE ARCHITECTURE OF SPACE

ARCHITECTURE OF SPACE
by Eleanor Heartney

Snelson's lifelong quest to understand the architecture of space finds yet another manifestation in a series of panoramic photographs taken with a camera which fell out of production decades ago. His interest in photography goes back to his childhood. Just as sculptures are rooted in a childhood fascination with models, Snelson's panoramas hark back to the hours spent with cameras in his father's camera shop. As he observes, "The Snelson Camera shop was an inestimable gift from my father, from the time I was six. It was a path into the aesthetics of seeing." Another such gift was a spiral bound book on photographic composition by William Mortensen entitled "The Command to Look." Young Snelson tagged along when his father went on photo shoots, capturing local events and groups with his panoramic camera. Later, after his move to New York, during the 1950s and 1960s, Snelson found work as a cameraman for documentary films, a job that took him to location shoots around the world.

All these experiences burbled back to the surface in 1975, when he stumbled on an old box camera in a flea market in Berlin. It was a Zeiss Ikon, one of the cameras his father sold in his camera shop. This discovery rekindled Snelson's interest in photography and he began collecting other vintage cameras, including a Widelux and then a Cirkut camera that could do the kind of panoramic photographs he remembered from his childhood. These cameras are large and complicated machines and parts are no longer manufactured; so Snelson had to rebuild and customize them himself. He also had to build his own printer, a huge wooden box able to accommodate a twelve-foot negative. Hauling his cumbersome 80-pound camera around New York City on his bicycle early on Sunday mornings when the streets were at their most quiet, he began to take panoramic photographs of the streets and buildings. He subsequently took his interest abroad, creating panoramic photographs in Europe and Japan as well. Eventually, the discovery of a Hulcherama camera, a smaller and more efficient panoramic camera, lightened his load.

Snelson in 1997 photographing with a 16" Cirkut camera. The largest of its kind; it was manufactured in 1917. The camera is driven by a spring motor to rotate 360 degrees and produces a negative 16 x 144 inches wide.

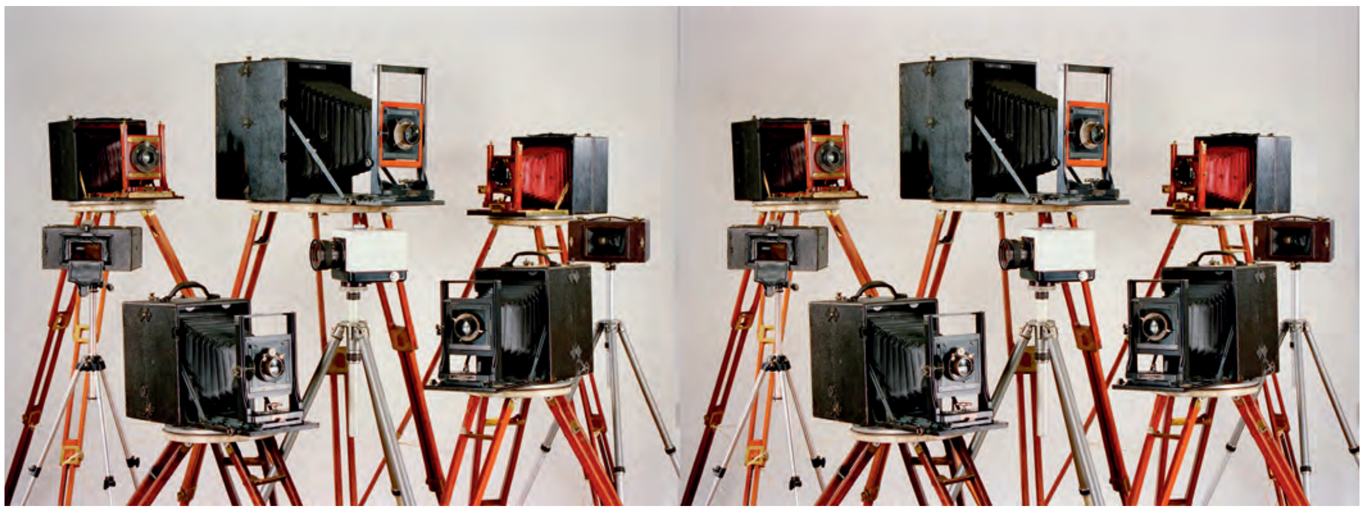
It is common to refer to panoramas as photographs made with wide-angle lenses or pieced together from images shot with an ordinary camera but a true panoramic camera rotates on a tripod while the film is driven in the opposite direction, enabling the photographer to create a seamless, 360 degree view. A panorama thus avoids the subtle distortion that comes from ordinary photography, in which curved space is rendered flat. Instead, the panorama offers a true picture of space as we experience it in the round, or it would, if it were presented within a circular space. However, laid flat, the panoramic photograph picks up distortions of its own, just as the flat map of the world is a much-distorted version of the globe. Thus, it presents a paradox, revealing the distance between the immediate, felt perception of the world, and representations of it.

Snelson makes the most of this dissonance, choosing largely urban vistas where the geometry of buildings and streets seems to curve and swell. This effect would be harder to discern in photographs of nature that lack the regular horizontals and verticals of the man-made environment, which is why such subjects are mostly absent from Snelson's oeuvre. He also tries to capture his scenes at times when cars and figures will be largely absent, thereby avoiding the moving blur that would distract from the architecture of the space.

With their undulating foregrounds and multiple vanishing points, these photographs sometimes suggest a world at sea, bobbing on the tops of waves. This is particularly the case in a panorama like *Montmartre Street with Paving Stones,* in which the normal grid of the paving stones is transformed into circular patterns that bear some resemblance to the spinning electrons of Snelson's atom. Similarly, in *Brooklyn Bridge* (1980), this magnificent structure becomes a sweeping arch that curves toward and then away from the viewer. One is reminded of Snelson's interest in a cosmos in constant motion, here expressed by the apparent dance of structures we normally view as stable.

In fact, with their multiple perspectives, Snelson's panoramas suggest a cubistic take on the visible world, which allows for the simultaneous experience of all possible views. Snelson confirms this interpretation of his photographs, noting "the panoramas come out of a voyeuristic impulse, a desire to see in all directions at once."

How do the panoramas fit in with Snelson's other concerns? One could argue that his interest in them is another example of his desire to make the invisible visible. Here he expresses his desire to take a godlike view, seeing everything at once. This may correspond to his desire to "see" the atom or to reveal the invisible forces of tension and compression in his tensegrity sculptures. Another related thread involves the fact that, like his atom and his sculptures, Snelson's panoramas are built out of modules. Here the multiple views of the rotating camera are then linked together into an indissoluble whole. Like the tensegrity sculptures and the atom, one cannot remove one part without altering the ensemble. So once again, Snelson expresses his vision of a universe in which interconnection is all.



Stereo photograph of panoramic cameras and Cirkut cameras. (Cross-eye stereo).

THE SNELSON CAMERA SHOP
by Kenneth Snelson

It was in 1975 at a photo-swap show that I discovered a 35 mm panoramic camera called a Widelux, made in Japan. Coming across that curious camera awakened memories of my father's camera shop when I was a child growing up in Pendleton, Oregon, known for its rodeo, the Pendleton Roundup. In 1933, the worst year of the Great Depression, my father, Jack Snelson, who owned and ran a laundry, decided to realize his dream of having a camera store, despite the fact that most families in that small town could barely afford a box camera, let alone the top brands Dad had in mind. He was a serious amateur photographer and in another life he probably would have become an artist. I was six years old then, my brother was nine.

At first the shop had only a few tiny Norton cameras made of Bakelite, priced at fifty cents. However, within a year or two, dad had the best brands of the '30s: Leica, Contax, Graflex, Kodak, Keystone, Rolleiflex, Victor and Voigtlander. These magical names were to become a big part of my childhood world as well as my playground as I grew older. Dad always let me try out each new model with a roll of film. My brother's talent worked best behind the counter, selling cameras. I was interested only in taking pictures, in developing and printing them in the darkroom. In a few short years the Snelsons became Pendleton's photographers. Dad made pictures for the Roundup, even panoramas of staged covered-wagon scenes to celebrate the Old Oregon Trail. Though it was never the center of Mother's world, she was always happy to have me take a portrait of her prize roses. This was, of course, very long ago but it was the lucky start for my long and great love of photographs and photography. After various art schools, I moved to New York and was soon supporting an expensive habit of making sculptures by working as a freelance movie cameraman, mostly with the networks shooting documentaries. My filming years ended in 1966 with my first sculpture exhibition at Dwan Gallery on 57th Street.

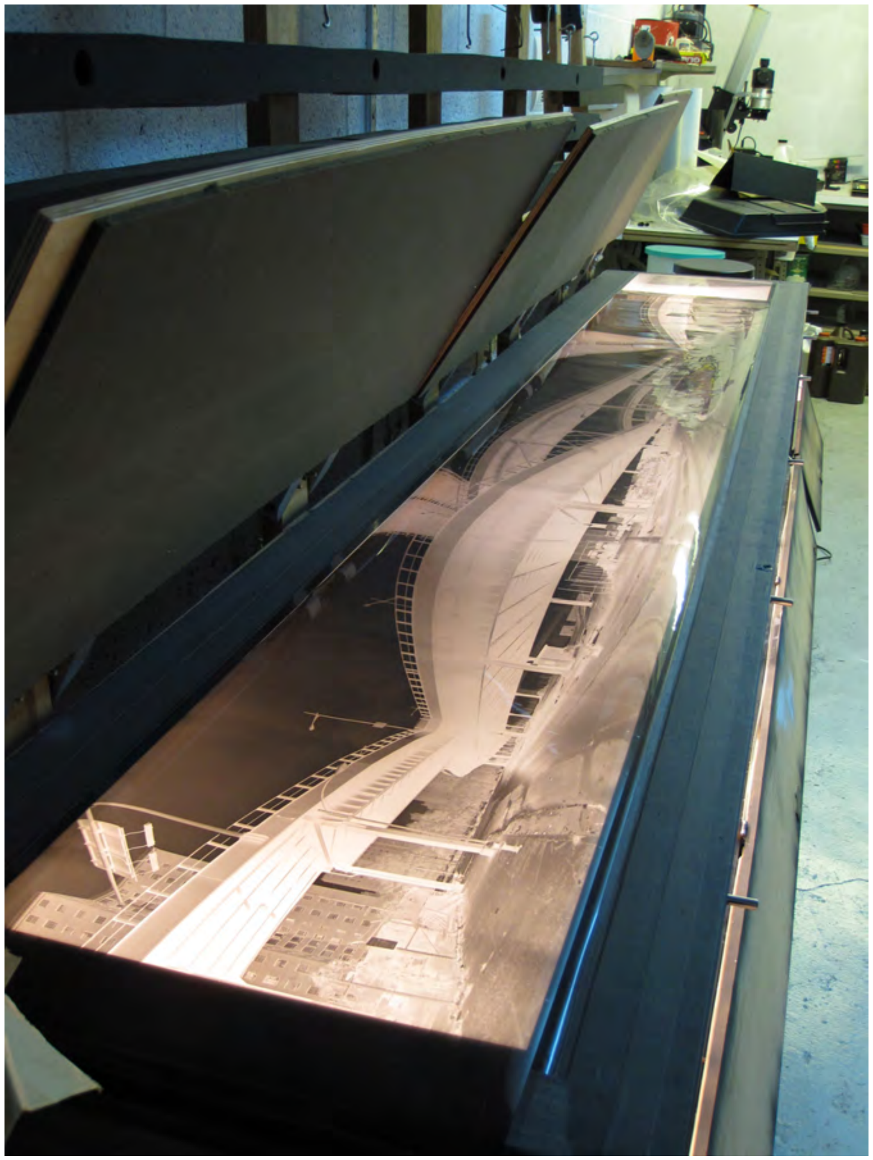
My New York panoramas are really about my love of the city, an affair that goes back sixty years when I first moved to Manhattan in 1950. Seeing New York as it was 30 or so years ago in these pictures -- Times Square in 1979, Wall Street in 1980 or Chambers and Greenwich Streets -- it's clear that great changes have happened to the face of the city. My aim wasn't especially to make historical records, yet all pictures become so as time passes.

Jack Snelson Photo, 1937

My primary interest in each panorama is to discover an unexpected order in reconstructing the location and its geometry, as if to transform an Earth globe into a cartographic projection; a new map of a known landscape. On occasion I've returned to a city somewhere, to a spot where I've once made a picture, only to realize that the scene is hardly recognizable against the panorama I've grown used to looking at. . Does that mean the camera lies as it changes straight architectural lines into arcs? No, the camera is telling the truth, but on its own terms, in its own transformative way. Standard cameras see in one gulp, with a wide-angle lens or with a longer lens that offers a telescope's detail on a picture plane. With a panoramic camera the lens scans in a circle, as one might survey the horizon with binoculars. The film sees just what the lens sees but through a narrow moving slit, much like peering through one's hands held close together. The curving of architectural planes is faithful to the incremental shift in the view as the narrow slit does its scanning.

The history of panoramas and the camera goes back to the early years of the nineteenth century, to the invention of photography. See: Wikipedia Panoramic photography I made these New York cityscapes with my vintage 1917 sixteen inch "Cirkut" camera, one of the mere thirty that were ever made. It is huge, weighs eighty pounds and has a powerful spring motor that drives the rotating mechanism against a large gear on top of the tripod. I built a special modified front for the camera, a box extension that raises the lens to include more sky and higher buildings. The negatives for these images are exactly the size of the prints themselves, in other words the prints you see are contact prints, meaning that in the darkroom process the sensitized unexposed paper is pressed in firm contact with the negative as light shines through it to make the exposure. From the time I found and bought this unusual camera, it was clear I'd need to reinvent or rediscover how to make the system work, since few people still living had ever used or even seen a 16 inch Cirkut camera, big brother to the 10 inch Cirkut and its several lesser relatives. Besides the fact that it needed a set of missing special size brass drive gears for each different lens used and each different distance from the subject, I learned that the film had to be ordered as a special "emulsion-run" from Eastman Kodak (a custom order requiring a greatly excessive number of square feet of the desired film type).

This meant 20 rolls, 16 inches wide by 100 feet long, much more than I knew I would ever use. Also, I would need an emulsion-run of printing paper 100 feet long by 20 inches wide. There were none of the necessary spools to hold film in the camera so I made those from scrap-spools from smaller formats. After a lot of testing in 1979, I was ready to begin taking pictures that summer. As a seasoned New York bicyclist, I saw that the most reasonable way to move about and search for possible locations was to transport my monster eighty-pound Cirkut camera on my bike. I designed a padded plywood rack on the back to tie the camera down plus hook eyes on the bottom and bungee cords to hold the tripod legs. Knowing that the camera's slow, one minute rotation made it impossible to freeze cars moving through the scene I decided



"Contact" printer for 16" Cirkut negatives up to 12' long.

the best time to go looking for locations was at dawn in the summer with the early light, especially on Sunday when there's little traffic. It's why Times Square, 1980 looks barren with shuttered storefronts. And, early morning or not, the busses still can unexpectedly cross the scene and appear in the picture like an unresolved blur of stretched out taffy. In brief, that is the way my large black-and-white Cirkut panoramas were made. Looking back, I can say it was like big game fishing where I rarely came home with a catch to boast about. In this unusual photographic endeavor, my success rate was especially low because of the many steps in which everything has to work perfectly or else that rare apparent lucky moment when the motor begins to rotate the camera ends up with nothing but a failed negative rolled up in the darkroom.

It's clear that this kind of adventure should be taken up only by a somewhat mad person or, as I see myself, one who obsessively enjoys the challenge/gamble of making art where failure hazards sit waiting at each step. In this regard, Cirkut photography is the champion. So many failures to capture one picture that worked out right, a work to be satisfied with. It's also clear that this antique technology with film and chemicals is becoming quickly extinct. It's true as is often said, "If it were easy everybody would be doing it." Well, I now have a panorama app on my cell phone but I can tell you, it's not quite the same.

Kenneth and Cirkut camera on Manhattan's elevated West Side Highway, 1981

Brooklyn Bridge, 1980
New York
gelatin silver print
15 X 91 in
38 x 231 cm

Corner Of Chambers And Greenwich Streets, 1979
New York
gelatin silver print
15.5 x 66.62 in
39.4 x 169 cm

Wall Street, 1980
New York
gelatin silver print
15.5 X 106.25 in
39 x 270 cm

Times Square, 1980
New York
gelatin silver print
15.5 X 110 in
39 x 280 cm

East River Drive With Brooklyn Bridge, 1980
New York
gelatin silver print
15.5 x 112 in
39 x 284.5 cm

Downtown From Westside Highway, 1979
New York
gelatin silver print
15.5 x 56 in
39 x 142.25 cm

Le Louvre, 1984
Paris
Cibachrome print
8.5 x 48 in
20.4 x 115.2 cm

Rue des Prêtres, 1985
Saint-Severin, Paris
Cibachrome print
8.5 x 39 in
20.4 x 93.6 cm

Ponte Duodo O Barbarigo 1989
Venice
Cibachrome print
8.5 x 35.5 in
20.4 x 85.2 cm

Rio de S. Barnaba, 1989
Venice
Cibachrome print
8.5 x 36.5 in
20.4 x 87.6 cm

Campo Pescaria, 1989
Venice
Cibachrome print
8.5 x 36.4 in
20.4 x 87.3 cm

Ponte De la Malvasia Vechia, 1989
Venice
Cibachrome print
8.5 x 38.25 in
20.4 x 97.15 cm

Mohonk In Fog, 1980
New Paltz, New York
Cibachrome print
10.5 x 46.5 in
26.5 x 118 cm

Hakusasonso Garden with Pond and Stone Bridge, 1989
Kyoto, Japan
Cibachrome print
8.5 x 35.5 in
20.4 x 85.2 cm

SNELSON: BOUNDARY CROSSER

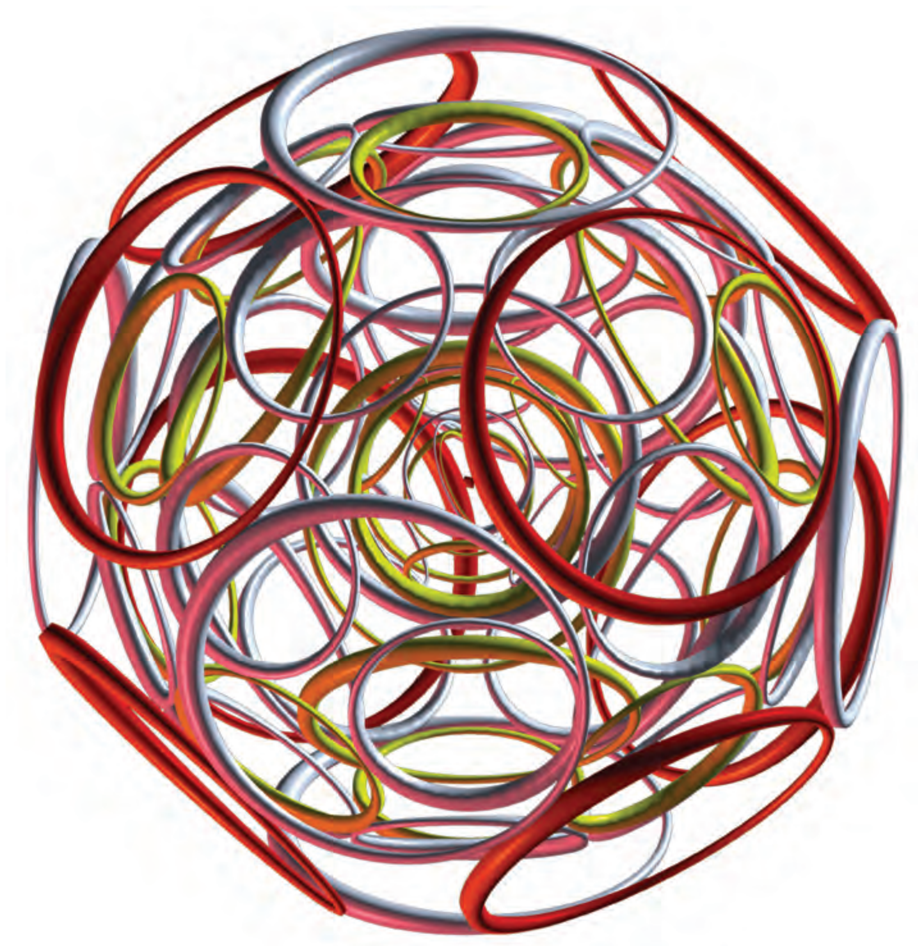
Though he is internationally renowned for his sculptures which have been exhibited, commissioned and purchased by major museums around the world, Snelson tends to be regarded as a maverick who does not fit comfortably within conventional art categories. The art world is often uncomfortable with artists who straddle disciplines and cannot be neatly linked within some established lineage. Thus, while the art establishment has embraced his sculptures and photographs, it has been slower to credit his obsession with the atom which inhabits a strange world where the distinctions between art and science are blurred. This territory makes both scientists and artists uncomfortable because conventional wisdom holds that here is a natural hostility between these two entities. Art is seen as an individual expression, answerable only to the creative imagination, while science is regarded as the pursuit of knowledge following an accepted path of observation, hypothesis and validation. One is singular, the other communal and reproducible. As a result, artists regard scientists with suspicion because they see their approach as overly deterministic. Scientists dismiss art as insufficiently rigorous. When artists and scientists try to bridge this gulf, they often run into surprising opposition. Snelson maintains that such distinctions are specious. And indeed, he finds support in the writings of psychologists and historians of science. Figures like gestalt psychologist Rudolf Arnheim and biologist Jacob Bronowski

Photo by Claudio Cafengiu

Snelson in his studio 2008

have described the parallels between scientific and artistic thinking, both of which involve abstracting from the multiplicity of nature to create a workable reality.

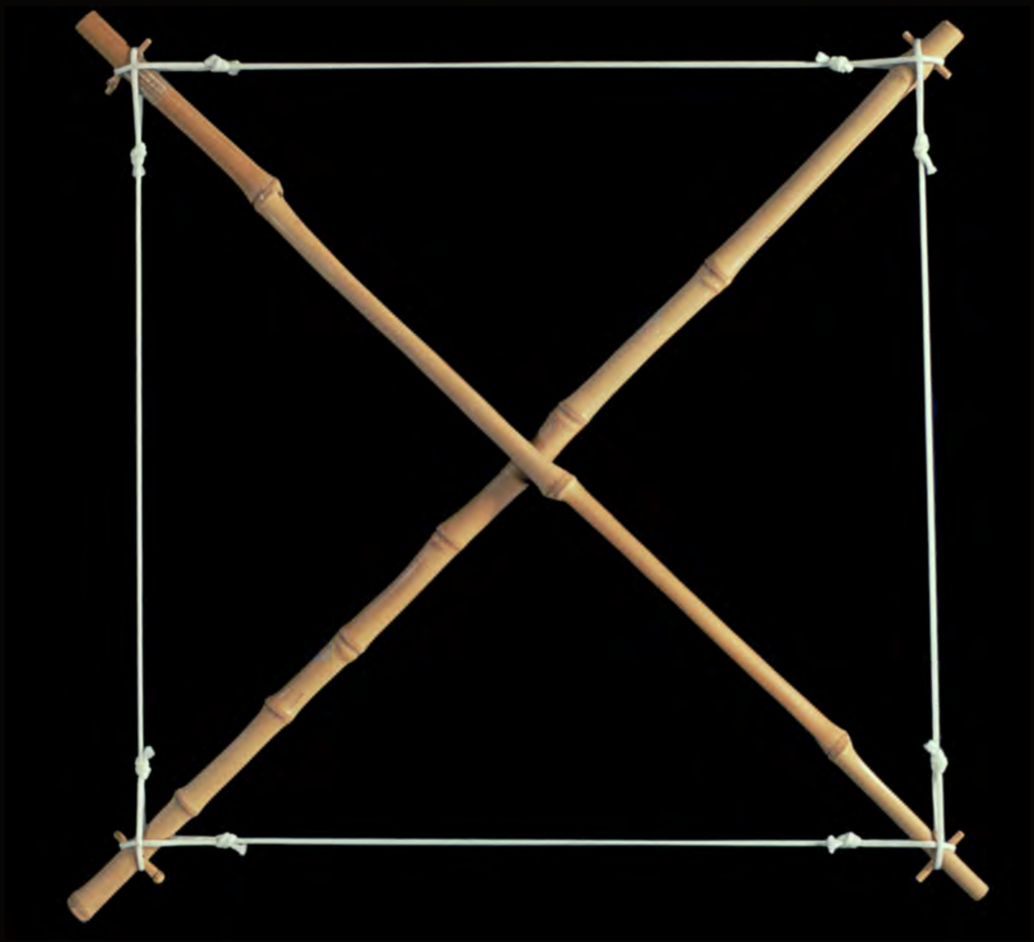
Meanwhile, historians of science have noted that, at the more theoretical reaches of science, scientists sometimes operate more like artists, relying on intuition rather than deductive reasoning. This idea has been most thoroughly theorized by philosopher Thomas Kuhn, whose groundbreaking book, The Structure of Scientific Revolutions (1962), attempts to explain the evolution of scientific thought. Kuhn rejected the conventional idea that science progresses in a rational way, with each new discovery building on and expanding the ideas that preceded it. Instead, he proposed the history of science as a series of ruptures, or paradigms, as he called them, which swept away the assumptions of the previous regimes. The illusion of continuity is created by the apparent recurrence of terms or concepts which are revealed, on closer examination, to have very different and often incompatible meanings from paradigm to paradigm. Paradigms determine what is thinkable, what constitutes a valid scientific question, what one means by a fact. Thus, for instance, the Newtonian idea of gravity as action at a distance was unthinkable in an Aristotelian world where scientific laws were based on movements of matter. Once gravity is understood purely in an instrumental mode, as a reliable mathematical formula, the old questions become simply irrelevant. Kuhn's thesis remains controversial in the scientific world, where his critics point to the remarkable breakthroughs in all fields of scientific knowledge as refutation of his notion that progress occurs only within paradigms and not between them.



But practitioners of disciplines outside science have been much taken with his ideas, which introduce the notion of intuition into knowledge by suggesting that revolutions in thinking occur not as a result of a careful accumulation of evidence, but through mysterious, creative leaps that suddenly restructure the whole edifice of a discipline. Kuhn suggests that it is the young, whose pictures of the world have not solidified, who are most capable of these leaps, or paradigm shifts. This idea gains credence from Snelson's own trajectory. His two great discoveries, tensegrity and the bonding properties underlying his atomic model, were both products of his early career, and like Kuhn's scientists, he has spent the rest of his life working out their implications.

Eleanor Heartney

BAMBOO KITE-FRAME SCULPTURES



IBIZA, BALEARIC ISLANDS, SUMMER OF 1971

Snelson and Carl Van der Voort

1971 July, Ibiza: Snelson with his month's collection of bamboo sculptures

Ibiza, July,1971, Katherine and I were on vacation. A friend and owner of the Carl Van Der Voort Gallery confided that he was stuck for his August show. The painter Conrad Marca-Relli who was scheduled had cancelled on short notice. Carl asked if I could somehow come to his rescue with a few small sculptures or maquettes. The opening would be only a month away.

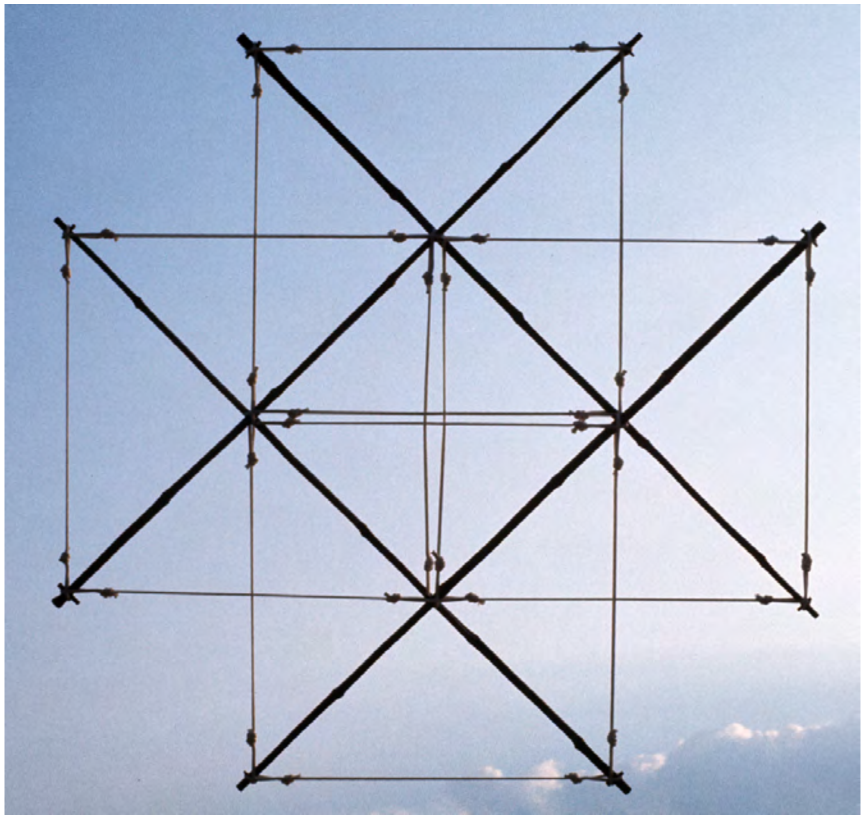
A fun-sounding opportunity; a casual show at a most free and easy summer vacation place. The gallery was quite small -- in fact a transformed stone cave. The challenge was that I had no studio except for the patio of the house Katherine and I were renting; no workshop, no tools, no materials. Searching for an idea to somehow produce enough pieces in a month I looked into all the Island's shops for a reasonable material to work with. Metal was out of the question.

One readily available material in a fishing village is bamboo, raw, skinny poles of all types, sizes and colors. I immediately fell in love with bamboo, amazingly light, strong and beautifully textured. I bought rolls of nylon rope for tension lines and worked furiously for the entire month. Using only a small hand-saw, a drill and a knife I constructed more than two dozen kite-form planar figures. (See the next two pages.)

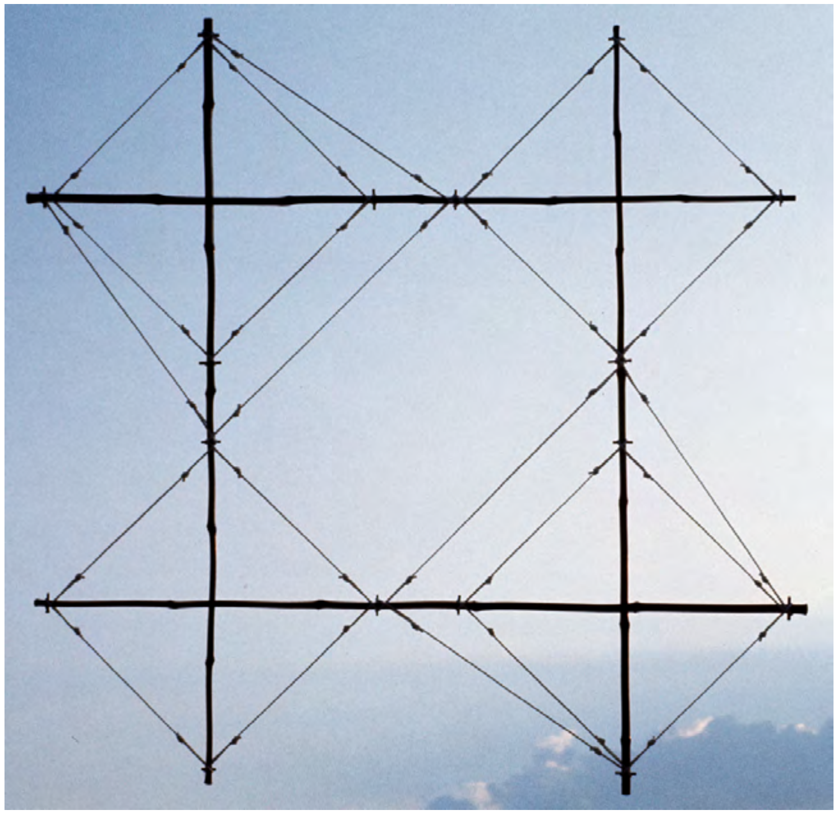
My 1971 summer exhibition consisted of fifteen bamboo and nylon rope sculptures. The local paper gave a glowing review but the most admiring, and most truthful, review was from a ten year old boy as he passed by the open gallery door. Seeing at all the bamboo and rope figures, he said, "Mucho trabajo".

ks

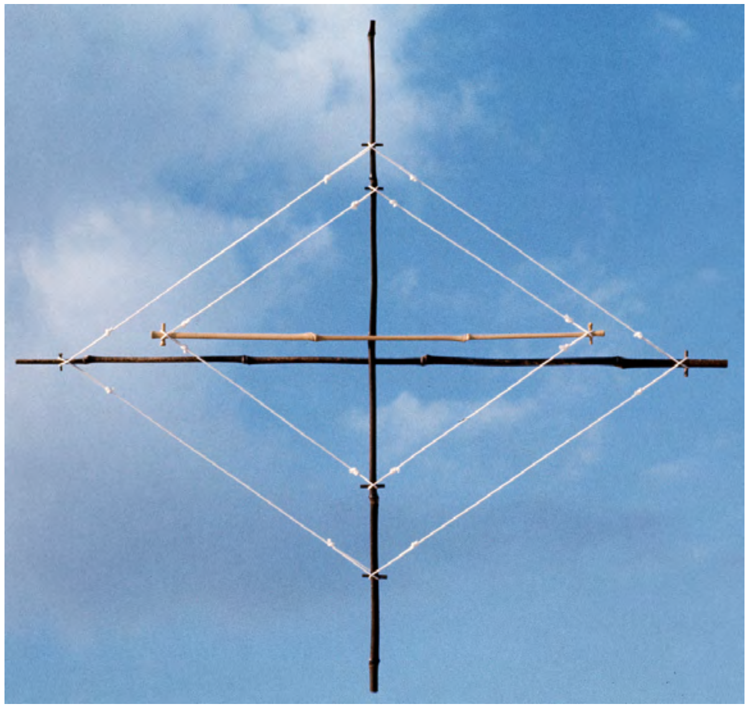
Snelson's bamboo works Galerie Van der Voort, August 1971



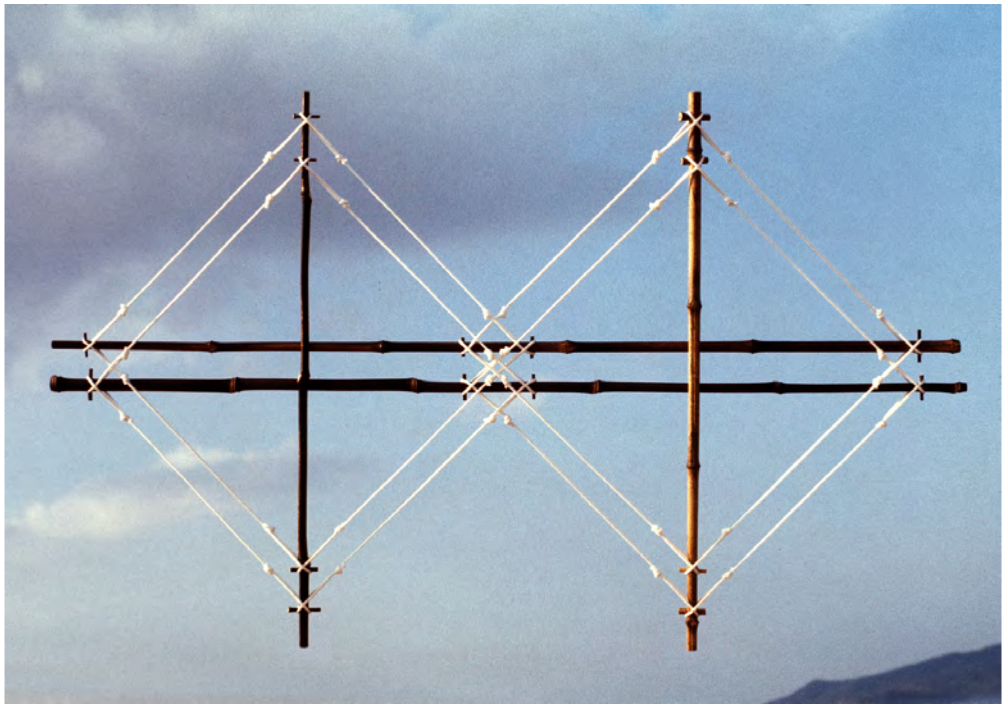
Crossweave Cross, 1971
black bamboo and nylon rope
41 x 41 x 1.5 in
104 x 104 x 4 cm



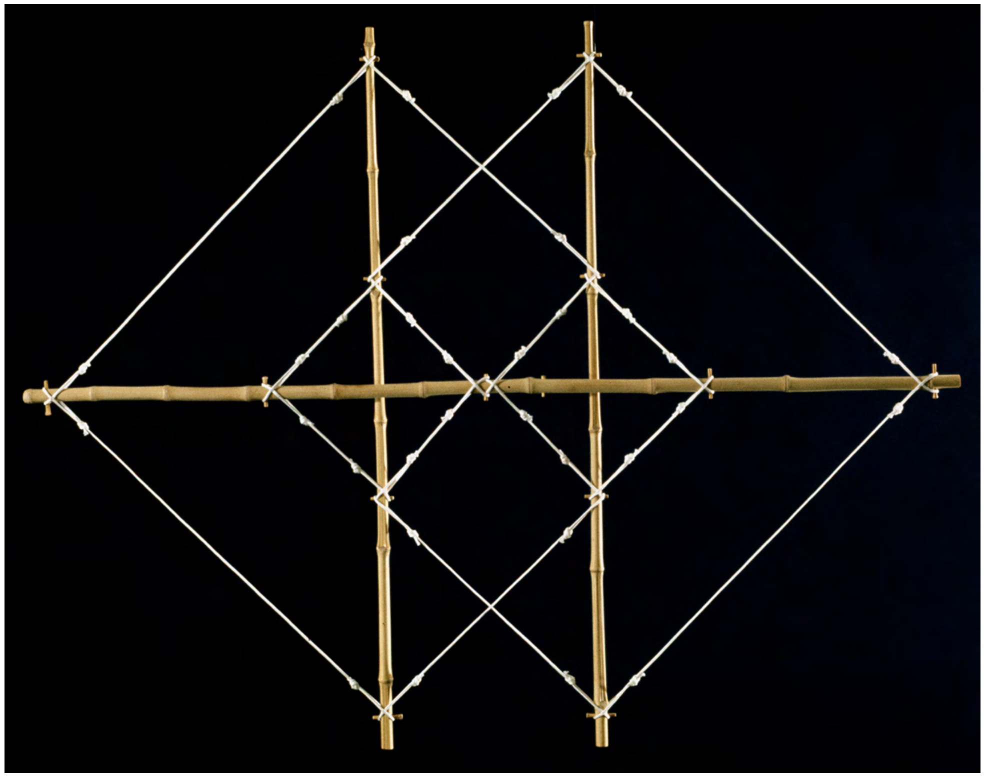
Four Kite Wedged, 1971
bamboo and nylon
40.25 z 40.25 x 1.5 in
102 x 102 x 3.5 cm



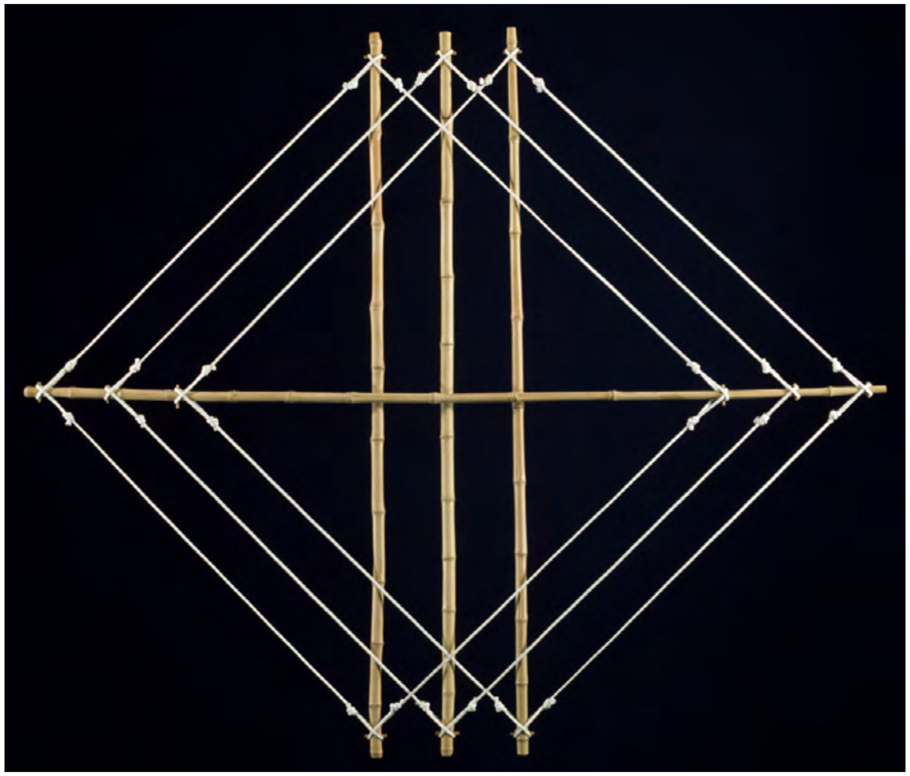
Double Kite, 1971
bamboo and nylon
28 x 29.5 x 1.25 in
71 x 75 x 3 cm



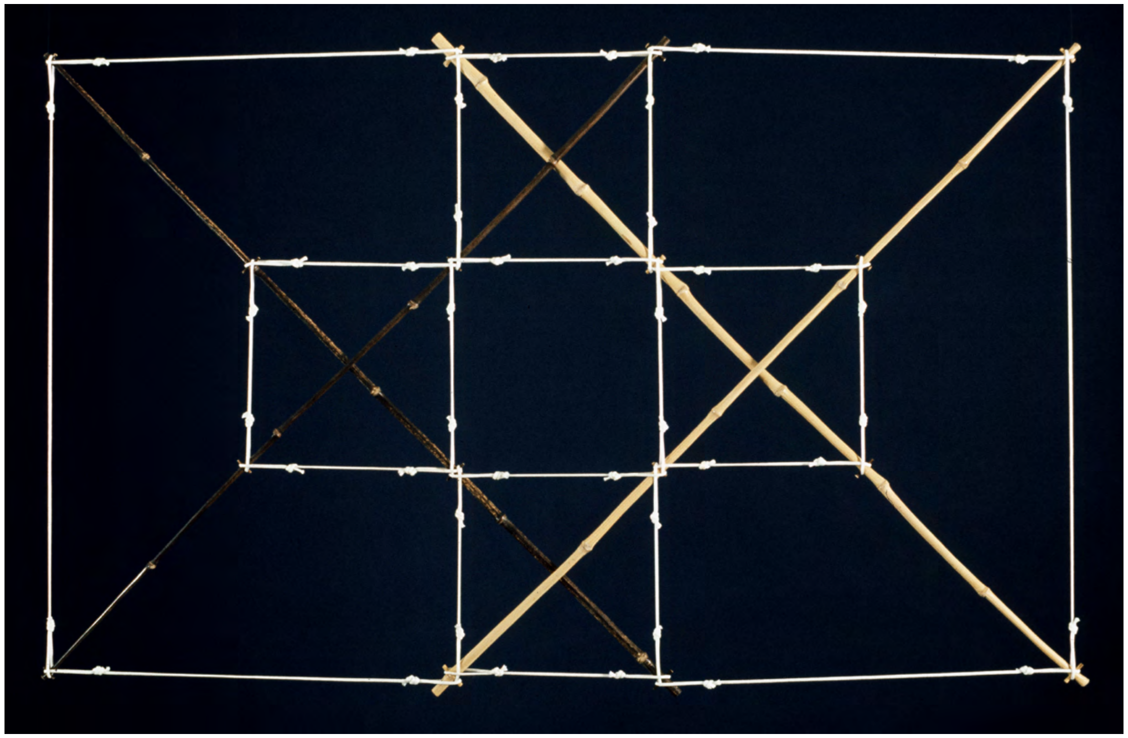
Double Track, 1971
black bamboo and nylon
rope
38 x 24 x 1 in
96.5 x 61 x2.5 cm



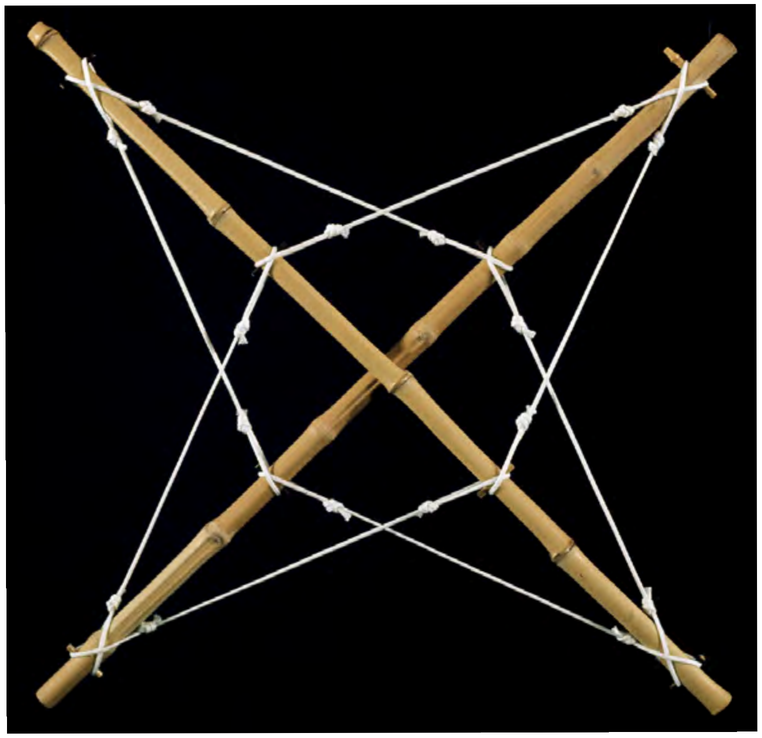
Two by Four 1971
yellow bamboo and nylon
31.23 x 40.5 x 1.5 in
79 x 103 x 4 cm



Tri-X 1971
yellow bamboo and nylon
44.5 x 52.5 x 1.5 in
113 x 133 x 4 cm



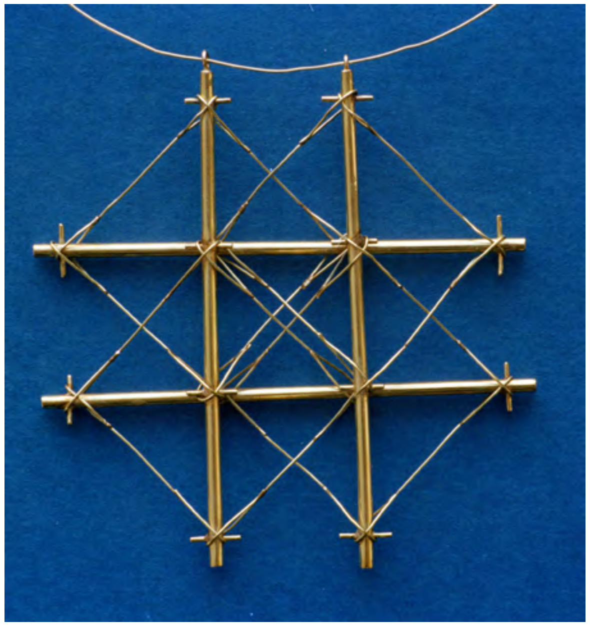
Black and White Frame 1971
brown and yellow bamboo and nylon
26 x 41 x 1in
66 x 104 x 2.5 cm



Crossed Diamonds 1971
yellow bamboo and nylon
17.4 x 17.4 x 1.3 in
44 x 44 x 3 cm

JEWELRY

SNELSON'S JEWELRY WORK; MADE AS GIFTS

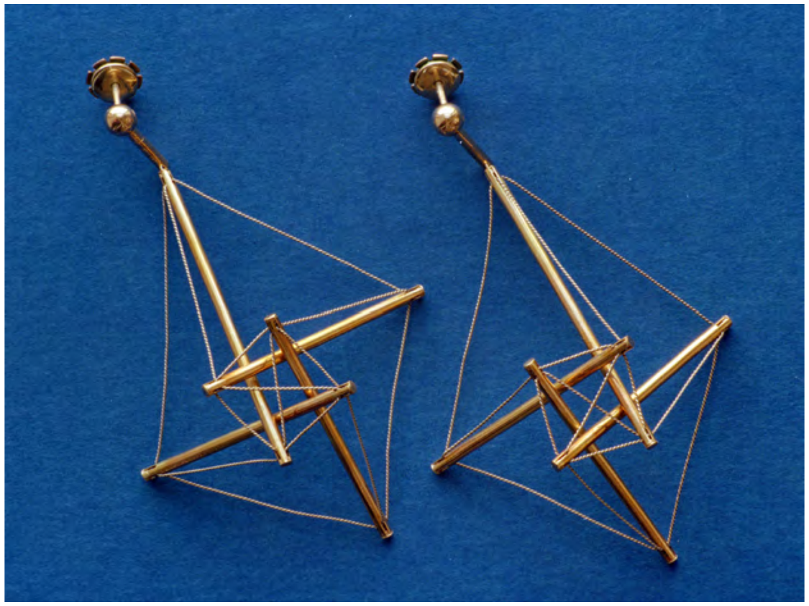


Kite-Square Pendant, 1973
gold
constructed

Roman XXV Earings 1989
gold
constructed

Torus Pendant 1999
gold
lost wax

Atom Pendant 1981
gold
constructed



Earings 1972
gold
Fabrication: Gem Montebello

Boromean Ring Pendant 1977
gold
constructed

Mask Pendant 1994
gold
lost wax casting

Oseibo Pendant 1991
silver casting
oseibo, gift for Contemporary Sculpture Center, Tokyo

Mask Pendant 1994
Silver
lost wax casting

Mask Pendant 1994
Silver
lost wax casting

Fierce Dog Statue 1994
gold
lost wax casting

Mask Pendant 1994
Silver
lost wax casting

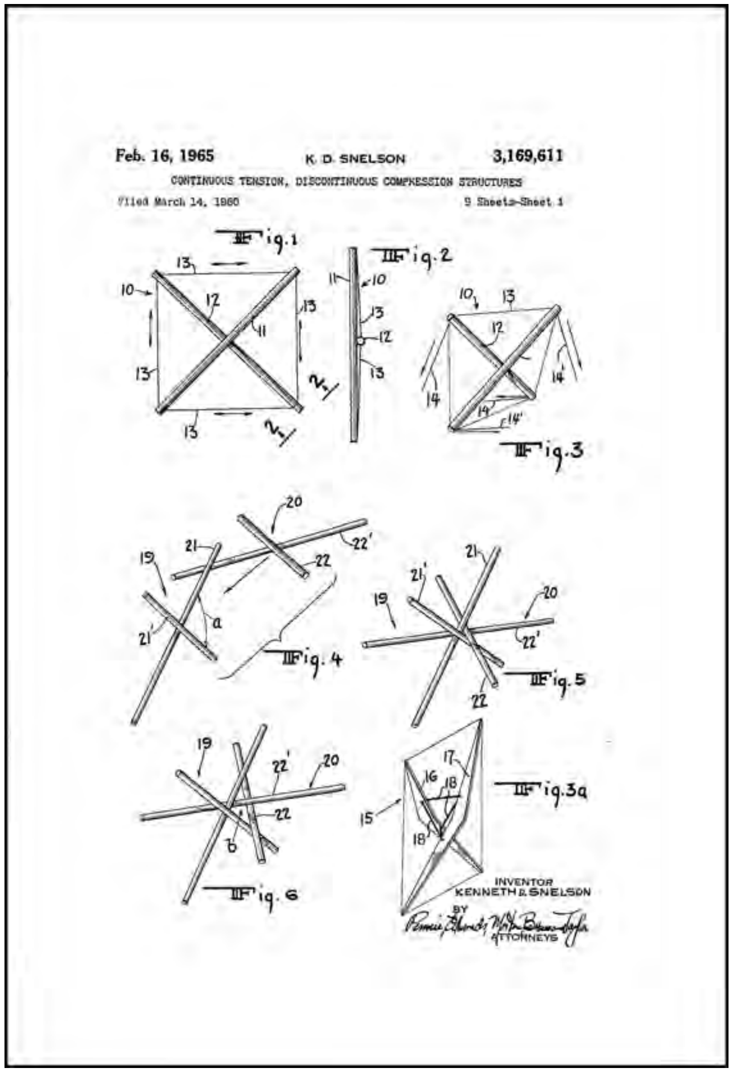
PATENTING AS PUBLICATION

Kenneth Snelson

A U.S. patent allows an inventor seventeen years of protection for his idea; or, as patenting is often called, “an invitation to litigation”. The applicant must describe and illustrate his invention and state his claims. The claims, the patent’s legal teeth, are whittled down by examiners who concede only what is new and different from existing patents or common knowledge familiar to “those skilled in the art”. From the moment the inventor submits his appliction it is available for the public to read.

It became clear to me long ago that the enduring value of patenting and the U.S. Patent Office is for the nation‘s history, to document new ideas and discoveries for future generations.

As an artist, I have found that patenting is a reasonable though expensive way to publish new and interesting ideas. Several times my papers were turned away by journals where I was convinced they should be seen. Architects, Engineers, Scientists and other professionals have access to such journals. Artists have art magazines with unintelligible articles written by art critics. This is the reason I have spent time and money to apply for patents. These papers are, or shortly will be, owned by the public: “public domain”. Copies are free of charge and available on the web for as long as the nation survives. (And one day even my Atom Model will be paid attention to.)



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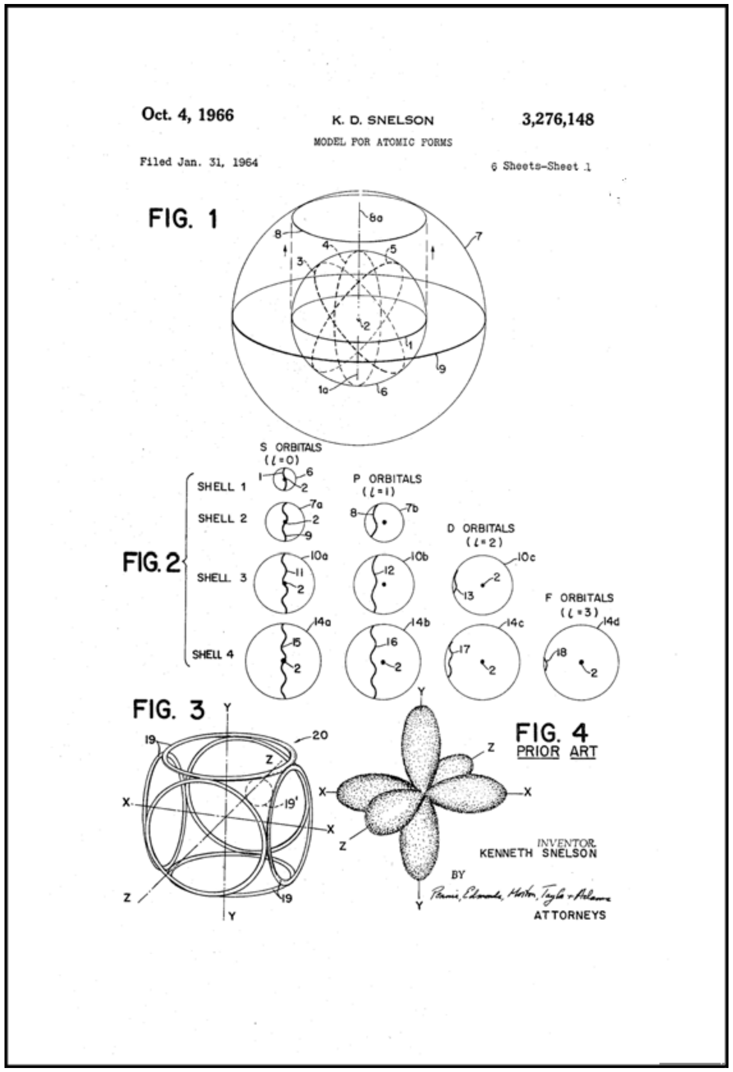

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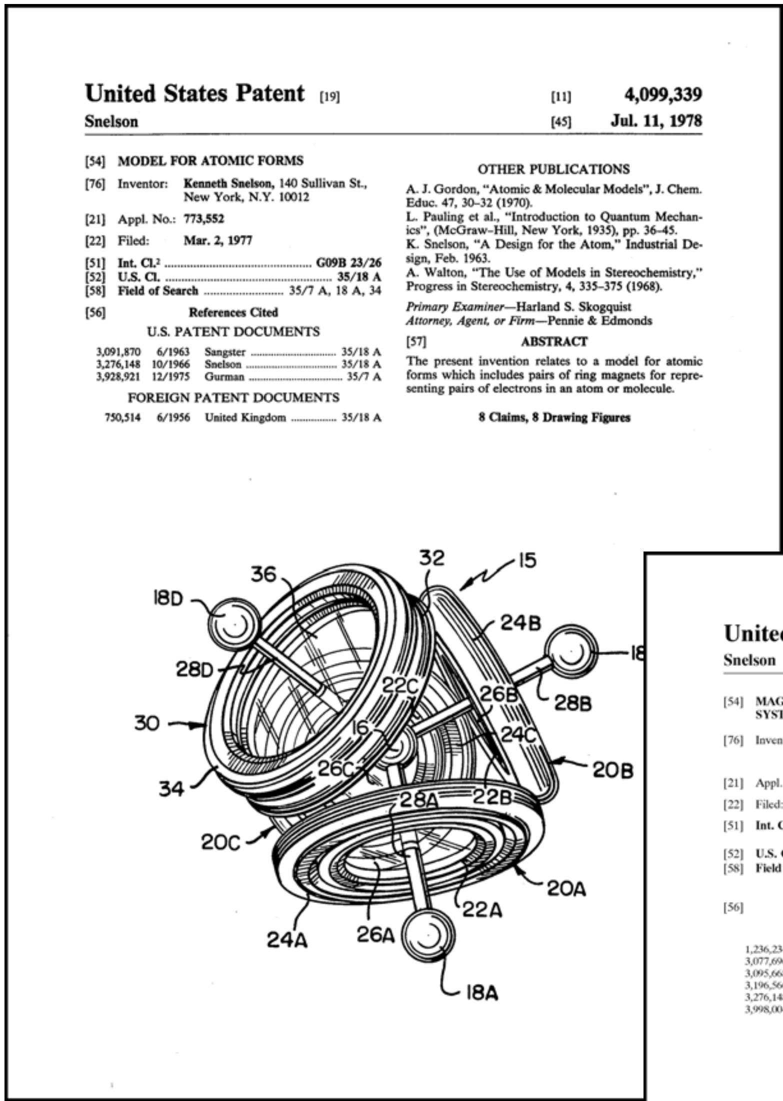

United States Patent [19] [11] **4,099,339**

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.: **773,552**

[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

[56] **References Cited**

U.S. PATENT DOCUMENTS

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3,276,148	10/1966	Snelson	35/18 A
3,928,921	12/1975	Gurman	35/7 A

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750,514	6/1956	United Kingdom	35/18 A

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A. J. Gordon, "Atomic & Molecular Models", J. Chem. Educ. 47, 30–32 (1970).
L. Pauling et al., "Introduction to Quantum Mechanics", (McGraw-Hill, New York, 1935), pp. 36–45.
K. Snelson, "A Design for the Atom," Industrial Design, Feb. 1963.
A. Walton, "The Use of Models in Stereochemistry," Progress in Stereochemistry, 4, 335–375 (1968).

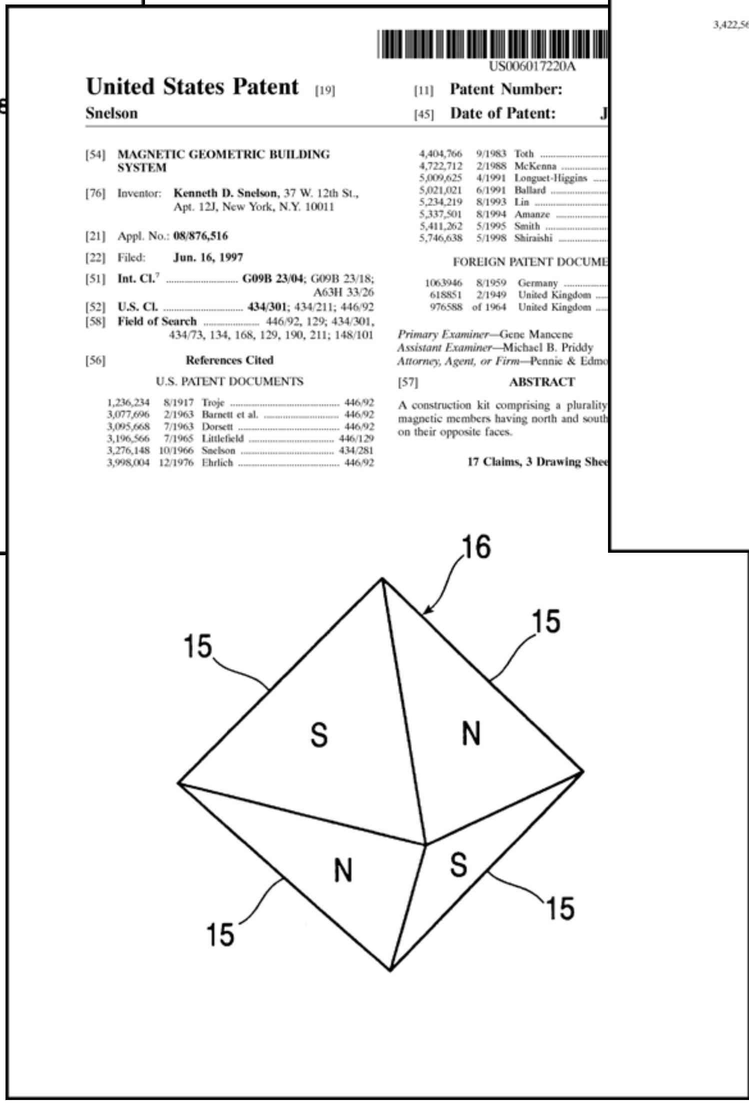
Primary Examiner—Harland S. Skogquist
Attorney, Agent, or Firm—Pennie & Edmonds

[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

Snelson, K 1978, Model For Atomic Forms
US Patent 4099339



US006017220A

United States Patent [19] [11] **Patent Number:**

Snelson [45] **Date of Patent:** J

[54] **MAGNETIC GEOMETRIC BUILDING SYSTEM**

[76] Inventor: **Kenneth D. Snelson,** 37 W. 12th St., Apt. 12J, New York, N.Y. 10011

[21] Appl. No.: **08/876,516**

[22] Filed: **Jun. 16, 1997**

[51] **Int. Cl.**[7] **G09B 23/04**; G09B 23/18; A63H 33/26
[52] **U.S. Cl.** **434/301**; 434/211; 446/92
[58] **Field of Search** 446/92, 129; 434/301, 434/73, 134, 168, 129, 190, 211; 148/101

[56] **References Cited**

U.S. PATENT DOCUMENTS

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3,077,696	2/1963	Barnett et al.	446/92
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3,196,566	7/1965	Littlefield	446/129
3,276,148	10/1966	Snelson	434/281
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4,404,766	9/1983	Toth	
4,722,712	2/1988	McKenna	
5,009,625	4/1991	Longuet-Higgins	
5,021,021	6/1991	Ballard	
5,234,219	8/1993	Lin	
5,337,501	8/1994	Amanze	
5,411,262	5/1995	Smith	
5,746,638	5/1998	Shiraishi	

FOREIGN PATENT DOCUME

1063946	8/1959	Germany
618851	2/1949	United Kingdom
976588	of 1964	United Kingdom

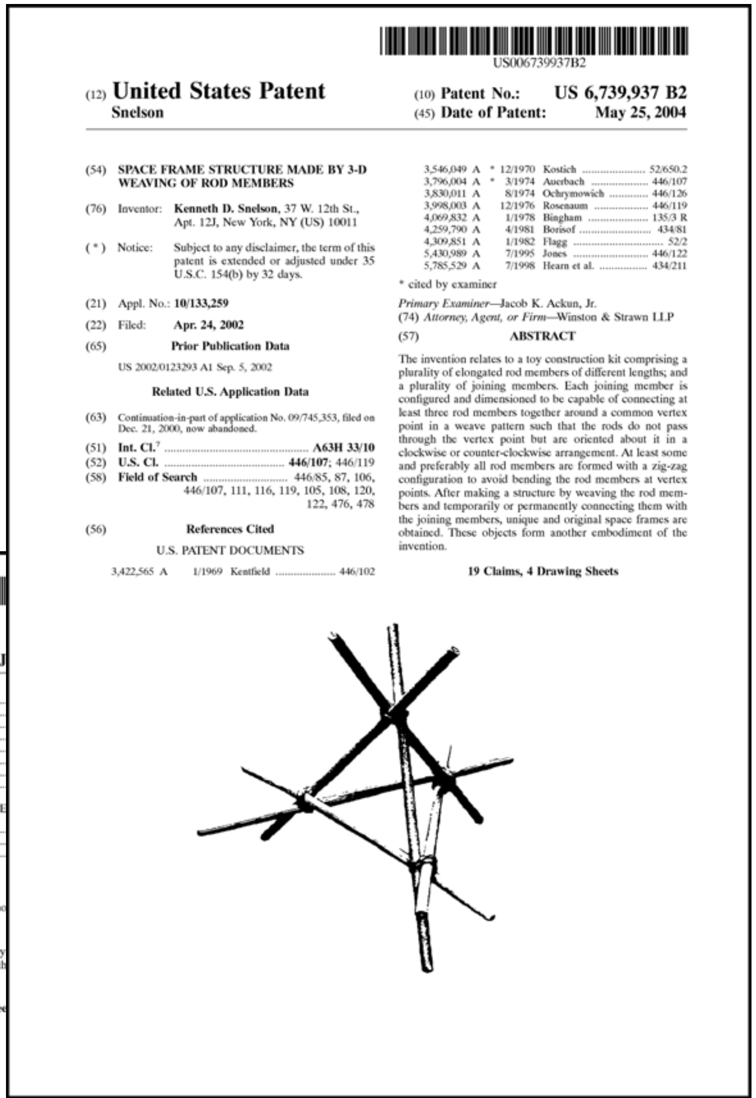
Primary Examiner—Gene Mancene
Assistant Examiner—Michael B. Priddy
Attorney, Agent, or Firm—Pennie & Edmo

[57] **ABSTRACT**

A construction kit comprising a plurality magnetic members having north and south on their opposite faces.

17 Claims, 3 Drawing Shee

Snelson, K 1997, Magnetic Geometric Building System
US Patent 6017220



US006739937B2

(12) **United States Patent** (10) **Patent No.: US 6,739,937 B2**

Snelson (45) **Date of Patent: May 25, 2004**

(54) **SPACE FRAME STRUCTURE MADE BY 3-D WEAVING OF ROD MEMBERS**

(76) Inventor: **Kenneth D. Snelson,** 37 W. 12th St., Apt. 12J, New York, NY (US) 10011

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 32 days.

(21) Appl. No.: **10/133,259**

(22) Filed: **Apr. 24, 2002**

(65) **Prior Publication Data**

US 2002/0123293 A1 Sep. 5, 2002

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/745,353, filed on Dec. 21, 2000, now abandoned.

(51) **Int. Cl.**[7] **A63H 33/10**
(52) **U.S. Cl.** **446/107**; 446/119
(58) **Field of Search** 446/85, 87, 106, 446/107, 111, 116, 119, 105, 108, 120, 122, 476, 478

(56) **References Cited**

U.S. PATENT DOCUMENTS

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4,259,790 A	4/1981	Borisof	434/81
4,309,851 A	1/1982	Flagg	52/2
5,430,989 A	7/1995	Jones	446/122
5,785,529 A	7/1998	Hearn et al.	434/211

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Primary Examiner—Jacob K. Ackun, Jr.
(74) *Attorney, Agent, or Firm*—Winston & Strawn LLP

(57) **ABSTRACT**

The invention relates to a toy construction kit comprising a plurality of elongated rod members of different lengths; and a plurality of joining members. Each joining member is configured and dimensioned to be capable of connecting at least three rod members together around a common vertex point in a weave pattern such that the rods do not pass through the vertex point but are oriented about it in a clockwise or counter-clockwise arrangement. At least some and preferably all rod members are formed with a zig-zag configuration to avoid bending the rod members at vertex points. After making a structure by weaving the rod members and temporarily or permanently connecting them with the joining members, unique and original space frames are obtained. These objects form another embodiment of the invention.

19 Claims, 4 Drawing Sheets

Snelson, K 2004 Space Frame Structure Made By 3-D Weaving of Rod Members
U.S. Patent 6739937

BIOGRAPHY

ARTIST STATEMENT:

My art is concerned with nature in its primary aspect, the patterns of physical forces in three-dimensional space.

BORN:

1927 Pendleton, Oregon, U.S.A.

STUDIES:

University of Oregon
Eugene, Oregon

Black Mountain College
Black Mountain, North Carolina

Chicago Institute of Design
Chicago, Illinois

Fernand Leger
Paris, France

SELECTED ONE MAN SHOWS

2009 Marlborough, Chelsea, New York, NY

2006 Jardin du Palais Royal, Paris, France (with George Rickey)

2003 Laurence Miller Gallery, New York, NY

2003 Marlborough Gallery, New York, NY

1999 Marlborough, Chelsea, New York, NY

1998 Maxwell Davidson Gallery, New York, NY

1995 Contemporary Sculpture Center, Tokyo, Japan

1994 Maxwell Davidson Gallery, New York, NY

1994 Anderson Gallery, Buffalo, New York, NY

1994 Laurence Miller Gallery, New York, NY

1993 Yoh Art Gallery, Osaka, Japan

1992 Contemporary Sculpture Center, Tokyo, Japan

1991 Yoh Art Gallery, Osaka, Japan

1990 National Academy of Sciences, Washington, D.C.

1990 Zabriskie Gallery, New York, NY

1989 New York Academy of Sciences, New York, NY

1986 Zabriskie Galleries (New York, NY and Paris, France)

1984 De Cordova and Dana Museum and Park, Lincoln, MA

1981 Albright-Knox Art Gallery, Buffalo, NY

1981 Hirshhorn Museum and Sculpture Garden, Washington D.C.

1981 Zabriskie Gallery, New York, NY

1977 Nationalgalerie, Berlin, Germany

1977 Wilhelm Lehmbruck Museum, Duisburg, Germany

1971 Kunstverein, Hannover, Germany

1970 Kunsthalle, Dusseldorf, Germany

1969 Rijksmuseum Kröller-Müller, Otterlo, Netherlands

1968 Bryant Park, New York, NY

1966 Dwan Gallery, New York, NY

SELECTED GROUP SHOWS

2002 Marlborough Gallery, New York, NY

1999 Neuberger Biennial Exhibiton of Public Art, Purchase, NY

1999 Stamford Outdoor Sculpture Exhibition, Stamford, CT

1999 Nassau County Sculpture Exhibition, Roslyn Harbor, NY

1995 Japan, U.S. Photography, Takashimaya Gallery, New York, NY

1994 Shoebox Sculpture Exhibition, Honolulu, Hawaii

1991 SIGGRAPH computer art exhibition

1989 Digital Visions, Ohio Wesleyan University

1988, 1989, 1990 SIGGRAPH computer art exihibitions

1988 Computers and Art, IBM Gallery, New York, NY

1987 The Arts at Black Mountain College, Gray Gallery, New York, NY

1983 Big Pictures, The Museum of Modern Art, New York, NY

1983 The Great East River Bridge, The Brooklyn Museum, Brooklyn, NY

1980 Hayward Gallery, London, England

1979 Albright-Knox Art Gallery, Buffalo, NY

1971 Sonsbeek '71, Arnhem, Netherlands

1970 Expo '70, Osaka, Japan

1970 Sammlung Etzold, Kolnischer Kunstverein, Cologne, Germany

1970 Salon International de Galeries Pilotes, Lausanne, Switzerland

1969 Twentieth Century Art from the Rockefeller Collection, Museum of Modern Art, New York, NY

1968 Prospect 1968, Dusseldorf, Germany

1968 Plus by Minus: Today's Half Century, Albright Knox Museum, Buffalo, NY

1967 Sculpture of the Sixties, Los Angeles County Museum

1966 Sculpture Annual, Whitney Museum, New York, NY

PUBLICATIONS

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Wieder, L. (1990) *Full Circle*, (book of panoramic photographs), New York, Aperture Foundation, Inc.

"Quantum Universe" Portion of Smithsonian World television production, 1990

The Nature of Structure, New York Academy of Sciences, 1989

Model for Atomic Forms, July, 1978, U.S. Patent #4,099,339

Snelson, K. (1981) *Portrait of an Atom*, Maryland Science Center, Baltimore

Model for Atomic Forms, October, 1966, U.S. Patent #3,276,148

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“How Primary is Structure”, Art Voices, Summer,1966

“Proprietary Protection”*,* Progressive Architecture, June, 1963

“A Design for the Atom”, Industrial Design, February, 1963

HONORS AND AWARDS

2002 The Elizabeth N. Watrous Prize, National Academy of Design, New York, NY

2001 City of Osaka Civic Enviornment Award, Osaka, Japan

1999 Lifetime Achievment Award, International Sculpture Center, U.S.

1999 Biennial Honoree, Neuberger Museum of Art, Purchase, NY

1994 Membership, American Academy of Arts & Letters

1991 American Institute of Architects, Kansas City; Biennial Artist's Award

1989 Award, Prix Ars Electronia, Linz, Austria

1987 American Academy and Institute of Arts and Letters, Art Award

1985 Honorary Doctorate, Arts and Humane Letters Rensselaer Polytechnic Institute, Troy, NY

1981 American Institutes of Architects Medal

1976 DAAD Fellowhship for Berlin Kunstlerprogram

1974-1987 Advisory Board, Public Arts Fund, New York, NY

1974 National Endowment for the Arts and Iowa City SculptureCompetition

1974 Reynolds Metal Sculpture Award

1971 New York State Council on the Arts Sculpture

ARTICLES

"Kenneth Snelson at Marlborough Chelsea" Review Magazine, February, 1999 by Mark Daniel Cohen

Joelle Bentley, "Art/Science, Science/Art," Print magazine, May/June, 1990

Eleanor Heartney, "Designs on the Universe," Contemporanea International Art Magazine, April, 1990

Charles Hagen "Full Circle," Camera Arts, January/February, 1982

Martica Sawin, "Kenneth Snelson: Unbounded Space," Arts Magazine, September, 1981

Richard Whelan "Kenneth Snelson: Straddling the Abyss Between Art and Science," Art News, February, 1981

Howard Fox, "Kenneth Snelson: Portrait of an Atomist," catalogue, Hirshhorn Museum, 1981

"Snelson: tensione e compressione," Carta Bianca, March, 1978

Deborah Perlberg, "Snelson and Structure." Artforum, May, 1977

Emmie Donadio, "Kenneth Snelson," Arts Magazine, February, 1975

Lazlo Glozer, "Structur und Spannung," Catalogue, Kunstverein, Hannover, April, 1971

Stephan Kurtz, "Kenneth Snelson: The Elegant Solution," Art News, October, 1968

John Coplans, "An Interview with Kenneth Snelson," Artforum, March, 1967 News, October, 1968

Gregory Battcock, "Kenneth Snelson, Dialogue between Stress and Tension at Dwan," Arts Magazine, February, 1968

Dore Ashton, "Jeunes talents de la sculpture Americaine" Aujourd'hui (Paris) December, 1966/January, 1967

SELECTED COLLECTIONS

Albright-Knox Art Gallery, Buffalo, NY

The Art Institute of Chicago, Chicago, IL

Birmingham Museum of Art, Birmingham, AL

Australian National Gallery, Canberra, Australia

City of Baltimore, Baltimore, MD

City of Buffalo, Buffalo, NY

City of Hamburg, Germany

City of Hannover, Germany

City of Iowa City, Iowa City, IA

City of San Diego, San Diego, CA

Cleveland Museum of Art, Cleveland, OH

Columbus Museum of Art, Columbus, OH

Dallas Museum of Fine Arts, Dallas, TX

Hirshhorn Museum and Sculpture Garden, Washington, D.C.

Hallmark Cards, Inc, Kansas City, MO

Frederik Meijer Gardens and Sculpture Park, Grand Rapids, MI

The Hunter Museum of Art, Chattanooga, TN

JT Building, Toranomon, Tokyo, Japan

Japan Iron and Steel Federation, Kobe, Japan

Metropolitan Museum of Art, New York, NY

The Milwaukee Art Institute, Milwaukee, WI

Musée de Grenoble, Grenoble, France

Museum of Art, Carnegie Institute, Pittsburgh, PA

Museum of Modern Art, New York, NY

New Jersey State Museum, Trenton, NJ

Daibiru Building, Osaka, Japan

Osaka Prefecture University, Osaka, Japan

Portland Art Museum, Portland, OR

The Art Museum, Princeton, NJ

Rijksmuseum Kröller-Müller, Otterlo, Netherlands

Rijksmuseum, Staedelijk, Amsterdam, Netherlands

Shiga Museum of Modern Art, Shiga, Japan

J.B. Speed Art Museum, Louisville, KY

Stanford University, Palo Alto, CA

Storm King Art Center, Mountainville, NY

University of Michigan, Ann Arbor, MI

Wakayama Museum of Art, Wakayama, Japan

Walker Art Center, Minneapolis, MN

Whitney Museum of American Art, NY

Wilhelm Lehmbruck Museum, Duisburg, Germany

Knoxville Museum of Art, Knoxille, TN

Kenneth Snelson; Art and Ideas

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