Storefront for Art and Architecture | Lars Müller Publishers

OR, WHAT IS THE POWER OF SHIT?

What do space capsules, submarines, and office buildings have in common? Each is conceived as a closed system: a self-sustaining physical environment demarcated from its surroundings by a boundary that does not allow for the transfer of matter or energy. As partial reconstructions of the world in time and in space, closed systems identify and secure the cycling of materials necessary for the sustenance of life.

This book presents an archive of 37 historical living prototypes from 1928 to the present that put forth an unexplored genealogy of closed resource regeneration systems. From the space program to countercultural architectural groups experimenting with autonomous living, *Closed Worlds* documents a disciplinary transformation and the rise of a new environmental consensus in the form of a synthetic naturalism.

The Architecture of Closed Worlds. Or, What is the Power of Shit? Lydia Kallipoliti Lars Müller Publishers | Storefront for Art and Architecture

Storefront for Art and Architecture | Lars Müller Publishers

THE ARCHITECTURE OF CLOSED WORLDS

Lydia Kallipoliti

PRINCIPAL RESEARCHER & AUTHOR
Lydia Kallipoliti

RESEARCH TEAM
Alyssa Goraieb, Hamza Hasan, Tiffany Montañez, Catherine Walker, Royd Zhang, Miguel Lantigua-Inoa, Emily Estes, Danielle Griffo, Ashley Dotson, Daniel Ruan and Chendru Starkloff

GRAPHIC DESIGN
Pentagram / Natasha Jen,
Jang Hyun Han, Joseph Han, Ena Yun, Rohan Chaurashia
Ji Park, Boqin Peng, Ran Zheng, Melodie Yashar,
CLOSED Typeface: Jangs Müller Type Foundry

FEEDBACK DRAWINGS
Temitope Olujobi

COPY EDITOR
Maureen Bemko and Irina Oryshkevich

PROOFREADER
Keonaona Peterson

IMAGE EDITOR AND PERMISSIONS ASSISTANT
Maria Vollas

COMMENTARY CONTRIBUTORS
Ross Exo Adams
Albert Narath
Wulf Böer
Caroline Maniaque-Benton
Jonathan Massey
Janette Kim & Eric Carver
Beatriz Colomina
Theodora Vardouli
Christina Ciardullo
Daniel Barber
Peder Anker
Mitchell Joachim

AFTERWORD ESSAYS CONTRIBUTORS
Mark Wigley
Bess Krietemeyer
Michelle Addington

BOOK SPONSORS
The Robert S. Brown '52 Fellows Program,
Rensselaer Polytechnic Institute
Elise Jaffe and Jeffrey Brown
Pentagram

EXHIBITION SPONSORS
The Graham Foundation
The New York State Council for the Arts (NYSCA)

RESEARCH SUPPORT
Syracuse University, School of Architecture
Rensselaer Polytechnic Institute, School of Architecture

LEXICON
An expanded lexicon on environmental history derived from the study of the 37 prototypes is available online at www.closedworlds.net.

MICHELLE ADDINGTON X NASA GODDARD SPACE FLIGHT CENTER

FEBRUARY. 27. 2016

I am actually very lucky today. I am not playing a role, I am not trying to inhabit someone's character, I am not even trying to represent an institution. I get to be myself, albeit my much younger self, when I was starting as a mechanical engineer at NASA's Goddard Space Flight Center. I was with NASA when the "worm" logo was used (Figure 1); the so-called "meatball" logo (Figure 2) both predated and postdated my three years at NASA. To help you visualize my life there, in the first photograph (Figure 3), I am inside a vibration laboratory, where we subjected satellites to intense vibrations to simulate launch conditions. In another photograph (Figure 4), I am plugging an accelerometer into a sounding rocket. I have to say that this is not how I typically dressed; these were photos for a publication showing what female engineers did at NASA and, at that time, I was required to wear a dress for this photo shoot.

Just outside my office door was a poster that appeared in many of the thirty-five buildings across the Space Center. It featured a quote by the English poet Robert Browning: "Ah, but a man's reach should exceed his grasp, or what's a heaven for?" This was for us the *sine qua non* of space exploration; it was about what lay beyond the limits of our corporeality. This leitmotif is why so many of us felt that July 20, 1969, sucked all the air out of the room. As a teenager, I considered seeing the Moon landing one of the defining moments of my life; indeed it is one of the reasons I chose NASA to start my career. My dream then was to be Neil Armstrong. But the public frenzy and fascination of the manned space program tended to push to the background everything else that NASA was doing, and it continues to do so to this day.

Today, no longer impressed by the man on the Moon or a woman in the space station, the public and our government are now pushing for a manned flight to Mars, arguably suggesting that NASA is relevant only when it enables an American body to occupy new territory. And this attitude is in spite of the fact that we did land on Mars in 1975 and we have had a mission on Mars operating continuously and successfully for the last forty years. It may just be a piece of equipment for you, but for us this is where the real science has been taking place. For many of us at NASA, manned flight was a distraction from serious space exploration. We were not interested in breaking the bounds of *terra firma*. We wanted to break the bounds of our own body, to be able to see beyond what our eyes could see, to be able to touch beyond what our hands could reach. We didn't see ourselves as a subject in some human-centered universe. Indeed, it would have been anathema to even think that the universe was small enough and knowable enough that the human body is capable of serving as its datum.

If I think about other projects that I have worked on during my few years there, I realize that the vast majority, including all the satellites, had booms and optics. The boom is essentially an extendable arm. Held tight to the body of a satellite when it launched, a boom would extend when orbit was reached—some to unfold photovoltaics at the perfect angle, some to position scanners and detectors, some to assist in positioning the satellite itself. The optics were there for transmitting, receiving, and processing light and other radiation. As such, the booms became our arms and the optics were our eyes. This very lack of corporeality gave us an unprecedented window as observers that no human body could ever achieve. I hesitate to call them our avatars, because the data that we collected have no

NASA's "worm" logo, used between 1975 and 1992, was designed by Richard Danne and Bruce Blackburn and offered a modernist interpretation compared to its predecessor.

NASA's "meatball" logo, dating back to 1959. Known officially as the insignia, NASA's logo was not called the "meatball" until 1975.

relevant translation to what any one body could perceive. This is what made them so remarkable. The very discreet extensions opened portholes into a scene of unimaginable depth. As such, we were flooded with information with no constituent framework through which the data could be positioned and, therefore, understood.

Our equipment collected photons. But, how does one know if a photon that strikes a detector was emitted a millisecond ago or a million years ago? In space, we must know *when* something is in order to tell *where* it is. This was my first introduction to Lagrangian coordinate systems. Cartesian coordinates allow us to map every aspect of our earth. An objective datum is established gravitationally, and once it is in place we can use any number of methods to determine dimensional relationships. Lagrangian systems, on the other hand, accept that objectivity does not exist. Instead, origin is assigned to a "moving thing of interest." Dimensional relationships between the thing of interest and its surroundings are entirely contingent on the behavior of the thing itself. As a result, one cannot know where something will be in the future without knowing where it was in the past; to make it much more complex, we also need to know what it was doing in the past. This still does not mean that we know what it will do in the future. The best we can hope for is the ability to speculate on an array of possible futures for the thing.

So, what was key for us at NASA was the negotiation between objective and subjective frames and reference. We looked to establish footholds that were either physically deployed from Earth, such as satellites, orbiters, landers, and sensor pods, or informationally related to Earth, such as space objects positioned less than four hundred light years away. In both cases, we could map these footholds objectively in Cartesian coordinates. These points then became discreet origins in the Lagrangian systems, which relationally collected data from their surroundings. A way to think about this is to imagine reaching into that infinite porthole and taking out a tiny scoop of material. We didn't think of that scoop as a microcosm of the universe; we didn't even imagine that if we took out enough scoopfuls, we could extrapolate to form some generalizable understanding. Each scoop, for us, was but an instance, an autonomous instance. Establishing all of these footholds was not meant to map space as if it were a dimensional entity but rather to see space as an array of behaviors. Perhaps the most "un-earthly" part of this was a denial of connectivity. We had no intention of creating a worldview of the universe or of constructing an integrated model of cosmic relationships. We wanted to be able to understand just one instance—one transient moment—and understand it very, very well. Indeed, this is why we were all there: to begin to understand things we had no awareness of even existing before.

Perhaps of all the concepts that I learned during my time at NASA this very idea of *dis*connection has been the most formative in my development. It has influenced me in two different ways: the first way is related to the isolation of phenomena. With reams of data flooding in, you begin by looking for what doesn't connect, for what doesn't fit. You look at what is moving in a different direction. You treat everything else as the quiescent field. We were looking for that one behavior that is the driver, and everything else got neglected. It was an incredible way of simplifying what would have been an intractable problem. But it did demand that the scientists and engineers have the ability to reason out scenarios, which in turn demanded remarkable aptitude and facility with the laws of physics.

Michelle Addington at NASA's Goddard Space Flight Center, where, among other projects, she worked on the development of NASTRAN, a finite-element structural analysis program that paved the way for the modeling and structural analysis programs now used in automotive and building design.

Michelle Addington in the early 1970s at NASA's Goddard Space Flight Center in Maryland, where her work was part of a co-op program with the engineering school from which she graduated.

Unfortunately, today we live in a world where most practitioners hope that the answers will somehow emerge on their own if they keep collecting enough data, whereas we were throwing away any data we could so as to get to the essential bits.

The second way that this idea of disconnection has influenced me was in thinking about how equipment was made. Integrated technology was, to us, a poor concept. When we designed a piece of equipment, we designed it to do a task in the most robust manner possible. Nevertheless, we still had to recognize that weight is the biggest enemy in space. One would think, then, that there would have been a push for multifunctionality, as that would be the easiest way to get the job done and reduce weight. But this rarely happens, as the entire mission is worthless if the job isn't done properly. Furthermore, when things are multifunctional and integrated, then failures can start to cascade. When everything is independent, one failure is just *one* failure. The mission can go on until the last component fails. In 2001 I heard Daniel Golden, who was then the administrator of NASA, speak about the design for the Mars rover (Figure 5). He stated that it would be the most dis-integrated lander that NASA had ever made. Even the wheels would have their own motors and controls. Because of this dis-integration, it could maintain some functionality, even after multiple catastrophic failures. If one wheel failed, the rover would still move. If two wheels failed, it would still move. If three wheels failed, it would still move—not very well, but it would still move. Everything was engineered for optimal performance of independent tasks, everything was engineered discreetly to protect the mission. Interestingly enough, that rover has already outlived its expected life and is still collecting data. When I think about our unrelenting commitment to clumsily integrate all of our building systems together, because it is, on the one hand supposedly good engineering and, on the other, holistic, I think the aspect we should learn from NASA's approach is not so much about failure but rather about the idea of optimal design for specific tasks. Instead, we perform several tasks in buildings quite poorly, because we collapse them all together into a single closed system.

When we think about the public's image of NASA, it is completely circumscribed by manned flight. The images people are most familiar with—the space suit, the space capsule, the space shuttle, the space station—all represent the NASA that was less about exploring the unknown and more about pandering to the narcissism of the body politic. All of these spacecraft, with their mini worlds carefully re-creating the human body's known environment within a tightly sealed, highly integrated system are, instead, the antithesis of what those of us in the other NASA were launching. All of these things we were sending out into space were about extending beyond, rather than closing in. We wanted to transcend our bodies and not allow them to restrict our reach. So, dear Neil Armstrong, while I so wanted to be you before I started working at NASA, when I left, I wanted to be Billy Pilgrim.

The Mars Exploration Rover, launched in 2003 to explore the Martian surface and geology.