*PRAXIS* 15: Bad Architectures

**Who Let the Air Out? How Pneumatics Went From Rad to Bad in the 1970s**

by Whitney Moon

The year was 1970. Kenzo Tange and Uzo Nishiyama’s World Expo in Osaka, Japan featured spectacular pneumatic visions within the long-span cable-stiffened dome of the US Pavilion, the air-filled arches of the Fuji Group Pavilion, and numerous other inflated, plastic, and bubble-shaped structures.[[1]](#endnote-1) Simultaneously, Ant Farm was completing their *Inflatocookbook* (1971), which became (and has remained) the go-to do-it-yourself (DIY) manual for pneumatic experimentation. Cedric Price and Frank Newby were also finalizing *Air Structures: A Survey* (1971)*,* an extensive research report covering the history, principles, applications and technical specifications for air-filled enclosures. The year 1970 also marked the formation of Chrysalis—a Los Angeles-based architectural collective—comprised of Mike Davies, Chris Dawson, Alan Stanton and Joseph Valerio. As Master of Architecture (M.Arch) students at the University of California, Los Angeles (UCLA), the four members were committed to the design and construction of experimental structures, especially with a penchant for anything pneumatic.[[2]](#endnote-2)

In 1970, Chrysalis headed to the desert. Unlike their countercultural peers, who were fascinated by the barren landscape as an unchartered terrain for aesthetic and rhetorical exploration, they initially employed the extreme environment as a method for advancing both the technical and social project of pneumatic structures **(Fig. 1)**.[[3]](#endnote-3) It was in Palm Desert, California that Chrysalis tested the thermal performance of various materials and inflated assemblies, calling into question issues of durability and human comfort. In the course of just a few years, they designed and executed dozens of innovative projects. Developed in collaboration with local aerospace, film, and media companies, Chrysalis’ early works eclipsed the low-tech naiveté of pneumatics being generated by many of their contemporaries (e.g., Ant Farm, Archigram, Haus-Rucker Co., Coop Himmelb(l)au, etc.), and were guided instead by the refined structural and material experimentation of lightweight engineers like Frei Otto and R. Buckminster Fuller.[[4]](#endnote-4)

Although little has been written about their practice, Chrysalis occupies a key position in the history of inflatable architecture. Their pioneering constructions index a few key ideas and phenomena: the rise of pneumatics as a radical project during the late 1960s and early 70s, the viability (and promise) of air structures as an alternative solution to conventional buildings, and the factors which likely led to the collapse of inflatables by the mid 1970s. By examining a selection of experimental structures generated by Chrysalis from 1970-1975—including those that prompted their initial formation—this essay maps their contributions to the development of pneumatic architecture as both a radical and pragmatic endeavor. Through their work with air, this collective of four young architects made visible the potential and pitfalls of an unorthodox construction type.

**“Rad”**

Coopted by the “counterculture” in the 1960s, pneumatics became the device for avoiding the formal, material and ideological constraints of architectural modernism.[[5]](#endnote-5) Capitalized on the allure and availability of plastics, air was the “rad” alternative to the establishment’s “bad” buildings. In addition to offering alternative methods of spatial construction and experiences, inflatables introduced an alluring temporality to an industry that has historically opted to monumentalize rather than ephemeralize.[[6]](#endnote-6) Through their plasticity and perceived impermanence, architectural inflatables also avoided the aestheticized iconography of a modernism tarnished by failed utopias.

According to Cedric Price, an advocate for architectural lightness and a leading figure in the research and development of pneumatics, “The value of permanence must be proven not merely assumed.”[[7]](#endnote-7) Price’s question of permanence within the pages of *Archigram*’s third issue—entitled *Expendability: Towards Throwaway Architecture* (1963)—called attention to the emerging ubiquity of disposable products in contemporary culture, and how this trend might be informing architectural production.[[8]](#endnote-8) What these emergent types shared was a conceptual and material quest for lightness, fueled by a radical rethinking of what architecture could be. This shift towards ephemerality in the mid to late 1960s exposed the discipline to new possibilities of performance, both technical and social. Building upon the recently established architectural terms ‘clip-on,’ ‘capsules,’ ‘pods’ and ‘plug-ins,’ novel architectures mirrored a pop-cultural fascination with notions of mobility, instantaneity, and scalability.

As a means to counteract the conventions, styles, and rules dictated by traditional definitions of architecture, Peter Cook—a founding member of Archigram—offered insight into a way out of this conundrum. In his book *Experimental Architecture* (1970) Cook writes, “Experimental work frequently finds its grit and inspiration in the desire to undermine and explode all rival positions.”[[9]](#endnote-9) Fed up with what he referred to as “decrepit technologies propped-up by an elitist aesthetic language,” Cook proposed an alternative solution for the next generation of aspiring architects: “to *experiment out of architecture.”*[[10]](#endnote-10) By encouraging the development of architecture beyond (and even against) buildings, Cook released a new generation of architects from the shackles of professional and disciplinary protocols. Yet, Cook’s message was also problematic: it suggested an antagonistic relationship towards architecture as buildings, prompting many young practices to pursue their radical ideas exclusively through representation and rhetoric, rather than actualized constructions.

Pneumatics provided an answer to Cook’s call for looking past “decrepit technologies” and a move “out of architecture,” without retreating to drawing. They were constructions that were not buildings with a capital b. As Reyner Banham observed in 1968,

All architecture has to mediate between an outer and an inner environment in some way, but if you can sense a rigid structure actually doing it (dripping sounds, tiles flying off, windows rattling) it usually means a malfunction. An inflatable, on the other hand, in its state of active homeostasis, trimming adjusting and taking up strains, is malfunctioning if it *doesn’t* squirm and creak. As an adjustable and largely self-regulating membrane it is more truly like the skin of a living creature that the metaphorical “skin” of, say, a glass-walled office block.[[11]](#endnote-11)

An early advocate for inflatables, Banham romanticized their instability. In his 1965 essay “A Home is not a House,” Banham proposed *Environment-Bubble*, a domesticated utopia equipped with modern amenities **(Fig. 2)**.[[12]](#endnote-12) Although a radical and anti-monumental prototype for rethinking architecture’s relationship to technology, humans and the environment, its pneumatic enclosure was a flimsy, barely-there membrane, deployed only when needed. So, did Banham and his contemporaries take pneumatics seriously? Banham did, after all, call inflatables “wind bags,”[[13]](#endnote-13) and referred to his *Environment-Bubble* asa “standard of living package,”[[14]](#endnote-14) suggesting, ironically, that the pneumatic environment, in the words of architect and historian Thomas Leslie, “may in fact be more of a lusty technofantasy than a legitimate tectonic proposition.”[[15]](#endnote-15)

Although pneumatics became the default strategy for artists and architects striving to push the boundaries of form and space, on the low-tech and DIY end of the spectrum, they also dismantled the notion of architectural expertise. For example, Ant Farm’s *Inflatocookbook* instructed everyday users to make “fast, cheap inflatables,” fueling the ethos “that maybe anybody can should must take space-making beautifying into her, his own hands.”[[16]](#endnote-16) As a result, their low-fi attributions perpetuated the image of air filled structures as impermanent, unstable and unpredictable, ushering in skepticism about their feasibility as an architectural solution. Despite any demystification on how inflatables were made—promoting their proliferation—Ant Farm also addressed the environmental impact of their afterlife, albeit in a rather alarming fashion. With respect to polyethylene, the plastic sheeting most commonly used for DIY pneumatic constructions, they write:

The best way to recycle polyethylene is to reuse it, but when it gets many holes in it, it is no longer good as rain cover. The worst thing you can do with it is to put it in a garbage can—it will probably end up as land fill and never decompose. The best thing you can do with it is BURN it. When polyethylene burns it breaks down into CO2, H2O, and carbon which is the ugly black smoke produced but which will precipitate out of the air quickly and be absorbed by the earth.[[17]](#endnote-17)

This suggestion brings to light the darker side of pneumatics. Not only did the DIY approach rely on cheap and everyday materials like polyethylene, a petroleum-based plastic product, but it also perpetuated a problematic ethos of expendability in an era of increasing environmental awareness. Although these ephemeral constructions allowed for nearly instantaneous countercultural experimentation, they were also resource-intensive and wasteful. In addition, because they needed to be “plugged in,” pneumatics began to call into question their efficacy as an alternative to conventional modes of building.

For instance, in a 1971 edition of *Whole Earth Catalog—*a grassroots, DIY, countercultural magazine published from 1968-72—founder Stewart Brand, who had previously expressed his fascination with pneumatics and supported the work of Ant Farm, began to question their viability. According to Brand,

Inflatables are trippy, cheap, light, imaginative space, not architecture at all. They’re terrible to work in. The blazing redundant surfaces disorient; one wallows in space. When the sun goes behind a cloud you cease cooking and immediately start freezing. Environmentally, what an inflatable is best at is protecting you from a gentle rain. Wind wants to take the structure with it across the country, so you get into heavy anchoring operations.[[18]](#endnote-18)

Despite the romanticism and promise of the pneumatic project in the 1960s, cynicism set in by the early 1970s. The flash-in-the pan approach to DIY inflatables had fueled their rise in popularity, but also called into question whether the hippy-dippy nature of these “wind bags” was really an advisable trajectory for architecture. Simply put, the proliferation of DIY pneumatics privileged the low-tech, and their reliance on non-renewable resources (plastic and electricity) undermined their radical agency.

Was there still a future for pneumatic architecture? In August 1972, *Progressive Architecture* published a feature on the latest developments in air structures, acknowledging their mixed reception, yet advocating for their promising future. Despite an “uphill fight for acceptance” as feasible and serious building types, the article focused on various pneumatic pioneers who were battling social misconceptions through technical solutions.[[19]](#endnote-19) Challenging the perception of air structures as simply “tents, or tennis court covers, or temporary whims,”[[20]](#endnote-20) the issue examined the future prospects for pneumatics in the wake of the Osaka 1970 Expo, highlighting their advantages from a technological, environmental and social perspective.[[21]](#endnote-21) Chrysalis was allocated a three-page spread, which presented a diverse range of proposed and built works, including two designs for pending pneumatic patents that addressed thermal comfort and mobility: a skin of varying opacities, and a self-anchoring device.[[22]](#endnote-22) In addition to highlighting their novel technical solutions, the magazine applauded Chrysalis for their commitment in “the ability of the bubble to adapt, its speed of erection, its dynamic possibilities and its alterability.”[[23]](#endnote-23)

**Chrysalis**

Although inspired by the rhetoric and representational allure of countercultural architectural groups like Archigram, Chrysalis aspired to move pneumatics beyond an editorial project. According to Valerio, “What we did is we said: ‘We believe in all that stuff, but we also think that we need to raise the level of technology so that it’s not purely ephemeral.’”[[24]](#endnote-24) Chrysalis viewed pneumatics as radical because they offered an alternative to the norms of professional practice and served as a vehicle to expand the boundaries of architecture without abandoning building altogether. Chrysalis was dedicated to the advancement of inflatables as a viable form of architectural production by asking what air structures can do, and how they could do it better. Their desire to explore experimental lightweight structures as a counterpoint to conventional modes of construction was born out of a desire to, as Valerio explains, “do good architecture in the context of a system, and architectural profession, that seemed completely beholden to and part of the establishment.”[[25]](#endnote-25)

Chrysalis first experimented with pneumatics in Los Angeles during the late 1960s amid the entertainment and aerospace industries. Although their inflatables initially served as stage sets for World Expos, Hollywood films, bathing suit advertisements, infant enclosures, and seaside bachelor pads in *Playboy* magazine, the architectural collective wasn’t simply interested in the spectacle of inflatables. Rather, they had a rigorous agenda that involved not only the cultural performance of pneumatics—namely, their construction in the media—but, more importantly, their technical performance (i.e., material, structural and environmental). As Valerio recounts,

I think what we were always trying to do is to make a leap from this romantic vision to something that actually worked. One of the freedoms you had at UCLA in an academic environment is you didn't have to really work it all out. Then when we were working for any of the Hollywood studios or for any of the commercial work that we were doing, that was a situation where we seriously had to get building permits and we had to make these environments really work.[[26]](#endnote-26)

As young architects, the members of Chrysalis were committed to seeing their projects actualized. From ideation to inhabitation, their temporary experiments not only challenged conventional materials and methods of construction, but also raised new questions about the future of building.

Although Chrysalis formed in 1970, their pneumatic beginnings trace back to 1968, when EnviroLab members Alan Stanton and Chris Dawson collaborated with a group of scientists and artists working with the Los Angeles division of Experiments in Art and Technology (E.A.T.) on the inner theater of the Pepsi-Cola Pavilion for the 1970 World Expo in Osaka, Japan **(Fig. 3)**.[[27]](#endnote-27) An enormous, 90-foot diameter dome-shaped pneumatic structure comprised of Mylar,[[28]](#endnote-28) and conceived by the artist Robert Whitman, Stanton and Dawson were the interim go-to experts on how to actually construct the mirrored inflatable.[[29]](#endnote-29) *Mirror Dome* (1968-70) was initially prototyped at a smaller scale: two 20-foot diameter air-structure models constructed on a donated soundstage at MGM studios in Culver City.[[30]](#endnote-30) According to electrical engineer and scientific journalist Nilo Lindgren, “The group [Envirolab] actually did all the work themselves, laminating boards, constructing the gore patterns and taping them together to create the hemisphere.”[[31]](#endnote-31) Although Envirolab was able to deliver a technically resolved mirrored pneumatic dome at this smaller scale, production of the final inner-theater was turned over to G.T. Schlajdehal—a military contractor who had recently produced PAGEOS, an inflatable satellite for NASA.[[32]](#endnote-32)

In an attempt to prevent structural failure and to achieve optimum optical effects, the logic of the pneumatic was inverted: rather than being inflated, the inner-theater employed negative pressure technology (i.e., a vacuum effect). As Billy Klüver, head of the E.A.T. group and overseer of the pavilion’s conception and actualization recounts, “The Mirror was the largest spherical mirror ever made and was the first use of a Melinex, negative-pressure, air structure.”[[33]](#endnote-33) After some trial and error tests in a blimp hangar at the Marine Corps Air Station in Santa Ana, the full-scale mockup convinced E.A.T. to move forward with its fabrication in Japan. The final mirrored dome was inflated inside the primary pavilion structure—a 120-foot diameter faceted dome, designed by Japanese architect Tadashi Doi—whose exterior was engulfed in an artificial cloud, created by artist Fujiko Nakaya and physicist Thomas Lee.[[34]](#endnote-34) The result was an immersive multimedia experience—referred to by E.A.T. as a “living responsive environment”—that dissolved the boundaries between art, architecture, and technology through multiple interventions and collaborations **(Fig. 4)**.[[35]](#endnote-35) Although Stanton and Dawson were not responsible for the final construction of the inner-theater, word of their ability to technically solve the structural, material, and atmospheric logistics of the mirrored inflatable led to yet another commission.[[36]](#endnote-36)

In 1970, Chrysalis designed and fabricated *Myra Dome,* a mirrored pneumatic dome for the film *Myra Breckinridge* **(Fig. 5)**.[[37]](#endnote-37) Directed by Mike Sarne and based on Gore Vidal’s 1968 novel of the same name, the film is about a man named Myron Breckinridge (played by Rex Reed), who has a sex change and becomes Myra Breckinridge (played by Raquel Welch).[[38]](#endnote-38) The enormous pneumatic set contributed a psychedelic flair to key scenes in the roundly maligned film.[[39]](#endnote-39) Clearly borrowing from the material, structural, and technical logic of the inner-theater at Expo ’70, *Myra Dome* allowed Chrysalis to execute their previous 20-foot diameter dome mockups for Osaka at the intended full scale, further advancing their architectural experimentation into the realms of both technical (aerospace) and cultural (entertainment industry) performance.

The next pneumatic set designed by Chrysalis was *Dodecahedron* (1970), a hybrid structure comprised of a metal frame with infill panels of inflated mirrored Mylar **(Fig. 6)**.[[40]](#endnote-40) Commissioned by Jantzen, a women’s swimwear company, it was conceived as a stage to photograph their new swimsuit collection.[[41]](#endnote-41) A polyhedron with twelve flat faces, it evoked the geometry and ethos of Fuller’s lightweight geodesic domes with the pop playfulness of Andy Warhol’s silver-lined Factory. Instead of a flimsy and variable pneumatic environment (a la Ant Farm’s “pillows”), or a monumental technical feat (as demonstrated with *Mirror Dome* and *Myra Dome*), *Dodecahedron* was well tailored and suited to the scale of the body, much like Jantzen’s fashions. Although humble in scale, and conceived as a temporary construction, the complex system of tubes designed to inflate the individual panels anticipates the logic of what is now known as an ETFE (ethylene tetrafluoroethylene) cushion system.[[42]](#endnote-42) The lighting experiments carried out in their previous two dome constructions additionally allowed Chrysalis to further interrogate the potential of Mylar as a surface for producing optical effects. By incorporating contemporary materials and methods in this demountable structure, they fashioned a lightweight and mobile environment that elevated Banham and Dallegret’s notion of a portable living module **(Fig. 7)**. Rather than the pneumatic membrane as a ‘barely there’ form of enclosure, the inflated panelized system of *Dodecahedron* asserts the potential of advanced hybrid constructions at the scale of domestic inhabitation.

Although Chrysalis demonstrated their pneumatic prowess with large-scale spectacle-inducing installations in collaboration with Hollywood and the aerospace industry, they were also focused on tackling technical issues that related to environmental controls—such as energy, thermodynamics and human comfort. Davies, along with four other students at the Architectural Association (AA) in London, had previously authored the feature article in the June 1968 “Pneu World” issue of *Architectural Design*.[[43]](#endnote-43) In the essay they challenged the commonly held assumption that a pneumatic is a basic enclosure system—a bubble or pillow—as they explored double-layer systems and their potential for building performance (i.e., to control light, heat and sound). They write, “What can pneumatics offer in furthering the relationship between environmental control and the individual?”[[44]](#endnote-44) Providing not only definitions and illustrations of various types of pneumatics, but also a critical commentary of their advantages and disadvantages, the article also featured the students’ own experiments for traveling and modular pneumatic systems. Referring to their proposals as “a kit of metamorphic parts,” they advocated for the lightweight, flexible, and mobile potential of inflatables—all properties Chrysalis would later uphold and further advance.[[45]](#endnote-45)

The *AD* article paid special attention to the opportunities for developing thermal controls with inflatable skin systems, as discussed in the work of physicist Nikolaus Laing.[[46]](#endnote-46) Laing’s unique designs for “a multi-layer skin system incorporating heat-reflecting and heat-absorbing elements, which can be dynamically controlled solely by air pressure,” elevated the pneumatic discourse beyond simply bubbles and into the realm of environmental controls.[[47]](#endnote-47) Undoubtedly, Laing was a major influence in the development of Davies’ *Light Mat* (1970)project at UCLA **(Fig. 8)**. As illustrated in these photographs, the mockup on the left demonstrates maximum opacity and prevents solar access, while its counterpart on the right illustrates a 50% transmission of sunlight. The appearance of Davies’ arm and hand behind the cushions indicates how the upper half of the module is composed of opaque white PVC (polyvinyl chloride), whereas the bottom half is completely transparent. Additional drawings indicate the role of air pressure in cylindrical pneumatic chambers to modulate the transmission of light and heat—evidence of the technical prowess and curiosity of Davies.

Alongside the enhancement of thermal performance in an active air-filled building system, Davies challenged the then dominant countercultural narrative that pneumatics were merely playful and ephemeral constructions, not to be taken seriously. The *Light Mat* mockupwas part of a studio project called *Energy House* and carried out by Davies at UCLA in fall 1970. The house, a technologically adept deployable structure, was also a hybrid construction: it was comprised of a folding, lightweight structure and dual-walled pneumatic mat, as indicated by Ping-Pong balls in the physical model **(Fig. 9)**. In addition to being mobile, it was off the grid—barely touching the ground altogether—and collected enough solar energy to operate a TV set. Valerio, who assisted Davies with the project just prior to their formation of Chrysalis, explains that the *Energy House* demonstrated a “leap from Romanticism to making things work.”[[48]](#endnote-48) He adds, “It’s mobile, you could pack it up, put it in the back of your van, take it out to the desert, and deploy it.”[[49]](#endnote-49) The performative pneumatic skin featured in the *Energy House* was further developed by Chrysalis as *Solar Mat* (1971), a proposal for an inflated solar-collecting roof canopy in the California desert **(Fig. 10)**.

Parallel to the development of technical performance in pneumatics, it should be noted that Chrysalis was also exploring their formal, material, and spatial possibilities. For example, they were invited by the University of Southern California (USC) School of Architecture in 1970 to create a conceptual pneumatic structure.[[50]](#endnote-50) Reminiscent of the more abstract, sculptural and playful pneumatic forms of artist Graham Stevens, the USC inflatable captured mastery in crafting a variety of geometries out of clear, opaque, and colored PVC meticulously seamed together. What Chrysalis learned was that most pneumatic structure designers, users, and clients are content with their delightful otherworldliness as pseudo-psychedelic environments, rather than a viable alternative to conventional buildings. Although the project was initially installed on the USC campus, it was taken soon thereafter to the California desert to be photographed. Chrysalis saw its potential once again as a stage set—as evidenced by the abandoned helicopter—and captured the inflatable in the near extra-terrestrial terrain just east of Los Angeles, where many films and commercials were shot (and still are today) **(Fig. 11)**.

Despite its allure as a destination for countercultural experimentation,the desert is also a hostile environment. Ant Farm experienced this first hand in January, 1971 when they were invited by *Whole Earth Catalog* founder Stewart Brand to erect a 50-by-50 foot pneumatic enclosure and two geodesic domes in Saline Valley, California for the production of the “Truth, Consequences” supplement*.*[[51]](#endnote-51)Their air-inflated vinyl enclosure, a transparent single-membrane, featured a second semi-inflated opaque white roof to deflect the sun. In addition, a giant cable net was designed to counteract uplift with tie-downs. Attempts to respond to the extreme temperatures that ranged from 106 degrees to freezing, coupled with the unusually high winds, ultimately failed. For Ant Farm, the difficulties posed by the desert conditions led to an inflatable impossibility. As a result, the catalog supplement was assembled in an airstream trailer Brand shared with his wife, Lois. The pillow’s failure demonstrated the limitations of air structures and converted Brand from a pneumatic advocate to skeptic (if not a denouncing critic) virtually overnight.[[52]](#endnote-52)

Coincidentally, as Ant Farm was packing up their plastic pillow in defeat, Chrysalis was headed to the desert to seek out environmental extremes in which to test their pneumatic experiments. As Davies explains, “In the spirit of *Dune,* the first eco-novel of the 1960s, we decided to build some oddball inflatable environments, some experimental solar collectors and desert survival suits for ourselves” **(Fig. 12)**.[[53]](#endnote-53) He continues,

We obtained the obligatory roll of Mylar shiny film and cut out nice body-tailored outfits and silver drapes to keep the sun off. In the broiling heat, we put our silver suits on and were drenched to the skin within five seconds! We learnt very quickly that in that environment, body transpiration is staggeringly high and without air circulation, you virtually drown in your own exuded body fluids! Back to the drawing board!—cookie cutters with spurs, prickly wheels all over the suits, vent holes! The modified suits were more tolerable—even though they were still sweaty, they were definitely keeping us cooler.[[54]](#endnote-54)

What Chrysalis gained from these desert experiments was “an understanding of construction and environmental engineering.”[[55]](#endnote-55) Through trial and error, they tested the pros and cons of various material assemblies with respect to solar gain and airflow rates. Namely, Chrysalis’ research began with the concept of failure and a pneumatic “project” emerged from these field tests. Building performance and human comfort were evaluated under drastic scenarios that could be measured both qualitatively and quantitatively (e.g., solar exposure, heat gain and loss, condensation, etc.). Upon closer inspection, however, their “experimental solar collectors and desert survival suits” functioned as architectural instruments to assess passive building technologies under extraordinary circumstances. The standard readymade pneumatic arsenal of plastic, vinyl, and Mylar was deployed, analyzed, and modified to amplify material performance.

Chrysalis once again brought one of their pneumatic prototypes to the desert, this time as a demonstration in its ability to be easily deployed amid any environment **(Fig. 13)**. Strolee, a major maker of products for young children, approached the architects to develop an inflatable enclosure for toddlers. Operating as a flexible, lightweight, mobile, and instantaneous enclosure, *Strolee Playpen* (1971) was sealed with a valve and could travel just about anywhere **(Fig. 14)**. One prototype, constructed from white and clear PVC, featured a series of plastic snaps along the playpen’s six arches, which allowed adults to monitor a child’s movement. A thin orange cord along the interior edge also facilitated vertical stability in young toddlers. According to Valerio, “The design was simple, inexpensive, and the Strolee analysts described as completely safe. But, in the end the company felt the idea was just too forward leaning, and it never went into production.”[[56]](#endnote-56) Chrysalis would soon design pneumatic enclosures for children, albeit unexpectedly, through a rather adult-centric audience.

In 1971, Chrysalis developed their own pneumatic prototype for “a good sized one room enclosure that was inexpensive, required no expertise to install, and offered additional living space for a family (with the land to deploy it)” **(Fig. 15)**.[[57]](#endnote-57) Widely covered by the media, *Pneudome* (1971) was featured in an article entitled “The Bubble House: A Rising Market” in the April 1972 issue of *Playboy*.[[58]](#endnote-58) The three-page spread presented Chrysalis’s inflatable enclosure as situated on a bluff overlooking the Pacific Ocean, an ideal romantic seaside getaway for two couples **(Fig. 16)**. A lightweight, transportable and economical pneumatic living space that required no expertise to install, the magazine pitched the house as a “pumped up pleasure palace,” and “the most revolutionary concept in mobile living since somebody invented the trailer—and a lot more fun.”[[59]](#endnote-59) A 25-foot diameter air-supported dome constructed of fire resistant PVC, *Pneudome* featured transparent wall sections and an opaque reinforced nylon roof. Touted as “ventilated and dust-free, too,” it was inflated in eight minutes with a portable air blower, and stabilized by either a water-filled tube along the dome’s perimeter or cable tie-downs.[[60]](#endnote-60)

According to historian Vanessa Grossman, “Pneudome represented the dematerialization of the bachelor pad, which was turned into a moveable package.”[[61]](#endnote-61) The “nearly 500 square feet of living space to do with as your imagination dictates” could also be packed down and easily transported in a 42” X 60” X 12” box.[[62]](#endnote-62) The first photo in the article shows two women and two men carrying a large box in which the inflatable is packed, demonstrating Pneudome’s lightweight and mobile features. According to Valerio, the box was empty for the shoot, as “it was actually pretty heavy, and not easily moved by four adults.”[[63]](#endnote-63) In another image, two models are shown filling up the 400-gallon tubular base of the pneumatic dome with a garden hose; the water, along with the electrical outlet for an air blower, were magically supplied at this remote seaside location. Available for purchase for $1950, readers were prompted to write to the magazine for more information.[[64]](#endnote-64) For *Playboy*,the concept was to be able to create an impromptu dwelling in an isolated setting—a picnic cum beach house—yet the magazine failed to find a likely consumer market in its wide-ranging readership. Some seven years after Banham and Dallegret’s *Environment-Bubble* (1965), Chrysalis had made the mobile pneumatic bachelor pad a reality. Much to their surprise, *Pneudome* found its actual home as a classroom for children **(Fig. 17)**. In 1972, the Denver School District purchased five for a new school they were building.

**C.O.W.**

Although Chrysalis had been breaking new ground in the design, fabrication, and marketing of pneumatic architecture, in addition to being featured in the August 1972 issue of *Progressive Architecture,* the group was quickly scattering geographically in pursuit of other professional opportunities.[[65]](#endnote-65) In 1972, its British members—Davies, Dawson and Stanton—moved back to Europe to work on Renzo Piano and Richard Rogers’ newly awarded Pompidou Center project.[[66]](#endnote-66) In the previous year, Valerio temporarily relocated from Los Angeles to Washington D.C. (1971-73) to design pneumatics for an exhibition at The Smithsonian.[[67]](#endnote-67) After completing this project, for which he received independent study credit, Valerio graduated from UCLA and accepted a teaching position in the School of Architecture and Urban Planning at The University of Wisconsin-Milwaukee (UWM).[[68]](#endnote-68) Soon after arriving in Milwaukee, Valerio formed C.O.W. (Chrysalis of Wisconsin) and received a phone call from the Carnegie Institute asking if he could design a demountable theatre and performance structure for The Three Rivers Arts Festival in Pittsburg, Pennsylvania.[[69]](#endnote-69)

Designed by C.O.W. members Valerio and Kent Hubbell, *Three Rivers* (1973-75) was a large-scale, double-layered pneumatic membrane developed and fabricated in collaboration with architecture students at UWM **(Fig. 18)**.[[70]](#endnote-70) At 35-feet tall, the inflated mobile exhibit and performance enclosure sat 200 people within a yellow prismatic form*. Three Rivers* was typically erected on a concrete plaza located over a parking garage adjacent to the Westinghouse building in downtown Pittsburg. The project presented a myriad of technical challenges for Valerio and Hubble. For example, because the client wanted to be able to inflate and deflate the project as needed, conveniently locating the air supply was an important problem to resolve. An existing airshaft divided the plaza and parking garage, which allowed them to run a conventional HVAC duct between the blower (permanently installed in the garage) and the inflatable structure.

For *Three Rivers*, the decision to work with a double-layer pneumatic membrane allowed for greater flexibility in the size, location, and number of apertures; it additionally provided enhanced thermal and acoustic properties **(Fig. 19)**. The inflatable could easily be repositioned and was anchored by either catenary edge cables or water ballast. Utilized as a seasonal event-space in Pittsburg for ten years, Valerio describes the temporary pneumatic enclosure as a “serious building.”[[71]](#endnote-71) He adds, “*Three Rivers* was supposed to be all about implied mass. The structure that in truth weighs less than a pound per square foot had a presence implying a far greater weight—air made visible and solid at the same time.”[[72]](#endnote-72) This “ambiguity of the structure”—oscillated somewhere between ephemeral and permanent, stable and unstable, light and heavy, etc.—and indexed Valerio’s desire to push pneumatic technology closer to that of buildings.[[73]](#endnote-73)

Due to its dual-walled enclosure and lack of an air seal or lock, *Three Rivers* afforded more structural, spatial, and programmatic freedom, yet much like a building, its plan was shaped not only by program and site, but also by codes. For example, in response to egress requirements, an extra access door had to be added to the north side of the event structure; likewise, electrical wiring for the lighting and sound systems were carefully incorporated into the design **(Fig. 20)**. Rather than simply running cords along the floor—those which might otherwise be taped down—the inflatable included an additional fabric sleeve (e.g., conduit) along its perimeter base, and O-rings were built into small fabric tabs at the access door. Despite being a temporary structure erected and dismantled each year, the attentiveness to detail and meticulous craft of *Three Rivers* demonstrated an advanced degree of expertise in the design and construction of DIY inflatables.

**Who Let the Air Out?**

On October 17, 1973, The Organization of Petroleum Exporting Countries (OPEC) made a decision to decrease oil production and to significantly raise prices.[[74]](#endnote-74) Over the next few months, the oil barrel prices quadrupled, calling into question the reliance of western nations on an economically unstable and environmentally non-renewable resource. The oil crisis of 1973 positioned plastics, and hence pneumatics, not only in a precarious political, social, and economic context, but also raised questions about environmental ethics. According to architect and author Simone Jeska, “By the end of the 1970s at the very latest, plastics no longer represented progress and modernism, but instead were associated with the stigma of ugly, cheap materials, and they disappeared temporarily from the architectural landscape.”[[75]](#endnote-75) The conditions that allowed inflatables to flourish in the 1960s—namely, the rise of plastics, the lure of expendability, and the quest for alternative environments—were the same factors that led to its demise in the 1970s. The optimistic rise and ironic fall of the pneumatic project involved factors far beyond the purview of any one individual or collective, yet Chrysalis played an instrumental role in demonstrating the architectural values of plugging in and blowing up.

Chrysalis was steadfast in their commitment to the advancement and development of inflatables “beyond just an editorial.”[[76]](#endnote-76) Self-described by Valerio as “a group of resources, applied to solve particular problems.” Chrysalis produced well over a dozen projects dedicated to pushing the pneumatic envelope in the course of just a few years. Their experimental output was grounded in a fascination with environmental controls and building technology, allowing them to innovate air structures through multiple forms of architectural performance. According to Davies, “We learnt much about design and environmental engineering, not by conventional routes but by learning from practical experience, mock-ups, trial and error and experiment.”[[77]](#endnote-77)

Although most historical narratives continue to re-write the rise—yet rarely the fall—of inflatables as a barely-there form of disciplinary propaganda fueled by rhetoric, representations and playful performance, Chrysalis deployed air structures as a means to pioneer new avenues for architectural experimentation and production. Its members went west to seek new opportunities for material and structural experimentation, tapping into the wide range of resources afforded by the greater Los Angeles area. Working with experts in aerospace and Hollywood, Chrysalis approached complex problems with a keen commitment to novel solutions. The rigor and precision they exercised suggests an alternative historiography of the rise and fall of the inflatable project—one that challenges the ‘trippy, cheap, light’ ethos propped up by the counterculture, and offers in its place a compelling case that pneumatics really were viable alternatives to conventional buildings.

Their pneumatic output resonated with various forms of media, including star-studded films, fashion catalogues and *Playboy* magazine, yet for Chrysalis, the project was never about inflatables per se. Once they, namely Valerio, caught wind that plugging in plastics was deemed “bad” and no longer “rad,” they were complicit with letting the air out.[[78]](#endnote-78) According to Valerio, who also worked extensively with tension structures at the time with C.O.W., it was always about lightweight demountable structures that could be used over and over again. He adds, “Experimental structures were a way to explore a different approach to building.” In the end, their decision to pull the plug was not predicated on a subjective or aesthetic agenda, but rather a moral and ethical decision that the pneumatic project was inextricably reliant on petroleum-based products, and no longer captured the ethos of an environmentally minded generation.

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NOTES

1. According to the *Expo ’70 official guide,* the United States Pavilion featured an “elliptical translucent domed roof” and was, at the time of its completion, “the largest and lightest clear span, air supported roof ever built.” Similarly, the Fuji Group Pavilion was “the world’s largest pneumatic structure” to date. For a comprehensive overview of the 1970 Osaka Expo, see *Expo ’70 official guide* (Osaka: Japan Association, 1970) 57 & 191.

 [↑](#endnote-ref-1)
2. Davies, Stanton and Dawson met at the Architectural Association in London, where they studied under Ron Herron of Archigram. Upon graduating, the three received scholarships to UCLA, and headed west. See Mike Davies, “Exploring, rehearsing, delivering” in *Innovation in Architecture,* Edited by Alan J. Brookes and Dominique Poole (London/New York: Spon Press, 2004) 15-28. [↑](#endnote-ref-2)
3. According to Davies, “[We] promptly headed for the desert in California to try out our crazy inflatable structures, which we were building and experimenting with at the time.” Davies, “Exploring, rehearsing, delivering” in *Innovation in Architecture,* 19. [↑](#endnote-ref-3)
4. As noted in *Joe Valerio: Valerio Dewalt Train*, “The firm focused on interdisciplinary design approaches teaming architects, artists, and scientists.” See Joseph M. Valerio, *Joe Valerio: Valerio Dewalt Train* (New York: Rizzoli International, 1999) 152. [↑](#endnote-ref-4)
5. “Counterculture” is a complex and loaded term typically attributed to the rise of anti-establishment thinking by a politically and socially left-leaning youth, beginning in the 1960s. For a comprehensive examination of the term, see Theodore Roszak, *The Making of a Counter Culture: Reflections on the Technocratic Society and Its Youthful Opposition* (New York: Doubleday & Company, 1968).For further reading on the emergence of the artistic and architectural counterculture during the 1960s and 1970s, see Elissa Auther and Adam Lerner, eds. *West of Center: Art and the Counterculture Experiment in America, 1965-77* (Minneapolis: University of Minnesota Press, 2012; Caroline Maniaque-Benton, *French Encounters with the American Counterculture 1960-1980* (Surrey, England/Burlington, VT: Ashgate Publishing, 2011); Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago/London: University of Chicago Press, 2006); and Andrew Blauvelt, ed., *Hippie Modernism: The Struggle for Utopia* (Minneapolis: Walker Art Center, 2015). [↑](#endnote-ref-5)
6. R. Buckminster Fuller coined the term “ephemeralization” in 1938. A proponent of technology and advocate for resource conservation (i.e., material, time and energy), Fuller’s aim was to do "more and more with less and less until eventually you can do everything with nothing." See R. Buckminster Fuller, *Nine Chains to the Moon*, (Anchor Books [1938] 1971): 252–59. For additional reading on Fuller’s concept of “ephemeralization,” see Joachim Krausse and Claude Lichtenstein, eds., *Your Private Sky: R. Buckminster Fuller Discourse* (Zurich: Lars Müller Publishers, 2001). [↑](#endnote-ref-6)
7. See Cedric Price, *Archigram 3,* 1963. It should be noted that in 1966, Price and Newby approached the British Ministry of Technology with proposals to conduct research on the use of air structures in the construction industry. As a result, the British Ministry of Public Building and Works commissioned them to undertake a survey on pneumatics in 1968. Their extensive research on the topic was published as a report entitled *Air Structures: A Survey* in 1971 and it covered the history, principles and applications of air structures. Although the British Government did not sponsor further research on the topic, what was particularly remarkable about this endeavor was Price and Newby’s commitment to both the technological and cultural dimensions of inflatables. According to Price and Newby, the publication “surveys the current research and development in this field and makes a number of proposals for future research.” Cedric Price and Frank Newby, *Air Structures: A Survey* (London: Her Majesty’s Stationery Office, 1971) iii. [↑](#endnote-ref-7)
8. This societal and material shift from heirloom to throwaway was addressed as early as 1960, when Banham addressed the topic of expendability in *Architectural Review*. He writes, “One of the great worries at the margins of the architectural profession is that building design just does not match the design of expendabilia in functional and aesthetic performance.” Reyner Banham, “Propositions 5,” *Architectural Review*, June 1960, 385. It should also be noted that Banham was affiliated with the International Group (IG), who had been working with the notion of expendability in architecture since the mid 1950s. [↑](#endnote-ref-8)
9. “Experimental work frequently finds its grit and inspiration in the desire to undermine and explode all rival positions. Yet there is the broad and horrific mainstream of recent architecture which must be recognized, and which the more cerebral world of experiment has to refer to and fight against—and ultimately give its sustenance: for in architecture this is its ultimate role.” Peter Cook, *Experimental Architecture* (New York: Universe Books, 1970) 7. [↑](#endnote-ref-9)
10. “[A] redefinition of experiment in architecture: to *experiment out of architecture.”* Cook, *Experimental Architecture*, 7. [↑](#endnote-ref-10)
11. Reyner Banham, “Monumental Windbags,” 18 April 1968, vol. 11, no. 290: 569-570, *Arts in Society.* Reprintedin *The Inflatable Moment: Pneumatics and Protest in ’68,* ed. Marc Dessauce (New York: Princeton Architectural Press & The Architectural League of New York, 1999) 31-33. [↑](#endnote-ref-11)
12. As illustrated by François Dallegret’s rendering, air-conditioning systems inflated a transparent plastic dome, and could be sited anywhere, even on a rock. A mobile bachelor pad with mechanical servicing, it featured the latest in environmental controls and electronic entertainment. Reyner Banham, “A Home is Not a House,” *Art in America*, Vol. 2, 1965: 70-79. [↑](#endnote-ref-12)
13. Banham, “Monumental Windbags,” 31-33. [↑](#endnote-ref-13)
14. Banham, “A Home is Not a House,” 70-79. [↑](#endnote-ref-14)
15. See Thomas Leslie, “Just What is it That Makes Capsule Homes So Different, So Appealing? Domesticity and the Technological Sublime, 1945 to 1975,” *Space and Culture,* Vol. 9, No. 2 (May 2006): 183. <http://sac.sagepub.com/cgi/content/abstract/9/2/180> (accessed February 15, 2008). [↑](#endnote-ref-15)
16. Ant Farm, *Inflatocookbook*, 1973. [↑](#endnote-ref-16)
17. See “Recycling” on the “Materials” page of Ant Farm’s *Inflatocookbook*. [↑](#endnote-ref-17)
18. *The Last Whole Earth Catalog* (Menlo Park, CA: Portola Institute, 1971) 107. [↑](#endnote-ref-18)
19. “For some reason, it has been difficult for some people to take membrane structures, as a viable building type, seriously. Viewed as tents, or tennis court covers, or temporary whims, the structures have had and continue to have, an uphill fight for acceptance. A relatively small but growing group is doing battle with the misconceptions, however, and is solving the real technical problems.” James A. Murphy, “Air Fare” in *Progressive Architecture* (August 1972) 76. [↑](#endnote-ref-19)
20. Murphy, “Air Fare” in *Progressive Architecture,* 76. [↑](#endnote-ref-20)
21. In addition, an essay by engineer David Geiger defines the technical performance and economical advantages of air structures, whereby he argues that their future resides in an “expanded scale.” See David H. Geiger, Ph.D., “Pneumatic Structures” in *Progressive Architecture* (August 1972) 81-84. [↑](#endnote-ref-21)
22. Murphy, “Air Fare,” 87-89. [↑](#endnote-ref-22)
23. Murphy, 87-89. [↑](#endnote-ref-23)
24. Joe Valerio, in conversation with the author, 06 October 2016. [↑](#endnote-ref-24)
25. Ibid. [↑](#endnote-ref-25)
26. Ibid. [↑](#endnote-ref-26)
27. The key text on the history and development of the Pepsi-Cola Pavilion at Expo ’70 is *Pavilion*, eds. Billy Klüver, Julie Martin, Barbara Rose (New York: E.P. Dutton & Co., 1972). In addition, recent essays by Mark Waisuta and Sylvia Lavin provide detailed narratives about the development of its inner pneumatic theater. See Mark Waisuta, “E.A.T. in Osaka: Transducing Technology” in *Exhibiting Architecture: A Paradox?,* ed. Eeva-Liisa Pelkonen (New Haven: Yale School of Architecture, 2015) 83-94; Sylvia Lavin, “Poof (2006)” in *Flash in the Pan,* Architecture Words 13(London: Architectural Association, 2015) 110-122. [↑](#endnote-ref-27)
28. Mylar, a metalized film (polymer film coated with a thin layer of metal, usually aluminum), offers a reflective silvery surface that is more lightweight and cost-effective than aluminum foil. Although typically used for decoration and food packaging, Mylar’s high-insulation properties made it popular with the aerospace industry (e.g., NASA uses it in its space suits), yet its flammable tendencies were eventually called into question by the airline industry. [↑](#endnote-ref-28)
29. “More properly called the Inner Theater at the Pepsi-Cola Pavilion at Expo ‘70. Prior to my arrival in LA, Alan and Chris were drawn into a group of scientists and artists working with the EAT group in New York. The problem with the LA group, they didn’t have anyone who knew how to build anything. The outcome was that Alan and Chris took things over in a very benevolent way to build the inner theater of the Pepsi-Cola Pavilion at Expo 70.” Joe Valerio, email correspondence with author, 07 July 2016. [↑](#endnote-ref-29)
30. Lavin, “Poof (2006)” in *Flash in the Pan,* 111. [↑](#endnote-ref-30)
31. Lindgren adds, “Moviemaker Eric Saarinen, who had been making films on artists, helped build the Mirror and began to shoot a movie of the project as well. The model domes were erected on the giant sound stage of an MGM movie studio, which the company had donated to the group.” Nilo Lindgren, “Into the Collaboration,” in Klüver, Martin, Rose (eds.), *Pavilion* (New York: E.P. Dutton & Co., 1972) 36. [↑](#endnote-ref-31)
32. Lindgren provides a clear account of this transition from Envirolab to G.T. Schjeldahl. “The small model simply did not convey an impression of what would really happen inside the full-scale ninety-foot Mirror. After discussions, it was agreed to push ahead to make a full-scale inflatable mirror structure, a project clearly beyond the means of the Los Angeles group.” Lindgren, “Into the Collaboration,” in *Pavilion* (New York: E.P. Dutton & Co., 1972) 36. See also Waisuta, “E.A.T. in Osaka: Transducing Technology” in *Exhibiting Architecture: A Paradox?,* 90. [↑](#endnote-ref-32)
33. Klüver adds, “It used the inside reflective surface of a sphere for the first time. It is conceivable that this method of making a concave reflective surface could be used in making various types of antennas.” Klüver, “The Pavilion” in Klüver, Martin, Rose (eds.), *Pavilion,* xii. [↑](#endnote-ref-33)
34. For further reading on the Pepsi-Cola Pavilion, and the contributions of E.A.T., see Jimmy Stamp, “When PepsiCola Allowed a Team of Artists to Wreak Creative Havoc” in *Smithsonian Magazine*. http://www.smithsonianmag.com/arts-culture/when-pepsicola-allowed-a-team-of-artists-to-wreak-creative-havoc-109661/ (Accessed 22 March 2017); Sebastian Schumacher, “All You Can E.A.T.: The 1970 Pepsi Pavilion in Osaka,” in *Uncube Magazine.* <http://www.uncubemagazine.com/blog/13753251> (accessed 22 March 2017). [↑](#endnote-ref-34)
35. For a thorough description of the Pepsi-Cola Pavilion, and a first-hand account of the optical and visual experience of entering into the mirrored inner inflatable dome, see “Experiments in Art and Technology—New York and other cities” in Jim Burns, *Arthropods: New Design Futures* (New York: Praeger, 1972) 122-128. [↑](#endnote-ref-35)
36. As Valerio explains, “With the success of the Mirror Dome, we were contacted by another studio to create a stage for the movie Myra Breckenridge.” Joe Valerio, email correspondence with author, 07 July 2016. [↑](#endnote-ref-36)
37. Project lead: Alan Stanton. [↑](#endnote-ref-37)
38. The film also features Roger C. Carmel, Farrah Fawcett, John Huston, Roger Herren, and Mae West. [↑](#endnote-ref-38)
39. According to Valerio, Welch refused to be photographed inside the mirrored inflatable dome because “she didn’t like how her nose looked in its reflection.” Apparently, this caused a “major brouhaha” with the studio, but actor Rex Reed “loved the set.” JoeValerio, email correspondence with author, 07 July 2016. [↑](#endnote-ref-39)
40. Project lead: Alan Stanton. [↑](#endnote-ref-40)
41. Jantzen, whose own designs sought to express the contemporary woman, was also known for innovating with new materials and methods—the company began in 1910 as Portland Knitting Company, and earned acclaim within the rowing community for its warm and lightweight knitted wool bathing suits. In the 1970s, they expanded their swimsuit line into beachwear and active wear, and began to work with nylon and spandex. See Jantzen, “Heritage,” <http://www.jantzen.com/timeline.html> (accessed May 31, 2017). [↑](#endnote-ref-41)
42. Remarkably, *Dodecahedron* (1970) anticipates by several years what is now commonly known as an ETFE (ethylene tetrafluoroethylene) cushion system. Architect and author Annette Lecuyer claims that it was not until 1973-74, as a result of the first oil crisis, that architectural interest in ETFE emerged. Yet, it would be another decade before field-testing would prove its efficacy as a permanent building material and system. In recent years, ETFE has come to be more widely accepted in the construction industry, although its status is still considered relatively novel. See Annette Lecuyer, *ETFE: Technology and Design* (Basel/Boston/Berlin: Birkhäuser, 2008) 32. [↑](#endnote-ref-42)
43. Commissioned by *AD* editor Monica Pidgeon, their feature article was a thorough compendium of lightweight pneumatic structures—possibly the most comprehensive to date. The “Pneu World” issue also featured an essay and works by the French student group Utopie—whose theoretical (and material) investigations into pneumatics were featured in the exhibition ‘Structures Gonflabes’ at the Musee d’art modern in Paris in March 1968. Simon Connoly, Mike Davies, Johnny Devas, David Harrison and Dave Martin, “Pneu World,” in *Architectural Design* (June 1968) 257-272. See also Beatriz Colomina and Craig Buckley (Eds.), *Clip Stamp Fold: The Radical Architecture of Little Magazines, 196X to 197X* (Barcelona: Actar and Media and Modernity Program Princeton University, 2010) 106. [↑](#endnote-ref-43)
44. Connoly, Davies, Devas, DaHarrison and Martin, “Pneu World,” in *Architectural Design* (June 1968) 268. [↑](#endnote-ref-44)
45. Connoly, Davies, Devas, DaHarrison and Martin, “Pneu World,” 268. [↑](#endnote-ref-45)
46. Connoly, Davies, Devas, DaHarrison and Martin, 267-268. [↑](#endnote-ref-46)
47. Ibid., 267. Additionally, it should be noted that Laing’s pneumatically operated walls, which incorporated folding films inside cylindrical air chambers to mediate between transmission and reflection, anticipated what is now referred to as a triple-layer ETFE (Ethylene Tetrafluoroethylene) system, where a third interior layer of a pneumatic pillow is capable of modulating its degree of transparency or opacity. For further reading on the history, development and contemporary architectural applications of ETFE, see Annette LeCuyer, *ETFE: Design and Technology* (Basel: Birkhäuser Verlag AG, 2006). [↑](#endnote-ref-47)
48. Joe Valerio, in conversation with the author, 06 October 2016. [↑](#endnote-ref-48)
49. Ibid. [↑](#endnote-ref-49)
50. Project lead: Alan Stanton. [↑](#endnote-ref-50)
51. *Difficult but Possible Supplement,* January 1971 (Menlo Park, CA: Portola Institute). It should be noted that the cover of this supplement is not labeled as “Difficult but Possible,” but rather “Truth, Consequences,” although architectural historians Felicity Scott and Caroline Maniaque-Benton both refer to it as the former. See Felicity D. Scott , *Living Archive 7: Ant Farm* (Barcelona/New York: Actar, 2008) 81-85; Caroline Maniaque-Benton (ed.), *Whole Earth Field Guide* (Cambridge, Mass.: MIT Press, 2016) 38-40. [↑](#endnote-ref-51)
52. “My love-hate relationship with inflatables is in full bloom here,” Brand writes. “They’re trippy, cheap, light, imaginative space, not architecture at all. They’re terrible to work in. The blazing redundant surfaces disorient. One wallows in space. When the sun goes behind a cloud you cease cooking and immediately start freezing. (Ant Farm is working on insulation schemes.) To counteract the cold Fred hung heat lamps from the ceiling which ascended and descended with variation in pillow pressure. Here, during blower adjustment, my light is busy scorching the floor. Environmentally, what an inflatable is best at is protecting you from a gentle rain, not a problem here.” Stewart Brand, “Production in the Desert,” 42. It should be noted that Brand’s account of the event was similarly captured about six months later in *The Last Whole Earth Catalog,* June 1971, 107. [↑](#endnote-ref-52)
53. Davies, “Exploring, rehearsing, delivering” in *Innovation in Architecture,* 19. [↑](#endnote-ref-53)
54. Davies, “Exploring, rehearsing, delivering,”19. [↑](#endnote-ref-54)
55. “All these experiments gave us confidence and an understanding of construction and environmental engineering in the sense that, despite the fact that we were struggling with the boundaries, we were learning, imagining, creating and moving forward, achieving things. We built inflatable structures where the margin between comfort and discomfort is very slight; where small differences have big effects...” Davies, 21. [↑](#endnote-ref-55)
56. Joe Valerio, email correspondence with author, 07 July 2016. [↑](#endnote-ref-56)
57. Ibid. [↑](#endnote-ref-57)
58. “The Bubble House: A Rising Market” in *Playboy*, ‘Modern Living,’ Vol. 19, No. 4, (April 1972) 117. [↑](#endnote-ref-58)
59. “The Bubble House: A Rising Market” in *Playboy*, 117. [↑](#endnote-ref-59)
60. “The Bubble House: A Rising Market,” 117. [↑](#endnote-ref-60)
61. Vanessa Grossman, “Chrysalis’s Pneudome, A Bubble-Pad-Survival-Kit or London Meets L.A.” Edited by Beatriz Colomina, *Volume* 33 (Fall 2012) 27. [↑](#endnote-ref-61)
62. “The Bubble House: A Rising Market,” 117. [↑](#endnote-ref-62)
63. Valerio, in conversation with the author, 06 October 2016. [↑](#endnote-ref-63)
64. *Pneudome* could also be customized, in terms of size and window area. [↑](#endnote-ref-64)
65. See Geiger, Ph.D., “Pneumatic Structures,” in *Progressive Architecture* (August 1972): 81-89. Chrysalis’s work, including *Pneudome,* is featured on pages 87-89. [↑](#endnote-ref-65)
66. According to Valerio, there was a large budget to do a plaza in front of the Pompidou and to fill it with pneumatics, but this was eventually cut for financial reasons. Joe Valerio, in conversation with the author, 11 March 2016. [↑](#endnote-ref-66)
67. Valerio was invited by Phillip Ritterbush to work on an exhibition at The Smithsonian. Around this time, Chrysalis was asked to develop a movie set for a picture that was never released. Valerio took the lead on the project—*Giantess* (1972)—an enormous, abstract inflatable female figure to be used as a supersized backdrop during a dialogue scene. Although the pneumatic set was completed, the film was never released. Joe Valerio, email correspondence with author, 07 July 2016. [↑](#endnote-ref-67)
68. Valerio began teaching at UWM in January 1973. Valerio in conversation with the author, 06 October 2016. [↑](#endnote-ref-68)
69. The Carnegie Institute client had seen Chrysalis’s work, featuring Joe Valerio, in the August 1972 issue of *Progressive Architecture*. [↑](#endnote-ref-69)
70. The Three Rivers Festival Event structure was completed in 1975. The team: Joe Valerio, Kent Hubbell, Michael Szczawinski, Aerovironment, Inc. (aeronautical engineering), Walter R. Ratai, Inc. (m/e/p engineering). See Valerio, *Joe Valerio: Valerio Dewalt Train* (New York: Rizzoli International, 1999) 61 & 155. [↑](#endnote-ref-70)
71. Valerio, in conversation with the author, 06 October 2016. [↑](#endnote-ref-71)
72. Valerio, *Joe Valerio: Valerio Dewalt Train*, 61. [↑](#endnote-ref-72)
73. Valerio, 61. [↑](#endnote-ref-73)
74. Giovanna Borasi and Mirko Zardini, eds., *Sorry, Out of Gas: Architecture’s Response to the 1973 Oil Crisis* (Montreal: Canadian Centre for Architecture, 2007) 50. In 2007, the Canadian Centre for Architecture in Montreal staged an exhibition entitled “Sorry Out of Gas: Architecture’s Response to the 1973 Oil Crisis.” Although the exhibition did not specifically address pneumatics, its discussion of the relationship between architecture and oil in the 1970s sheds light on the development of environmentally responsive building materials, methods, technologies and concepts. [↑](#endnote-ref-74)
75. Simone Jeska, *Transparent Plastics: Design and Technology* (Basel/Boston/Berlin: Birkhäuser, 2008) 22. [↑](#endnote-ref-75)
76. “We wanted to move beyond just and editorial.” Joe Valerio, in conversation with the author, 06 October 2016. [↑](#endnote-ref-76)
77. Davies, “Exploring, rehearsing, delivering,” 21. [↑](#endnote-ref-77)
78. In several conversations with the author, Valerio attempts to pinpoint the exact moment that he caught wind that pneumatics were a “bad” idea. He cites that the Whole Earth Catalog must have had something to do with it—as well as a larger pop cultural understanding that energy and oil were no longer finite resources. For an elucidation on the disadvantages of inflatables, and a likely claim for their being put to rest, see Robert Greenway, “Inflatocookbook” in *Whole Earth Catalog* (January 1971) 43. [↑](#endnote-ref-78)