Richard Buckminster Fuller

Born 1895. Designer.
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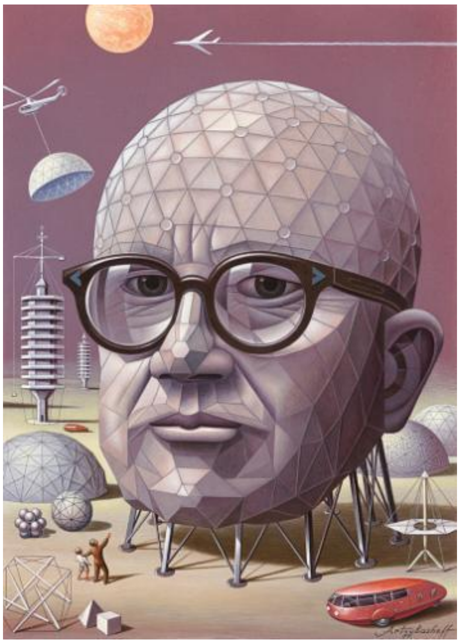

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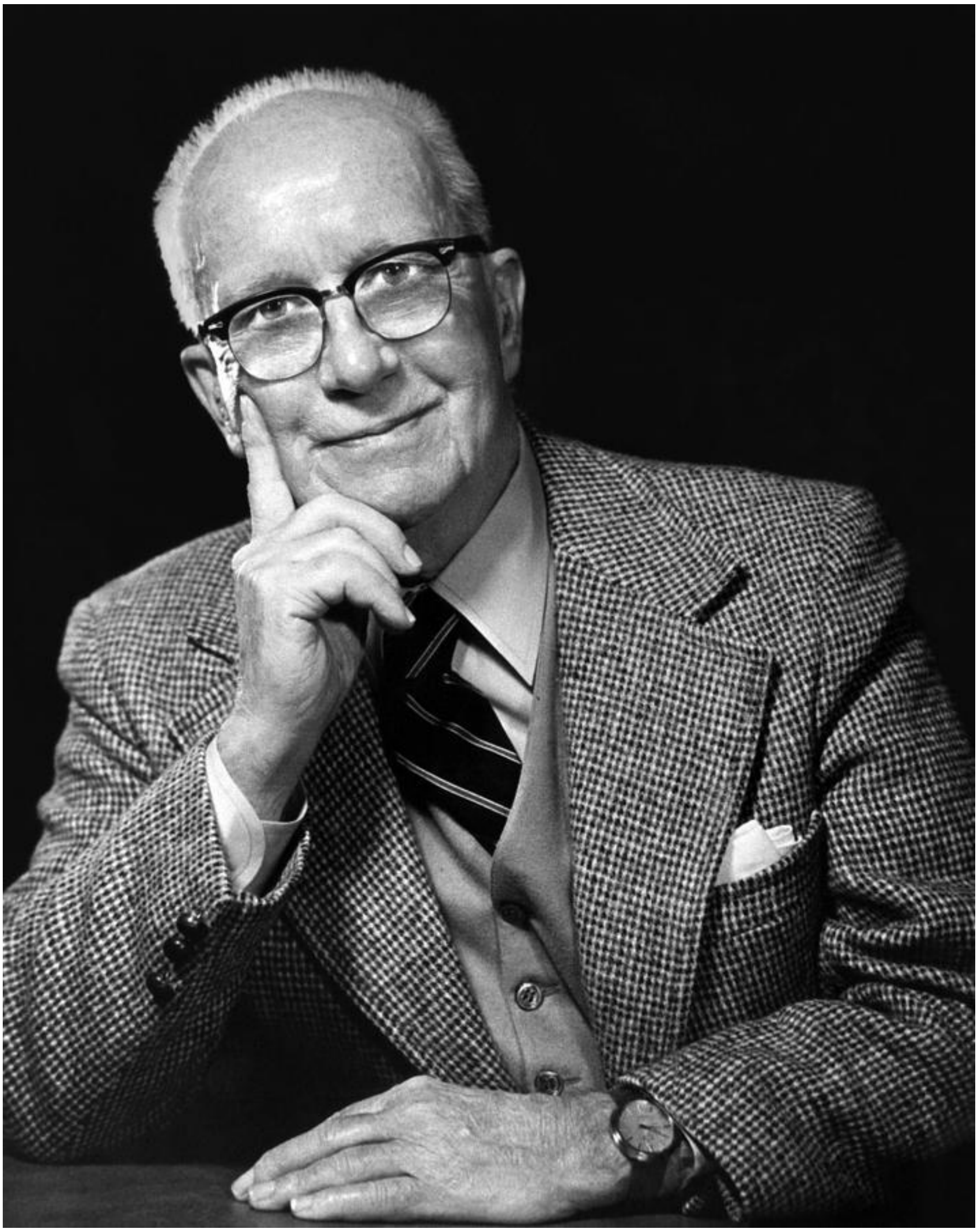
The portrait of Richard Buckminster Fuller above was painted by Boris Artzybasheff for Time magazine, and was donated to the National Portrait Gallery of the Smithsonian Institution.

1. Introduction



The following chapters 1 to 10 were archived in 2021, with acknowledgement and thanks, from Wikipedia. Additional images and sub-headings have been added.

Richard Buckminster Fuller (July 12, 1895 – July 1, 1983) was an American architect, systems theorist, author, designer, inventor, and futurist. He styled his name as R. Buckminster Fuller in his writings, publishing more than 30 books and coining or popularizing such terms as "Spaceship Earth", "Dymaxion" (e.g., Dymaxion house, Dymaxion car, Dymaxion map), "ephemeralization", "synergetics", and "tensegrity".

Fuller developed numerous inventions, mainly architectural designs, and popularized the widely known geodesic dome; carbon molecules known as fullerenes were later named by scientists for their structural and mathematical resemblance to geodesic spheres. He also served as the second World President of Mensa International from 1974 to 1983.

2. Early Life and Work

Buckminster Fuller at the age of about 15.

Fuller was born on July 12, 1895, in Milton, Massachusetts, the son of Richard Buckminster Fuller and Caroline Wolcott Andrews, and grand-nephew of Margaret Fuller, an American journalist, critic, and women's rights advocate associated with the American transcendentalism movement.

The unusual middle name, Buckminster, was an ancestral family name. As a child, Richard Buckminster Fuller tried numerous variations of his name. He used to sign his name differently each year in the guest register of his family summer vacation home at Bear Island, Maine. He finally settled on R. Buckminster Fuller.

Propelling a boat with an umbrella

He often made items from materials he found in the woods, and sometimes made his own tools. He experimented with designing a new apparatus for human propulsion of small boats. By age 12, he had invented a 'push pull' system for propelling a rowboat by use of an inverted umbrella connected to the transom with a simple oar lock which allowed the user to face forward to point the boat toward its destination. Later in life, Fuller took exception to the term "invention".

Years later, he decided that this sort of experience had provided him with not only an interest in design, but also a habit of being familiar with and knowledgeable about the materials that his later projects would require. Fuller earned a machinist's certification, and knew how to use the press brake, stretch press, and other tools and equipment used in the sheet metal trade.

Bear Island lighthouse, off the coast of Maine.

Fuller spent much of his youth on Bear Island, in Penobscot Bay off the coast of Maine. He attended Froebelian Kindergarten. He disagreed with the way geometry was taught in school, being unable to experience for himself that a chalk dot on the blackboard represented an "empty" mathematical point, or that a line could stretch off to infinity. To him these were illogical, and led to his work on synergetics.

Partying with a vaudeville troop

Fuller attended Milton Academy in Massachusetts, and after that began studying at Harvard College, where he was affiliated with Adams House. He was expelled from Harvard twice: first for spending all his money partying with a vaudeville troupe, and then, after having been readmitted, for his "irresponsibility and lack of interest". By his own appraisal, he was a non-conforming misfit in the fraternity environment.

Meat packing and World War I

Between his sessions at Harvard, Fuller worked in Canada as a mechanic in a textile mill, and later as a laborer in the meat-packing industry. He also served in the U.S. Navy in World War I, as a shipboard radio operator, as an editor of a publication, and as commander of the crash rescue boat USS Inca.

USS Inca, SP-1212.

A versatile craft, Inca was first assigned to the First Naval District and patrolled outer Boston Harbor. She also performed coast convoy duties with submarines during this period, and acted as test ship for submarine signaling and detector devices.

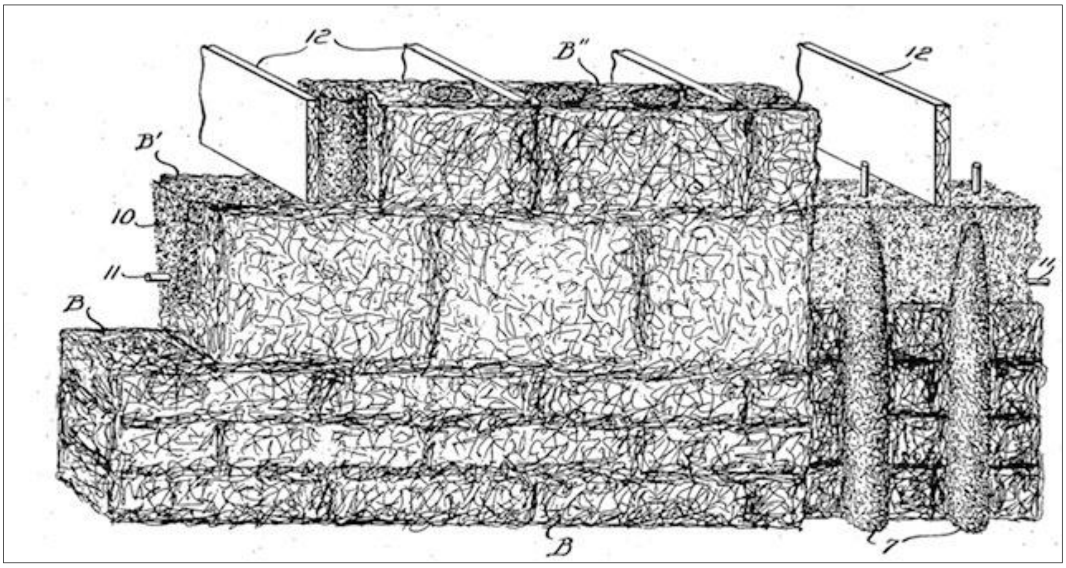
She was reassigned to Fifth Naval District in October 1917 and arrived Hampton Roads, Virginia, 3 November. Inca's job was to serve as rescue ship for aircraft from the Naval Air Station on flights over the Chesapeake Bay and Potomac River.

She also served as a seaplane tender during 1918, and spent time on harbor patrol in Hampton Roads. Inca was assigned 26 July 1918 to the Industrial Department, Hampton Roads, as a dispatch boat, and remained on this duty for the rest of her time in Navy service. Inca lost her name in 1918 and was thereafter called simply USS SP-1212. Inca was returned to her owner on 17 April 1919 after the end of the wartime emergency.

After discharge, he worked again in the meat packing industry, acquiring management experience.

Marriage and fireproof housing

In 1917, he married Anne Hewlett. During the early 1920s, he and his father-in-law developed the Stockade Building System for producing light-weight, weatherproof, and fireproof housing—although the company would ultimately fail in 1927.



The Stockade Building System was designed by Richard Buckminster Fuller and his father-in-law, James Monroe Hewlett, and was patented in 1927. Both of them had previously formed a company, in 1922, which made bricks out of compressed wood shavings with vertical holes cast in them.

The blocks were made up of a fibrous material with large interstices between the fibers. (One suggested fiber was excelsior, which is also known as wood wool.) Despite having large interstices, Fuller and Hewlett designed the blocks so they would not be absorbent. To make the blocks, the fibers were coated with plaster and molded in a form. This is called the Stockade Pneumatic Forming Process.

These blocks were cast with large holes in them so that a weight-bearing structure, such as concrete, could be poured inside them. The block's fibers were designed to be easily sawed so workers could cut holes in them to rest floor joists on the weight-bearing structure. The blocks came in various shapes and sizes. Some had two vertical holes for filling with concrete. Other blocks were much larger, with openings in the side for inserting large beams.

The system was evaluated at a residence in Tarpon Springs Florida in 1926. On October 8, 1926, Fuller and Hewlett filed for a patent for their brick design. After several months, on June 28, 1927, they received US patent #1,633,702 entitled Building System. It was an extension of Fuller's previous patent (US patent #1,604,097) from October 19, 1926.

Depression

Buckminster Fuller recalled 1927 as a pivotal year of his life. His daughter Alexandra had died in 1922 of complications from polio and spinal meningitis just before her fourth birthday. Stanford historian, Barry Katz, found signs that around this time in his life Fuller was suffering from depression and anxiety.

Fuller dwelled on his daughter's death, suspecting that it was connected with the Fullers' damp and drafty living conditions. This provided motivation for Fuller's involvement in Stockade Building Systems, a business which aimed to provide affordable, efficient housing.

In 1927, at age 32, Fuller lost his job as president of Stockade. The Fuller family had no savings, and the birth of their daughter Allegra in 1927 added to the financial challenges. Fuller drank heavily and reflected upon the solution to his family's struggles on long walks around Chicago. During the autumn of 1927, Fuller contemplated suicide by drowning in Lake Michigan, so that his family could benefit from a life insurance payment.

Ephiphany in a white sphere of light

Fuller said that he had experienced a profound incident which would provide direction and purpose for his life. He felt as though he was suspended several feet above the ground enclosed in a white sphere of light. A voice spoke directly to Fuller, and declared:

From now on you need never await temporal attestation to your thought. You think the truth. You do not have the right to eliminate yourself. You do not belong to you. You belong to the Universe. Your significance will remain forever obscure to you, but you may assume that you are fulfilling your role if you apply yourself to converting your experiences to the highest advantage of others.

Fuller stated that this experience led to a profound re-examination of his life. He ultimately chose to embark on "an experiment, to find what a single individual could contribute to changing the world and benefiting all humanity".

Speaking to audiences later in life, Fuller would regularly recount the story of his Lake Michigan experience, and its transformative impact on his life. Historians have been unable to identify direct evidence for this experience within the 1927 papers of Fuller's Chronofile archives, housed at Stanford University. Stanford historian Barry Katz suggests that the suicide story may be a myth which Fuller constructed later in life, to summarize this formative period of his career.

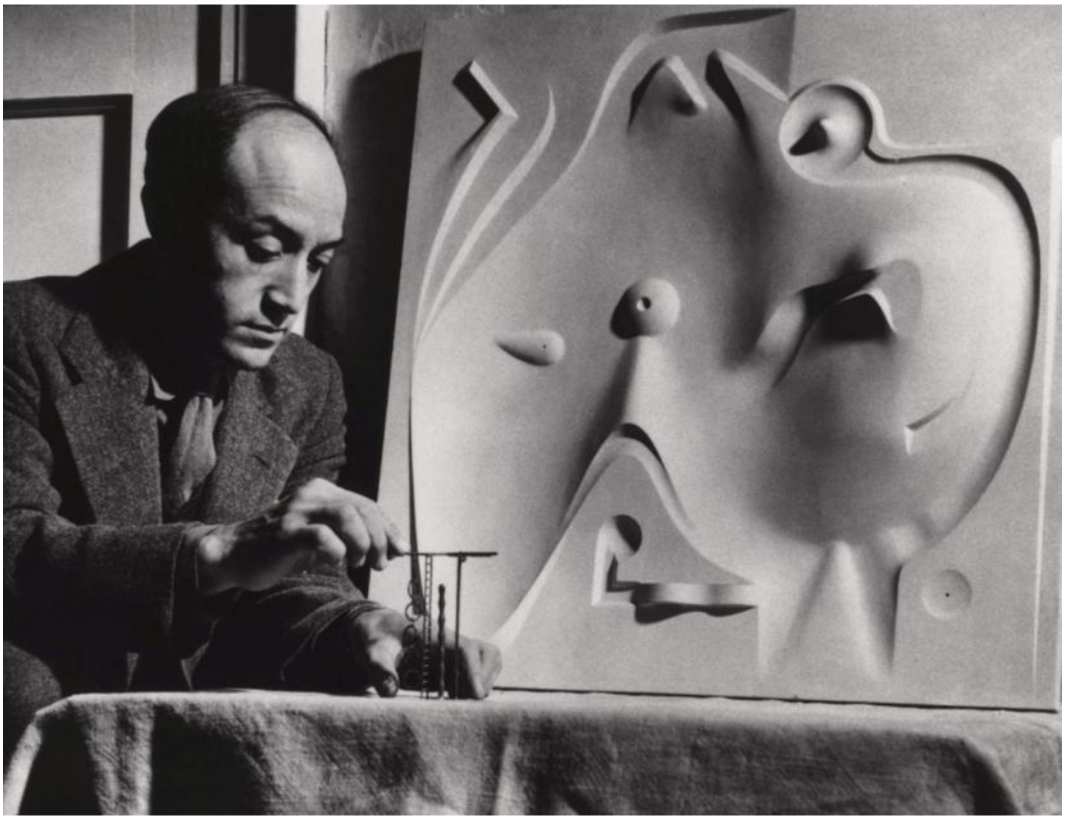
Recovery

If you were a struggling artist in the early 1900s, Romany Marie was your ally. Born in Moldavia, the former anarchist came to Greenwich Village in the early 1900s, when the neighborhood was gathering steam as a hotbed of radical politics and artistic creativity. For the next several decades she ran a series of dimly lit tea rooms and taverns offering gypsy music, cheap eats, and a salon-like vibe where ideas flowed freely. She sometimes fed artists for free when they couldn't afford a meal. John Sloan's famous sketch, "Romany Marye's in Christopher Street, 1922" (above) was drawn at her 20 Christopher Street restaurant.

In 1927 Fuller resolved to think independently which included a commitment to "the search for the principles governing the universe and help advance the evolution of humanity in accordance with them ... finding ways of doing more with less to the end that all people everywhere can have more and more".

By 1928, Fuller was living in Greenwich Village and spending much of his time at the popular café Romany Marie's, where he had spent an evening in conversation with Marie and Eugene O'Neill several years earlier. Fuller accepted a job decorating the interior of the café in exchange for meals, giving informal lectures several times a week, and models of the Dymaxion house were exhibited at the café.

Isamu Noguchi arrived during 1929 — Constantin Brâncuși, an old friend of Marie's, had directed him there — and Noguchi and Fuller were soon collaborating on several projects, including the modeling of the Dymaxion car based on recent work by Aurel Persu. It was the beginning of their lifelong friendship.



Isamu Noguchi in his studio, and (below) his famous coffee table design.

3. Black Mountain College

Elaine de Kooning (center), R. Buckminster Fuller, Ray Johnson, Albert Lanier, and others with the Supine Dome, 1948.

Fuller taught at Black Mountain College in North Carolina during the summers of 1948 and 1949, serving as its Summer Institute director in 1949. Fuller had been shy and withdrawn, but he was persuaded to participate in a theatrical performance of Erik Satie's Le piège de Méduse produced by John Cage, who was also teaching at Black Mountain. During rehearsals, under the tutelage of Arthur Penn, then a student at Black Mountain, Fuller broke through his inhibitions to become confident as a performer and speaker.

Geodesic domes

At Black Mountain, with the support of a group of professors and students, he began reinventing a project that would make him famous: the geodesic dome. Although the geodesic dome had been created, built and awarded a

German patent on June 19, 1925 by Dr. Walther Bauersfeld, Fuller was awarded United States patents. Fuller's patent application made no mention of Bauersfeld's self-supporting dome built some 26 years prior. Although Fuller undoubtedly popularized this type of structure he is mistakenly given credit for its design.

Suspending students from the structure

One of his early models was first constructed in 1945 at Bennington College in Vermont, where he lectured often. Although Bauersfeild's dome could support a full skin of concrete it was not until 1949 that Fuller erected a geodesic dome building that could sustain its own weight with no practical limits. It was 4.3 meters (14 feet) in diameter and constructed of aluminium aircraft tubing and a vinyl-plastic skin, in the form of an icosahedron. To prove his design, Fuller suspended from the structure's framework several students who had helped him build it. The U.S. government recognized the importance of this work, and employed his firm Geodesics, Inc. in Raleigh, North Carolina to make small domes for the Marines. Within a few years, there were thousands of such domes around the world.

Fuller's first "continuous tension – discontinuous compression" geodesic dome (full sphere in this case) was constructed at the University of Oregon Architecture School in 1959 with the help of students. These continuous tension – discontinuous compression structures featured single force compression members (no flexure or bending moments) that did not touch each other and were 'suspended' by the tensional members.

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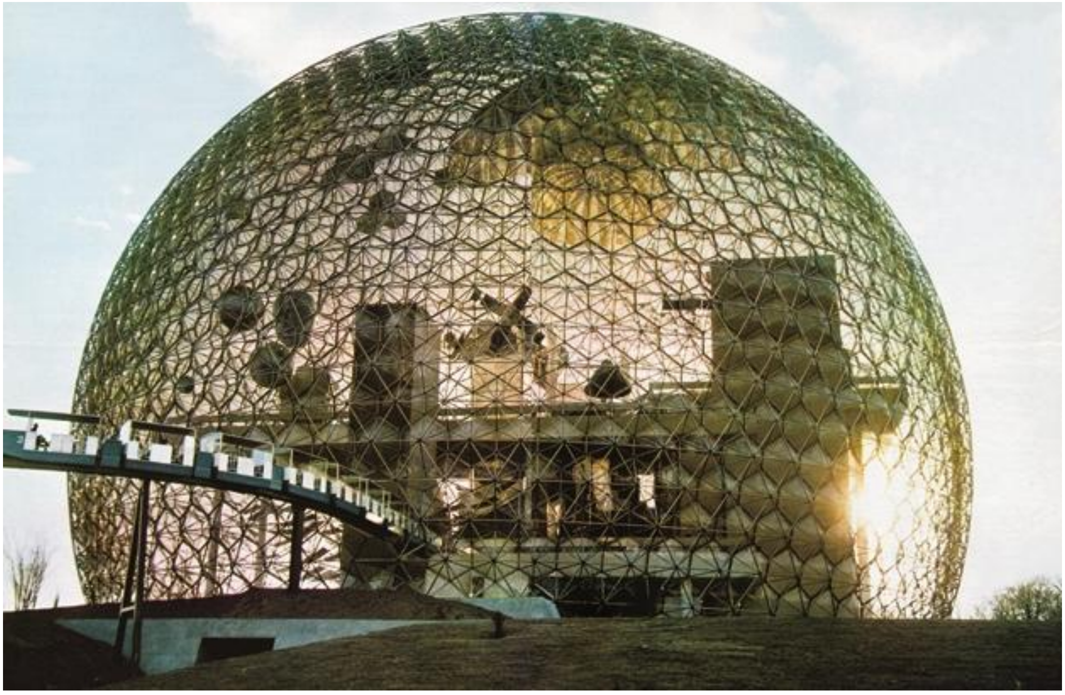
4. International Recognition

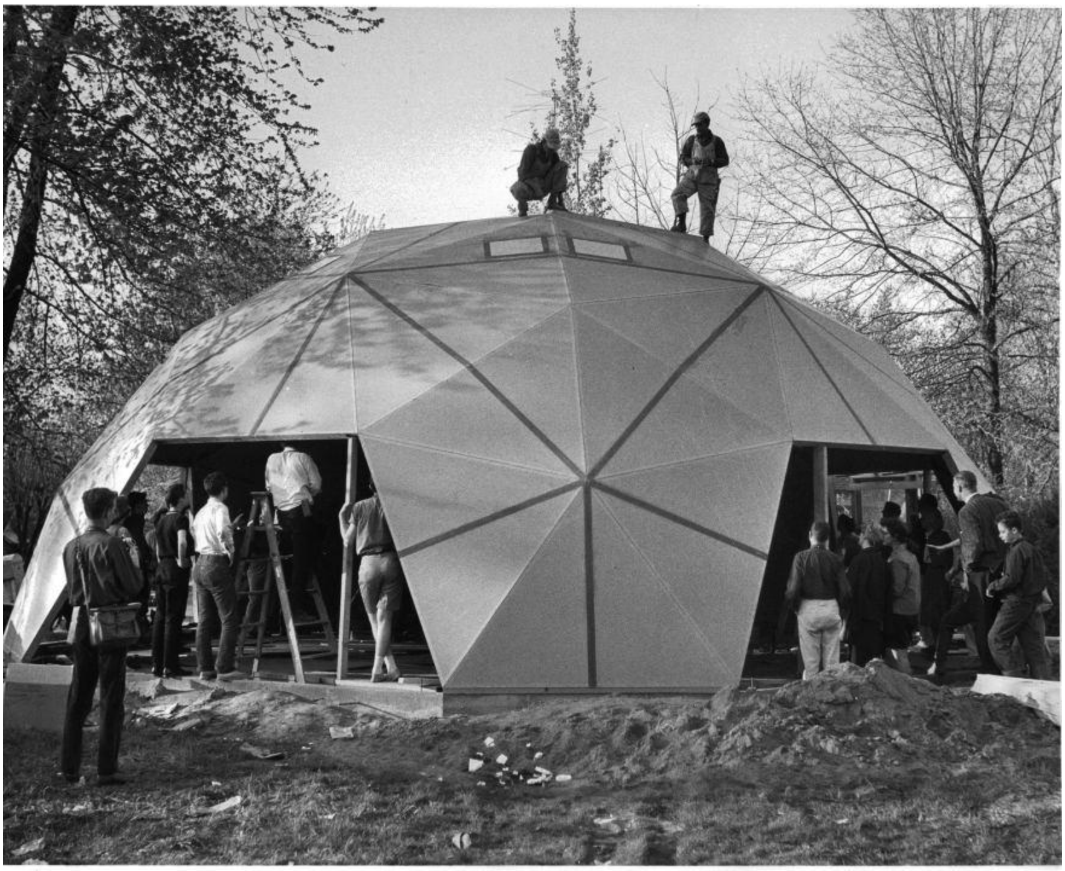
For half of a century, Fuller developed many ideas, designs and inventions, particularly regarding practical, inexpensive shelter and transportation. He documented his life, philosophy and ideas scrupulously by a daily diary (later called the Dymaxion Chronofile), and by twenty-eight publications. Fuller financed some of his experiments with inherited funds, sometimes augmented by funds invested by his collaborators, one example being the Dymaxion car project.

International recognition began with the success of huge geodesic domes during the 1950s. Fuller lectured at North Carolina State University in Raleigh in 1949, where he met James Fitzgibbon, who would become a close friend and colleague. Fitzgibbon was director of Geodesics, Inc. and Synergetics, Inc. the first licensees to design geodesic domes. Thomas C. Howard was lead designer, architect and engineer for both companies. Richard Lewontin, a new faculty member in population genetics at North Carolina State University, provided Fuller with computer calculations for the lengths of the domes' edges.

Fuller began working with architect Shoji Sadao in 1954, and in 1964 they co-founded the architectural firm Fuller & Sadao Inc., whose first project was to design the large geodesic dome for the U.S. Pavilion at Expo 67 in Montreal. This building is now the "Montreal Biosphère" (below). In 1962, the artist and searcher John McHale wrote the first monograph on Fuller, published by George Braziller in New York.



5. Southern Illinois University, Carbondale



Buckminster Fuller's geodesic home at Carbondale, under construction, and below, in the living room with his wife Anne.

Buckminster Fuller in the loft of his dymaxion home, which featured a built-in, curved bookcase.

After employing several Southern Illinois University Carbondale graduate students to rebuild his models following an apartment fire in the summer of 1959, Fuller was recruited by long time friend Harold Cohen to serve as a research professor of "design science exploration" at the institution's School of Art and Design. According to SIU architecture professor Jon Davey, the position was "unlike most faculty appointments [...] more a celebrity role than a teaching job" in which Fuller offered few courses and was only stipulated to spend two months per year on campus. Nevertheless, his time in Carbondale was "extremely productive," and Fuller was promoted to university professor in 1968 and distinguished university professor in 1972.

Working as a designer, scientist, developer, and writer, he continued to lecture for many years around the world. He collaborated at SIU with John McHale. In 1965, they inaugurated the World Design Science Decade (1965 to 1975) at the meeting of the International Union of Architects in Paris, which was, in Fuller's own words, devoted to "applying the principles of science to solving the problems of humanity."

From 1972 until retiring as university professor emeritus in 1975, Fuller held a joint appointment at Southern Illinois University Edwardsville, where he had designed the dome for the campus Religious Center in 1971. During this period, he also held a joint fellowship at a consortium of

Philadelphia-area institutions, including the University of Pennsylvania, Bryn Mawr College, Haverford College, Swarthmore College and the University City Science Center; as a result of this affiliation, the University of Pennsylvania appointed him university professor emeritus in 1975.

Fuller believed human societies would soon rely mainly on renewable sources of energy, such as solar- and wind-derived electricity. He hoped for an age of "omni-successful education and sustenance of all humanity". Fuller referred to himself as "the property of universe" and during one radio interview he gave later in life, declared himself and his work "the property of all humanity". For his lifetime of work, the American Humanist Association named him the 1969 Humanist of the Year.

In 1976, Fuller was a key participant at UN Habitat I, the first UN forum on human settlements.

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6. Major design projects

The Geodesic Dome

Fuller was most famous for his lattice shell structures – geodesic domes, which have been used as parts of military radar stations, civic buildings, environmental protest camps and exhibition attractions. An examination of the geodesic design by Walther Bauersfeld for the Zeiss-Planetarium, built some 28 years prior to Fuller's work, reveals that Fuller's Geodesic Dome patent (U.S. 2,682,235; awarded in 1954) is the same design as Bauersfeld's.

Their construction is based on extending some basic principles to build simple "tensegrity" structures (tetrahedron, octahedron, and the closest packing of spheres), making them lightweight and stable. The geodesic dome was a result of Fuller's exploration of nature's constructing principles to find design solutions. The Fuller Dome is referenced in the Hugo Award-winning novel Stand on Zanzibar by John Brunner, in which a geodesic dome is said to cover the entire island of Manhattan, and it floats on air due to the hot-air balloon effect of the large air-mass under the dome (and perhaps its construction of lightweight materials).

Dymaxion Car

With such a vehicle at our disposal, [Fuller] felt that human travel, like that of birds, would no longer be confined to airports, roads, and other bureaucratic boundaries, and that autonomous free-thinking human beings could live and prosper wherever they chose. —Lloyd S. Sieden, Bucky Fuller's Universe, 2000

To his young daughter Allegra, Fuller described the Dymaxion as a "zoom-mobile, explaining that it could hop off the road at will, fly about, then, as deftly as a bird, settle back into a place in traffic".

They Dymaxion Car.

The Dymaxion car, c.1933, artist Diego Rivera shown entering the car, carrying coat.

The Dymaxion car was a vehicle designed by Fuller, featured prominently at Chicago's 1933-1934 Century of Progress World's Fair. During the Great Depression, Fuller formed the Dymaxion Corporation and built three prototypes with noted naval architect Starling Burgess and a team of 27 workmen — using donated money as well as a family inheritance.

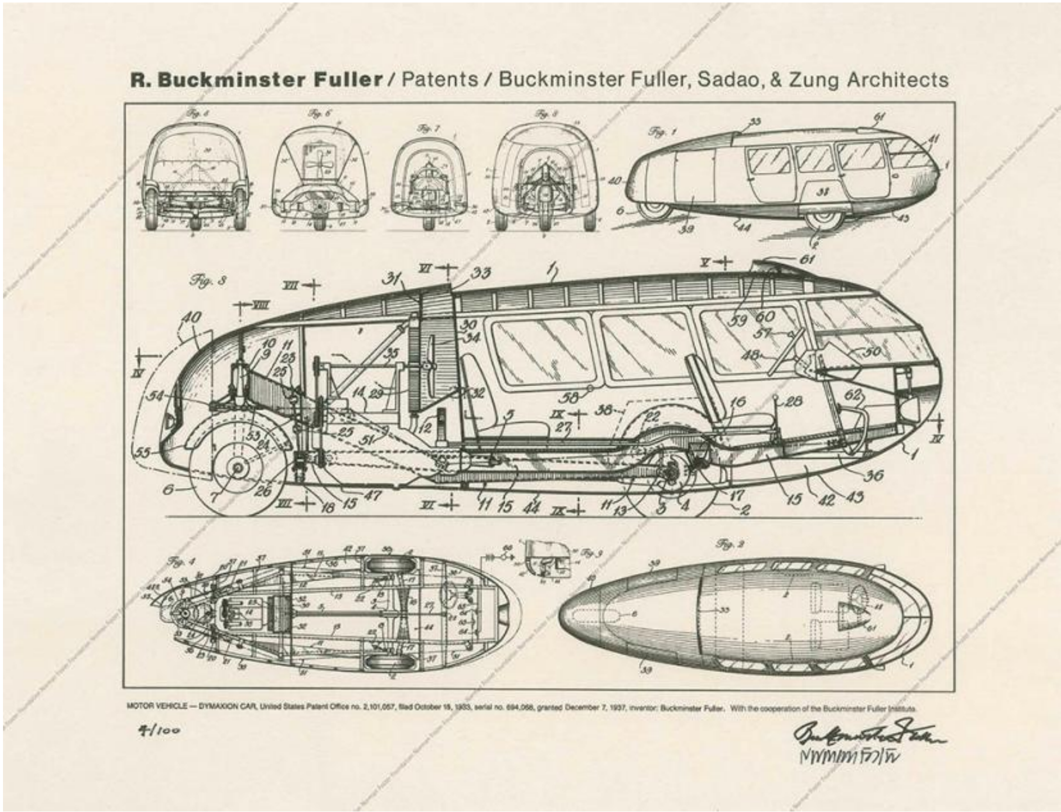
Fuller associated the word Dymaxion, a blend of the words dynamic, maximum, and tension to sum up the goal of his study, "maximum gain of advantage from minimal energy input".

The Dymaxion was not an automobile but rather the 'ground-taxying mode' of a vehicle that might one day be designed to fly, land and drive — an "Omni-Medium Transport" for air, land and water. Fuller focused on the landing and taxiing qualities, and noted severe limitations in its handling. The team made improvements and refinements to the platform, and Fuller noted the Dymaxion "was an invention that could not be made available to the general public without considerable improvements".

The bodywork was aerodynamically designed for increased fuel efficiency and its platform featured a lightweight cromoly-steel hinged chassis, rear-mounted V8 engine, front-drive and three-wheels. The vehicle was steered via the third wheel at the rear, capable of 90° steering lock. Able to steer in a tight circle, the Dymaxion often caused a sensation, bringing nearby traffic to a halt.

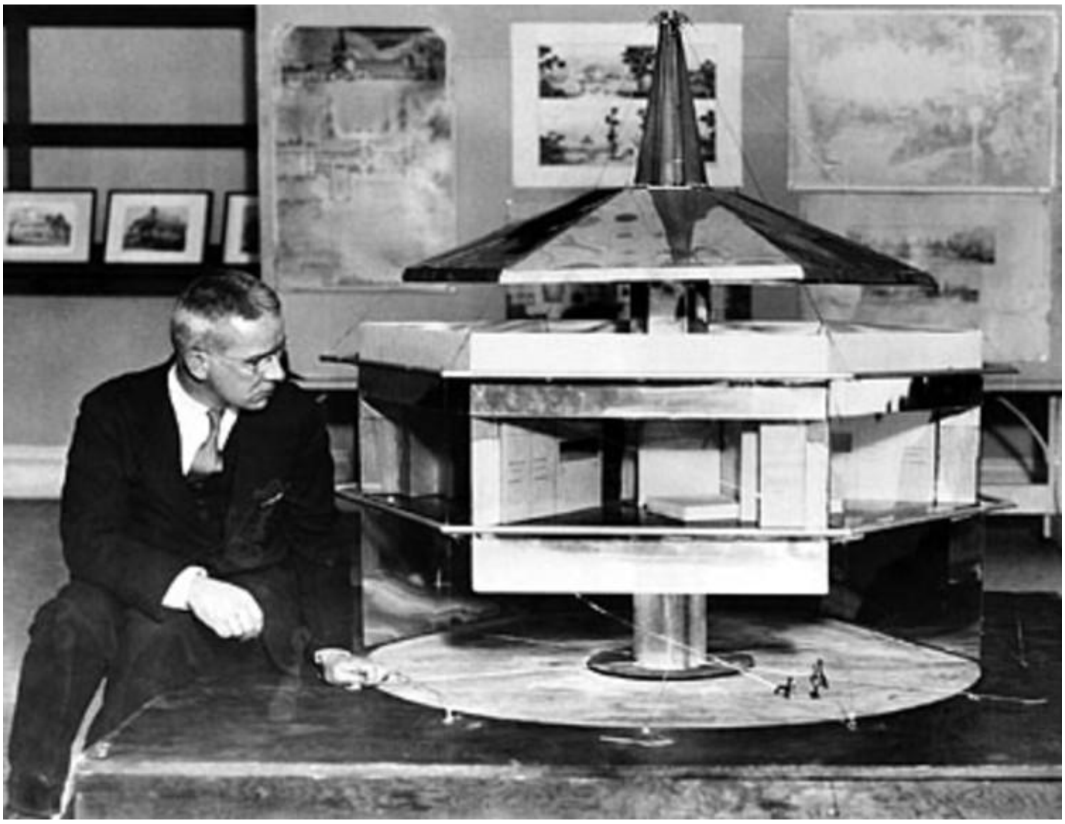
Shortly after launch, a prototype crashed after being hit by another car, killing the Dymaxion's driver. The other car was driven by a local politician and was removed from the accident scene, leaving reporters who arrived subsequently to blame the Dymaxion's unconventional design — though investigations exonerated the prototype. Fuller would himself later crash another prototype with his young daughter aboard.

Despite courting the interest of important figures from the auto industry, Fuller used his family inheritance to finish the second and third prototypes — eventually selling all three, dissolving Dymaxion Corporation and maintaining the Dymaxion was never intended as a commercial venture. One of the three original prototypes survives.



Dymaxion Car patent drawing.

Dymaxion houses.



The first version of the Dymaxion House was hexagonal, and was suspended from a central pillar.

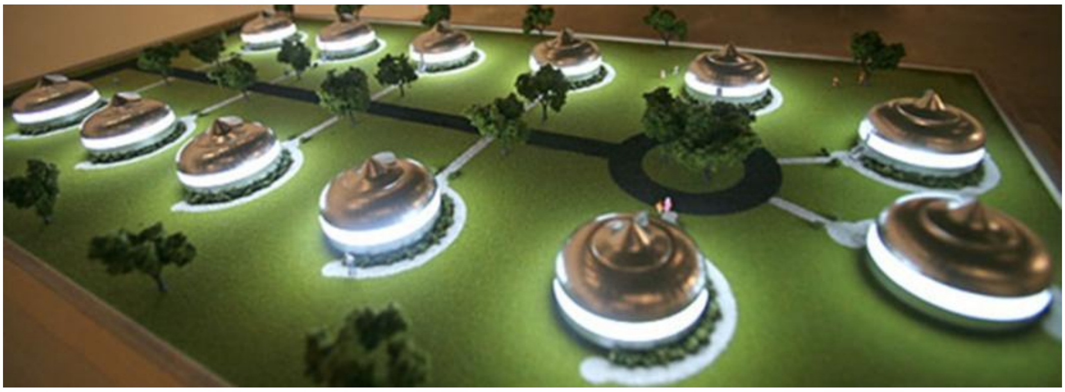
The later Dymaxion House was circular in plan.

Fuller's energy-efficient and inexpensive Dymaxion house garnered much interest, but only two prototypes were ever produced. Here the term

"Dymaxion" is used in effect to signify a "radically strong and light tensegrity structure". One of Fuller's Dymaxion Houses is on display as a permanent exhibit at the Henry Ford Museum in Dearborn, Michigan. Designed and developed during the mid-1940s, this prototype is a round structure (not a dome), shaped something like the flattened "bell" of certain jellyfish. It has several innovative features, including revolving dresser drawers, and a fine-mist shower that reduces water consumption. According to Fuller biographer Steve Crooks, the house was designed to be delivered in two cylindrical packages, with interior color panels available at local dealers. A circular structure at the top of the house was designed to rotate around a central mast to use natural winds for cooling and air circulation. Conceived nearly two decades earlier, and developed in Wichita, Kansas, the house was designed to be lightweight, adapted to windy climates, cheap to produce and easy to assemble.

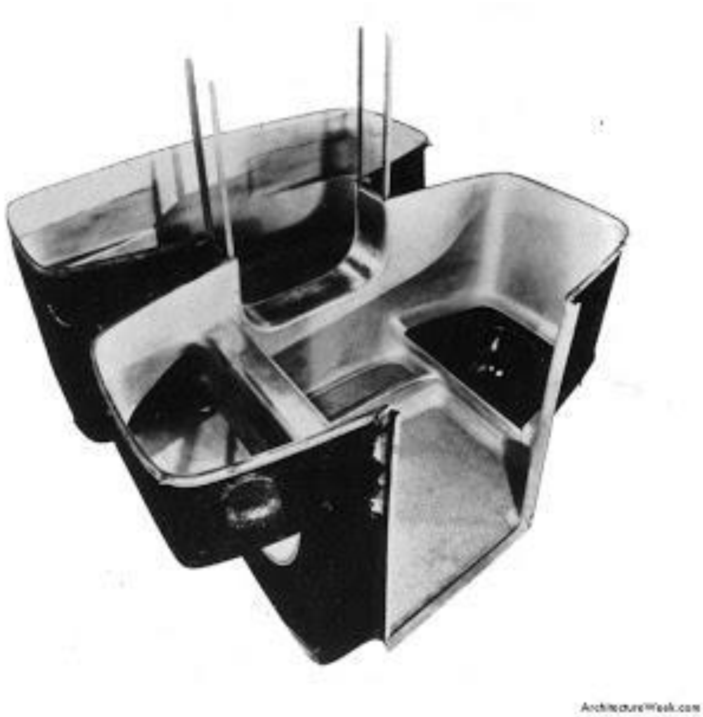
Because of its light weight and portability, the Dymaxion House was intended to be the ideal housing for individuals and families who wanted the option of easy mobility. The design included a "Go-Ahead-With-Life Room" stocked with maps, charts, and helpful tools for travel "through time and space". It was to be produced using factories, workers, and technologies that had produced World War II aircraft. It looked ultramodern at the time, built of metal, and sheathed in polished aluminum. The basic model enclosed 90 m2 (970 sq ft) of floor area. Due to publicity, there were many orders during the early Post-War years, but the company that Fuller and others had formed to produce the houses failed due to management problems.

U.S. pilots stand in front of a cluster of Dymaxion Deployment Units, North Africa, 1944.



An imaginary cluster of Dymaxion houses.

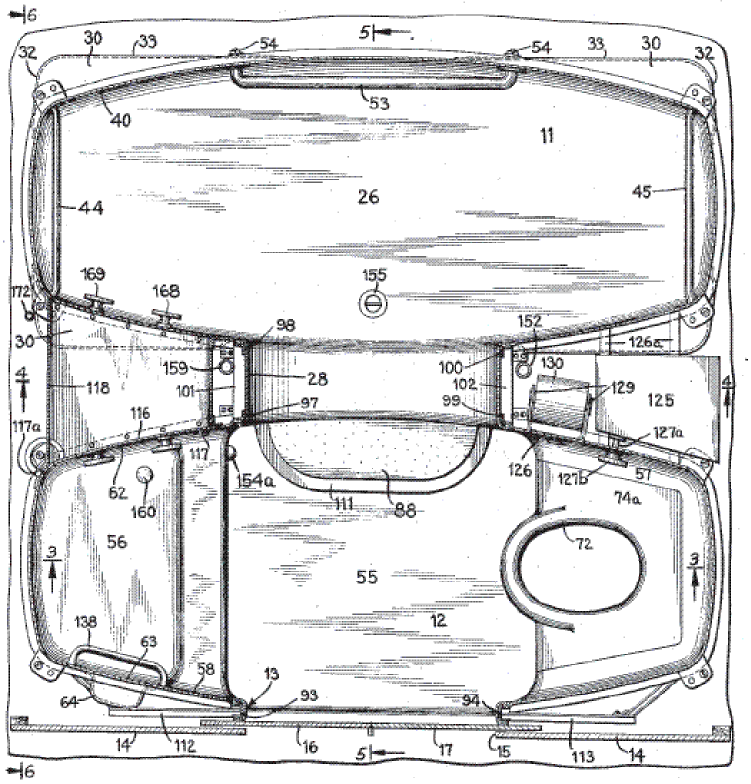
Dymaxion Bathroom



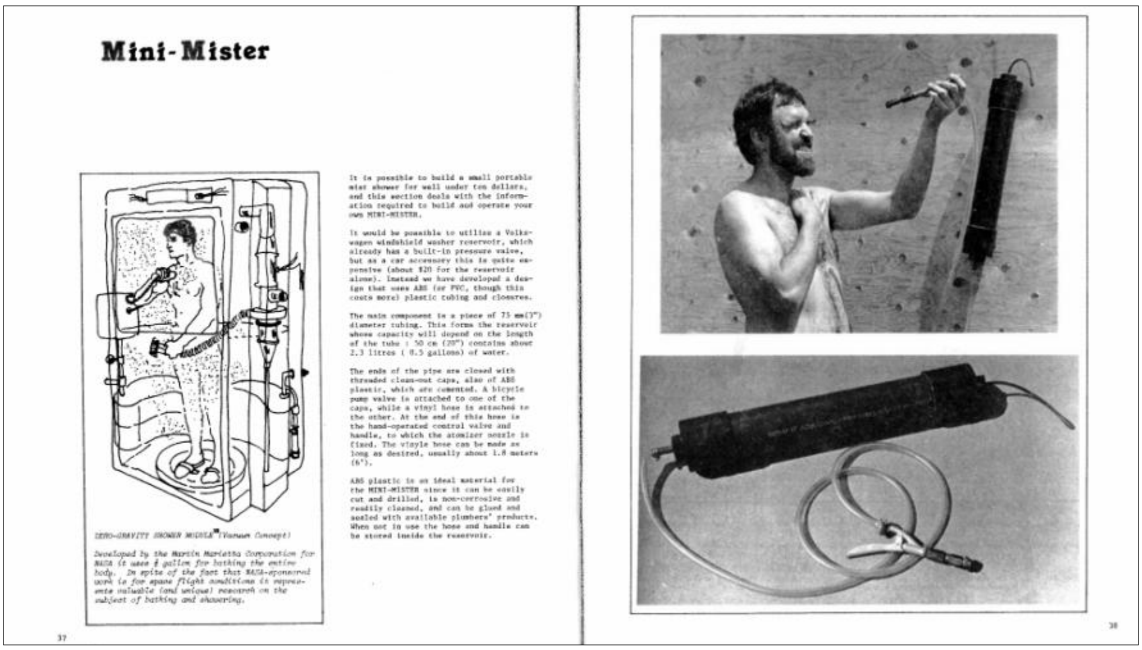
Worried by the poor sanitation, inefficiency, and high cost of bathrooms, Bucky came up with a solution in 1936.

The four, stamped sheet metal or molded plastic sections are each light enough to be carried by two workers. They'll fit up tight staircases and through narrow doors, allowing retrofitting in existing structures. All the appliances, pipes, and wires are built-in, limiting on-site construction to mere hook-up.

With the sections bolted together, the interior has no germ-harboring nooks, crannies, grout cracks or anything that can rot. Large-radius corners make germicidal swabbing easy and complete. Downdraft ventilation draws fumes and steam to the undersink vent. Both sink and (deep) bath-shower are arranged to ease the care of children and seniors. The mirror doesn't steam up, the sink doesn't splatter, and the toilet paper stays dry.



Prototype and drawing of the Dymaxion Bathroom.



Mini-Mister

ZERO-GRAVITY SHOWER MODULE™ (Vacuum Concept)

Developed by the Martin Marietta Corporation for NASA it uses ½ gallon for bathing the entire body. In spite of the fact that NASA-sponsored work is for space flight conditions it represents valuable (and unique) research on the subject of bathing and showering.

It is possible to build a small portable mist shower for well under ten dollars, and this section deals with the information required to build and operate your own MINI-MISTER.

It would be possible to utilize a Volkswagen windshield washer reservoir, which already has a built-in pressure valve, but as a car accessory this is quite expensive (about $20 for the reservoir alone). Instead we have developed a design that uses ABS (or PVC, though this costs more) plastic tubing and closures.

The main component is a piece of 75 mm(3") diameter tubing. This forms the reservoir whose capacity will depend on the length of the tube : 50 cm (20") contains about 2.3 litres (0.5 gallons) of water.

The ends of the pipe are closed with threaded clean-out caps, also of ABS plastic, which are cemented. A bicycle pump valve is attached to one of the caps, while a vinyl hose is attached to the other. At the end of this hose is the hand-operated control valve and handle, to which the atomizer nozzle is fixed. The vinyle hose can be made as long as desired, usually about 1.8 meters (6').

ABS plastic is an ideal material for the MINI-MISTER since it can be easily cut and drilled, is non-corrosive and readily cleaned, and can be glued and sealed with available plumbers' products. When not in use the hose and handle can be stored inside the reservoir.

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Dymaxion Bathrooms were to be equipped with "Fog Gun" hot water vapor showers (above) that use only a cup of water to clean hygienically without soap. Remarking that "Nature had designed humans to separate urine and excrement. Both are valuable chemistry, and should be collected for further use," Bucky specified a waterless "Packaging Toilet" that deftly shrink-wrapped the stuff for pickup for later composting. (Ordinary toilets use approximately 2000 gallons of pure drinking water per year to flush - and waste - one human's "exhaust" that, if dried out, would scarcely fill two 5-gallon pails.)

Dome over Manhattan

The Dome over Manhattan was a 1960 proposal for a 3-kilometer-diameter geodesic domed city covering Midtown Manhattan by the architects Buckminster Fuller and Shoji Sadao.

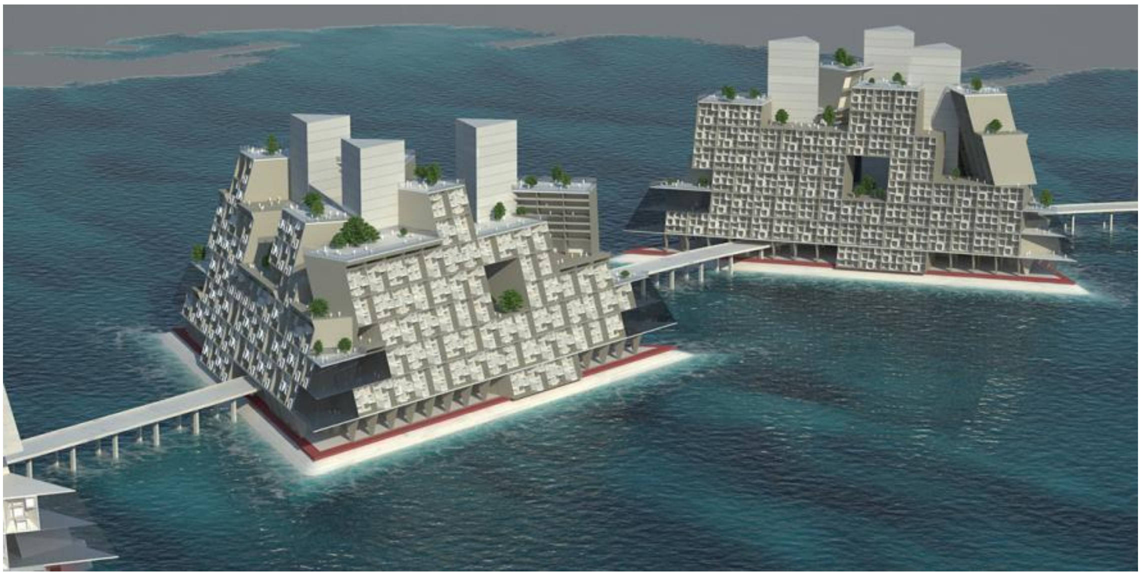
Fuller expanded on his earlier work designing geodesic domes and advocating for decreased use of resources, and made a variety of claims to support the "Dome Over Manhattan," such as that it would reduce energy usage in NYC to 20% of what it was in 1960.

The concept inspired the science fiction writer Ben Bova's story "Manhattan Dome" in the September 1968 issue of Amazing Stories, subsequently expanded into the 1976 novella City of Darkness.

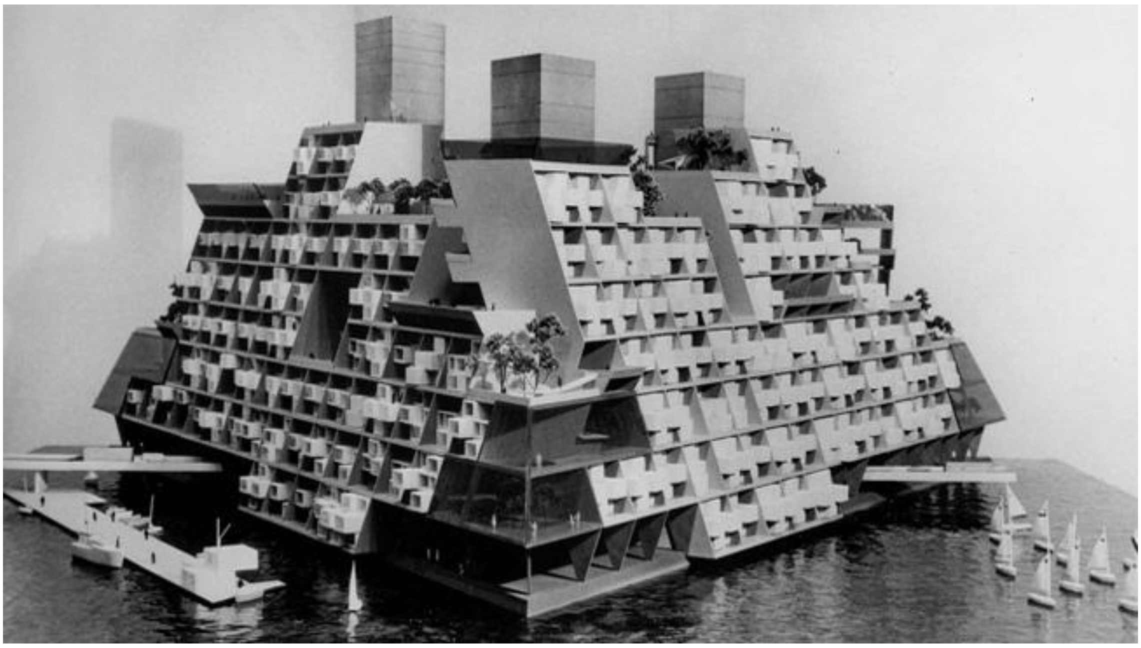
Visualisation of Buckminster Fuller's proposed dome over Manhattan. It was intended to keep out the rain and modify the climate to reduce energy consumption of buildings.

An offshore floating city

In 1967, Fuller developed a concept for an offshore floating city named Triton City and published a report on the design the following year. Models of the city aroused the interest of President Lyndon B. Johnson who, after leaving office, had them placed in the Lyndon Baines Johnson Library and Museum.

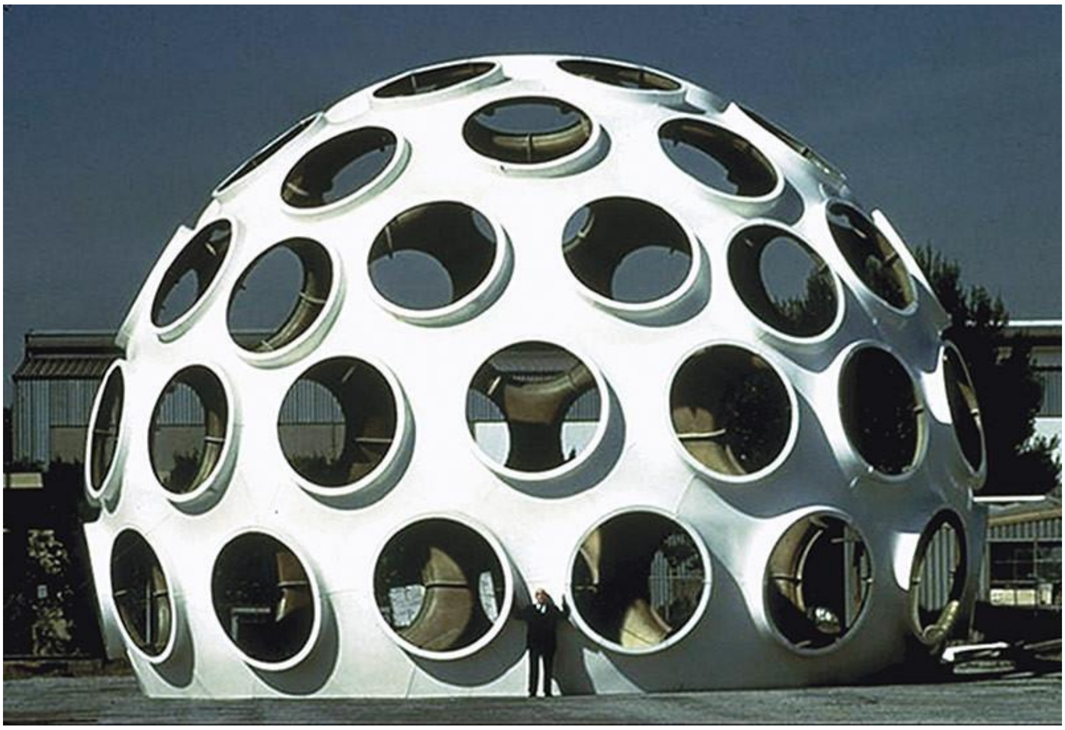


The Triton floating city project, above and below.



Concrete domes

In 1969, Fuller began the Otisco Project, named after its location in Otisco, New York. The project developed and demonstrated concrete spray with mesh-covered wireforms for producing large-scale, load-bearing spanning structures built on-site, without the use of pouring molds, other adjacent surfaces or hoisting. The initial method used a circular concrete footing in which anchor posts were set. Tubes cut to length and with ends flattened were then bolted together to form a duodeca-rhombicahedron (22-sided hemisphere) geodesic structure with spans ranging to 60 feet (18 m). The form was then draped with layers of ¼-inch wire mesh attached by twist ties. Concrete was sprayed onto the structure, building up a solid layer which, when cured, would support additional concrete to be added by a variety of traditional means. Fuller referred to these buildings as monolithic ferroconcrete geodesic domes.



One of Buckminster Fuller's Fly's Eye concrete domes, designed and patented in 1965 as a futuristic prototype for low-cost portable housing. He made three differently sized versions of the prototype by hand prior to his death in 1983.

However, the tubular frame form proved problematic for setting windows and doors. It was replaced by an iron rebar set vertically in the concrete footing and then bent inward and welded in place to create the dome's wireform structure and performed satisfactorily. Domes up to three stories tall built with this method proved to be remarkably strong. Other shapes such as cones, pyramids and arches proved equally adaptable.

The project was enabled by a grant underwritten by Syracuse University and sponsored by U.S. Steel (rebar), the Johnson Wire Corp, (mesh) and Portland Cement Company (concrete). The ability to build large complex load bearing concrete spanning structures in free space would open many possibilities in architecture, and is considered as one of Fuller's greatest contributions.

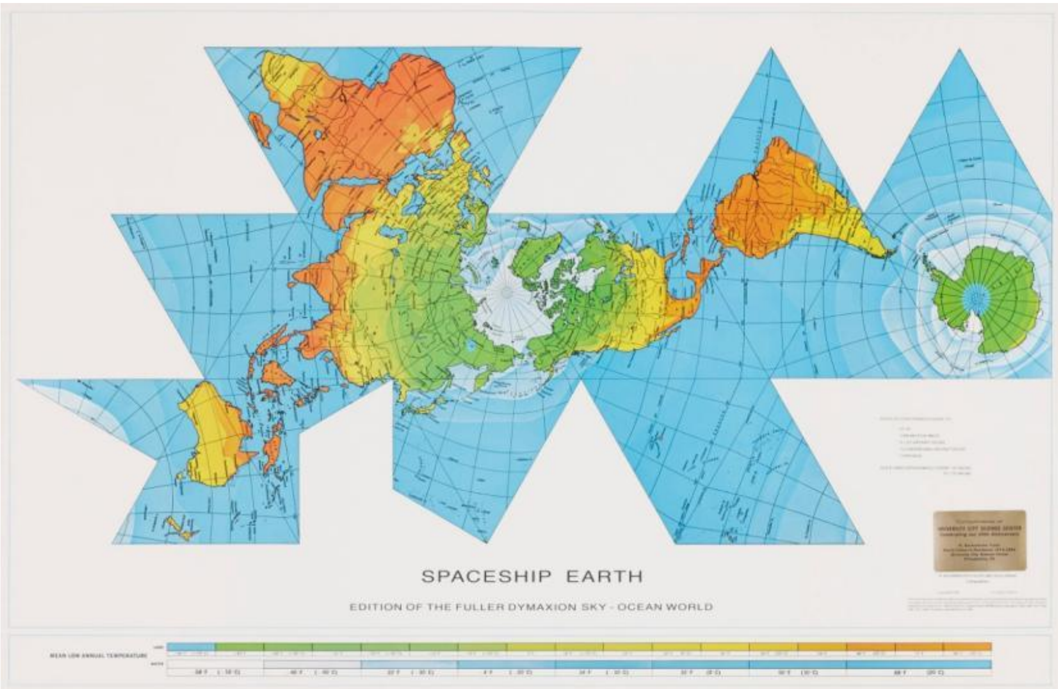
Dymaxion map and World Game

Fuller, along with co-cartographer Shoji Sadao, also designed an alternative projection map, called the Dymaxion map. This was designed to show Earth's continents with minimum distortion when projected or printed on a flat surface.

The Dymaxion map or Fuller map is a projection of a world map onto the surface of an icosahedron, which can be unfolded and flattened to two dimensions. The flat map is heavily interrupted in order to preserve shapes and sizes.

The projection was invented by Buckminster Fuller. The March 1, 1943 edition of Life magazine included a photographic essay titled "Life Presents R. Buckminster Fuller's Dymaxion World". The article included several examples of its use together with a pull-out section that could be assembled as a "three-dimensional approximation of a globe or laid out as a flat map, with which the world may be fitted together and rearranged to illuminate special aspects of its geography." Fuller applied for a patent in the United States in February 1944, the patent application showing a projection onto a cuboctahedron. The patent was issued in January 1946.

The 1954 version published by Fuller, made with co-cartographer Shoji Sadao, the Airocean World Map, used a modified but mostly regular icosahedron as the base for the projection, which is the version most commonly referred to today. This version depicts the Earth's continents as "one island", or nearly contiguous land masses.

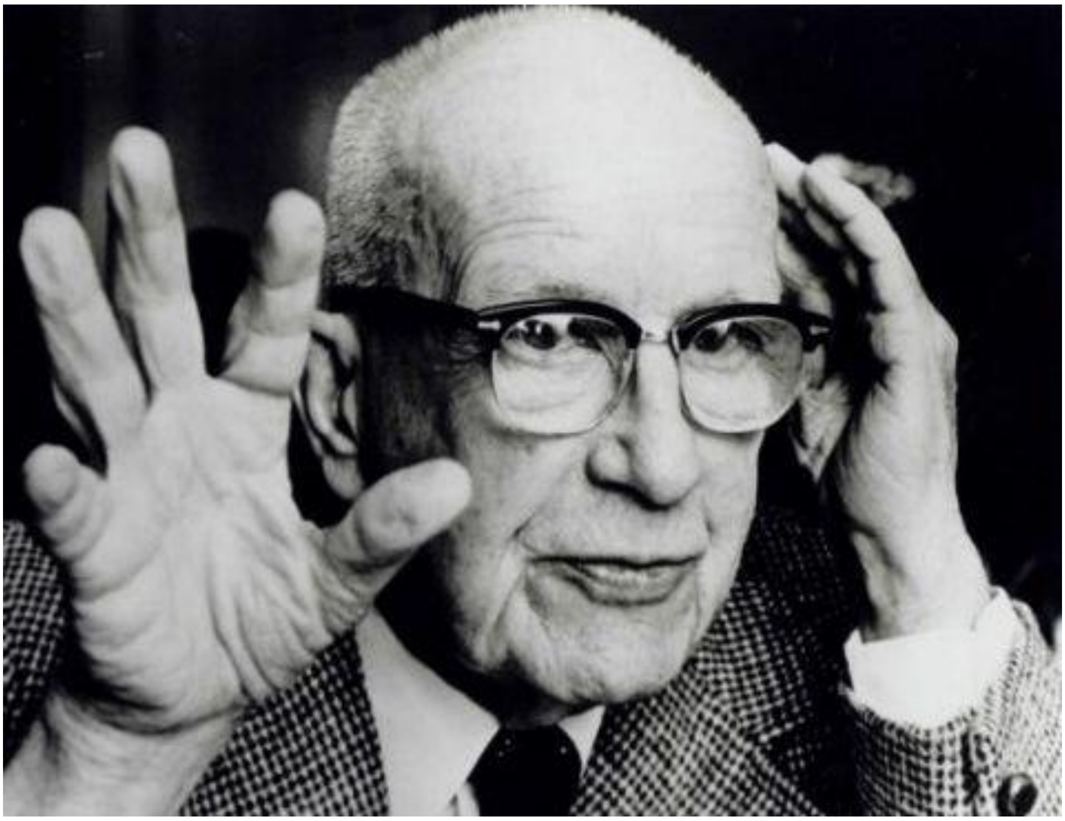


The Dymaxion map can be constructed with any part of the world at its centre. The areas are true to scale.

In the 1960s, Fuller developed the World Game, a collaborative simulation game played on a 70-by-35-foot Dymaxion map, in which players attempt to solve world problems. The object of the simulation game is, in Fuller's words, to "make the world work, for 100% of humanity, in the shortest possible time, through spontaneous cooperation, without ecological offense or the disadvantage of anyone".

The Dymaxion board for the World Game.

7. Philosophy and worldview



Buckminster Fuller was a Unitarian, like his grandfather Arthur Buckminster Fuller, a Unitarian minister. Fuller was also an early environmental activist, aware of the Earth's finite resources, and promoted a principle he termed "ephemeralization", which, according to futurist and Fuller disciple Stewart Brand, was defined as "doing more with less". Resources and waste from crude, inefficient products could be recycled into making more valuable products, thus increasing the efficiency of the entire process. Fuller also coined the word synergetics, a catch-all term used broadly for communicating experiences using geometric concepts, and more specifically, the empirical study of systems in transformation; his focus was on total system behavior unpredicted by the behavior of any isolated components.

Fuller was a pioneer in thinking globally, and explored energy and material efficiency in the fields of architecture, engineering and design. Citing François de Chardenèdes' opinion that petroleum, from the standpoint of its replacement cost in our current energy "budget" (essentially, the net incoming solar flux), had cost nature "over a million dollars" per U.S. gallon (US$300,000 per litre) to produce. From this point of view, its use as a transportation fuel by people commuting to work represents a huge net loss compared to their actual earnings. An encapsulation quotation of his views might best be summed up as: "There is no energy crisis, only a crisis of ignorance."

Though Fuller was concerned about sustainability and human survival under the existing socio-economic system, he remained optimistic about humanity's future. Defining wealth in terms of knowledge, as the "technological ability to protect, nurture, support, and accommodate all growth needs of life," his analysis of the condition of "Spaceship Earth" caused him to conclude that at a certain time during the 1970s, humanity had attained an unprecedented state.

He was convinced that the accumulation of relevant knowledge, combined with the quantities of major recyclable resources that had already been extracted from the earth, had attained a critical level, such that competition for necessities had become unnecessary. Cooperation had become the optimum survival strategy. He declared: "selfishness is unnecessary and hence-forth unrationalizable ... War is obsolete." He criticized previous utopian schemes as too exclusive, and thought this was a major source of their failure. To work, he thought that a utopia needed to include everyone.

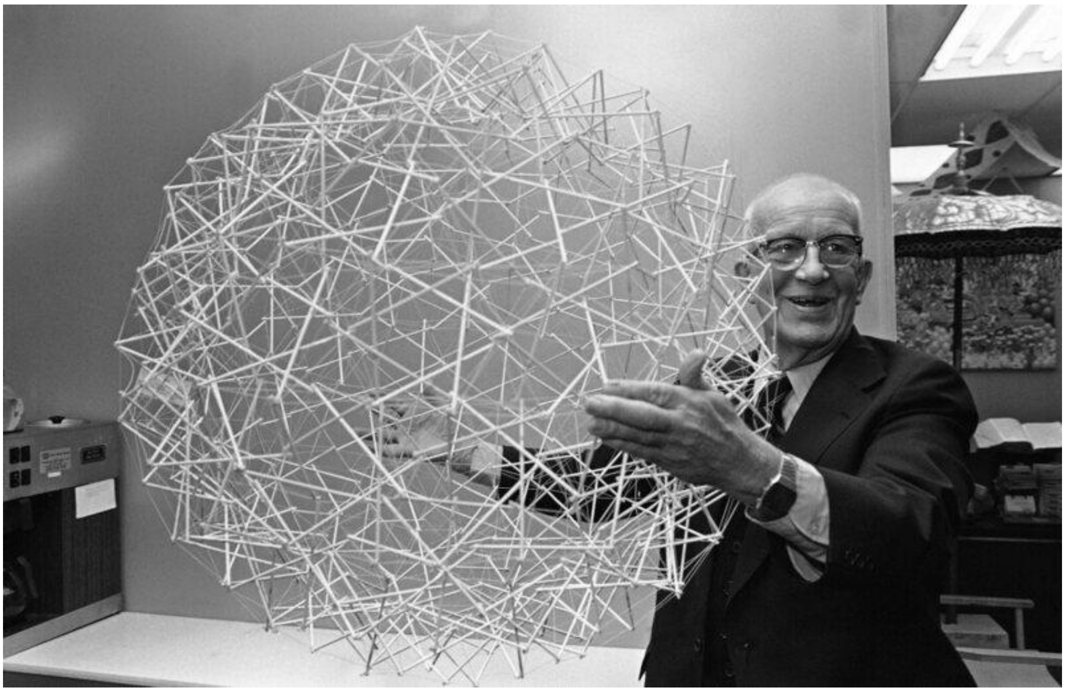
Fuller was influenced by Alfred Korzybski's idea of general semantics. In the 1950s, Fuller attended seminars and workshops organized by the Institute of General Semantics, and he delivered the annual Alfred Korzybski Memorial Lecture in 1955.Korzybski is mentioned in the Introduction of his book Synergetics. The two shared a remarkable amount of similarity in their formulations of general semantics.

In his 1970 book I Seem To Be a Verb, he wrote: "I live on Earth at present, and I don't know what I am. I know that I am not a category. I am not a thing—a noun. I seem to be a verb, an evolutionary process—an integral function of the universe."

Fuller wrote that the natural analytic geometry of the universe was based on arrays of tetrahedra. He developed this in several ways, from the close-packing of spheres and the number of compressive or tensile members required to stabilize an object in space. One confirming result was that the strongest possible homogeneous truss is cyclically tetrahedral.

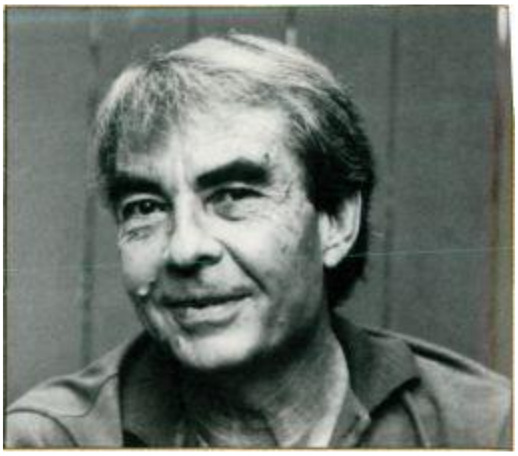
He had become a guru of the design, architecture, and 'alternative' communities, such as Drop City, the community of experimental artists to whom he awarded the 1966 "Dymaxion Award" for "poetically economic" domed living structures.

8. Appearance and style



Buckminster Fuller wore thick-lensed spectacles to correct his extreme hyperopia, a condition that went undiagnosed for the first five years of his life. Fuller's hearing was damaged during his Naval service in World War I and deteriorated during the 1960s. After experimenting with bullhorns as hearing aids during the mid-1960s, Fuller adopted electronic hearing aids from the 1970s onward.

In public appearances, Fuller always wore dark-colored suits, appearing like "an alert little clergyman". Previously, he had experimented with unconventional clothing immediately after his 1927 epiphany, but found that breaking social fashion customs made others devalue or dismiss his ideas. Fuller learned the importance of physical appearance as part of one's credibility, and decided to become "the invisible man" by dressing in clothes that would not draw attention to himself. With self-deprecating humor, Fuller described this black-suited appearance as resembling a "second-rate bank clerk".



Writer Guy Davenport (right) met him in 1965 and described him thus:

He's a dwarf, with a worker's hands, all callouses and squared fingers. He carries an ear trumpet, of green plastic, with WORLD SERIES 1965 printed on it. His smile is golden and frequent; the man's temperament is angelic, and his energy is just a touch more than that of [Robert] Gallway (champeen runner, footballeur, and swimmer). One leg is shorter than the other, and the prescription shoe worn to correct the imbalance comes from a country doctor deep in the wilderness of Maine. Blue blazer, Khrushchev trousers, and a briefcase full of Japanese-made wonderments.

9. Quirks

Unusual language

Buckminster Fuller spoke and wrote in a unique style and said it was important to describe the world as accurately as possible. Fuller often created long run-on sentences and used unusual compound words (omniwell-informed, intertransformative, omni-interaccommodative, omniself-regenerative) as well as terms he himself invented. His style of speech was characterized by progressively rapid and breathless delivery and rambling digressions of thought, which Fuller described as "thinking out loud". The effect, combined with Fuller's dry voice and New England accent, was varyingly considered "hypnotic" or "overwhelming".

Fuller used the word Universe without the definite or indefinite articles (the or a) and always capitalized the word. Fuller wrote that "by Universe I mean: the aggregate of all humanity's consciously apprehended and communicated (to self or others) Experiences".

Don't use down or up

The words "down" and "up", according to Fuller, are awkward in that they refer to a planar concept of direction inconsistent with human experience. The words "in" and "out" should be used instead, he argued, because they better describe an object's relation to a gravitational center, the Earth. "I suggest to audiences that they say, 'I'm going "outstairs" and "instairs."' At first that sounds strange to them; They all laugh about it. But if they try saying in and out for a few days in fun, they find themselves beginning to realize that they are indeed going inward and outward in respect to the center of Earth, which is our Spaceship Earth. And for the first time they begin to feel real 'reality.'"

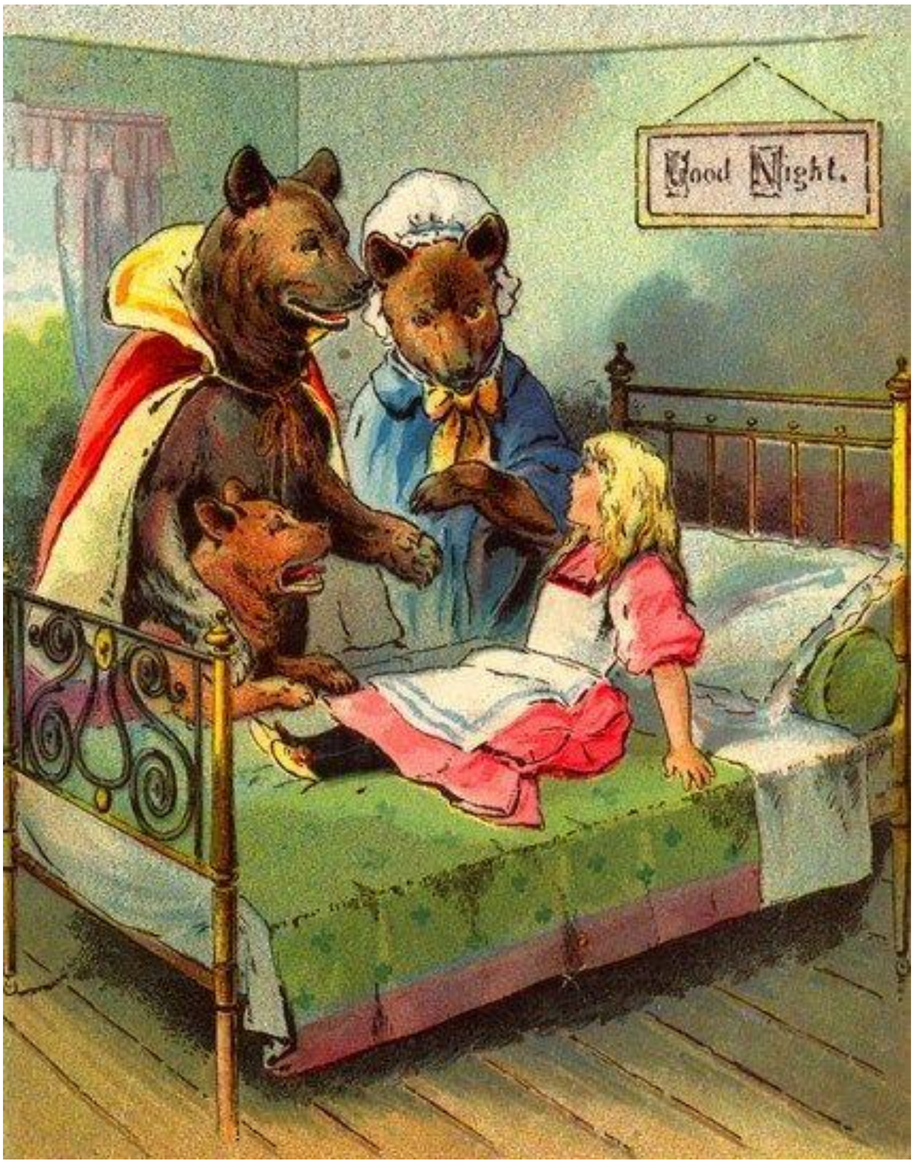
Don't use worldwide

"World-around" is a term coined by Fuller to replace "worldwide". The general belief in a flat Earth died out in classical antiquity, so using "wide" is an anachronism when referring to the surface of the Earth—a spheroidal surface has area and encloses a volume but has no width. Fuller held that unthinking use of obsolete scientific ideas detracts from and misleads intuition. Other neologisms collectively invented by the Fuller family, according to Allegra Fuller Snyder, are the terms "sunsight" and "sunclipse", replacing "sunrise" and "sunset" to overturn the geocentric bias of most pre-Copernican celestial mechanics.

Fuller also invented the word "livingry," as opposed to weaponry (or "killingry"), to mean that which is in support of all human, plant, and Earth life. "The architectural profession—civil, naval, aeronautical, and astronautical—has always been the place where the most competent thinking is conducted regarding livingry, as opposed to weaponry."

As well as contributing significantly to the development of tensegrity technology, Fuller invented the term "tensegrity", a portmanteau of "tensional integrity". "Tensegrity describes a structural-relationship principle in which structural shape is guaranteed by the finitely closed, comprehensively continuous, tensional behaviors of the system and not by the discontinuous and exclusively local compressional member behaviors. Tensegrity provides the ability to yield increasingly without ultimately breaking or coming asunder."

Goldilocks and the three bears



In the preface for his "cosmic fairy tale" Tetrascroll: Goldilocks and the Three Bears, Fuller stated that his distinctive speaking style grew out of years of embellishing the classic tale for the benefit of his daughter, allowing him to explore both his new theories and how to present them.

The Tetrascroll narrative was eventually transcribed onto a set of tetrahedral lithographs (hence the name), as well as being published as a traditional book.

The word Dymaxion was invented by admen

"Dymaxion" is a portmanteau of "dynamic maximum tension". It was invented around 1929 by two admen at Marshall Field's department store in Chicago to describe Fuller's concept house, which was shown as part of a house of the future store display. They created the term utilizing three words that Fuller used repeatedly to describe his design – dynamic, maximum, and tension.

Spaceship Earth

Fuller also helped to popularize the concept of Spaceship Earth: "The most important fact about Spaceship Earth: an instruction manual didn't come with it."

Three watches

Following his global prominence from the 1960s onward, Fuller became a frequent flier, often crossing time zones to lecture. In the 1960s and 1970s, he wore three watches simultaneously; one for the time zone of his office at Southern Illinois University, one for the time zone of the location he would next visit, and one for the time zone he was currently in. In the 1970s, Fuller was only in 'homely' locations (his personal home in Carbondale, Illinois; his holiday retreat in Bear Island, Maine; and his daughter's home in Pacific Palisades, California) roughly 65 nights per year—the other 300 nights were spent in hotel beds in the locations he visited on his lecturing and consulting circuits.

Very little sleep

In the 1920s, Fuller experimented with polyphasic sleep, which he called Dymaxion sleep. Inspired by the sleep habits of animals such as dogs and cats, Fuller worked until he was tired, and then slept short naps. This generally resulted in Fuller sleeping 30-minute naps every 6 hours. This allowed him "twenty-two thinking hours a day", which aided his work productivity. Fuller reportedly kept this Dymaxion sleep habit for two years, before quitting the routine because it conflicted with his business associates' sleep habits. Despite no longer personally partaking in the habit, in 1943 Fuller suggested Dymaxion sleep as a strategy that the United States could adopt to win World War II.

Despite only practicing true polyphasic sleep for a period during the 1920s, Fuller was known for his stamina throughout his life. He was described as "tireless" by Barry Farrell in Life magazine, who noted that Fuller stayed up all night replying to mail during Farrell's 1970 trip to Bear Island. In his seventies, Fuller generally slept for 5–8 hours per night.

270 feet of papers

Fuller documented his life copiously from 1915 to 1983, approximately 270 feet (82 m) of papers in a collection called the Dymaxion Chronofile. He also kept copies of all incoming and outgoing correspondence. The enormous R. Buckminster Fuller Collection is currently housed at Stanford University.

He wrote: If somebody kept a very accurate record of a human being, going through the era from the Gay 90s, from a very different kind of world through the turn of the century—as far into the twentieth century as you might live. I decided to make myself a good case history of such a human being and it meant that I could not be judge of what was valid to put in or not. I must put everything in, so I started a very rigorous record.

In his youth, Fuller experimented with several ways of presenting himself: R. B. Fuller, Buckminster Fuller, but as an adult finally settled on R. Buckminster Fuller, and signed his letters as such. However, he preferred to be addressed as simply "Bucky".

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10. Honours and Final Days

Fuller was awarded 28 United States patents and many honorary doctorates. In 1960, he was awarded the Frank P. Brown Medal from The Franklin Institute. Fuller was elected as an honorary member of Phi Beta Kappa in 1967, on the occasion of the 50th year reunion of his Harvard class of 1917 (from which he was expelled in his first year).

He was elected a Fellow of the American Academy of Arts and Sciences in 1968. In 1968, he was elected into the National Academy of Design as an Associate member, and became a full Academician in 1970. In 1970, he received the Gold Medal award from the American Institute of Architects. In 1976, he received the St. Louis Literary Award from the Saint Louis University Library Associates. In 1977, Fuller received the Golden Plate Award of the American Academy of Achievement. He also received numerous other awards, including the Presidential Medal of Freedom presented to him on February 23, 1983, by President Ronald Reagan.

Last filmed appearance

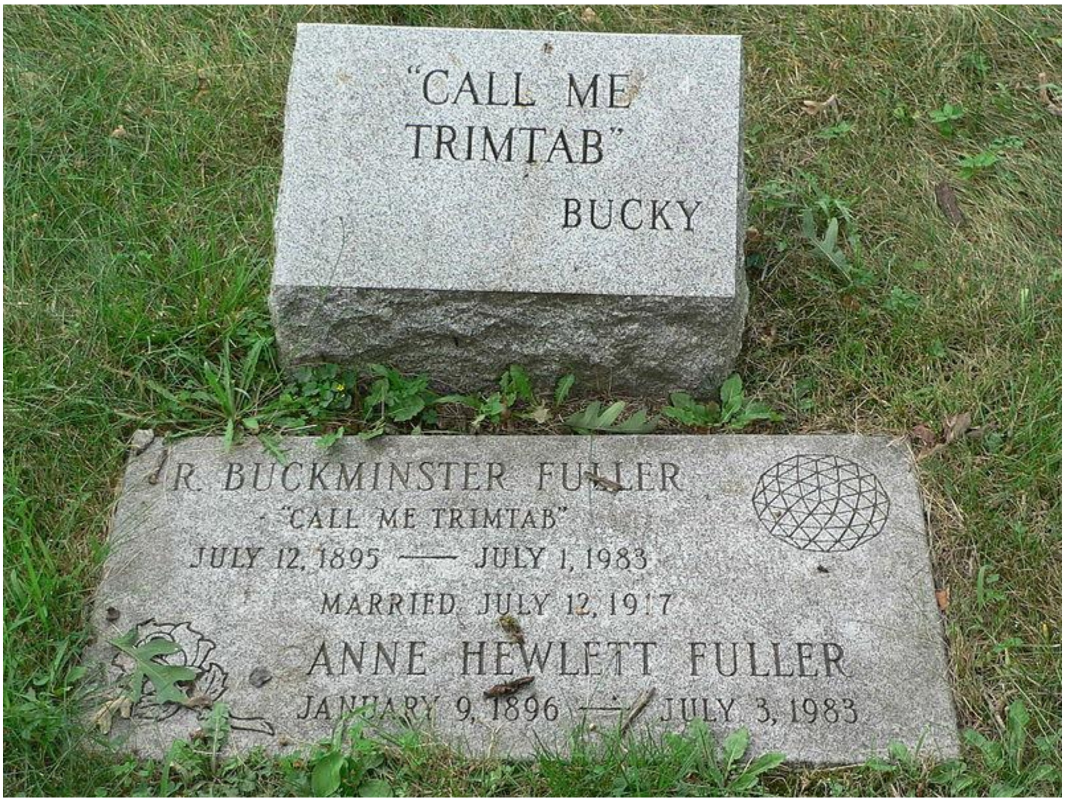
Fuller's last filmed interview took place on June 21, 1983, in which he spoke at Norman Foster's Royal Gold Medal for architecture ceremony] His speech can be watched in the archives of the AA School of Architecture, in which he spoke after Sir Robert Sainsbury's introductory speech and Norman Foster's keynote address.

Death

In the year of his death, Fuller described himself as follows:

Guinea Pig B: I AM NOW CLOSE TO 88 and I am confident that the only thing important about me is that I am an average healthy human. I am also a living case history of a thoroughly documented, half-century, search-and-research project designed to discover what, if anything, an unknown, moneyless individual, with a dependent wife and newborn child, might be able to do effectively on behalf of all humanity that could not be accomplished by great nations, great religions or private enterprise, no matter how rich or powerfully armed.

Fuller died on July 1, 1983, 11 days before his 88th birthday. During the period leading up to his death, his wife had been lying comatose in a Los Angeles hospital, dying of cancer. It was while visiting her there that he exclaimed, at a certain point: "She is squeezing my hand!" He then stood up, suffered a heart attack, and died an hour later, at age 87. His wife of 66 years died 36 hours later. They are buried in Mount Auburn Cemetery in Cambridge, Massachusetts.



Buckminster Fuller explained why he likes to think of himself as a trim tab:

Something hit me very hard once, thinking about what one little man could do. Think of the *Queen Elizabeth* — the whole ship goes by and then comes the rudder. And there's a tiny thing at the edge of the rudder called a trim tab. It's a miniature rudder. Just moving the little trim tab builds a low pressure that pulls the rudder around. Takes almost no effort at all. So I said that the little individual can be a trim tab. Society thinks it's going right by you, that it's left you altogether. But if you're doing dynamic things mentally, the fact is that you can just put your foot out like that and the whole big ship of state is going to go. So I said, "Call me Trim Tab."

11. Allegra Remembers her Father

The following memoir of her father by Allegra Fuller Snyder was archived in 2021, with acknowledgement and thanks, from the www.metropolismag.com website. It was published to mark the 100th anniversary of Buckminster Fuller's birth on July 12th 1995.

Allegra Fuller Snyder with her father in the 1950s.

My father was a warm, concerned, and sharing father. As focused as he was on his own work, he nevertheless included me in his experiences and his experiencing. I remember with great clarity when I was about four years old, I was sick in bed, and he was taking care of me. He sat down on the bed beside me with his pencil in hand and told me—through wonderful freehand drawings—a Goldilocks story.

I was Goldilocks, and with his pencil he transported me not to the bears' house, but to the universe to help me understand something of Einstein's theory of relativity. In later years, reflecting on Einstein himself, my father would often repeat, “Change is constant, change is normal.” But that had been a phrase I had heard, as Goldilocks, in the very earliest days of my own thinking. What he was telling me was neither remote nor abstract. I was in a newly perceived universe. I was experiencing my father's thoughts and he was experiencing his own thinking as he communicated with me. It was exciting. We were sharing something together, and I felt very warm and close to him in that experience.

I also shared very participatorily in the emergence of the Dymaxion car, visiting the plant in Bridgeport, Conn., as his vision came to life, riding with him as he tested first the chassis, and then the whole car and its many marvels. I was then six or seven. After he published Nine Chains to the Moon, I was, at 12, an active part of the first seeding of synergetic geometry. I loved numbers and patterns of numbers and was a witness as these numbers began to take on shape and form, a three-dimensional geometry. He asked me to work alongside him in that process.

As I review all of these experiences, and I review my life in its relation to my father, there emerges a central core, something that was a key to so much else. I begin to perceive something that I learned very fundamentally from my father, which was essential in his own work and became a seed that flowered into much of my own life and work. To tell you about that core, I have to tell you something about myself.

I have pioneered a field called dance ethnology. A dance ethnologist is one who is concerned with studying the process of dance in culture. My work calls for a comprehensive perspective that seeks out that pattern of human behavior called dance and asks what its functions are in world societies. This field of investigation has been the major focus of my work and life for the last 30-plus years.

I came to dance, as every child does, because it was one of those natural, first, nonverbal responses to life—after walking, almost always comes dancing. What, perhaps, made my experience different from that of most children, however, was that as I "grew up" and entered school, this experience was not negated. Nor was I told that I should now be a good girl and just sit still and listen to what others told me. I went to an extraordinary school in New York called Dalton, which was founded on the educational thinking of a woman named Helen Parkhurst. Miss Parkhurst, in turn, had evolved a part of her work on the principle of John Dewey's "learning by doing." Through Dalton I came to know dance as a way of knowing that was as indispensable and critical as any other way of knowing.

Let me tell you very briefly about this educational process. In the third grade we spent the year focused on the origins of man. We came to the dinosaur age, I did a dance, or rather I experienced and communicated through movement, about dinosaurs and how some got stuck in the La Brea tar pits. Then there was a dance about the solar system, as we continued forward in our exploration of the universe. The following years we were submersed first in the history of Egypt, then Greece in the fifth grade, and the medieval period, through medieval China and India as well as Europe, in our sixth year. All these studies were brought to a culmination and integration by an "experiencing," a performance, of which dance was a critical part. My understanding of these moments in history, and of ideas that were vital to them, was, and is, embedded in my viscera. This was a form of self-education of which Bucky spoke so often, for experiential learning is self-generated and self-propelled, particularly in a supportive environment.

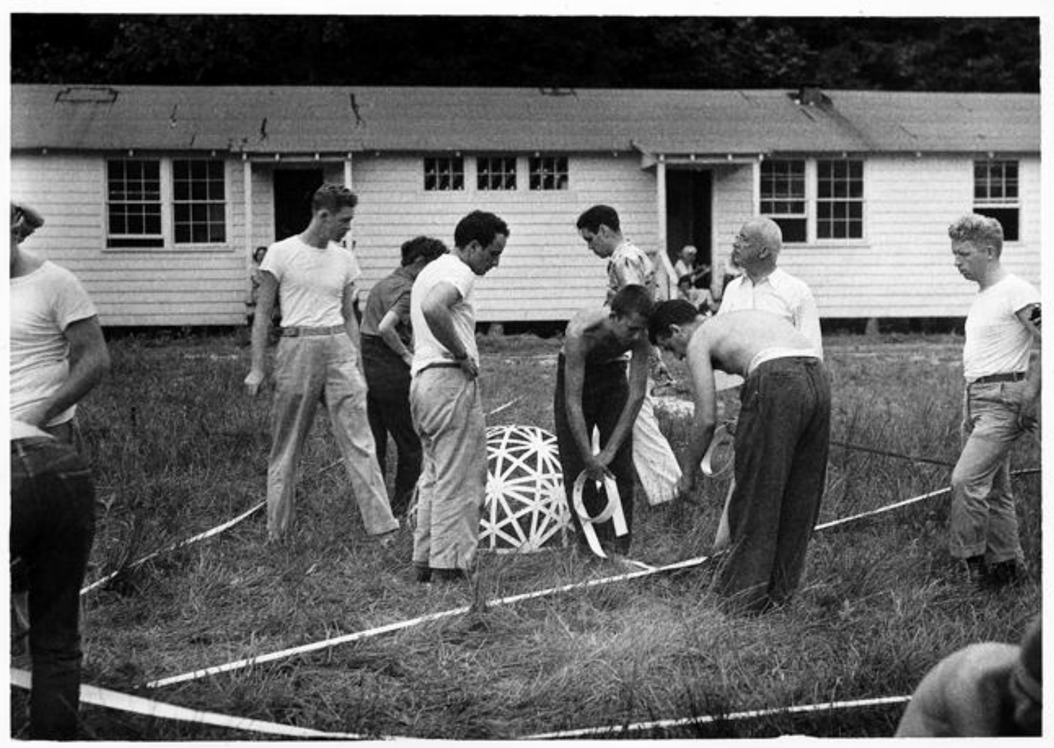
Snyder and her father in Greek costume at the Delos Symposium in 1966. The symposium, held aboard the yacht of the Greek architect-planner Constantinos Doxiadis, facilitated discussions surrounding ekistics—the study of human settlements.

My father had carefully sought out Dalton and, though it was a private school and quite expensive, he found a way to borrow on, or barter, his work so I could attend that school and learn through that process. Providing this kind of education for me was hard for him financially, but he saw in this curriculum something of the "progressively coordinated apprehension and comprehension of universe" that he felt "the mind was spontaneously prone to deal with." This, he felt, was the essence of education.

It is the relation between the mind, which Bucky so often talked about, and experience or experiencing that I found to be the key that unlocks his work and inspired my own. I believe inherently that Bucky's concept of mind has, at its base, mind processing through experience. By "experiencing" I mean involving one's whole self, not being present at, or observing, something, but "doing" that thing. I remember how my father always loved to wash dishes. I had a perfectly good dishwasher, a piece of excellent technology, but he preferred to get his hands wet, to rinse, soap, and stack the dishes in just the right way. (Technology, from my father's point of view, was always an extension and enrichment of experience, not a substitute for experience.)

One of the most vivid images I have of my father is of his fingertips. I can see him sitting with his eyes closed, searching deeply into his mind/experience, with his fingertips barely tapping together or his hands reaching out in one of those broad and animated gestures so common in later years when he lectured. His fingertips were exploring the universe around him. His fingertips were his antennae to experience. What he processed in his mind was only ever processed through that link to experience. The largest concepts, his generalized principles, were a summarization and culmination of what he called "special-case experience." Many times his fingertips seemed to suggest that he was tuning in to, was in touch with, that special-case experience.

What is so important to recognize is that this was physical experience. My father was a very physical person. He used to pride himself on being quite an athlete. It was a knee injury, in his last year at Milton Academy or just before he entered his first year at Harvard, that may have very well shifted the directions of his life, for when he thought of going to Harvard it was with great visions of playing football and hockey and "making the team." He didn't because of his knee, and his energies shifted elsewhere, at first mostly toward other forms of physical pleasure—parties and such—and for that he was dismissed from Harvard.



Bucky works with students on the construction of the Supine Dome at Black Mountain College in North Carolina in 1948. Courtesy Winslow Wedin/The Estate of R. Buckminster Fuller.

He was sent to work as an apprentice millwright in a cotton mill in Sherbrooke, Quebec. He loved it. It was tangible as well as physical work, and he was transformed by the experience. He was accepted back again at Harvard, but once he was there he felt that all he was asked to do was memorize, not validate through experience. He rebelled, and again he was dismissed. The commencement of World War I followed immediately thereafter. He went to Annapolis, where, in the navy, he discovered again the “hands on” and the physical. For my father, the direct sensorial understanding and application embodied in his navy experiences were a turning point. It set a course that very critically affected the rest of his life.

My father was a walker. When he was courting my mother, who lived in Brooklyn Heights, he would walk down from the mid-thirties in Manhattan, where he lived with his mother, across the Brooklyn Bridge and into Brooklyn Heights, about a ten-mile walk, to see my mother and home again. He once told me about walking an extraordinary number of miles, perhaps 100, to see my mother during one of his weekend leaves from the navy, just after they were married. This was his best thinking time. His thinking was connected to his body.

It was an integration of his body and his mind. This is what dance is, as I have come to understand it. He intuitively made this connection too, so he had no difficulty in understanding and supporting my interest in dance.

And I felt no great separation between my own essential interests and what lay at the core of his work.

It is the sense of the physicalization of ideas that I see as so important in understanding and accessing my father’s work. It is the sense of physicalization that propels synergetics, or holistic thinking, and sets the criteria in his demand for a “modeling universe.” I don’t think one can really confront Bucky’s work without turning to the resource of one’s own experiences and the wiliness to use those experiences as a basis for understanding. Understanding is an experiential word, particularly used in this context, with its sense of the necessity of actually “standing” physically “under” an idea and experientially supporting the concept.

He loved Bear Island, our family-owned island in Maine, because it was a physically involving place. We had no freshwater, except cistern-caught rain and well water— which had to be drawn or pumped and then hauled—kerosene and candles for light, a fire in the hearth for heat. Each of these basic requirements involved physical action to produce the needed results. And then, of course, there was sailing, which he loved, where the dialogue between nature and human action is so dynamic.

At the heart of each one of these actions was the sense of the “special case” that would lead to a generalized principle. Any experience would become a special case, the doorway to larger comprehensivity. When you were around him you were aware of how sensitive he was to the smallest experience. His focus could zero in on a pebble on the beach, a twig or flower along a path. Each became the stepping-stone to the largest whole. “The human brain apprehends and stores each sense-reported bit of information regarding each special-case experience,” he said. “Only special-case experiences are recallable from the memory bank.”

Bucky didn’t use the word feeling often, but he quotes this wonderful E.E. Cummings thought at the beginning of his book Critical Path. I believe what Cummings meant by “feel” and “feeling” relates to Bucky’s “experience” and “experiencing”:

A lot of people think or believe or know they feel [experience]—but that’s thinking or believing or knowing; not feeling [experiencing]. Almost anybody can learn to think or believe or know, but not

a single human being can be taught to feel [experience]. Why? Because whenever you think or you believe or you know, you’re a lot of other people. But the moment you feel [experience], you’re nobody but yourself. To be nobody but yourself—in a world which is doing its best, night and day, to make you everybody else—means to fight the hardest battle which any human being can fight; and never stop fighting.

That was the scenario of Bucky's life—to fight the hardest battle that any human being can fight and never stop fighting. Intuition and imagination both relate to and are a part of experience. Let me turn for a moment to Bucky's own words on these matters. (What follows is drawn from E.J. Applewhite's wonderful Synergetics Dictionary.)

Intuition is practically physical, the kind of supersensitivity that a child has. Imagination. Image-ination involves rearranging the "furniture" of remembered experience as retrieved from the brain bank.

Speaking with an audience, Bucky would say, "All that I can really give you I must always identify by experience." One of his great gifts as a speaker was the fact that he made you experience his ideas and carried you along with the connection between your experience and his experience. "Information is experience. Experience is information." He then goes on to really explore the essence of experience: Thinking is inherently exclusive. Experience, which comes before thinking, is inherently inclusive. Experience is complex consciousness of being, of self, co-existing with all the non-self.

Re-experienced consciousness is re-cognition. Re-cognitions generate identifications. Re-cognition of within self rhythms, of heart beatings or other identities, generate a matrix continuum of time consciousness upon which, like blank music lines, are superimposed all the observances by self of the non-self occurrences.

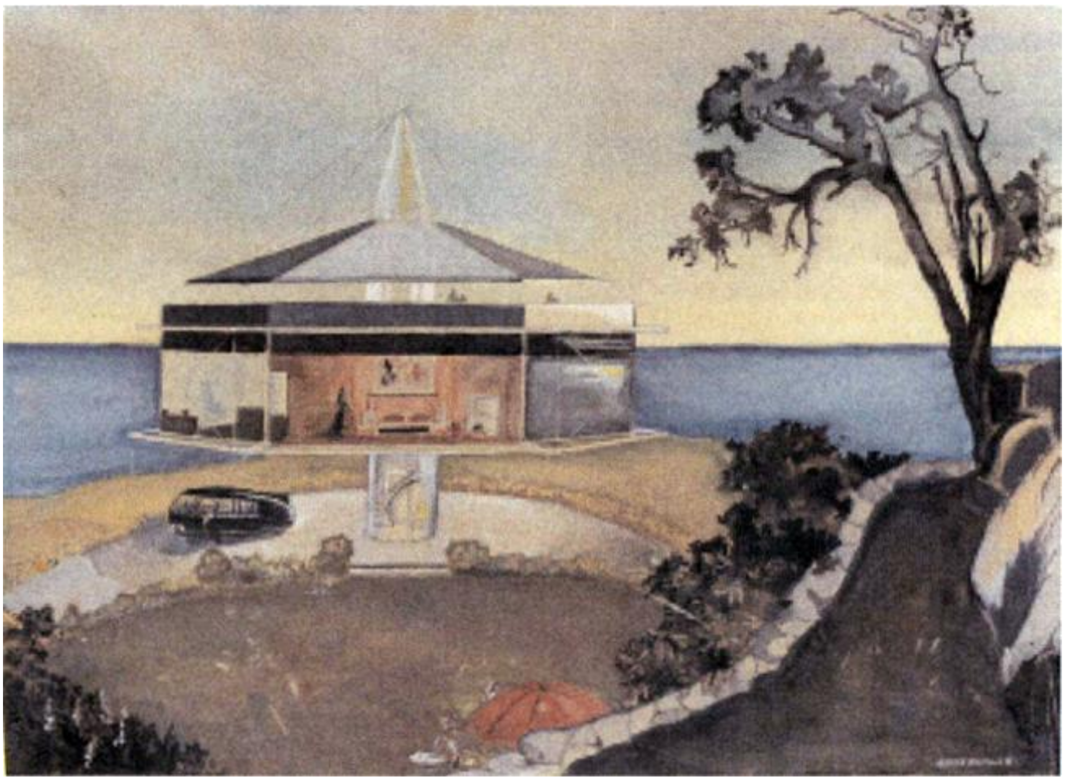
Experience is inherently discontinuous and islanded and each special experience represents a complex of generalized principles operative in special or limited-size modulated realization. Experience is finite; it can be stored, studied, directed; it can be turned, with conscious effort to human advantage. [This means that] evolution pivots on the conscious, selective use of cumulative human experience. Universe is the coordinate integral of all experience.

Where or how does experience continue to be a part of the picture when, as Bucky pointed out, "at the dawning of the 20th century, without warning to humanity, the physical technology of Earthians' affairs was shifted over from a brain-sensed reality into a reality apprehended only by instruments"? His response was that invisibility can be "understood and coped with only by experience-educated mind."

Let me turn again, for a moment, to my own work in hopes of clarifying this very important point. It is my observation that dance is most significant in those societies that are least literate, where they have had no need for a tool to document the spoken word, and it is least significant in societies, such as our own, where literacy, rather than knowledge and understanding, is set up as the criteria of education and cultivation. Since I have learned a very great deal from understanding dance, what does this tell me? The written word was and is an extraordinary technological tool, but it was the first step in the separation of knowledge from experience. It extended knowledge, in time and space, but away from self and made invisible, and often forgotten, the source of knowledge, the reason for knowledge.

There are trade-offs in the process of literacy that I think are very important to examine. Literacy allows detachment, lack of involvement, sometimes, and most important of all, irresponsibility to the essential understanding and retention of knowledge. Physical conceptualization is deeper and more lasting as a learning process, and the individual is propelled into a sense of responsibility by that process; that, I think, is why Bucky said invisibility can be "understood and coped with only by experience-educated mind."

From my perception of reality, and orientation to life, all of the above suggests that in order to really understand Bucky's work, you must, in essence, be a dancer yourself. You must understand your body and experience as a way of knowing. In a functional way the ideas need to be embodied in your own thinking/experiencing. My father was at his most essential "Bucky" when he burst into his wonderful clogging dance. He was a dancer in the way I understand dance, as a way of knowing, and his understanding of universe was through his dancing in his mind.



A painting, done by Bucky's wife and Snyder's mother, Anne Hewlett Fuller, in 1932, depicting the never-realized 4D Dymaxion house with the Dymaxion car parked out front. Courtesy Anne Hewlett Fuller/The Estate of R. Buckminster Fuller.

12. Commentary by Patrick McCray

This chapter was archived in 2021, with acknowledgement and thanks, from the website of the Los Angeles Review of Books. It is a review of Jonathon Keats' book 'You Belong to the Universe: Buckminster Fuller and the Future'. It was written by Patrick McCray (below), Professor of History at the University of California, Santa Barbara.

IF ONE BELIEVES the story, at the peak of his fame, Buckminster Fuller wore three wristwatches — one set for his current location, one for his previous one, and one for his next one. Jonathon Keats's new book You Belong to the Universe appropriately situates the designer and autodidact in the present, past, and future — not just Fuller's, but ours too. In fact, Keats's central argument is that today's would-be "world changers" can extract inspiration and even concrete examples from Fuller's 20th-century life and apply them to 21st-century design futures.

His book is rooted in two orthogonal pictures of Fuller. One of them goes like this: Buckminster Fuller — "Bucky" to friends and family — was a true American visionary, a solitary innovator who forged ahead even as corporate research and development displaced the lone inventor. A kindly bespectacled blend of Henry David Thoreau, Thomas Edison, and Henry Ford, Fuller was in fact so far ahead of his time that the future, let alone the present, has yet to catch up to him. From his sleekly experimental Dymaxion cars (designed in the 1930s to be driven and, eventually, even flown) to the grand geodesic domes that made him an international celebrity and unlikely counterculture guru, Fuller promoted environmentally conscious designs with the potential to benefit everyone on Spaceship Earth.

Reverse that image 90 degrees and you find a contrary perspective. A consummate bullshit artist, Bucky Fuller's career was built on failure, if not outright fraud. With few of his ideas achieving commercial success, he amounted to nothing more than a hand-waving proponent of outlandish notions. Worse still, he was an aggressive manager of his own profile and patents, an authoritarian technocrat who sought not students but compliant disciples to disseminate his muddled messages. The lynchpin of this view: even the geodesic dome, Fuller's greatest "success," rested on a concept borrowed (to be charitable) from an aspiring student sculptor.

The reality in Keats's book is a smeared superposition of these two representations — Fuller as a blend of the visionary's own image-making and of the historical record. The book balances these complementary images — genius and crackpot — until they are in tension with one another like the trusses in one of Fuller's geometrical structures.

It should be noted that Keats (right) is a colorful character himself. An experimental philosopher and conceptual artist, in 2000 he sold his thoughts, priced by the minute, to patrons at a San Francisco art gallery. Even if we accept that he is tuned-in to aspects of Fuller's "persona," Keats still appraises him as a "cultish prophet." He was "rightly renowned," writes Keats, but "for the wrong reasons." Disentangling his inventions from the cult of personality, Keats in fact concludes that Fuller has real legs, even practical gravitas. In particular, Fuller's advocacy of what he called "comprehensive anticipatory design science" promulgates principles relevant to fixing today's societal and environmental problems. In this century, "innovation" is far more than a corporate buzzword. As our new national mantra — "Be an entrepreneur! Innovate! Disrupt!" — it generates billions of dollars in tech sector investment and encourages a generation of students to pursue science and engineering careers. Places as diverse as university labs, art museums, and "maker spaces" promote the idea that the future can be — must be — consciously designed.

Finding a Fuller Life

Peeling away the myths that Fuller and his acolytes applied to his life like so many layers of fertilizer is no easy task. It's not for a lack of historical sources. Fuller consciously, even obsessively, documented his own existence, referring to himself as an experiment: "Guinea Pig B," as he phrased it. The Chronofile, assembled by Fuller and his assistants, is perhaps, Keats says, the most comprehensive record of any individual's life. Now maintained by Stanford University, it challenges scholars with 1,200 linear feet of boxes containing manuscripts, drawings, and tapes of lectures (as well as overdue library notices and grocery lists). Fuller's was not a life unrecorded. But it is a life practically un-examinable in any comprehensive way. The finding aid for the Fuller collection — the basic tool historians use to find something in an archival collection — is 1,283 pages long. Keats's book just breaks 200 pages.

Fuller advertised those records as evidence of his commitment to autobiographical objectivity. Yet peeking through that smokescreen of self-mythologizing in fact provides ample evidence that, even when it came to basic moments in Fuller's life, the visionary designer was anything but a reliable narrator. For instance, central to Bucky Fuller's story was a winter evening in 1927 when, beset by financial woes and a string of business failures, he resolved to end his life in the icy waters of Lake Michigan. A voice, telling Fuller that he "belonged to the Universe," convinced him that his life had purpose. Returning home in a trance, he then remained silent for two years (maybe); wrote 5,000 pages of notes (maybe); became a vegetarian (maybe); started to lecture, publish, and craft his own legend (certainly).

Readers who possess sufficient fortitude to brave the Chronofile, writes Keats, might be disconcerted at how little of Fuller's autobiography agrees with facts. Clearly, interpretative flexibility with his personal life and professional accomplishments was central to Fuller's success. It enabled him to appeal to audiences as diverse as Pentagon procurement officers and 1970s-era college students.

I Seem to Be a Verb

In 1970, when he was traveling 250 days or more a year, the kinetic Fuller noted that he had ceased being a noun. Instead, he wrote, "I seem to be a verb, an evolutionary process." Grammar aside, Fuller's life was certainly a dynamic one. Born in Massachusetts in 1895, the same year that the x-ray was discovered and H. G. Wells published The Time Machine, Fuller believed in the power of technology to change society. Before Harvard University expelled him in 1915 for what Fuller once described as "general irresponsibility," the future designer witnessed the appearance of Marconi's wireless telegraphy, Taylor's scientific management principles, and Ford's assembly line. Presumably, these fired his imagination far more than did fusty university rules and traditions.

Fuller's kineticism — his alleged verb-like quality — enabled him to vault between disparate communities and across disciplinary boundaries and link them. Yet for someone whom left-leaning university students embraced as an iconoclastic advocate for international peace and cooperation, his professional life was enormously shaped by the military. During World War I, Fuller offered himself and his family's cabin cruiser to the US Navy for submarine spotting patrols. The Navy reciprocated by sending Fuller to Annapolis for officers' training, which may well have been the making of him. Learning about ocean navigation, wireless communications, and mechanics would prove inordinately useful in helping him imagine and invent things in decades to come.

With the war's end, Fuller, now married, turned his attention to business. Working with his father-in-law, he focused on improving the design of affordable modular housing. After years of effort, their company failed just before the Great Depression. Undaunted, Fuller then attempted to reinvent the average American's two main possessions: house and car. He also trademarked the name "Dymaxion" — coined by a publicist at a Chicago department store who tried to meld three of Fuller's favorite words: dynamic, maximum, and tension. He also built futuristic prototypes. These were summarily rejected by the design establishment and construction industry.

In 1940, he was again saved by the military. Fuller had developed a design for a Dymaxion Deployment Unit. This was a lightweight, circular metal structure inspired by the grain storage bins he saw while driving through the Illinois countryside. With war on the horizon, Fuller offered the units to the US Army to house troops and store supplies. By October 1941, the first ones were coming off assembly lines for deployment at Allied military sites throughout the world. At the same time, in New York, the Museum of Modern Art put one on display in its courtyard. Milking this first notable career success, Fuller was able to spend the war in Washington directing mechanical engineering for the Board of Economic Warfare.

While in DC, Fuller designed and patented his Dymaxion World Map. Eliminating the spatial distortions of traditional Mercator projection, Fuller broke the world into 20 equilateral triangles, projected onto a multi-sided polyhedron, which could then be unfolded and flattened. As Keats describes it — inexplicably, the book does not have illustrations — Fuller's Dymaxion map was a "remarkably neutral platform." One could use it to center the world around any one point instead of privileging a particular country or landmass. A March 1943 issue of Life included "Buckminster Fuller's Dymaxion World," a cuttable, colorful centerfold for the magazine's 3,000,000 readers who could assemble and reconfigure it as they liked.

The success of his Dymaxion structures and map, after two decades of business failures, showcases two key aspects of Fuller's acumen. One was his unrelenting perseverance in the face of skepticism and outright rejection. Connected to this was what we might rightly think of as Fuller's greatest product: himself. The striving designer, writes Keats, "could easily have been an ad man himself." But, in 1945, with the war coming to a close, Fuller had not yet succeeded in turning himself into a household name. That would take another global conflict and another geometric reconfiguration of his architectural ideas.

From Cold War to Communes

Playboy's 1972 interview with the "visionary architect/inventor/ philosopher" — he was then 77 years old — is classic Fuller. Nuggets of insights are scattered amid a morass of quasi-scientific monologue that must have tested the interviewer's patience (e.g., humans are essentially "walking coral reefs […] an aggregate of electromagnetic waves," the drug problem in the United States was caused by “Chinese psycho-guerrilla warfare,” etc.). If it weren’t for the incredible proliferation of geodesic domes throughout the world, Fuller confessed he “wouldn’t be very well known.” And, when asked whether he was bothered by the fact that his most famous innovation was used by the military, Fuller demurred. “How tools are used,” he explained, “is not the responsibility of the inventor.”

Even in his seeming candor, Fuller obfuscated. True, Fuller had not developed the geodesic dome for the American military, but without the catalysis of the Cold War and the military’s subsequent embrace of the structure, Fuller would not have achieved his global reputation. Before the structure became an icon of 1960s counterculture, it passed first through the crucible of the Cold War’s military-industrial complex. (Domes sheltered radar stations that served as the United States’s early warning system against a Russian bomber strike, for example.) And, because the Cold War was a global conflict that reached deep into every aspect of American life, geodesic domes built overseas at world’s fairs served as symbols of American technological prowess. Fuller’s dome design swiftly became a symbol and instrument of American power.

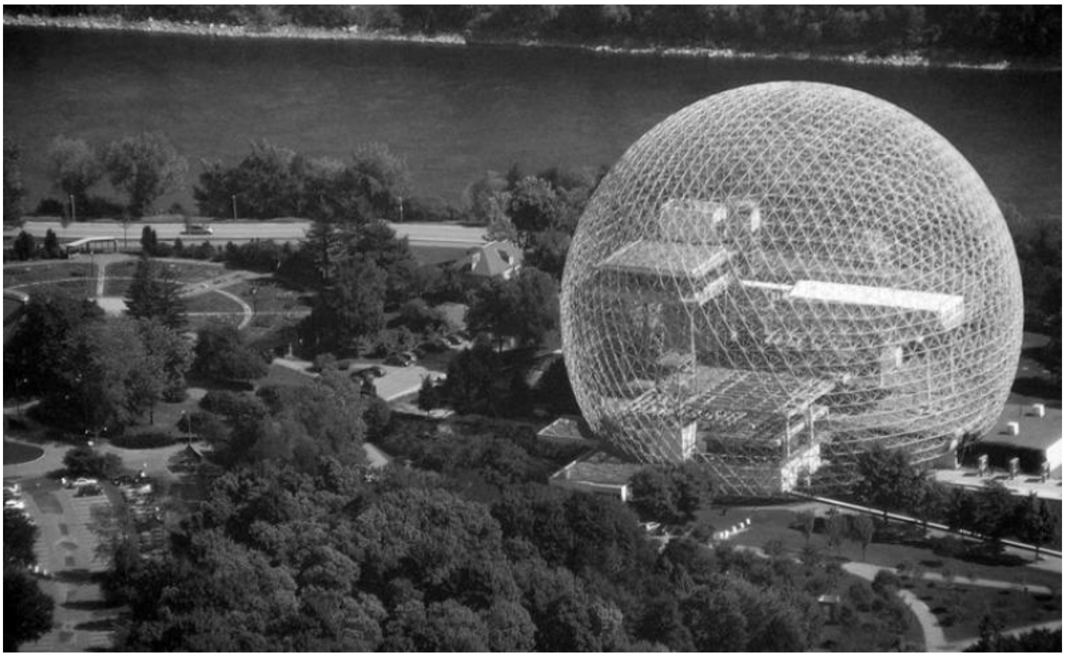
Fuller’s Playboy interview also strategically elides a historical detail that Keats reveals in You Belong to the Universe: the geodesic dome’s invention is contested territory. Fuller’s most prominent invention originated not in some military laboratory but in the avant-garde atmosphere of North Carolina’s Black Mountain College. Fuller arrived there in 1948 as a visiting architecture professor with an Airstream trailer full of geometrical models. Under Fuller’s supervision, students first tried to build a structure using venetian blind slats as trusses held in place via tension. It collapsed.

Kenneth Snelson was one of the Black Mountain students mesmerized by Fuller’s blend of design and futurism. Over the winter of 1948–’49, Snelson built models whose parts were secured by taut wires, the balance of tension providing structural stability. Snelson showed Fuller his model. By the summer of 1949, the school’s students, guided by Fuller, successfully built a geodesic dome using metal curtain rods purchased at the Woolworth’s in Asheville.

A geodesic dome is a complex icosahedron — imagine some of those many-sided dice from Dungeons & Dragons — curved into a spherical shape. The dome’s basic design principle features a superstructure based on interconnected triangles. Adding triangles approximates a sphere more closely. The structure’s advantage comes from its strength-to-weight ratio and relative ease of transport and assembly.

Fuller began to refer to the engineering principle Snelson had used as “tensegrity” — a clever portmanteau of “tension” and “integrity.” He later patented this design concept just as he did the geodesic dome itself. Snelson's name appears in neither patent application. (Fuller's intellectual property claims notwithstanding, Snelson went on to have a successful career as a sculptor. His "Needle Tower," a 60-foot-tall tensegrity piece, sits in front of the Hirshhorn Museum in Washington.) In historical research, playing the "who discovered it first?" game is a tricky and often unenlightening business. Examples of simultaneous invention litter the past. In this case, the truth likely lies somewhere between Fuller's ready opportunism and Snelson's years of protestations. Developing and promoting the geodesic dome — inventing something isn't the same as nurturing its diffusion — certainly required some synergy between teacher and student.

As a skilled booster-cum-huckster, Fuller excelled at promoting the geodesic dome's potential. Starting in 1949, he advertised geodesic domes as a technocratic tool for American success on Cold War battlefields overseas and at home. That same year, he oversaw the construction of a demonstration dome at the Pentagon and worked with MIT students to design a bigger one that could shelter Air Force planes and their crews. The Marine Corps, which eventually built 300 of them, envisioned their speedy deployment into combat hot zones. To manufacture his domes, Fuller set up companies on his own, and then, starting in 1966, he licensed scores of other firms to do so for a five percent royalty. As they migrated from military bases to trade fairs, the thousands of geodesic domes sprouting around the world became not just a product of American capitalism but a symbol of it as well.



The Biosphere geodesic dome, designed by Buckminster Fuller, at the Montreal 1967 Expo.

The dome's final, wonderfully ironic transmutation occurred at the hands of the United States's counterculture. At places like Drop City, a Colorado hippie commune started in 1965, geodesic domes popped up like so many mushrooms. And, like many aspects of that groovy era, geodesic domes — promoted by venues such as The Whole Earth Catalog — were marketed and sold. Keats's final chapter describes how Californian Lloyd Kahn converted to Fuller-ism after hearing him speak at the Esalen Institute in Big Sur. "Enthralled by Fuller's idea that waste could be eliminated by design," Kahn produced books extolling domes as homes. Only years later did he renounce them as the universal panacea for housing shortages and environmental problems.

Over the course of three decades Fuller's architectural icon had traveled from art project, to Cold War instrument of power, to countercultural icon, to a fading symbol of utopian aspirations. What a long strange trip it had been.

Spaceship Earth's Captain

Geodesics — the domes themselves and their underlying geometry — made Buckminster Fuller into an international celebrity. When Time featured him on its cover in 1964, the now-familiar architecture dominated the picture, just as it did 50 years later when a US postage stamp honored Fuller. In 1985, when three scientists discovered a novel form of carbon, a molecule of 60 atoms arranged in a soccer ball-like shape, the new molecules — formally called "buckminsterfullerenes" — became known as "buckyballs."

As Fuller told Calvin Tomkins in a lengthy profile for The New Yorker, his primary career goal was "to find nature's geometry." Although there isn't a specific chapter devoted to geodesic domes in You Belong to the Universe, it's hard to escape their presence in Jonathon Keats's book. Whether he's describing Fuller's Dymaxion car or his World Game (an educational simulation Fuller began promoting in the 1960s as an alternative to the war-gaming of nuclear strategists at places like the RAND Corporation), Keats signals Fuller's long obsession with geometries of space and power.

By the 1960s, Fuller's attentions were shifting away from actual designs to global implementation. Having secured a professorship at Southern Illinois University, he spent increasing amounts of time on the road disseminating his ideas. Articles about him often called attention to the number of times he had circled the planet via plane and ship. He became an example of what Keats might call a "world-changer", a person with an expansive view of our planet's systemic shortcomings and how Big Ideas — specifically, Fuller's — could fix them. His lecturing stamina became legendary. Picture a sprawling TED talk lasting for hours with dozens of ideas, concepts, and neologisms projected at the audience in a manic torrent of words. (Thanks to You Tube, one can get a sense of the Fuller experience.) He became, as one 1970s-era hagiographer called him, the “Dymaxion messiah.”

In the mid-1960s, the phrase “Spaceship Earth” — a term Fuller claimed to have coined (falsely, according to the Oxford English Dictionary) — entered the lexicon. A perfect phrase for the Space Race, the popularization of the idea began with Kenneth E. Boulding, an economist at the University of Michigan. In May 1965, Boulding declared that society needed to recognize earth as a “single spaceship, without unlimited reservoirs of anything.” Instead of wasteful consumption coupled with relentless pressure to increase production, this “spaceman economy” must be commensurate with life aboard “a tiny sphere, closed, limited, crowded.” The idea that the earth might be likened to a spaceship became much less abstract in December 1968, when Apollo astronauts sent back the first color pictures of the whole planet from space.

This planetary perspective was perfect fodder for Fuller. In his 1969 book Operating Manual for Spaceship Earth, he urged engineers, scientists, and world leaders to steer the planet away from imminent eco-catastrophe. Fuller was well-suited for an era when “the future” became an object of serious scholarly study and professional “futurologists” like Alvin Toffler became jet-setting celebrities. This anxiety about the future dovetailed with fin de siècle thinking as the 20th century drew to a close. Through his public talks, voluminous writings, and promotion of cooperation simulations like the World Game, he presented himself — by dint of his life experience and comprehensive approach to “whole systems” design — as the putative captain of Spaceship Earth.

Finding a Fuller for Today

Buckminster Fuller was different in an essential way from other future-tellers of his era. Not content with hand-waving prognostications about what was over the horizon, Fuller, and the students and designers he attracted, traded pencils and paper for the hammer and welder’s torch to build things they imagined as essential for the future. In this way, they acted not as visionaries but what I have called “visioneers.” The former offer only speculations, informed or not, about what the future, especially the technological future, might hold. The latter work to bring these over-the-horizon conjectures closer to physical reality. Being a visioneer demands a capacious view of the future — something Fuller had in spades — and a pronounced ability to rally people to one’s vision of the future (ditto) coupled with some modicum of real-world technical expertise and credentials. No mere speculator, Fuller transformed at least some of his ideas into artifacts in order to see how they might perform in the real world.

So, how, if at all, does this history of past "futures" matter for us in the present? Keats argues that the design principles embedded in Fuller's innovations, even if they might not have been successful when first proposed, are "pertinent to Spaceship Earth in 2016." Artifacts like the Dymaxion car are, he argues, "exemplars of design science." For example, Fuller's car anticipated, according to Keats, today's use of biomimesis, in which features from nature are incorporated into designs. However, this said, unless Keats is a believer in intelligent design, nature is not the "world's most experienced problem solver." Evolution in nature proceeds via random events, not conscious choices.

The author's imagination occasionally runs too wild. A case in point is his suggestion that the "distributed decision making" of slime molds "can provide a new model for democracy." And Keats misses some low-hanging opportunities as well. Fuller's failed plan to mass produce houses for the post–World War II American family could easily have been juxtaposed with the commercial success of suburban houses built in assembly line fashion — at considerable environmental cost — in places like Levittown, New York. Yet his even-handed treatment of Fuller's failures and successes enables him to tease out their lessons. One can read Keats's book as a thought experiment about how the future might be designed.

Today, it's common to think in terms of technological ecosystems, whether they are centered around specific products — your smartphone and its myriad apps — or a region such as Southern California. Familiar species of people in these ecosystems include engineers, designers, patent lawyers, and so forth. One certainly wouldn't want an ecosystem populated with too many self-promoting, longwinded autodidacts. But a healthy innovation system certainly needs at least a few Buckminster Fullers to pipe compelling tunes that draw in aspiring comprehensive designers to new visions of tomorrow.
