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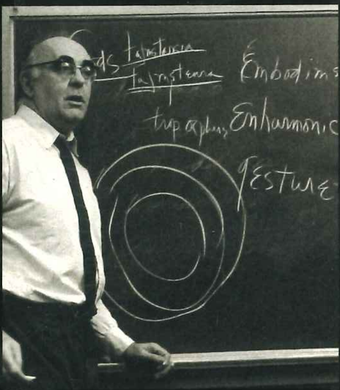
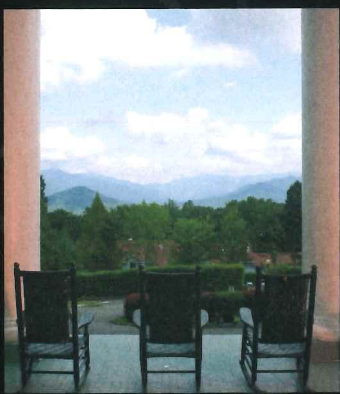
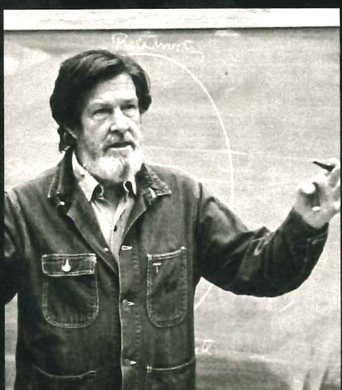
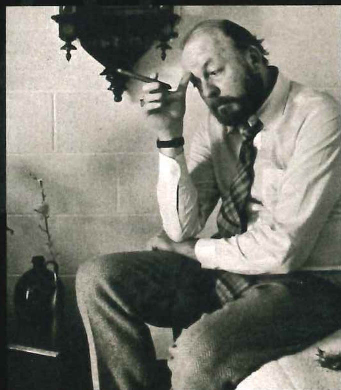
BLACK MOUNTAIN COLLEGE Special Edition











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R. Buckminster Fuller's Strange Bedfellows

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R. Buckminster Fuller's peripatetic teaching and design practices made for some unusual partnerships. In the years immediately following World War II, support for Fuller's work toggled between a seemingly incongruous set of patrons: educational institutions and the U.S. military. For example, while Fuller's first successful geodesic dome construction was erected on the lawn of the Pentagon Garden in Washington in 1949, Fuller recreated that version and tested a new plastic insulating skin a few weeks later at Black Mountain College, an experimental arts college in rural western North Carolina. Throughout the 1950s and 1960s, he lectured and hosted workshops at colleges and universities around the U.S. while simultaneously working with the U.S. military to develop surveillance structures still in operation today. I've come to think of Fuller as one of the 20th century's most charismatic performance artists, time and again drumming up interest in the most unexpected places for his vision of nomadic, computer-managed, data visualization structures. The results of that self-promotional project are quixotic: the adoption of his ideas by military intelligence with just as much enthusiasm as by art and architecture students, and arts and educational organizations.

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Efficiency and bricolage, portability and ad hoc construction: Fuller's designs were employed for often contradictory purposes by their various audiences. But this may in fact be the thread of continuity in Fuller's work. Fuller's sense of the geodesic dome as evocative of a networked Earth, his claim of "Spaceship Earth" as a hybrid ecological-architectural-technological object, his World Game project designed as a heuristic device to encourage college students' participation in managing global resources; in various ways each of these projects advocate for portable constructions to be used for information collection and display. This goal was understood in very different ways by his supporters in the U.S. military, his college student fans, or countercultural figures like Stewart Brand and the satellite communes profiled in Brand's *The Whole Earth Catalog* that formed Fuller's expanding audience by the 1960s.[1]

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Fuller's connection to the U.S. military began well before his experiments with geodesic construction. Fuller had joined the U.S. Navy in 1917 and served during and after World War I. His experiences in the war, including his invention of a winch to haul downed airplanes out of the ocean, became the basis for a career-long exploration of nomadic constructions, oceanographic and aerial cartography, and naval and aeronautic engineering as avenues to move toward a more equitable distribution of resources and efficient architectural forms. By the late 1920s Fuller began to apply naval engineering principles about buoyancy and hydrodynamic resistance to structures built on land.

Taking as his examples both aeronautic and maritime constructions (and their pairing on military aircraft carriers), Fuller realized that land-bound structures had a tremendous implicit advantage that encumbered greater efficiency: an almost complete avoidance of the factors of mass and mobility. Both air and sea vessels were preeminently concerned with weight, for purposes of either buoyancy or lift. This emphasis on weight separated more vulnerable constructions for flight and sailing with the fixed, overbuilt, and inefficient architecture on land. As Fuller lamented, "No architects even know what buildings weigh ... Buildings are being built as fortresses, historically, really, the heavier, bigger the better."[2]

By emphasizing the materially efficient and moveable constructions of naval designs, Fuller set out to revolutionize shelter design. Due to the onset of WWII, the easiest way to do that by the 1940s was to seek out the wealthiest patron in the U.S.—the military. In 1940 Fuller tweaked the design of his 1927 4-D House, a circular structure with a flexibly arranged internal wall scheme organized around a central supporting "mast," to construct Dymaxion Deployment Units (DDUs), war shelters 20 feet in diameter made of corrugated steel. After one was displayed in the MoMA's sculpture garden in New York in 1941, the U.S. Army Signal Corps commissioned 200 from Fuller, and these silo-like structures were deployed in Mediterranean, Persian Gulf, and Pacific U.S. military bases. Fuller folded the design of the DDU into his 1944-46 Wichita House. Designed in collaboration with a Beech Aircraft engineering team, the Wichita House featured a curved steel exterior with a 360-degree continuous window skin encasing its radial plan, and was promoted as an easily transported, quick-assembly affordable suburban home.

In the lightweight Wichita House, Fuller strove to distribute the load of the structure off the walls in order to allow the home to be moved easily. When Fuller arrived at Black Mountain College in 1948 for his first ever teaching commission, he began collaborating with sculpture student Kenneth Snelson in developing what Fuller termed "tensegrity," an engineering principle of discontinuous compression and continuous tension that updated Fuller's previous mast structures. In Snelson's 1948 *X-Piece*, for example, nylon wires suspend the topmost wood form, the lower wood figure acting as a strut bracing the threads. Load is distributed through the wires' high tension, rigging the top figure to balance upright. The tensegrity principle dispersed many compressive elements, creating an internal energy system that strengthened synergistically with the addition of further elements. Tensegrity allows radio towers, for example, to rise to great heights without external buttresses or deeply grounded foundations.

Fuller and Snelson's tensegrity developments precipitated the construction of a large-scale, 22-foot high geodesic dome at Black Mountain College. After a long series of (pre-computer era) calculations, one damp morning, cheap, commercially available Venetian blind slats were assembled as the dome's armature. The dome unsurprisingly failed to rise, and was good-naturedly termed the Supine Dome. According to Fuller, though he was aware that the Venetian blinds needed to be doubled-up in order to have sufficient tensile strength to elevate the dome, he decided to push ahead with insufficient materials so as to demonstrate that structures could be gradually built up to the point of standing in order to create materially and economically efficient buildings. Lightness was a prime feature of the dome's design, as he stated, "I want to build a building that they're not afraid of having it collapse because it's so light it can't hurt anybody, it's like confetti ... [to] stop having it fall down ... [to] make it stand up."[3] As he continued, "So you start with this supine thing, and then keep fortifying until now ... it's standing up."[4]

He returned to Black Mountain as Director of the Summer Institute in 1949 with a dozen or so Institute of Design students from Chicago and a newly manufactured prototype dome, this one a more modestly scaled 14-foot diameter, constructed of flexible metal tubing. The dome was erected successfully, the same one that had been prepared earlier for the demonstration at the Pentagon.[5]

Fuller's greatest hope for the lattice dome was that it could be easily transported, thereby uncoupling shelter from site in a way that would harbinger a new post-war era of nomadism. Though Fuller anticipated the turn towards domestic home construction in the 1950s, his greatest patronage remained U.S. military contracts. In 1954-55 Fuller was asked by the U.S. Air Force to develop a design for their Defense Early Warning (DEW) line surveillance radar installation to be situated along a 3,000-mile stretch of the Arctic in Alaska and Northern Canada. Geodesics, Inc., Fuller's newly created company for government and military contracts staffed by his former students, responded with a 55-foot diameter fiberglass plastic "radome" design, standing 40 feet high, which could be airlifted to areas with unpredictable weather and rapidly constructed on site. Eventually hundreds of domes were purchased by the U.S. Air Force and Marines.

The exterior silhouette of the radome was indelibly Fuller's; it is interesting that what was happening *inside* these domes was also deeply connected to his desire to reorient perspectives about the representation of space. Fuller had long sought to visualize the world in new ways; for example, in his *Dymaxion Projection* map from 1946 one orientation of the map's dynamic plan could arrange the world according to an "Airocean" or "one ocean route" which emphasized the critical part played by seafaring and air traffic in global transit, while also indicating features such as air and ocean currents.

The DEW line was initiated by the predecessor agency of the North American Aerospace Defense Command (NORAD), and the form of radar surveillance undertaken in 1950 would become known by 1954 as the Semi-Automatic Ground Environment (SAGE) system, a program initiated in collaboration with the British Royal Air Force (RAF).[6] SAGE was a system of computers and networking equipment drawing data from many radar sites to create a single picture of the airspace over a wide area. It utilized what was then the largest and most powerful computer ever built, the AN/FSQ-7. Operators at various "direction centers" used light guns to select targets visible on one of 100 system console individual screens, targets that could be sent to a remote launch site by the U.S. Strategic Air Command (SAC) via teleprinter. Information about the whole of the surveillance and deployment activity was simultaneously returned to SAC Command Centers to plot courses on a large projected map in a darkened theater environment.[7]

Fuller adapted this notion of a dynamic, ever-updating projected map in his Geoscope proposal, a precursor to today's "digital globes." A 21-foot prototype of a completely elevated geodesic dome sphere had been constructed at his instigation at Cornell University in 1952, and he brought versions of it to other college campuses in 1953-54. In 1961-62 Fuller developed the idea for the Geoscope, which would allow spectators inside a 200-foot-diameter globe covered in colored lights functioning as a large spherical display of constantly refreshed networked information data. This would allow visitors to visualize, study, and possibly redesign the total human environment, including shelter, infrastructure, communication, and other interconnected systems—in order to quickly and efficiently allocate those resources globally.[8]

The Geoscope project never harnessed sufficient computing power to function as a real-time data visualization object, nor did Fuller develop a lighting source with sufficiently detailed sensors to represent complexly shifting variables. Fuller went low-tech in his next real-time information mapping project, the World Game, which launched in 1969 at the New York Studio School for Drawing, Painting, and Sculpture in Greenwich Village. The intention of the project, developed with John McHale, was to return the responsibility of design (both in the sense of construction and information design) to college students in much the way his 1948-49 Black Mountain College dome assemblies had. In the case of the World Game, the map is a large projection of the Earth beneath the feet of participants, treating the world as a target of almost extraterrestrial inspection. As an educational simulation, students were invited to collect and share data about global resources and weapons represented as chips moved around the "game" board, performing global planning at a collective level.

The notion of a supercomputer capable of real time-data collection and visualization was farfetched in 1969—the World Game Institute offices, founded in 1972 in Philadelphia, were eventually chockablock with data typed on index cards stuffed into card catalog files, a supremely low-tech database. However, Fuller's radome is to this day an emblem of high-tech digital surveillance—so-called "golf ball" radomes are used around the world as ground stations housing antennae for satellite surveillance, most visibly in RAF Menwith Hill, England, a compound constructed in 1954 and currently the largest electronic communication monitoring station in the world, run by the RAF in conjunction with the U.S. National Security Agency (NSA). Unfortunately, the 100,000 phone calls able to be intercepted simultaneously at Menwith Hill are indicative more of an era of shadowy surveillance than the open information age Fuller hailed. And yet the geodesic dome became one of the ubiquitous structures of the 2012 Occupy encampments. Fuller's influence has thrived in quarters most uneasy: he is perhaps the only man loved by both the military-surveillance complex and radical university students.

Notes

1. See Fred Turner, "Technocrat for the Counterculture," in Hsiao-Yun Chu and Roberto G. Trujillo, eds., *New Views on R. Buckminster Fuller*, Stanford: Stanford Univ. Press, 2009.

2. Fuller interviewed by Martin Duberman, 26 June 1969, 13. Duberman Papers, North Carolina State Archives.

3. Fuller interview with Duberman, 15.

4. Ibid., 16.

5. The second dome, according to Fuller, was a "small Geodesic Structure of fourteen-foot diameter erected in [the] garden of [the] Pentagon Building in Washington, D.C. March 13, 1949." Letter to Dean Wells Bennett, School of Architecture & Design, University of Michigan, May 14, 1949. Fuller Archive at Stanford University.

6. NORAD's predecessor was the Continental Air Defense Command (CONAD). Until 1981 NORAD as known as the North American Air Defense Command. NORAD was founded in 1956 to provide warning and defense in the event of an air attack against the United States and Canada. Its command center is located outside Colorado Springs, Colorado, with bases around North America.

7. The war room design of Stanley Kubrick's 1964 movie *Dr. Strangelove* was based on the SAGE Command Center at Ent Air Force Base in Colorado.

8. The plan for a geodesic sphere as data hub connected to Fuller's proposal of "satellite structures," for which he imagined a series of geodesic domes of up to two-miles in diameter in orbit around the Earth and the moon that would function both as telecommunications satellites and as off-planet housing. His vision of domes as mobile information hubs cum shelters may help explain why domes acquired their special purchase in post-war public and military cultures, especially through their uses in exhibition design and as a setting for projection. The viewing subject's processing of complex media in such a space, which was deemed a crucial aesthetic confrontation with the psychic and physical demands of Cold War modernity, helped to meet the most important challenge: to imagine humans inhabiting spaces beyond the envelope of the Earth.