

R. Buckminster Fuller's Model of Nature:

Its Role in His Design Process and the
Presentation and Reception of His Work

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Abstract

R. Buckminster Fuller's design and architectural work is frequently described as being "inspired by nature." However, to date there has been little investigation of this claim. What was Fuller's understanding of "nature" and how did it affect the conception, production, and presentation of his work? This thesis attempts to characterize R. Buckminster Fuller's understanding of nature, which will be called a *model of nature*, and to trace its impact upon his work over the course of his career using an interdisciplinary historical approach.

Fuller's model of nature was a unique amalgam of religious, scientific, and philosophical ideas from the past and the present. It drew upon Enlightenment ideas about natural laws, and American Transcendentalist ideas about the spiritual importance of experiences in the natural world. Fuller combined these with 20th century ideas about technological progress and the efficiencies of mass production.

This model of nature affected both the conception and presentation of Fuller's work. For example, his understanding of nature shaped the design of the 4D/Dymaxion house from the late 1920s until the 1940s, in particular the notion of the house as a living organism and the use of natural metaphors such as circulation and respiration to describe its functions. Other works are also discussed.

Fuller's understanding of nature was present throughout his lifetime, yet it did not always figure into the presentation of his work. Fuller deftly adapted his message to his audiences—in some cases foregrounding the role of nature in his work, in other cases omitting it altogether. He found a particularly avid audience for nature-related narratives of his work with the 1960s counterculture, and established common ground with the counterculture in part by appealing to their ideals of pastoralism, holism, and individualism. The countercultural understanding of Fuller as a designer deeply inspired by nature has persisted to this day.

The 1960s also saw the rise of alternative models of nature, such as an eco-political model of nature adopted by the burgeoning environmental movement; and a cybernetic ecology model of nature that grew out of systems theory and cybernetics. In the thesis, these two alternate models of nature are compared and contrasted with Fuller's. In particular, comparison with the eco-political model of nature affords the opportunity to discuss whether Fuller was an early environmentalist, as some scholars have argued, or whether, as I argue, he largely chose to sidestep the environmental debate.

Taken together, these investigations into Fuller's model of nature help us to understand his unique, comprehensive view in which nature, mankind and technology were bound together in continuous coevolution under the benevolent watch of a Greater Intellect. Nature was a source that he returned to again and again to provide conceptual and formal inspiration for his architectural projects; confirmation of his religious faith; and a way of understanding the role of technology in human civilization.

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Notes on Language

In this thesis, I have chosen language that is most consistent with my subject. For example, throughout the thesis I refer to *man* and *mankind* because these are the words that R. Buckminster Fuller used during his time. I use these terms in order to remain consistent with Fuller's terminology, even though the terms *human* and *humankind* might be preferred today.

Fuller was a lifelong Christian and a believer in God in the Western Christian sense. Fuller also used the terms *Universal Intelligence*, *Greater Intellect*, *Greater Integrity*, and *The Almighty*, in reference to God. When referring to God as Fuller understood the term, I have capitalized the word, as Fuller did in his writing.

I have also chosen to use the American English spellings of words such as *characterize*, *realize*, and *program* instead of the British English spellings, *characterise*, *realise*, and *programme*. The majority of my research resources, including both published texts and manuscripts by Fuller, were written with American spellings. Therefore, I chose American spellings for consistency and ease of reading, such that the reader need not toggle between two different spelling styles.

Additional notes on language are found at the beginning of Chapter 5, when I discuss my use of the terms *counterculture* and *the 1960s*, as applicable to that chapter. Minor notes on language are also annotated in the text.

This thesis is dedicated to the two Petras.

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Prof. Jonathan Woodham's book *Twentieth Century Design* enticed me to study at the University of Brighton; and his unflagging support over four years has seen me through to the end of this project. Jonathan's vast knowledge of design history, thoughtful feedback, and nimble humor made me look forward to our meetings even when it meant getting up at 6am for a Skype call. I am deeply thankful.

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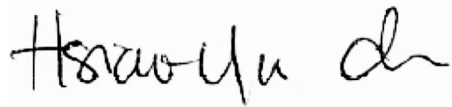
Roberto Trujillo and the staff of the Department of Special Collections and University Archives at Stanford University Libraries have offered friendly and collegial support throughout the course of my studies.

My parents, Petra and Fen-Dow, have always valued education for its own sake and have passed this value on to me. My mother, Petra, has been my most energetic cheerleader and sustainer. My brother Wei spent many hours guiding me through the low points of my PhD journey, and has offered invaluable advice. My sisters Lidy and May-Ying, in addition to moral support, have provided welcome distractions from my writing in the form of long chats. I thank my husband, Andre, for supporting my educational ambitions even when it meant double-duty babysitting for him. And I would like to thank my daughter Petra, who was born during the course of my PhD studies. After I had given birth and survived the first three months of parenthood, writing the thesis seemed comparatively easy.

Finally, I recall my former professor Arthur Lee Loeb (1923-2002), who taught Visual Mathematics at Harvard University. Prof. Loeb's class made such a lasting impression that it led to my studying design at Stanford, working in the Fuller Collection, and eventually to writing this thesis. I remember Prof. Loeb very fondly as a wonderful teacher, an inspired geometer, and a true humanist.

Declaration

I declare that the research contained in this thesis, unless otherwise formally indicated within the text, is the original work of the author. The thesis has not been previously submitted to this or any other university for a degree, and does not incorporate any material already submitted for a degree.

A handwritten signature in black ink, appearing to read "Hsiao-Yun Chu" followed by a stylized flourish.

Signed: Hsiao-Yun Chu

Dated: September 29, 2014

Research Approach and Methods

Introduction

Research Questions and Methodology

Literature Review

Research Framework

Historical Research Tools and Methods

Introduction

The purpose of this research is to investigate the role of nature in the design process of an industrial designer whose work is frequently described as “nature-inspired,” namely R. Buckminster Fuller (1895-1983). Although Fuller is not the only designer to share this distinction,¹ an in-depth examination of his design philosophy, process, and resultant works allows us to understand better how Fuller’s unique and personal model of nature informed his designs. It also allows us to investigate the social, technological, economic and cultural context of his work as well as its presentation and reception within the public sphere. This chapter outlines the research questions, sketches out the methodological approaches used, and presents an overview of the research tools.

The idea that nature and design might be connected is not new. In the broadest sense, all design may be said to have a connection to nature. That being said, some

¹ Certainly there are other designers and particularly architects whose work is described in this way, including but not limited to Ross Lovegrove, Frederick Kiesler, Bruce Goff, Frank Lloyd Wright, Frank Gehry, Tapio Wirkkala, Alvar Aalto, and Antonio Gaudì.

forms of design seem much more directly and fruitfully inspired by nature than others. In the modern period, close and visible connections between design and nature have been recognized, for example, in the architecture and decorative arts of the Art Nouveau period, and in the work of select architects of the 20th century, as discussed in the literature review. However, critical explorations of the role of nature in design are few and far between. Furthermore, there is no established methodology for discussing the relationship between nature and industrial design. This is due in part to the difficulty of defining “nature.”

The word “nature” has a myriad of meanings: the natural world, biological life, the cosmos, human nature, and that which is not manmade, to name just a few.² Ideas extracted or abstracted from nature might affect design implicitly, in terms of a conceptual inspiration; or explicitly, in terms of its form, decorative program, functionality, geometry, and/or structure. *Simply put, there are a vast number of possibilities for some aspect of “nature” to affect or influence some outcome in design.* The outcomes may vary further, depending upon such factors as the designer’s understanding of nature, design process and goals, and their social, historical and technological context, leading to a fairly overwhelming number of possibilities.

Mental Models and Models of Nature

In order to manage this complexity, I borrow from the cognitive science idea of *mental models*. In 1983, Dedre Gertner and Albert Stevens wrote that “people’s views of the world, of themselves, of their own capabilities, and of the tasks that

² See Kate Soper, *What is Nature?* (Oxford: Blackwell, 1995).

they are asked to perform, or topics they are asked to learn, depend heavily on the conceptualizations that they bring to the task."³ They called these conceptualizations "mental models."⁴ Mental models are representations of complex or nebulous concepts in reality that help individuals to think, reason, and make decisions with these concepts. As such, mental models are "deeply held images of thinking and acting."⁵

From this point, it is proposed that individuals construct working (if necessarily limited) mental models of the amorphous subject of nature that I will call "models of nature." These models of nature are shaped and influenced by an individual's social/educational/cultural context and life experiences; and these models may also be flexible and incomplete, as is the case with most mental models.

Nevertheless, such models of nature represent a core set of beliefs about nature that an individual holds to be true in the absence of evidence to the contrary.⁶

The view that individuals construct "models of nature" and use them as a lens with which to view the world is supported by Kate Soper in *What is Nature?* (Blackwell, 1995). Soper points out that people adopt cultural 'constructions' of nature,

³ Dedre Gentner and Albert L Stevens, *Mental Models* (Hillsdale, NJ: Erlbaum, 1983).

⁴ Gentner and Stevens were not the first to use the term "mental model." It is believed to have originated with Kenneth Craik in his 1943 book *The Nature of Explanation*.

⁵ Ralph D. Jacobson, *Leading for a Change: Maps and Tools*, (Oxford: Butterworth-Heinemann, 2000), 102, cited in "Mental Model." Wikipedia. Wikimedia Foundation, 15 May 2013. Web. 26 June 2013.

⁶ The idea that people construct mental models of nature is supported in literature from fields such as cognitive science and anthropology. See Megan Bang, Douglas Medin, and Scott Atran, "Cultural Mosaics and Mental Models of Nature," *Proceedings of the National Academy of Sciences* 104:35, 2007, 13868–13874. In this thesis, I am looking specifically at an individual's (Fuller's) model of nature and how it affected his design process and the resultant designs. Therefore, this is a somewhat novel application of the mental models theory to the field of design, but not an unprecedented one.

subject to context and intention, and that these constructs are sometimes used to advance political ends.⁷

Returning to the research at hand, it is proposed here that Fuller had a particular model of nature—a personal construct, shaped by context—that manifested itself in his design work. In this thesis, Fuller’s individual model of nature will first be described and characterized, followed by a review of the evidence and expression of his conceptualizations of nature in his writings, speeches, and design oeuvre. Fuller’s model of nature was particularly influenced by the Enlightenment and American Transcendentalist tradition. We will look at how Fuller blended 18th and 19th century ideas about nature with a distinctly 20th century faith in technology to come up with a unique vision of nature that was entirely compatible with technological progress.

As mentioned, the field of design history lacks a consistent methodology for discussing the overlap between nature and design. Therefore, this project proposes a research framework^{8,9} for investigating the relationship between nature and industrial design that involves first considering an individual’s model of nature and then assessing its impact on their industrial design practice. On the one hand, this framework provides an underlying structure to our analysis of Fuller’s work that begins by characterizing his model of nature and then investigating its effects

⁷ Kate Soper, *What is Nature?* (Oxford: Blackwell, 1995.) See especially pages 1-14.

⁸ The word “framework” here refers to a broad outline or basic structure which supports the overall research project, in this case starting with models of nature and then moving to an analysis of an individual’s work. As mentioned above, the models of nature should also be considered within an individual’s historical and technological context.

⁹ The research framework particularly with regard to models of nature is discussed in greater detail in Section C, *Research Framework*, below.

on his design philosophy and work. But this framework also makes a methodological contribution to future research concerning nature and industrial design, since the same approach could be applied to different designers whose work is assumed to be nature-inspired.¹⁰ This might lead to a deeper and more lasting understanding of what the phrase “inspired by nature” meant, or means, to a particular designer working in a given context. In addition, applying a similar framework to future investigations of nature and design might facilitate interesting comparisons and contrasts between different designer’s approaches at different points in time.

¹⁰ One might, for example, apply this framework to better understand the role of nature in the design process of Tapio Wirkkala (1915-85), Ross Lovegrove, (1958-) or any one of a number of industrial designers whose work is typically described as “nature-inspired.”

A. Research Questions

The essential research question and subquestions for the project are identified as follows:

Primary question

What was R. Buckminster Fuller's model of nature, and how did that model affect his design philosophy and practice of architecture and industrial design?

Subquestions

1. How was Fuller's model of nature influenced by earlier traditions (specifically, Enlightenment and American Transcendentalist ideas about nature)?
2. How did Fuller's model of nature accommodate technology and technological progress?
3. How did Fuller's understanding of nature enter into the design process? Does his design work show analogies to nature or the natural world?
4. How did the presentation and reception of Fuller's work change over time with respect to nature? How did Fuller present his work at different points in time, and how receptive was his audience to his ideas about nature?¹¹
5. Did Fuller's lightweight and efficient designs prefigure sustainable design as we know it today?
6. How did Fuller's model of nature differ from alternate models of nature of the same period?
7. Can we establish, in the course of this project, a useful framework for investigating the relationship between models of nature and industrial design?

Fuller's work is often described as being nature-inspired, but prior to this project there has been little attempt to investigate what "nature" meant to Fuller, or how his understanding of nature affected his work. The research questions above allow

¹¹ In other words, has Fuller's work always been described as being "nature-inspired," or did this understanding come about in the later part of his career, as I will argue in a later chapter.

us investigate those questions in more deeply and critically. In addition, Subquestion #6 allows us to compare and contrast Fuller’s ideas about nature with contemporaneous models, helping to contextualize his outlook.¹² Taken as a whole, these research questions will increase our understanding of how R. Buckminster Fuller’s ideas about nature affected his design work in real terms, by viewing his work through the lens of his particular model of nature. They will also allow us to trace how his work was perceived by his audiences—how receptive they were to Fuller’s ideas about nature (as well as technology) at different points in time, as indicated in Subquestion #4.

B. Literature Review

One of the first steps in this project was to identify a language and organizational framework for discussing nature and design through a thorough literature review. Rather than being helpful in this effort, the literature review revealed the lack of coherent or reliable methods for assessing the possible connections between nature and industrial design, as discussed above.

Although the relationship between design and nature has been more thoroughly considered in the realm of architectural design, even that field lacks a consistent vocabulary or approach. The majority of books and articles on architectural design and nature tend to identify visual or structural connections to nature in specific works. They neither construct a larger framework for looking at the relation

¹² For example, Fuller claimed that by applying design science principles of ephemeralization and intelligent resource management, design scientists could make the world work for 100% of humanity with minimal use of raw materials. How did this compare to other ecological programs or ideas? And how successful was the design science movement at reaching these goals?

between nature and design, anchored in the designer's model of nature, nor discuss the cultural context of the work the design of which presumably is affected by nature. The most successful books in discussing the links between nature and design narrow the topic down to a specific aspect of nature and its impact on design over a defined period of time: discussing biological analogies in the case of Philip Steadman's *The Evolution of Designs* (Cambridge Univ. Press, 1979), or theories of organicism in the 19th century in the case of Caroline van Eck's *Organicism in Nineteenth-Century Architecture* (Architectura & Natura Press, 2004).

C. Research Framework

In the introductory section, we discussed the research approach using models of nature that will be discussed in more detail here.¹³ In the course of this research project, a useful conceptual framework emerged, which is described in simplest terms as follows: Individual designers construct models of nature consistent with their personal philosophies, life experiences, education, and/or spiritual and religious beliefs. These models of nature may be consulted to a greater or less degree in formulating their design philosophies. "Nature," as the designer understands it, may also furnish conceptual, formal, or analogical inspirations for their design work. This is the basic premise that I adopted for this research. The more the model of nature impacts the design work, the greater the area of overlap between the two domains. (See Figure 2)

¹³ In the introductory section, the lack of a consistent methodological approach was indicated and the possible value of using a framework as proposed was also discussed.

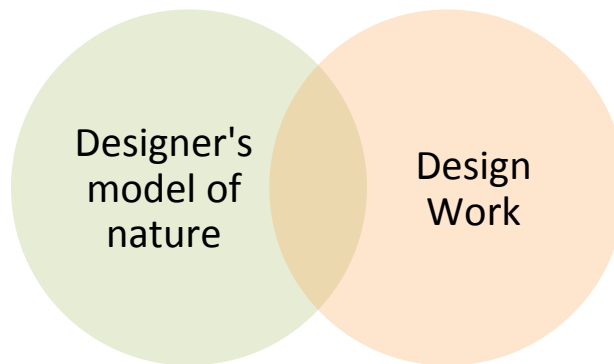


Figure 1: The overlap between model of nature and design work

This basic approach could be broadened and set within a larger technological, and cultural context as indicated in the diagram on the next page. (Figure 2.) The designer has a personal design philosophy and model of nature, formed through culture, education, personal reflection, and/or religious belief. But the production and reception of the designer's work is dependent upon the technological and cultural context.

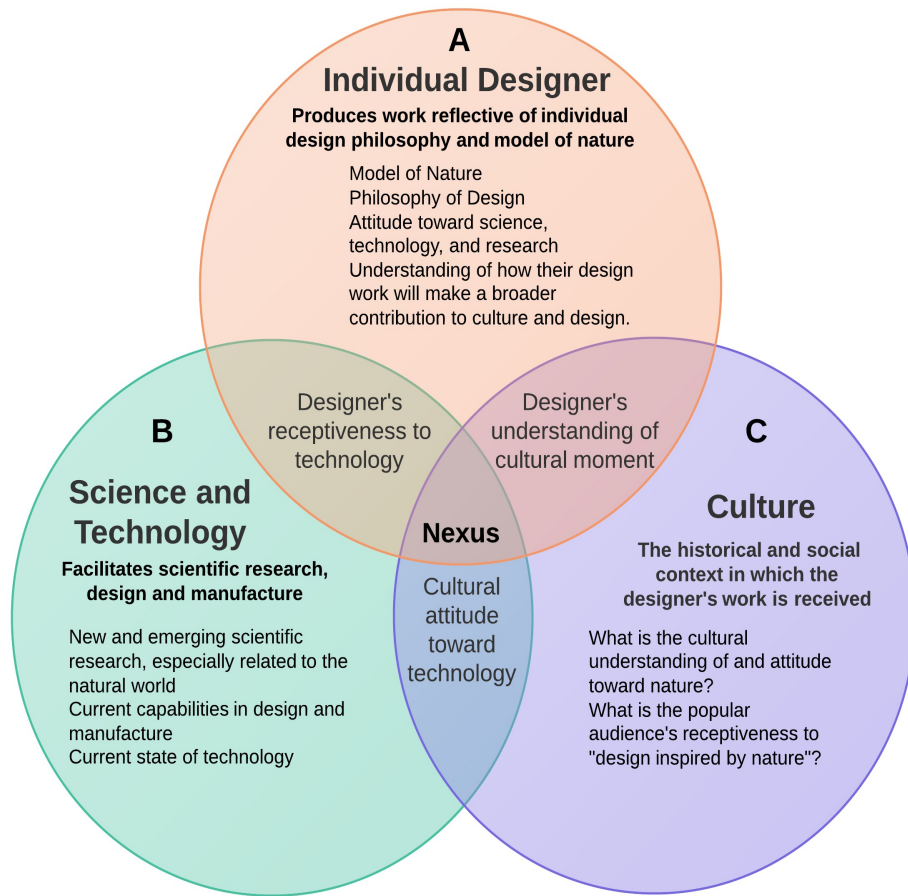


Figure 2: How the cultural and technological context might affect the reception of "nature-inspired" design

When the designer's intentions(A) are facilitated by current technologies(B) against a cultural backdrop that is receptive toward nature, technology and design(C), then the idea of "nature inspired design" comes into focus, and the designer finds a receptive audience and a fertile context for the development of this theme within his/her work. Although this is something of an oversimplification it serves to illustrate that the designer's work is dependent in both its production and its reception upon the surrounding technological and cultural context. This comes into play when discussing Fuller's work. For example, during the 1960s, there was a greater receptivity toward naturalistic and holistic ideas. Therefore, Fuller (through

his lectures and writings) began to promote more purposefully naturalistic interpretations of his design activities, since he found a more receptive and enthusiastic audience for such ideas. This theme is taken up in Chapters 4 and 5 of this thesis. At the same time, the production of Fuller's designs, notably the geodesic dome, was dependent upon current technologies and existing systems of manufacture and distribution: "nature inspired design" would not have been possible without these systems. This example illustrates how the more contextual model sketched above could be applied to understand the contexts in which "nature-inspired" design must operate.

With the conceptual frameworks described above, this thesis has sought to:

- Describe Fuller's model of nature, with particular attention to Transcendentalism;
- Describe his design philosophy and relationship to nature;
- Discuss examples of his design work, particularly those that show a clear conceptual and/or visible relation with their model of nature, and discuss how this was facilitated by available technologies;
- Understand the presentation of and the reception of their work in the public arena, paying attention to the cultural context;
- Discuss the historical importance or influence of Fuller's work in light of the above;
- Discuss how Fuller's model of nature resembled or differed from contemporaneous models of nature.

By proposing and applying some simple frameworks for addressing the issue of nature and design, this research makes a contribution to a field sorely lacking in consistent methodological approaches. This may provide a model for future

scholars investigating the relationship between nature and industrial design, particularly when evaluating the work of an individual designer.

Other Methodological Approaches

As described in the literature review, unlike industrial design history, the field of architectural history provides an array of literature on the possible links between architecture and nature, although it is similarly lacking in an overarching methodology. Nonetheless, in certain specific aspects of the relation between nature and design, especially between design and biological life, Philip Steadman's biological classifications from *The Evolution of Designs* (1979, revised 2008) proved a useful reference for describing analogies between Fuller's design work and the biological world.

The Importance of a Contextual Approach

The literature review helped to probe the relation between design and nature in context. Although the literature on design and nature did not converge on a preferred methodology or set of defined critical approaches, it did provide a platform for understanding the changing context of design in the nineteenth and twentieth centuries, and how that might have affected the conception, production, and reception of different nature-inspired designs. For example, as discussed above, Fuller always had a strong sense of nature and geometry throughout his career, yet his work was not typically seen as being related to nature during the early years (1920s-1950s). During that time, it was more readily understood as a

manifestation of technical progress in ‘machine age.’¹⁴ The “nature inspired” reading of Fuller’s work came about during the 1960s and 70s, when there was strong anti-corporate sentiment and a burgeoning interest in holistic and naturalistic ideas. Because of the changing context, as well his self-promotion¹⁵, Fuller’s work was increasingly recognized and praised for representing “nature’s geometry.”

D. Historical Research Tools and Methods

1) Close reading of primary texts

A key method in understanding Fuller’s model of nature was the close reading of primary and secondary texts. Fuller, who lectured and published profusely, left a generous, if somewhat tortuous, trail of work both through his published books and articles and through the manuscripts and notes housed in the enormous Fuller archive at Stanford University. Key texts that give clues to Fuller’s attitude toward nature include the rare, self-published *4D Timelock* manuscript (1928), *Nine Chains to the Moon* (1938), *Ideas and Integrities* (1969), and *Utopia or Oblivion* (1969). *Ideas and Integrities* and *Utopia or Oblivion* are both anthologies of previously-written essays or transcribed speeches, some dating back to the 1940s. As such, the two volumes represent Fuller’s outlook during the height of his professional career.

¹⁴ I do not mean to suggest here that Fuller was not interested in nature or natural phenomena prior to the 1960s. On the contrary, he was curious about natural laws, naturally-occurring geometries, natural phenomena, and so forth throughout his life. However, there was not as much interest in discussing the possible relationships with his work to nature, and therefore nature was not a major part of the narrative of his work.

¹⁵ By “self-promotion,” I mean the various ways in which Fuller presented, promoted and explained his design work through lectures, speeches, books and articles. During the 1960s and 70s, he made increasing references to nature’s geometry, which fell on sympathetic ears. See Chapters 4-6.

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Expanded Statement on Methodology Framework

It has been established throughout the discussion that design history lacks a consistent or reliable methodology for investigating the theme of nature and design. An interdisciplinary approach was used throughout this research, not only for lack of an obvious methodology, but also because it proved a more fruitful approach for this particular research. This included bringing together ideas and approaches from the history of science, history of ideas, studies of nature and architecture, history of environmentalism, cultural history, historical biography, and more, as appropriate to a broad range of research questions.

Several design historians have noted that an interdisciplinary approach in and of itself has value for design history. For example, Kjetil Fallan in *Design History: Understanding Theory and Method* (Berg, 2010) notes that whereas design history has often borrowed from art historical methods, other approaches taken from the history and sociology of technology (such as script analysis and actor network theory) hold great promise for the history of design. Fallan goes so far as to say that the boundaries of what constitutes design are themselves indistinct and shifting, and therefore a more open-ended approach may be more rewarding (Fallan, xvii.) *The Design History Reader*, edited by Grace Lees-Maffei (Bloomsbury, 2010) also takes an interdisciplinary approach in terms of themes and primary text selections, ranging from “eighteenth century economics to manifestoes on sustainability” (noted by Deborah Sugg Ryan, University College Falmouth).

Given that the research focuses on R. Buckminster Fuller’s (1895-1983) life and career, this research might also be put into the wider context of a life history approach that attempts to understand Fuller’s design activities and his attitudes toward nature as unfolding over decades against a changing landscape of economic and ideological forces. In Daniel Bertaux’s *Biography and Society: The Life-History Approach in the Social Sciences* (Sage, 1981) it is precisely this changing context against which individuals define themselves, and an individual’s choices in turn help to reshape that context over time. *Biography and Society* brings together interdisciplinary perspectives from different traditions and disciplines in order to enrich the methodologies and approaches that can be applied to historical biography. An analogous, if not identical approach, is taken here.

Finally, an interdisciplinary approach is particularly applicable to R. Buckminster Fuller, whose unusually comprehensive career touched upon not only architectural, automotive, and product design, but also cartography, education, public speaking, mathematics and geometry, systems engineering, military service and contracts, and poetry. (See “Big Ideas,” *Buckminster Fuller Institute* website, <https://bfi.org/about-fuller/big-ideas>).

In order to understand Fuller's model of nature, it was also necessary to revisit the writings of his great aunt Margaret Fuller and other prominent New England Transcendentalists (including Ralph Waldo Emerson and Henry David Thoreau) in her circle. This helped to establish a clear link between Transcendentalist thinking and Fuller's own philosophy of nature. Fuller took their general view that the natural world and its natural laws provided evidence of God's omnipotence and wisdom, and linked it to a twentieth century understanding of the importance of technological progress. What emerged was a view of nature as the source of all life and knowledge, and man as the intellectual, capable of understanding nature's wisdom and using it toward ethical ends.

Technology for Fuller was not to be feared; it was rather an indication of the continuous evolution of human knowledge, bounded by the natural laws. Fuller was more concerned that this technology be applied in ethical ways, to support 'livingry' rather than 'killingry'.¹⁶ This insistence upon ethical uses of technology became a hallmark of his thinking. This can be traced throughout Fuller's writings over the years.

2) Using Secondary Sources to Establish Context

Secondary sources in the case of this research were used to establish a context and framework for discussing Fuller's work. Scholarly books such as Krause and Lichtenstein's *Your Private Sky: Buckminster Fuller* (Lars Müller, 1999), and Chu and

¹⁶ Fuller used the word 'livingry' to describe artifacts and inventions related to peaceful human survival, such as family dwellings and transportation. He used 'killingry' to describe artifacts related to war, such as weapons and military satellites. Fuller correctly observed that the same technologies could be applied to either peaceful or destructive ends, i.e. to either 'livingry' or 'killingry,' and as an ethical matter, Fuller clearly preferred the former.

understanding of Fuller's model of nature, grounded by examples, discussion and analysis, is thus the major outcome of this work.

Trujillo's *New Views on R. Buckminster Fuller* (Stanford Univ. Press, 2009) were useful references. Several books regarding the cultural landscape of the 1960s were used to understand how the public reception of Fuller's work changed during the 1960s. In particular, Fuller became a hero to a generation of disillusioned youth, providing them with utopian visions of a technologically-enabled future where poverty would be eradicated through better distribution of resources. Particularly useful for understanding the counterculture were Theodore Roszak's *The Making of a Counter Culture* (1969) and Bennett Berger's *The Survival of a Counterculture* (1981).

It was difficult to establish a common approach or vocabulary for discussing design and nature from existing sources, as discussed in the literature review. Nonetheless, Philip Steadman's *The Evolution of Design* offered a rich discussion of different biological analogies found in architecture and design. Kate Soper's *What is Nature?* (Wiley-Blackwell, 1995) argued for the existence of a variety of different models of nature, dependent upon time and context, which proved a useful impetus for considering the context surrounding Fuller's model of nature, its presentation and reception throughout the research project.

One source that proved very useful in understanding how Fuller's model of nature both resembled and differed from what I call the "cybernetic ecology" model of nature (see Chapter 7) was Adam Curtis' 2011 documentary series, "All Watched Over by Machines of Loving Grace."¹⁷ I drew upon this series heavily to understand

¹⁷ Adam Curtis, "All Watched Over by Machines of Loving Grace" [documentary series], BBC, 2011. This comprises a three-part series, each episode approximately one hour long. Of particular note is Episode 2, "The Use and Abuse of Vegetational Concepts."

the development of a model of nature (and by extension, society) as a self-regulating ecosystem that might be “tuned” through feedback loops. Curtis’ research was deeply informed by interviews, clips of which are included in the film, as well as essays by Peder Anker, which I also consulted in my research (see Literature Review).

3) Telephone Interviews

Telephone interviews were used to collect secondary or support information.

Although an in-person interview would have been preferable, phone interviews were a less resource intensive method of information collection that nevertheless allowed for discussion and exploration of different research questions.

This method was used to interview Peter Pearce—a product designer and architect who worked on the manuscript of *Synergetics* with R. Buckminster Fuller—during August of 2012. The interview questions dealt with Fuller’s growing influence as a speaker and public intellectual during the 1960s, and his emergence as a comprehensive anticipatory design scientist. Some of the topics treated in the telephone interview included the following:

- What was your relationship to R. Buckminster Fuller?
- Did the cultural context of the 1960s enhance Fuller’s reputation as a design scientist? Why did he enjoy such popularity with the countercultural youth?
- Knowing the geodesic domes in architecture have existed at least since the Zeiss Dome (Jena, 1923), do Fuller’s domes represent an original contribution to architecture? If so, what is that?

Benefits and Limitations of Telephone Interviews

Telephone interviews represent a cost-effective method of gathering information, both factual and anecdotal. The interviews were transcribed, which was the main expense for this technique. As compared to face-to-face interviews, the telephone interview was somewhat less intimate and was more closely dependent on the structured interview questions. This allowed comparatively less opportunity for spontaneous exploration of topics. Also, because personal interviews are somewhat dependent upon individual's memories and experiences, they represent subjective accounts of events rather than entirely objective accounts of those events. This is a known limitation of interviews in general. However, because the technique is generally cost-effective and efficient, it was in this case a useful method for checking basic facts as well for finding specific answers to questions that were not answered in the literature, but that could be answered by individuals.

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Literature Review

Introduction

This thesis examines R. Buckminster Fuller's model of nature, and its impact on his design work and its presentation. Prior to focusing on Fuller, I was interested in the question of how nature impacts on design more broadly, and spent considerable time trying to understand the topic as a whole. To some degree, this literature review reflects my own journey of starting with a wide perspective, and narrowing down.

The first part of the review gives an overview of literature on nature and design that helped me to frame the topic, with occasional reference to Fuller's work. I spend some time discussing nature in design and, more specifically, nature in architecture. The second part surveys literature specific to Fuller, and how it informed to my arguments concerning his work. I identify some of the gaps in the research that currently exist, areas that will be addressed to some degree in the chapters that follow.

I. Nature and Design

The literature on nature and design, in general, lacks a consistent methodological approach. In many cases, a connection to nature is assumed on the basis of organic form or a visual inspiration drawn from the natural world. However, the specifics of the link between nature and the manufactured object are often vague. Part of this obscurity lies in the difficulty of isolating or even defining nature.

Nature is perhaps the most complex word in the language. It is relatively easy to distinguish three areas of meaning: (i) the essential quantity and character of something; (ii) the inherent force which directs either the world or human beings or both; (iii) the material world itself, taken as including or not including human beings. Yet it is evident that within (ii) and (iii), though the area of reference is broadly clear, precise meanings are variable and at times even opposed.

-Raymond Williams, "Nature" (1983)¹

On the one hand one can acknowledge the difficulty of defining 'nature,' while at the same time still attempting to illuminate and define better the connections between nature and industrial design.

A. Literature on Nature and Design

1. General Interest Work

An easily-accessible overview of the ways in which artists and designers have observed nature and translated that into design is found in *Nature Design: From Inspiration to Innovation* (Lars Müller, 2007), with contributions by Barry Bergdoll, Dario Gamboni, and Philip Ursprung. This volume accompanied an exhibition of the same name and date that was shown at the Museum für Gestaltung, Zürich. Although the essays are too short and few in number to do full justice to the topic, this book's lavish illustrations provide an alluring introduction to the theme. In Bergdoll's compact essay (p. 46-59), entitled "Nature's Architecture: The Quest for the Laws of Form and the Critique of Historicism," the author makes a link between Goethe and other Romantic theorists who saw nature as a source of both

¹ Williams, Raymond. *Keywords: A Vocabulary of Culture and Society* (London: Flamingo, 1983), 219.

unity and endless variety, and the work of later German architects such as Karl Friedrich Schinkel (1781-1841) and Gottfried Semper (1803-1879). "Architecture is the continuation of nature in her constructive activity. This activity is conducted through that natural product: Mankind," wrote Schinkel.² Interestingly, R. Buckminster Fuller shared much the same viewpoint, as will be explored in subsequent chapters.

Philip Ursprung, in his essay entitled "Double Helix and the Blue Planet: The Visualization of Nature in the Twentieth Century" (p. 180-189) argues that designers and architects moved from a more romantic notion of nature to a more ecologically-oriented understanding of nature as a system of forces, both large (e.g. ecosystems) and small (e.g. molecules). This shift in understanding led to a growing environmental and global consciousness in the late 1950s and 1960s. This is a very broad sweep, arcing from the late 19th century to the post Second World War periods, incidentally encompassing Fuller's generation.

Although the broad brushstrokes of Ursprung's essay seem reliable, some of the details of his argument require further exploration - or at least explanation. For example, Ursprung calls the work of mid-century designers Eero Saarinen, Alvar Aalto, and Henry Moore "ultimately anti-modern" and a continuation of late nineteenth century Art Nouveau traditions.³ Yet this viewpoint seems to negate

² Schinkel, cited in Peschken, *Das Architektonische Lehrbuch*, p. 50, as translated in Angeli Sachs, ed., *Nature Design: From Inspiration to Innovation* (Zürich: Museum für Gestaltung, 2007), 49.

³ Sachs, *Nature Design*, 180-181.

the ability of these designers to successfully realize organic forms within a wholly contemporary context of mass-production and distribution.

Overall, Müller's *Nature Design* should be recognized for bringing the subject to life visually and with three well-written essays, without necessarily establishing the guidelines for it as a field of study.

2. Visual References

A number of contemporary books try to show how natural forms can be used as visual sources for form and decoration.⁴ These often take the form of full color "coffee table" books or catalogs that generally don't provide a comprehensive or critical context for a discussion of nature and design. Philip Steadman has criticized the "superficial picture-book" on nature and design, based on "artistic photos of the wonders of nature...juxtaposed with buildings or the products of industrial design."⁵ Unfortunately, a large number of books fall into this category. At best, they provide some food for thought; at worst, such books can descend into promoting mystical conceptions about nature.

Alan Powers' *Nature In Design* (1999) is an example of the former. By juxtaposing images of designed objects with natural objects and patterns, Powers tries to point out ways in which nature has historically been a source for architecture and decorative design. Unfortunately, Powers is prone to making sweeping statements

⁴ This technique has been used throughout history, and was especially prevalent during the Art Nouveau period, where decorative motifs (flowers, insects, tendrils, and the like) were often adapted from the natural world.

⁵ Philip Steadman, *The Evolution of Designs*, revised edition (London: Routledge, 2008), 6.

("At the Bauhaus...in Weimar, students worshipped nature...")⁶ that fail to properly characterize different historical conceptions of nature or how they affected design. Although Powers' book makes more of an attempt than others to sketch out historical overview of the theme of nature and design, his overview comes across as generic and occasionally trite.

Maggie MacNab's *Design by Nature* (2011) falls into the latter camp. The author takes us through an opinionated discussion of how a relationship with nature can guide our intuition and creativity as designers, punctuated with personal narratives from her own career. While this may be inspirational for some on some level, this account is far too subjective to be considered a helpful reference for enhancing our understanding of nature and design.

Such books illustrate two key problems with the literature on nature and design: On the one hand is the impossibility of neatly summarizing the subject due to vast number of ways that "nature" can be interpreted, as well as the enormous amount of variation in the world of design, as illustrated by Powers' book. Our relationships to nature and our understanding of design are both constantly shifting, which only complicates the situation. On the other hand is the tendency to romanticize a supposed primal creative connection with nature without illustrating either how or why that connection exists, or how design taps into that connection. At the same time, such books also indicate a widely held and abiding desire to draw some

⁶ Alan Powers, *Nature In Design: The Shapes, Colors and Forms that Have Inspired Visual Invention* (London: Conran Octopus, 1999), 23.

fundamental connection(s) between nature and design, in spite of the difficulty of articulating the particulars of those links.

3. Biological Analogies: *The Evolution of Designs*

Philip Steadman's *The Evolution of Designs* stands out, even after several decades, for attempting to build a true framework for discussing the theme of nature and design. Specifically, Steadman focuses on biological analogies in design, which delimits the discussion to life science analogies rather than nature in general. This is a wise choice, since, as has been discussed, the word *nature* has an extraordinary range of meanings, making it nearly impossible to define.^{7,8}

Originally published in 1979, the book was revised and republished in 2008 to include an afterword on "developments after 1980." As Steadman acknowledges in the preface to the revised edition, both the growing concern over environmental impacts of design, as well as the steady rise and availability of computers have caused a "flowering of new theory" in which architects and designers are using new methods, looking into biological processes, and using increasingly sophisticated modeling tools to extend the frontiers of how biological analogy can be applied. However, since the book relies mostly on its original 1979 text, Steadman does not cover these latter developments in great detail.

Steadman discusses various ways in which biology can provide aesthetic, technical, developmental, or conceptual models for works of art. His individual chapters

⁷ In fact, whole books have been written about this subject. See Kate Soper, *What is Nature?* (Oxford, UK: Blackwell, 1995).

⁸ In this dissertation, discussions of nature are not limited to biological analogies alone, although they are an important part of the discussion. In some cases, nature may be seen as a divine manifestation of God's natural laws, for example. In other words, this dissertation doesn't impose the same limitations as Steadman's book.

discuss different types of analogies in detail, referencing historical texts and examples. Chapter 2, dealing with “The Organic Analogy,” is perhaps most recognizable and relevant, and he discusses it in four parts. The first is the idea that natural forms have a unity and integrity of form, a refined beauty resulting from their continuous adaptation to the conditions of life. A second interpretation is a functionalist one, where each structure in a natural form performs some function, and all the structures orchestrated together keep the organism alive. The functional interpretation could eventually lead to the interpretation of an organism as a kind of elaborate machine, as in René Descartes’ *The Description of the Human Body* (1647). It follows from this interpretation that anatomical models might provide a sound functional basis for designed objects.

A third idea is a geometric/proportional analogy, where some recognizable and recurrent geometries (logarithmic spirals, the golden mean, and so on.) can be extracted from nature and applied to art and design. This analogy is particularly relevant to R. Buckminster Fuller, who often spoke of the tetrahedron as ‘nature’s building block.’ and whose geodesic dome was supposed to be a reflection of ‘nature’s geometry.’⁹ Steadman criticizes geometric or proportional analogies on several fronts; first, he comments on the tendency to ascribe an “exaggerated significance” to the proportions found in nature, which in some cases “degenerated in the end into pedantic mysticism and mumbo-jumbo.”¹⁰ Secondly, he notes that geometric patterns and models are by nature fixed, so any idea of

⁹ See Buckminster Fuller, *Ideas and Integrities* (Collier Books: 1979), 146-148. See also Scott Eastham, *Buckminster Fuller and the Sacred Geometry of Nature* (Cambridge: Lutterworth Press: 2007).

¹⁰ Steadman, *The Evolution of Designs: Biological Analogy in Architecture and the Applied Arts* (Cambridge: Cambridge University Press, 1979), 21-22.

biological form as a series of intrinsic geometries conflicts with the very plasticity attributed to organic life, its capacity for constant functional adaptation. In the end, geometrical systems analogies derived from nature are—in Steadman’s assessment—overly reliant on assuming that natural forms reflect some underlying order in nature (as opposed to being the product of functional adaptation), and ultimately a dead end.¹¹

Chapter 3 discusses classificatory analogies, in which various attempts are made to classify building structures or parts in the hope of creating a logical tree of structure, similar to Linnaeus’ classification of the species, that might illuminate some underlying theoretical principles of form.¹² Chapter 4 discusses the anatomical analogy, namely how anatomical models might provide constructional lessons for architecture, for example in terms of ribs, skeletons, skins, and connectors. Such analogies existed in the writings of J.R. Perronet, Eugène Viollet-le-Duc, and Georges Cuvier. During the twentieth century, further analogies would be made with circulation, respiration, and refuse systems, and so on. All these systems would be shaped not only by their function, but also by the climate, available materials, cultural factors, and technological context. R. Buckminster Fuller’s 4-D/Dymaxion house, with its systems of ventilation, circulation and its central “spine,” conformed to an anatomical analogy as explored in Chapter 4. The next five chapters of Steadman, while worthwhile in their own right, are not as directly applicable to this research and will not be discussed in detail. They deal

¹¹ Steadman, *Evolution of Designs* (1979), 17.

¹² In particular, Steadman cites J.N.L. Durand’s *Lecons d’Architecture* of 1819 as proposing a method of architecture based on previous classificatory models. See Steadman, *Evolution of Designs* (1979), 29.

with ecological analogies, Darwinian analogies, evolution of decoration, tools as organs or extensions of the body, speeding up craft evolution, and design as a process of growth, in that order.

Chapter 11 of Steadman is entitled *Biotechnics: plants and animals as inventors*. The concept of 'biotechnics' or 'biotechnique,' which gained some traction in the late 1920s and 1930s, basically proposed that nature had "already made a great variety of 'inventions', embodied in the designs of organs or in the adaptations of limbs." By studying this vast library of natural innovations, structures, and moving parts, "man would find [there] the solution to all his needs."¹³ The idea was not completely new; in particular, Steadman cites the Reverend J. Wood's book *Nature's Teachings: Human Invention Anticipated by Nature* (1877) as an early example of this analogy. Writing in the *Circle* anthology of 1937, a classic text of international modernism in architecture, design and the visual arts, leading architectural critic and thinker Lewis Mumford argued that, whereas powerful machines unchecked could serve to enslave life, 'biological' technologies operating with an economy of means and balanced orchestration of necessary functions, could liberate and simplify life.¹⁴ Mumford's broad claims for biotechnics, Steadman points out, suggest Mumford was more concerned "with larger Utopian political and economic goals than it has with the everyday working procedures of designers."¹⁵ In this sense, Mumford may have had more in common with R. Buckminster Fuller than he would later care to admit. Both saw technology as a

¹³ Steadman, *Evolution of Designs* (1979), 159.

¹⁴ Steadman *Evolution of Designs* (1979), 167.

¹⁵ Steadman *Evolution of Designs* (1979), 167.

reality of the modern world, while at the same time hoping it would be used for ethical ends.¹⁶

Steadman's critique of biotechnics is that any original inspirations in natural form or anatomy eventually become specialized and subsumed into the research field in question. For example, a study of bird flight might be copied initially as an idea for an airplane wing, but that idea would quickly be adopted into aviation technology and become "codified into a generalised theory of the behaviour of flying bodies."¹⁷ In other words, the initial analogy does not remain, for long, a biological one. In short, drawing functional or aesthetic inspiration from organic forms is a valid starting point; but it is not equivalent to embodying or replicating nature within industrial design. This is a potent point when evaluating the work of R. Buckminster Fuller. This could also be a critique of the more contemporary (but closely related) field of biomimicry, discussed below.

Steadman notes that "there is a strong naturalistic, even pantheistic belief among some modern organicists in the symbolic role of natural form in architecture, and in the long-established cultural and aesthetic responses that this symbolism can

¹⁶ Paul Goldberger's 1995 article in *The New York Times* points out that both Mumford and Fuller were utopian thinkers, albeit arrogant ones. During the 1930s, they probably shared some of the same hope for biotechnical approaches appropriate to local problems. By the 1970s, Mumford had soured on this idea, feeling that big technology and the global economy had eclipsed the possibility of local and regional solutions. See Paul Goldberger, *Missionaries of Human Possibility Who Sought Solutions for All*, <http://www.nytimes.com/1995/12/24/arts/architecture-view-missionaries-of-human-possibility-who-sought-solutions-for-all.html?pagewanted=all&src=pm> (Dec. 1995).

¹⁷ Steadman, *Evolution of Designs* (1979), 168.

evoke.”¹⁸ This point seems valid, considering that some design writers, notably Victor Papanek (quoting H.J. Eysenck), have gone so far as to suggest that the very evolutionary basis for aesthetic experience might lie in associational memories which “...derive from the immemorial terrestrial environment of humans.”¹⁹ Surely the symbolic role of forms and geometries found in nature was not lost on Buckminster Fuller; he was deeply drawn to the symmetry and inherent stability of geometric forms, as evidenced by his lifelong interest in tetrahedra and spherical geometries.

Steadman touches, albeit briefly, on the role of computers in generating organic form. In some cases, these forms are based on evolutionary algorithms, meaning that a number of potential forms to a given problem can be executed by a computer modeling program, and the most suitable of these can be selected and manipulated by the designer. He describes this method as “evolutionary design by computer.” This method is relevant to the work of contemporary designers (Ross Lovegrove, Zaha Hadid, Greg Lynn, and others) who use computers as a generative tool for achieving both the formal and functional characteristics that are desired, although they were not available to Fuller in his time.

Philip Steadman’s *The Evolution of Designs* provides a sturdy critical framework for understanding different types of biological analogies that have been used in

¹⁸ Steadman, *Evolution of Designs* (2008), 240. This idea of organic symbolism is also discussed in Portoghesi’s *Nature and Architecture* (2000), cited below.

¹⁹ David Stairs, “Biophilia and Technophilia: Examining the Nature/Culture Split in Design Theory,” *Design Issues* 13:3, Autumn 97, 37.

architectural design. Where applicable in this research, Fuller's work is discussed with reference to these analogies.

4. Nature as Structural Model for Design

A number of books, some falling more into the engineering field, deal with nature as a structural model for design. Peter Pearce's *Structure in Nature is a Strategy for Design* (1978) is such an example. Pearce illustrates certain geometries and structures found in nature, such as tetrahedra, dodecahedra, and molecules closely-packed in hexagonal and triangular arrays. These same strategies, he argues, can be applied to problems of structure and space filling in the built environment. Specifically, Pearce demonstrates that modular building systems can be constructed from a minimal number of component parts which, depending upon their arrangement, can take on a vast number of forms. Here, nature can be considered a repository of space filling, structurally sound geometries which can be replicated and used as building blocks for design. Because Pearce is so specific about geometries and arrays, his book was most well-received by geometers and crystallographers.²⁰ *Space Structures* by Arthur L. Loeb (Birkhauser, 1991), who was himself a crystallographer and friend of R. Buckminster Fuller's, is similarly concerned with 'natural geometries' that could be put to practical use. Indeed, R. Buckminster Fuller himself sought to uncover "nature's coordinate system," which in his mind was based on the triangle and the tetrahedron. He elaborated on this coordinate system in *Synergetics* (1975) and *Synergetics 2* (1979). (Interestingly enough, Peter Pearce provided some of the geometric illustrations

²⁰ Peter Pearce, Personal Telephone Interview, August 2012.

for *Synergetics*.) But few mathematicians, or designers for that matter, paid much attention to his idiosyncratic system of geometry. Nor (unlike Pearce's *Structure in Nature*) did either *Synergetics* book discuss how the geometric system could be applied to structural design.²¹

5. Nature as a Conceptual or Practical Model for Sustainable Design

Because nature is seen as a regenerative system, where organic matter (air, water, nutrients) is constantly recycled into the life process, it seems intuitive that nature (in the sense of "the natural world") might provide a conceptual or practical model for sustainable design. Indeed, there is a closed-loop efficiency to natural systems, which recycle their nutrients and where waste products from one biological process become raw materials for another. This type of efficiency can be invoked in models for sustainable architecture, as well as sustainable industrial design.

Victor Papanek's *The Green Imperative: Natural Design for the Real World* (1995) was a call to industrial designers to acknowledge the toll that pollution, waste, and conspicuous consumption are taking on the environment. The new design aesthetic proposed by Papanek assumes that design can either help or hinder sustainability, giving designers the moral responsibility to take the environment into account when proposing a new product or project. Design "nourished by a deep spiritual concern for planet, environment, and people...will provide the new

²¹ *Synergetics* contains a section on space filling structures; ostensibly this could be applied to design, but it is not discussed in the book. *Synergetics 2* contains a miniscule section on Design (792.00), amounting to less than 1 page in a 500 page volume, in which Fuller says that "Design is intellectually deliberate." See R. Buckminster Fuller and Ed Applewhite, *Synergetics 2* (New York: Macmillan, 1983), 171.

forms and expressions—the new aesthetic—we are all desperately trying to find.”²² In this sense, Papanek’s book reflected what Timothy O’Riordan called an “ecocentric” rather than a “technocentric” outlook, where “the ecocentric attitude is based on bioethics and a deep reverence for nature.”²³ These two attitudes are succinctly discussed in Pauline Madge’s *Ecological Design: A New Critique* (1997), which traces the evolution of different strands of thought within the ecological design movement from the late 1970s to the mid-1990s when the article was written.

The Green Imperative was a continuation of Victor Papanek’s longtime call for ethics in design, first treated in *Design for the Real World* (1971). Although *Design for the Real World* is often cited as an pioneering book about design’s impact on the environment and the Third World, Madge points out that was really more a critique of the design of socially irresponsible products to feed a rampant consumerism in the first world.²⁴ In either case, Papanek’s ideas came full circle by the 1990s, by which time the thinking on ecological design had matured and deepened. By then, ecodesign broadly writ encompassed not only a new array of tools and techniques for industrial designers to apply to the design of sustainable products, but also the notion on the part of design critics and activists that more radical changes to lifestyles of consumption would be needed.²⁵

²² Victor Papanek, *The Green Imperative: Natural Design for the Real World* (New York: Thames and Hudson, 1995), 235.

²³ Pauline Madge, “Ecological Design: A New Critique,” *Design Issues* 13:2, 1997, 44-54.

²⁴ Pauline Madge, “Design, Ecology, Technology: A Historiographical Review,” *Journal of Design History* 6:3, 1993, 149-166.

²⁵ Madge, “Ecological Design,” 53-54.

Cradle to Cradle: Remaking the Way We Make Things (2002) by William McDonough and Michael Braungart offers a more business-oriented view of how nature, and natural cycles in particular, might serve as models for industrial design. (This book, with its positive and generally uncritical tone, is not aimed at a scholarly audience but rather at the environmentally-conscious consumer.) McDonough, an accomplished architect, and Braungart, an industrial chemist, suggest that product life cycles can be modeled after natural cycles. They describe designed objects as being composed of technical and biological nutrients that should remain in continuous, closed-loop circulation. This would mimic nature's closed loop cycles where water and other resources are continuously recycled and repurposed. Thus, waste materials from one industrial process can be used as raw materials for another process, reducing or eliminating waste from the manufacturing process. Manufactured objects, at the end of their useful life, should be able to be disassembled or recycled into something else. They call this a "cradle to cradle" manufacturing strategy, as opposed to the "cradle to grave" model that many consumer goods have traditionally followed. More broadly, their viewpoint exemplifies a sustainable design strategy in which cycles of growth, consumption, and rematerialization over time are kept in balance.²⁶ The "cradle to cradle" strategy is promoted throughout McDonough Braungart Design Chemistry, a consulting company that the two co-founded in 1995 to help manufacturers develop more sustainable design and manufacturing processes.

²⁶ Madge, "Ecological Design," 51-52.

Conceptually, *Cradle to Cradle* resembles Fuller's thinking in its receptiveness toward industrial technology as part of the solution to the humanity's challenges. Like McDonough and Braungart, Fuller was also interested in the development of new and more efficient technologies that would conserve natural resources, and saw mass production as part of the solution rather than part of the problem.

6. Nature as a Generative Model for Design

A contemporary understanding of biological evolution includes not only the general outlines of organisms adapting in form and function to their environment over time; it also extends to the biochemical mechanisms of evolution, wherein small variations and mutations in DNA can generate a large number of outcomes. In this sense, biological DNA can be seen as a "code" for life. Small variations in this code can lead to very different results.

Over the past 30 years, computers have increasingly been used in industrial design, in the generation of forms as well as their manufacture. Computers likewise read codes; one can therefore draw a metaphor between nature's codes, embedded in DNA, and computer aided design codes. Like DNA, computer codes can be manipulated and varied to generate different forms and outcomes in designed objects. This can be termed a "generative model" of computer-aided design. Since Fuller did not use computers in form generation, computer aided design will not be discussed at length—but it nevertheless figures into the discussion of nature and contemporary design. A few resources on this subject include Celestine Soddu's 2002 article, "*New Nature: A Generative Approach to Design.*" Soddu

expands upon the metaphor of life, calling computer codes the DNA by which complex and unique designs, imbued with “artificial life,”²⁷ can be created and evolved.

The analogy between nature’s codes (like DNA) and computer codes is similarly acknowledged in *Form + Code in Design, Art and Architecture* (2010) and discussed at various points in the book. The codes of nature lead to specific adaptive forms. A natural form, a fern leaf, for example, is formed through constant recursive branching. This repetitive pattern can be written as a simple code, and executed on the computer to create similar branching forms, which could be applicable to design. Obviously, the end use of those forms must be determined by the designer.

A second way in which ‘nature’s codes’ can be used in a generative sense in design is to use computer-based simulations of natural phenomena and to apply them in the field of design. Over the years, biologists and computer scientists have come up with computer programs to emulate natural phenomena such as the swarming patterns of bees, the aggregation of particles, and the behavior of waves. These programs can be borrowed by designers and applied to generate patterns or forms in design. Figure 1 shows how a swarming pattern was applied to a plan for the Melbourne Docklands, to develop a more dynamic picture of how crowds would move through the space.

²⁷ Celestino Soddu, “New Nature: A Generative Approach to Design,” *Leonardo*, 35:3 (2002), 291-294.

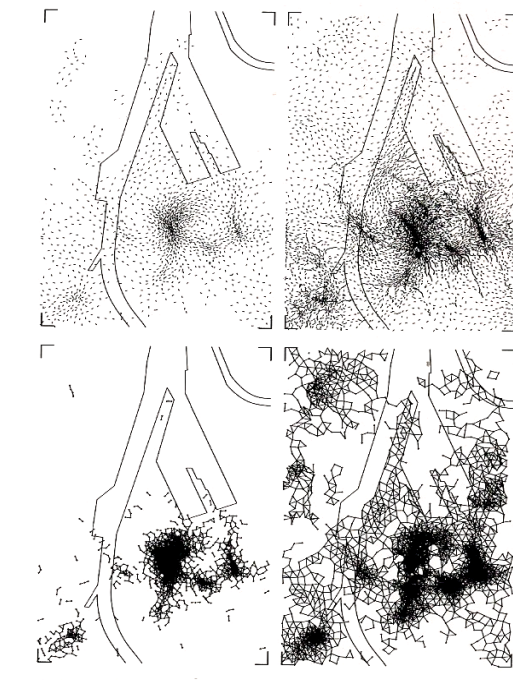


Figure 1: A swarming pattern is applied to help visualize traffic flows around the Melbourne Docklands. (*Form+Code*, p. 167.)

Although patterns found in nature or adopted from nature, as in the examples above, can be applied to design, this does not *necessarily* mean that the resultant design has some innate connection to the natural world. Certainly, in some cases designers exploit such codes to generate organic-looking forms or surfaces. But in other cases, the codes are used more as an alternate means of design exploration than as an expression of some necessary link between design and nature.

B. Nature in Architecture

1. Overviews of Nature in Architecture

Compared to the field of industrial design, the field of architecture has yielded a considerably larger body of literature on nature and design. The literature varies in its depth of research, critical stance, and thoroughness. A sound critical starting point is *Organicism in Nineteenth-Century Architecture* (1994) by Caroline van Eck. What distinguishes this book from general interest literature or monographs on the subject is a valid attempt to provide a philosophical and historical context around the emergence of organic architecture in the nineteenth century, and its transformation from a philosophical complex of thought, emphasizing classical unity, toward a more purposive application of organic form aimed at some functional advantage.²⁸ The main disadvantage of this work, for the purposes of this research, is that it concentrates almost exclusively on nineteenth-century architectural organicism, which the author calls fundamentally different from modernist organicism. "The modernist variety orients itself on biology and concentrates on functional correlation as the defining characteristic or organisms...it is predominantly practical in orientation. Nineteenth-century organicism, on the other hand, is based upon the artistic theory of classical antiquity and the Renaissance."²⁹

A book that is more pertinent to the twentieth century, while still bringing in some historical background is *Nature and Architecture* by Paolo Portoghesi (Skira, 2000). It

²⁸ Christian Hubert, "Organicism," *Christianhubert.com*, <http://www.christianhubert.com/writings/organicism.html>

²⁹ Caroline van Eck, *Organicism in Nineteenth-Century Architecture: An Inquiry into its Theoretical and Philosophical Background*, (Amsterdam: Architectura & Natura Press, 1994), 37.

differs from van Eck's book in that it relies less on historical analysis and argument, and more on the discussion of architectural examples. The book contains an impressive compendium of works that demonstrate different types of analogies between nature and architecture, in which the architectural forms are symbolic of "the primordial and universal logic behind living forms."³⁰ Portoghesi discusses different archetypes and their symbolic relationship with nature. In fact, he argues that the symbolic relationship subsumes whatever functionalism may be gained from the archetype.³¹ The book contains dozens of historical examples of archetypes having symbolic relationships with nature. One area which Portoghesi does not really touch upon is the contemporary use of computers in architectural design.

A possible complement to Portoghesi's book, although less critical and less thorough, is *Architecture: Nature* (2006) by Philip Jodidio. The author acknowledges the many ways in which nature can provide architectural inspirations, from mimicry of natural forms, to the metaphor of the building as a body, to the use of geometric models that are also found in nature. He also touches upon the cultural importance of nature particularly in Eastern countries such as Japan, and how that is manifested in architectural design. *Architecture: Nature* provides several dozen examples of projects around the world and briefly discusses what he sees as their relationship to nature including, but not limited to, Frank Lloyd Wright's *Fallingwater* (Pennsylvania, 1935); Nicholas Grimshaw's *Eden Project* (Cornwall,

³⁰ Paolo Portoghesi, *Nature and Architecture* (Milano: Skira, 2000), 15.

³¹ See Portoghesi, *Nature and Architecture*, 33-36.

2000); R. Buckminster Fuller's 1967 *Expo Dome* (Montreal); and Frank Gehry's *Fishdance Restaurant* (Kobe, 1986).

A fourth useful book is Sarah Bonnemaïson and Philip Beesley's *On Growth and Form: Organic Architecture and Beyond* (Tins Press, 2008), a collection of essays on organicism since the publication of D'Arcy Wentworth Thompson's *On Growth and Form* (1917). As references for the interface between architecture and nature, the authors recommend Peter Stevens' *Patterns in Nature*; Norman Crowe's *Nature and the Idea of a Man-Made-World*, and George Hersey's *The Monumental Impulse*. Of these, Crowe's *Nature* is probably the most useful in terms of discussing the historical relationship between nature and the built environment, focusing on the Western world.

2. Organic Architecture

One major approach in architecture may be connected to nature is embodied in the phrase 'organic architecture.' The phrase was used by Frank Lloyd Wright³² in a 1908 article for the *Architectural Record*, in which he wrote that "Nature furnished the materials for architectural motifs out of which the architectural forms as we know them today have been developed...her wealth of suggestion is inexhaustible; her riches greater than any man's desire." In "Form Follows Nature," (1989) Mark Mumford argues that origins of American organic architecture can be traced back

³² Wright was neither the first nor the last designer to use the phrase 'organic architecture,' although he receives most credit for it. Wright returned to the theme often, for example in a series of lectures that he delivered to an audience of young British architects in 1939. The lectures were later published in a volume entitled *An Organic Architecture*. See Mark Mumford, "Form Follows Nature: The Origins of American Organic Architecture," *Journal of Architectural Education*, 42:3 (1989), 26-37.

to Frank Furness (1839-1912) and Louis Sullivan (1856-1924), who handed this tradition down to Wright.³³ Furness and Sullivan, according to Mumford, were influenced by American transcendentalist writers such as Emerson³⁴, by the painters of the Hudson River School, and by European aesthetic theory, particularly the French "Romantiques."³⁵ Mumford attributes the dynamic compositions of Furness' work to his organic approach.

Wright, in 1908, goes on to say that there is no more fertile source for the architect than the "comprehension of natural law."³⁶ Here emerges a sense of a unity of form and function, a respect for integrating the building with the local landscape, and a sense of integrity about the laws supposedly governing natural phenomena. To aspire to anything less than the same integrity in architecture, Wright suggests, is unethical and shows weakness of character. R. Buckminster Fuller shared this same sense of the timeless integrity of nature, and the responsibility of the designer to understand the laws of nature, as described in Chapter 1.

Over the course of the twentieth century, the term *organic architecture* came to encompass much more than the Arts and Crafts ideal set down by Wright in 1908.

Contemporary architect David Pearson proposed a set of principles for organic

³³ Mumford notes on page 42 that "Sullivan was an apprentice in Furness' office and Wright was Sullivan's greatest disciple." See Mumford, "Form Follows Nature," 26-37.

³⁴ R. Buckminster Fuller's model of nature also shows the influence of American Transcendentalist thought, a point that will be taken up later at various times in this dissertation.

³⁵ Furness would have become familiar with French Romantic theory, including the works of Viollet le Duc, through his studies with Richard Morris Hunt from 1859-61 and in the atelier of Hector Martin Lefeul from 1846-55.

³⁶ Frank Lloyd Wright, "In the Cause of Architecture" (1908). Reproduced in the *Architecture 20* website, Columbia University.

<http://learn.columbia.edu/courses/arch20/pdf/art_hum_reading_51.pdf>

architecture, known as the “Gaia Charter.” These include “Let the design unfold, like an organism, from the seed within. [Let the design] follow the flows and be flexible and adaptable.”³⁷ Although such principles are inspirational, they are also fairly broad and unspecific. It would be difficult, on the basis of the Gaia Charter alone, to clearly distinguish organic architecture from non-organic architecture. The manifestations of organic architecture can be similarly diverse, from Wright’s *Fallingwater* (1935), which dynamically integrates the building with natural rock and waterfalls of the site; to Alvar Aalto’s use of organic curves and natural materials in the *Finnish Pavilion* (Paris, 1937); to Bruce Goff’s use of a logarithmic spiral as the basis for the *Bavinger House* (Oklahoma, 1955). Do these works necessarily embody some aspect of nature, or do they merely reflect some of its visual characteristics?

3. Blobitecture

The biomorphic tendencies seen in mid-century designers such as Alvar Aalto, Eero Saarinen, and Russel Wright, were brought to a new level with the advent of computer-aided design. During the 1990s, computer software developed for the animation and game industries began to be applied to the design of structures and objects to create malleable, bulbous and undulating continuous surfaces far more complex than had been realizable in the past. As discussed in the 2003 book *Blobitecture*, “What emerged from those dynamic flows could only be described

³⁷ “Organic Architecture,” *The Gaia Charter*, <http://www.zimbio.com/Organic+architecture/notes/1/The+Gaia+Charter>

with biological metaphors: a museum with layered and luminous 'skin; a private residence with walls that functioned as "thermo-dynamic organs..."³⁸

The term *blobitecture* has been applied to the profusion of computer-aided organic forms that began appearing in both architecture and industrial design starting in the 1990s, from Frank Gehry's *Guggenheim Museum* in Bilbao to Greg Lynn's conceptual embryo houses, to Foster & Partners' *Sage Gateshead Building* (Figure 2). What these works share in common is the use of computer modeling software in the realization of organic-looking forms. This design strategy does not necessarily result in a functional advantage or a more innate connection to the site. As such, blobitecture differs from organic architecture, which ostensibly seeks the latter advantages. Nor, it should be pointed out, does blobitecture necessarily confer sustainable advantages through form.

One way in which blobitecture *does* metaphorically connect with the natural world is in conceiving of the form as a body protected by a semipermeable, occasionally malleable skin. This point of view is taken up in Greg Lynn's book *Animate Form* (Princeton Architectural Press, 1999). Lynn's paradigm is for an architecture that would be plastic, animated by its underlying forces, or what he calls a "dynamically conceived architecture." This could open up a new expressive medium for architects who have traditionally worked with a kit of static parts.

³⁸ John K. Waters, *Blobitecture* (Gloucester, MA: Rockport Publishers, 2003), 9. See also Greg Lynn, *Folds, Bodies and Blobs: Collected Essays* (Bruxelles: La lettre volée, 1998).



Figure 2: The Sage Gateshead Building (Gateshead, UK, 1997-2004) by Foster & Partners

4. Sustainable Architecture

A growing area within the field of architecture has been the design and planning of more sustainable buildings, also referred to as 'green' architecture.³⁹ Current interest in sustainable architecture theory and practice has yielded a large body of literature, which this brief discussion cannot attempt to summarize. Rather, I would like to investigate possible links between nature and sustainable architecture in light of the overall discussion of nature and design.

³⁹ Because of his interest in the design of efficient lightweight buildings, Buckminster Fuller is considered by some to be an early environmentalist or 'sustainable architect,' a question that will be explored at length in a subsequent chapter. This section of the literature review attempts to give an overview of sustainable architecture, and its relationship to ideas of nature. This may be helpful to keep in mind when considering Fuller's contributions toward sustainable architecture.

In *Ecological Architecture: A Critical History* (Thames and Hudson, 2009), James Steele notes “the terms sustainable, ecological, and green are often used interchangeably to describe environmentally responsive architecture.” (p. 6) Steele attempts to clarify these terms in the preface to his book, but for the purposes of simplicity, the words will be used interchangeably here.⁴⁰

Design with Nature by Ian McHarg (Wiley, 1969) was one of the first books to bring up the designer’s responsibility to the environment, although primarily in the field of landscape design. McHarg argues that an unhealthy separation has sprung up between the industrialized, artificial world and the natural one, and that an ecological view in design can help to repair this disjunction. Specifically, McHarg stresses the importance of understanding the environment within which one is designing, to choose features and plant species that are compatible with that environment and as such more efficient and sustainable over the long term. *Design with Nature* was an influential text for the next generation of sustainable designers and ecologists,⁴¹ some of whom were also influenced by Fuller.

A variety of factors can contribute to the overall sustainability of a building, not only during its construction but also in terms of its energy consumption over time. Sustainable features within a building might include (but not be limited to) the use of recycled, reclaimed, or recyclable construction materials; energy efficiency

⁴⁰ Pauline Madge noted in 1997 that the use of the word “green” in relation to design was becoming outdated. She seemed to favor the terms ecological design, sustainable design, and ecodesign. See Madge, “*Ecological Design*.”

⁴¹ See Frederick Steiner, “Healing the earth: the relevance of Ian McHarg’s work for the future,” *Philosophy & Geography* Feb. 2004. *Taylor and Francis Online*.

conferred by the design of the building as well as its internal systems; renewable energy systems; landscaping that conserves water, and so on. A large number of books cover the practical aspects of sustainable design, from project examples to best practices to technical specifications. A good general-purpose introduction can be found in David Bergman's *Sustainable Design: A Critical Guide* (Princeton University Press, 2012.)

Resource Efficiency, Natural Materials, and Relationship to Environment: Implied Connections with Nature

Sustainable architecture often implies a connection to the natural world, and a concern for conserving natural resources. Sustainable buildings are often described as being *earth-friendly, ecologically friendly, in harmony with nature*, and so on. If one assumes that the natural world offers models for energy and resource efficiency, then it is easy to see how much sustainable architecture might be metaphorically connected to nature. This resource efficiency is one sense in which R. Buckminster Fuller's designs for geodesic domes may be considered to be ecologically friendly. This point is made in Timothy Luke's "Ephemeralization as Environmentalism: Rereading R. Buckminster Fuller's Operating Manual for Spaceship Earth." (*Organization Environment* 23:3, 2010). Luke argues that Fuller's design science strategies made him an early environmentalist, a point which I dispute in Chapter 6.

If one assumes that natural or recyclable materials are more reflective of nature's building materials, then a second link could be drawn between green architecture's use of renewable materials and the natural world. Sustainable

architecture might also take into close consideration the particular terrain and climate at the building site in order to operate more efficiently. This could be a third connection to the natural world.⁴²

With that said, it is difficult to say that sustainable architecture *necessarily* has a deeper connection to the natural world than any other. For example, a highly energy efficient office building might be constructed, but it could be made using non-renewable materials that would ultimately damage the environment. Likewise, a large single family home could be constructed out of renewable materials, but over its lifetime it wouldn't necessarily be more environmentally friendly than a small home constructed of manmade materials. Thirdly, a building could be well integrated into the natural site, but it need not necessarily be efficient. The point here is that while sustainable architecture may be *assumed* to be more "in harmony" with nature than traditional architecture, that is not necessarily the case. Any assessment of a building's sustainability needs to take into account the many factors that contribute to its environmental impact over time.

In the United States, sustainable buildings are rated according to a set of building standards known as the LEED, or Leadership in Energy and Environmental Design, system.⁴³ It is important to note that a respect for nature, inspiration from nature, or connection to nature in no way contributes to a building's LEED credential. This

⁴² The use of natural materials was by and large not a feature of Fuller's architectural work; he tended to prefer high-tech materials including metals and industrial plastics.

⁴³ Depending upon a building's energy efficiency and environmentally-friendly features, it may be awarded a LEED silver, gold, or platinum certification, platinum being the highest (most sustainable.)

is yet another indication that, although a connection to nature is often assumed in sustainable design, it is neither a necessary nor a measurable criterion for it.

Likewise, the Brundtland Commission's⁴⁴ 1987 report entitled *Our Common Future* emphasizes the importance of balancing the needs of a growing population with the need to protect the environment; but it does not suggest that nature itself holds the answers to sustainable development. (This point may be kept in mind when evaluating Fuller's architectural designs; in spite of natural inspirations, they were not always environmentally friendly according to contemporary criteria.)

Natural Analogies with Sustainable Benefits

Despite the tendency to conflate 'natural' with 'sustainable,' a connection to nature is neither a sufficient nor a necessary condition for sustainable architecture. With that said, one can still investigate certain areas where there is a clear connection with nature that *does* yield measurable sustainable benefits in architecture, using Steadman's classifications. One could look at anatomical analogies, looking at the building as a "body" which must maintain a constant temperature, harvest energy, and circulate air, people, and so on. An example of this is the *Core* building, designed by Nicholas Grimshaw at the Eden Project in Cornwall, UK. The design for the *Core* is based on a tree, with a central supporting trunk and a canopy that harvests the sun while providing a large umbrella of shade. This allows for natural

⁴⁴ The Brundtland Commission was convened by the United Nations in 1983 to encourage countries to pursue sustainable development together. The Commission's report, *Our Common Future*, was released in 1987 after which the Commission dissolved. The report gave an overview of sustainable development issues and challenges as well as a set of recommendations; these would influence the subsequent development of the *Rio Declaration on the Environment and Development* at the UN Conference on the Environment and Development held in Rio de Janeiro in 1992.

lighting, as well as natural ventilation from air flows across the top of the building.⁴⁵ (Interestingly enough, as discussed in Chapter 3, Fuller's early 4D house was also based on the analogy of a tree, although not necessarily with the intent of environmental sustainability.)

One could also look at geometrical analogies, where geometries found in nature are applied to the design of buildings or other structures. An example of this would be R. Buckminster Fuller's 1967 *Expo Dome* in Montreal, Canada. From a geometrical perspective, the geodesic dome does resemble geometries found in nature, most famously that of the C-60 molecule or "buckyball." In terms of efficiency of construction, the dome uses materials sparingly and has an extremely high strength-to-weight ratio, meaning that relatively few materials yield a surprisingly durable structure. According to some calculations, geodesic domes may also be more energy-efficient than traditional square buildings.⁴⁶ In the case of the *Expo Dome*, it was probably not particularly efficient due to the lack of insulating materials and the relatively thin acrylic panels that skinned the dome.⁴⁷ It nevertheless shares a geometric similarity with naturally occurring molecular forms.

⁴⁵ Additional sustainable features of the building include the use of recycled materials, superinsulated walls to maintain a constant temperature, and photovoltaic panels on the roof. See Grimshaw Architects, "The Eden Project: The Core," <http://grimshaw-architects.com/project/the-eden-project-the-core/>.

⁴⁶ Taralynn Fender, "Are Geodesic Dome Homes More Energy Efficient and Wind Resistant Because They Resemble a Hemisphere?" Jacksonville University, 2010, <http://library.ju.edu/ETD/Fender-4-20-2010.pdf>.

⁴⁷ I am not aware of any studies that specifically compare the energy efficiency of the Expo Dome against a more traditional building of similar scale, using similar materials.

Finally, one could look at nature as providing conceptual or practical models for architectural design, as suggested by both McDonough and Braungart's *Cradle to Cradle* and Victor Papanek's *The Green Imperative*, discussed above. One example of this would be Paolo Soleri's building complexes *Cosanti* (Paradise Valley, AZ, 1951) and *Arcosanti* (Mayer, AZ, 1965), which utilize principles of complexity and density to create more ecologically-sound dwellings.⁴⁸ A second example is Peter Eisenman's design for the Ciudad de Cultura de Galicia, (Spain, 2000-06) which uses historical, geographic, and climactic information about the site to inform the design. The topography of the building mimics the undulating curves of the Galician landscape, helping to integrate the building complex with its surroundings. Computer models of the building were tested and evaluated, to identify structures that would be both efficient and buildable.

5. Nature as a Generative Model in Architecture

This point of view is similar to that discussed in Section I.A.6, above. The use of computers to aid in the generation of forms that can be 'evolved' in analogy to biological evolution is also active within a small subset of current architectural practice. A useful reference book is John Frazer's *An Evolutionary Architecture* (Architectural Association, 1995), which discusses Frazer's various experiments with computer-generated architecture. Frazer proposes that a model of nature, which generates form through evolution, could be used as a model for form generation in architecture using digital tools. Architectural form can be evolved in analogy to

⁴⁸ Soleri comments that "In nature, an organism increases in complexity as it evolves and it also becomes a more compact or miniaturized system. This city, too, is an organism, one that should be as alive and functional as any living creature." Paolo Soleri, quoted in James Steele, *Ecological Architecture: A Critical History* (London: Thames & Hudson, 2005), 137.

biological form, as was the case in the Ciudad de Cultura and in a number of projects discussed in the book.

Books by Greg Lynn, Nick Dunn and Lisa Iwamoto on digital fabrication in architecture should not be overlooked in understanding contemporary digital modeling in architecture. Greg Lynn's books *Animate Form* (Princeton Architectural Press, 1999) and *Folds, Bodies & Blobs : Collected Essays (La lettre volée, 1998)* help one understand how computers have revolutionized the creation and manipulation of form in architectural design. In *Animate Form*, Lynn discusses different types of computer-generated surfaces and topologies. Aesthetically, he points to a "shift from volumes defined by Cartesian coordinates to topological surfaces defined by U and V vector coordinates"(Lynn 18) to create undulating surfaces. Another paradigm shift that Lynn points to in the use of computer-generated forms is the ability to continually mutate the form, which contrasts with the static and permanent character of architecture in the past.(Lynn 13)

Lynn takes a firm stance on the tendency to liken computer-generated design to a natural process. "Genetic [design] processes should not be equated with either intelligence or nature."(Lynn 19) He argues that computer-generated forms are organic in appearance only because of their amorphous shapes. On the one hand, one can agree with Lynn that computers are not a substitute for nature; while at the same time acknowledging that computers allow for designers to produce forms in analogy to nature, forms that might evoke similar aesthetic responses to true organic forms.

More recent overviews of architectural projects featuring computer aided design include Nick Dunn's *Digital Fabrication in Architecture* (Laurence King, 2012) and Lisa Iwamoto's *Digital Fabrications: Architectural and Material Techniques* (Princeton Univ. Press, 2009). Haresh Lalvani's article "Genomic Architecture" makes a more explicitly biological analogy with computer-generated form, and can be found in Deborah Gans' *The Organic Approach to Architecture* (West Sussex: Wiley Academy, 2003).

C. Biomimicry

Biomimicry, or biomimetics, is the study of natural forms and processes to inform the solution of human problems. It overlaps considerably with what Philip Steadman calls "biotechnics" or "biotechnique." However, in recent decades *biomimicry* has become a popular term, arguably more recognized than *biotechnics*, and will thus be discussed here with that understanding.

Biomimicry assumes that over eons of biological time, nature has engineered elegant, effective solutions to a large number of problems. By studying the structures and processes of nature, humans can engineer analogous solutions to human problems. A classic example of biomimicry is the design of Velcro; George de Mestral, the inventor of Velcro, noticed the tiny hooks that allowed seed burrs to attach to his socks and to his dog's coat. He used this observation to create a two-sided fastener, one side lined with tiny stiff hooks, the other side a series of

soft loops to which the hooks would stick. In essence, he engineered a solution from a model found in nature.⁴⁹

Biomimicry is closely related to the idea of drawing formal or functional inspiration from nature, since in a general sense that is what takes place. But biomimicry's success stories usually involve more formal research and engineering design. Typically, it is used to describe practical engineering inventions that result from scientific inquiry and testing, as opposed to just decorative or formal inspirations. For example, a nanotube based upon the structure of a virus would be considered a biomimetic invention, whereas an art nouveau wallpaper resembling roses and vines would not.

Janine Benyus helped to popularize the term biomimicry in her 1997 book *Biomimicry: Innovation Inspired by Nature* (William Morrow). Benyus gives several detailed examples of biomimicry in design and engineering, and describes some of the scientific studies behind those innovations. Several books subsequently have followed Benyus' general model, including Peter Forbes' *The Gecko's Foot: Bio-Inspiration: Engineering New Materials from Nature* (W.W. Norton, 2006) and Robert Allen's *Bulletproof Feathers: How Science Uses Nature's Secrets to Design Cutting-Edge Technology* (University of Chicago Press, 2010). Generally speaking, these books go into considerable detail about the process of technological innovation, and less

⁴⁹ As a youth, R. Buckminster Fuller designed a "mechanical jellyfish" to push his rowboat through the water. The invention, which resembled an inside-out umbrella, was based on his observations of how jellyfish propelled their bodies. Although it was a technically simple design, one could say that in principle Fuller was biomimetically inspired. If we used Steadman's classifications, however, it would be considered an example of biotechnics.

into detail about how those innovations impact upon the field of design; in this sense they are more about scientific inquiry and innovation than design.

Still, there is an undeniable connection between biomimetic design and nature, in the sense that a natural form or phenomenon is carefully studied and then 'engineered' into a usable solution. Without the biological models, the engineering solution would not exist. One question that comes up is similar to Steadman's critique of biotechnics, namely at what point in biomimicry does engineering take over the design process? At some point, a biomimetic project will cease to be dependent upon nature (will cease to be a biological problem), and will develop, essentially, into an engineering problem on how best to artificially replicate a natural phenomenon. This is not to negate the importance of nature during the early phases of design, but rather to dispel the notion that nature or biology alone is responsible for the solution.

D. Nature in Industrial Design

The literature discussed above suggests a wide-ranging interest in linking nature and design. However, the review reveals a lack of literature specifically related to the role of nature in industrial design practice, where industrial design basically refers to the conceptualization, manufacture, and distribution of consumer goods. Certainly, consumer goods from jewelry to wallpaper drew visual and formal inspiration from nature during the Art Nouveau period, although again the 19th century is somewhat out of the scope of this review. And certainly, biomimetic engineering solutions may be applied to the design of consumer goods in the form of better screens, more functional connectors, better adhesives, and so on. One can

accept the value of the current literature on nature and design, while at the same time indicating a lack of literature specific to industrial design.

Of the literature discussed so far, Victor Papanek's *Design for the Real World* probably has the most relevance to industrial designers as a call to consider the ecological impacts of designed goods; however, it gives few practical examples of how that might be achieved. *Cradle to Cradle* by McDonough and Braungart does discuss some examples of sustainable product design; although those products are more ecologically friendly, they are not necessarily inspired by nature.

The lack of literature on the role of nature in industrial design stems from a number of factors. First, as discussed, is the difficulty of defining "nature" and the many ways that nature, in some sense or another, might impact design—whether as a visual or formal inspiration, in terms of engineering functionality, in terms of natural materials, or in a more metaphorical sense. It is impossible to pin down one way in which nature impacts design, in the same way that it is difficult to pin down one way in which nature influences architecture. Second is the great variety inherent in the industrial design practice. Design firms, ranging in size from one person to hundreds, may design everything from cutlery to furniture to handheld electronics to packaging. This makes it impossible to define a standard or even a typical design process or practice. The number of ways in which 'some aspect' of nature might affect 'some outcome' in industrial design is fairly staggering.

As a result, the theme of nature or organicism in industrial design is generally discussed with respect to the work of a single designer or small firm, rather than the profession as a whole. Examples of such monographs include *Nature Form &*

Spirit: The Life and Legacy of George Nakashima by Mira Nakashima (Harry N. Abrams, 2003) and *Tapio Wirkkala: Eye, Hand and Thought* by Marianne Aav (WSOY, 2000).

These monographs suggest an implicit connection to organic form and a deep understanding of natural materials, emphasizing the subtlety and master craftsmanship of these two industrial designers. But they generally consider the designer in isolation; refraining from painting a broader picture the cultural or economic climate surrounding the individual, and how that might have impacted the reception of their work.

E. On Nature: Models of Nature

The difficulty of defining the word “nature” has been mentioned several times here. In the broadest sense, nature might refer to the universe and all the life, material, and natural phenomena contained within it. Clearly, it is difficult to treat such a colossal topic with any authority, so it is often useful to adopt a narrower viewpoint. In some cases, as in Steadman’s *The Evolution of Designs*, the author treats mostly biological paradigms; natural structures, forms, evolutionary processes, geometries, and so on that may be used as metaphors or analogies for design. However, design with nature might equally refer to a unity between the manmade and natural, as in Ian McHarg’s *Design with Nature*. Or it might refer to carefully engineered solutions that mimic biological structures for different purposes, as in biomimicry. All of these can qualify for discussions of the role of nature in design. Rather than considering ‘nature,’ one might consider instead a variety of *models of nature*, many of which have already been discussed.

This proved essential for discussing the role of nature in R. Buckminster Fuller's work. Rather than positing a definition of nature and assuming that Fuller's work could be explained in reference to it, I assumed that Fuller had his own model of nature and that it affected his work in various ways.

The models of nature approach was inspired by Kate Soper's *What is Nature* (Blackwell Publishers, 1995,) which argues that different constructs (models) of nature are used at different times and for different purposes. In the beginning, Soper defines nature as being that which is "not ourselves," meaning that which exists outside of the self. Regardless of whether we consider ourselves part of nature, Soper maintains that an otherness from nature is often an *a priori* condition for discussing it. As such, nature refers to "that part of the environment which we have had no hand in creating" (Soper 16).

At the same time, Soper also acknowledges that humanity, especially in the Christian tradition, has long been believed to be part of the Great Chain of Being, part of nature's order (Soper 21). There is a spiritual and material unity to the cosmos, from the worms in the ground to the angels above, and mankind occupies one rung on this ladder. This idea of a unified cosmos, governed by natural laws, was shared by R. Buckminster Fuller.

Finally, Soper touches upon the notion of human nature, that 'essence' that at once ties us to the natural world and also separates us from the animal world. In some

cases, this is seen as a positive; human nature's greatness being reflected in the achievements of civilization and culture. In other cases, human nature is seen as a negative; an animalistic or amoral strain which must be kept in check by culture (Soper 29).

Soper goes on to elaborate the many ways in which nature has been conceptualized (models of nature), and in some cases the political ramifications of those conceptualizations. Rather than summarizing her complex philosophical discourse, suffice it so say that her overarching message is that the models of nature that one assumes or adopts can be used toward political ends. This is especially applicable to the environmental movement, which she points out generally paints 'nature' as being aesthetically pristine, pure, and in need of saving. In her assessment, this is a one-sided characterization adopted to suit the environmental movement's ends. Assuming that nature "needs saving" ignores the reality that our economic systems are totally dependent upon natural resources, and that human beings as a whole remain painfully reliant on consuming nature. This point is relevant, and discussed in detail in Chapter 6 of this thesis. While Fuller's environmentally-minded contemporaries, notably Rachel Carson, did paint nature as something "in need of saving,"⁵⁰ Fuller himself did not. Fuller saw human evolution and technological progress as one and the same, since technology was the wholly natural outcome of the human intellect. Instead, Fuller focused on the

⁵⁰ I do not mean to oversimplify Carson's investigations of American chemical companies, which were based on careful research over many years. However, her popular book *Silent Spring* (1962) did suggest imminent threats to the natural world and its biological diversity because of rampant industrialization. This is the sense in which she represented the natural world as an entity in need of protection.

need to manage natural resources wisely in order to secure a higher standard of living for all.

Overall, Soper's book successfully illustrates that models of nature are not fixed, but are shaped by culture, place and time and may be adopted in some cases for political ends. Rather than referring to *nature*, her book encourages us to consider different models of nature that together make up the discourse of nature. By extension, in our discussion of the role of nature in design, one can consider the *models of nature* that may be applied to the field of design, and even the possible cultural and political implications of those models.

II. R. Buckminster Fuller

A. R. Buckminster Fuller Archive

The 'mother lode' of primary source material on R. Buckminster Fuller is the Fuller Collection, acquired by Stanford University in 1999. It includes over 1300 linear feet of papers and manuscripts, 2000 hours of audio and visual recordings, and numerous models and artifacts that Fuller amassed over the course of his career. One of the

highlights of the archive is the Dymaxion

Chronofile, a chronologically-ordered

collection primarily made up of personal and business letters that Fuller began compiling around 1916 and maintained until his death in 1983. The Chronofile comprises about 270 linear feet.

The Fuller Collection is a valuable research resource, but oddly enough—considering its gargantuan size—it doesn't reveal all that much about Fuller's personal thoughts or his design process. Fuller did not, for example, keep a personal diary of thoughts, or write articles about design theory. Personal letters between Fuller and his wife reveal some of their personal and social preoccupations, but little about his attitudes toward design or his professional



Figure 3: Cover of 4D Timelock Manuscript (www.olats.org)

work. With the exception of the period 1927-1929, when he was feverishly working on the concept of a 4D house, Fuller did not sketch much. Many of the materials inside the archive—newspaper articles, business correspondence, brochures and catalogs from manufacturers—are actually fairly generic.⁵¹ There's a great deal of ephemera within the archive, and not all of it useful. A second limitation of the archive that access is limited to five file boxes per day, making it difficult to make real headway in sifting through all the contents.⁵²

The archive contains a section of manuscripts by Fuller. By and large, these manuscripts represent essays or chapters of books that Fuller was working on, and do not differ substantially from the final published versions. The most valuable document, in terms of this research, is the *4D Timelock* manuscript that Fuller self-published in 1928 and sent to family members, acquaintances, and architects. (See Figure 3). The *4D Timelock* manuscript was Fuller's early manifesto for affordable single family housing, emphasizing among other things the importance of "time and weight saving." The manuscript complemented the sketches and plans for the 4D single family home that Fuller had simultaneously been working on. Because Fuller self-published and distributed this manuscript, there are likely very few

⁵¹ For more on the Fuller Archive, please see Hsiao-Yun Chu, "Fuller's Laboratory Notebook," *Collections, a Journal for Museum and Archives Professionals*, Fall 2008: 295-305.

⁵² The Fuller Archive is not a searchable open-shelf archive; rather, materials must be requested in advance, to a maximum of five boxes. This severely limits the amount of material that one can consult in one day. Furthermore, in spite of a descriptive finding aid provided by the library, it's still very difficult to pinpoint where within the giant archive a particular bit of information might be found.

copies in existence outside the archive,⁵³ and the manuscript was never reproduced in its entirety besides the original copies.

B. Writings by Fuller

R. Buckminster Fuller was a fairly prolific writer, particularly toward the end of his career. His writing frequently paralleled his speaking style: commentary on different subjects, written in a dense and often convoluted way, with occasional stories or anecdotes woven in as evidence of his points. Reviewers of Fuller's books commented often on his belabored language, and even today's charitable biographers call his writing "complex and difficult to understand."⁵⁴

Fuller's first book, *Nine Chains to the Moon* (1938) is one of his more readable efforts. *Nine Chains* is a collection of Fuller's thoughts on the evils of financial capital, which becomes a character named "Fincap" in his narrative. Fincap is an entirely materialistic and selfish force bent on amassing capital with little regard for the fate of humanity. Fuller argues that individuals must overcome their fears and break Fincap's monopoly by turning to art, industry, and science to continue the forward progress of science and by extension the progress of mankind. More efficient methods of building and using energy will help to realize this universal progression

⁵³ According to Joachim Krause and Claude Lichtenstein, Fuller originally had 128 copies of *4D Timelock* printed in 1928. In order to obtain copyright, he increased that to 200 total copies in 1929. See Joachim Krause and Claude Lichtenstein, *Your Private Sky: R. Buckminster Fuller The Art of Design Science* (Baden: Lars Müller Publishers, 1999), 120.

⁵⁴ "R. Buckminster Fuller," American National Biography Online, <http://www.anb.org/articles/13/13-02560.html/>.

toward a higher standard of living. Indeed, *Nine Chains* touches upon many of the themes of the *4D Timelock* manuscript as well as Fuller's subsequent writings.⁵⁵ The underlying message of saving humanity through technology was a frequent subject of Fuller's books, including *Ideas and Integrities* (1963), *Utopia or Oblivion* (1969), and *Critical Path* (1982). Chapters for Fuller's books were often based on transcriptions of lectures that he had given at universities or professional societies that were edited into a series of chapters on different themes. For example, *Ideas and Integrities* includes selections from the 1940s, such as "I Figure," a series of prognostications written in 1942, and *Utopia or Oblivion* includes Fuller's keynote address at the *Vision '65* conference, held at Southern Illinois University in 1965.

Of all Fuller's writings, *Ideas and Integrities* is probably one of the most accessible and reflective of Fuller's overall program of anticipatory design science. Its early chapters, *Influences on my Work* and *Later Development of my Work*, are interesting personal reflections on how he began to develop his philosophy of design science. *Ideas and Integrities* also refers with some frequency to the inherent efficiency of nature's designs, reflecting not only the development of Fuller's thinking but likely also the receptiveness of his audience, composed largely of countercultural young people toward holistic and naturalistic philosophies. Fuller was a frequent speaker on college campuses, where he drew large audiences of liberal students. "Energetic synergetic geometry discloses Nature's own system of coordination," writes Fuller.

⁵⁵ There was considerable antitrust sentiment throughout the early 1900s. For example, the Progressives passed numerous antitrust laws from the late 1880s through the 1930s aimed at breaking up what Fuller characterized as "Fincap." *Nine Chains to the Moon* suggests that Fuller was highly sympathetic to the antitrust political viewpoint. However, throughout Fuller's career he became increasingly wary of politics and politicians and their ability to foster the kind of global change that he advocated.

“Possessing this knowledge and taking the design initiative, man can enjoy Nature’s exquisite economy and effectiveness.”⁵⁶

Utopia or Oblivion is similarly reflective of Fuller’s design science thinking, and includes an eponymous essay in which Fuller promotes design science as the means of ensuring “peaceful accomplishment of 100% industrialization and its comprehensively bounteous support of man.” It is representative of Fuller’s mature views on design science, and reflective of how he represented it in the hundreds of lectures he gave during the 1960s and 70s.

Arguably the masterworks of Fuller’s career as a geometrician were *Synergetics 1* and *Synergetics 2*, published in 1975 and 1979, respectively. Fuller’s proposed new coordinate system relied on triangles as an essential building block, and was supposed to be more reflective of nature’s inherent geometry. The concepts never took root within the scientific community, and the volumes are today generally shelved in the philosophy section of the library. The most useful parts of *Synergetics*, for the purposes of this research, were the sections in which Fuller discusses the nature of the universe, or Universe, as Fuller called it. Universe for Fuller represented the sum total of all discrete events and experiences, “embracing all intelligible, inherently separate evolutionary events.”⁵⁷

⁵⁶ Fuller, *Ideas and Integrities*, 244.

⁵⁷ R. Buckminster Fuller, *Synergetics: Explorations in the Geometry of Thinking* (New York: MacMillan, 1975), 83.

C. Biographies of Fuller

The most widely-cited general biography of R. Buckminster Fuller is Lloyd Steven Sieden's *Buckminster Fuller's Universe: His Life and Work* (Plenum Press, 1989). While comprehensive and a good overall reference on Fuller for those unfamiliar with his career, this book tends to eulogize Fuller rather than taking a critical view of his work. As such, it also perpetuates the popular notions that Fuller was at once a Renaissance man, design guru, and planetary messiah. The more problematic aspects of Fuller's life—his infidelities, his tendency to take credit for other peoples' work, his failed projects—are not discussed in this book.

Martin Pawley's *Buckminster Fuller* (Taplinger, 1991) gives a more balanced view of Fuller's work; but as a survey and part of the *Design Heroes* book series, it does not provide more than an introduction. A more recent attempt at a biography is Loretta Lorance's *Becoming Bucky Fuller* (MIT Press, 2009), which recounts the early part of Fuller's career in the late 1920's and early 1930's when he came up with the plans for his 4D/Dymaxion House. Unfortunately, Lorance's book is cursorily researched and clearly demonstrates that she is not familiar with contemporary scholarship on Fuller.⁵⁸

D. Contextual Work on R. Buckminster Fuller

Over the past 12 years, a considerable amount of new scholarship has emerged on R. Buckminster Fuller. This was in part due to the acquisition of the Fuller Archive

⁵⁸ Better alternatives for learning about Fuller's 4D/Dymaxion house project include *Your Private Sky* by Krause and Lichtenstein, cited above, and *New Views on R. Buckminster Fuller* by Chu and Trujillo (Stanford, 2009).

by Stanford University in 1999. Around the same time, an exhibition entitled *Your Private Sky*, featuring many original documents and sketches from the Fuller archive, traveled to several cities in Europe.⁵⁹ Accompanying the exhibition were two volumes, namely *Your Private Sky: R. Buckminster Fuller The Art of Design Science* and *Your Private Sky: R. Buckminster Fuller Discourse*, co-edited by Joachim Krausse and Claude Lichtenstein, which seemed to foreshadow a new generation of scholarship on the horizon.

Rather than sidestepping the more problematic aspects of Fuller's career, Krausse and Lichtenstein rather acknowledge them and try to clarify the nature of Fuller's contributions. Fuller is described as "bipolar"; on the one hand, a technologist and collector of numbers, on the other hand, a metaphysician interested in the fate of humans in the universe. They describe this as "religiosity sublimated by science," an interesting departure from the conventional ways of looking at Fuller.⁶⁰ The books also investigate some of Fuller's influence in the 1960s, particularly on the counter-culturalists who were inspired to start the Whole Earth Catalog (WEC), a subject that had not been previously investigated. The WEC, which was published regularly between 1968-72 and intermittently thereafter, was a grassroots countercultural publication that promoted "access to tools" (such as seeds, hand tools, and clothing) for independent living. Although it was philosophically aligned with the back-to-the-land movement, the WEC was unique in its promotion of

⁵⁹ There was no relation between the acquisition of the archive by Stanford University and the traveling exhibition. Preparations for the exhibition were already well underway by the time Stanford purchased the archive in 1999.

⁶⁰ Joachim Krausse and Claude Lichtenstein, *Your Private Sky: R. Buckminster Fuller The Art of Design Science* (Baden: Lars Müller Publishers, 1999), 19.

small-scale technologies and a 'hacker' mentality toward survival. This willingness to experiment with technology, it has since been recognized, helped to set the stage for the computer revolution that began Silicon Valley in the late 1970s.⁶¹ In 2005, Michael John Gorman published *Buckminster Fuller: Designing for Mobility*, a heavily illustrated volume of Fuller's architectural projects (Skira). Contrary to the title, Gorman's chapters do not always seem to relate to the theme of mobility. Nevertheless, Gorman does provide understandable descriptions of the energetic-synergetic geometry that Fuller was trying to reveal in his structures. Where Gorman's book really excels is in a well-written critical survey of the development of geodesic structures, which he relates to the development of the earlier Dymaxion Air-Ocean World Map in the early 1940s. Given Gorman's experience as the assistant curator of the Fuller Collection at Stanford University and his access to primary source materials, the book is a credible, well-written and well-illustrated source.

In 2008, the Whitney Museum of American Art held an exhibition entitled "Buckminster Fuller: Starting with the Universe" with an accompanying catalog co-edited by curators K. Michael Hays and Dana Miller (Yale University Press, 2008). The exhibition emphasized Fuller's comprehensive and inclusive approach, and the articles support this presentation, pointing out Fuller's friendships with artists, his utopian world vision, and his interest in communication among other themes.

⁶¹ Since the publication of *Your Private Sky*, the Whole Earth Catalog has been further recognized as setting the stage for the computer revolution of the 1980s by promoting small technologies and a 'hacker' mentality. This subject is explored at length in Fred Turner's *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: Univ. of Chicago Press, 2006).

New Views on Buckminster Fuller, by Hsiao-Yun Chu and Roberto Trujillo (Stanford University Press, 2009) brought together contemporary scholarship on Fuller, featuring the Fuller Archive as a primary resource. Of particular note was an essay by Barry Katz, calling into question the real events of 1929, the year that Fuller supposedly had an epiphany and decided to devote the rest of his life to the betterment of mankind; and Fred Turner's article "A Technocrat for the Counterculture," which further investigates Fuller's influence on the counterculture generation.⁶² As a whole, the book offers scholarly perspectives on a number of different themes, and is a good starting point for a contextual historical look at the impact of Fuller's work.

E. Domes and the 1960s

This thesis looks in particular at the presentation and reception of R. Buckminster Fuller's design work, and points out that Fuller's contemporary reputation as a designer "inspired by nature" was largely forged during the 1960s. Prior to that decade, although nature was in the background of Fuller's worldview, it was not a prominent feature in the public presentation of his work.

In order to illustrate this, the presentation of geodesic domes is considered from the 1950s through to the 1970s. During the 1950s, the domes were presented to the U.S. Military as an efficient and portable geodesic weapon, perfectly suited for guerilla warfare in the tropics. By the late 1960s, geodesic domes were associated with hippie communes as in the case of Drop City, a hippie commune in rural

⁶² See also Turner's *From Counterculture to Cyberculture* (2006), cited above.

Colorado consisting of a collection of ramshackle geodesic domes. Other hippie communes, such as the *Red Rockers* commune in Colorado, *The Farm* in Tennessee, and the *Crow Hall* commune in Norfolk, UK, also featured one or more geodesic domes.

A key text in understanding how the presentation and reception of domes changed from the 1950s through to the 1960s and 70s is Alex Pang's "Dome Days: Buckminster Fuller in the Cold War," in *Cultural Babbage* (Faber and Faber, 1996). Pang illustrates how Fuller developed geodesic domes by cooperating with universities and the U.S. military throughout the late 1940s and 1950s; the military provided significant investments to develop air-liftable geodesic shelters as well as protective domes for an arctic early warning system called the DEW line.⁶³ While Pang concentrates on Cold War applications of the domes, he also foreshadows the complete turnaround in the geodesic dome's symbolism, from architecture of war to hippie homestead.

A useful summary of the development of geodesic domes is found in Chapter 6 of Gorman's *Buckminster Fuller, Designing for Mobility* (discussed in Section IID, above). Gorman points out the continuity between Fuller's earlier experiments with spherical geometry, such as the Dymaxion Map project, and his subsequent experiments with geodesics beginning around 1946.

⁶³ The DEW, or Distance Early Warning line, was a radar and communications network across northern Canada developed by the U.S. Military in cooperation with MIT's Lincoln Laboratory between 1952-1957. Geodesic domes were used to protect the sensitive radar equipment from the elements. See also Lincoln Laboratory, Massachusetts Institute of Technology, <http://www.ll.mit.edu/about/History/earlywarningradars.html>.

Scott Eastham's *American Dreamer: Bucky Fuller and the Sacred Geometry of Nature* (Lutterworth Press, 2007) is a text worth mentioning, more for what it attempts to do than for what it achieves. In this book, Eastham tries to connect Fuller's religious and metaphysical ideas with Synergetics and architecture, and draws on many primary sources in his effort to do so. He attempts to understand Fuller's worldview, relating it, for example, to Transcendentalism. Unfortunately, Eastham's approach is sometimes too esoteric and subjective to be considered authoritative.⁶⁴

With the background information on domes in place, it was important to understand the cultural context of the 1960s, when Fuller found an avid new audience of idealistic college students. The countercultural generation, disaffected with the status quo, was committed to social change, and attracted to alternative lifestyles and means of creative self-expression. In his speeches and writings, Fuller painted a vision of a peaceful world where technology and information would be used to distribute resources equitably, providing food, shelter, and education for people around the world. His utopian vision of what a design science revolution could bring provided an ideological accommodation for technology for a generation that was generally disaffected by it, inspiring such thinkers as Stewart

⁶⁴ In his introduction, Eastman writes "If this book works at all, it will cohere in a non-linear way, like the tensional great circle continuities which hold together the figures of Bucky's synergetic geometry." (Eastman, 11.) This prefigures Eastham's wandering approach. On the positive side, Eastham does explore some connections with historical traditions such as Transcendentalism, making this book a worthwhile if occasionally confusing read.

Brand, founder of the *Whole Earth Catalog*; architect Norman Foster; and Medard Gabel, cofounder of the *World Game*.⁶⁵

Several books were helpful in understanding the cultural context of the 1960s and how Fuller fit into it. General sources included *The 1960s Cultural Revolution* (Greenwood Press, 2000) by John C. McWilliams, a historical overview of the decade. The book sketches the major political events of the 1960s and discusses their social importance, as well as providing an overview of the counterculture movement and its ideals. Theodore Roszak's *The Making of a Counter Culture* (Univ. of California Press, 1995) was also useful in understanding some of the historical roots of the counterculture. (The title of this book, first published in 1968, in fact gave rise to the term "counterculture.") Roszak argues, among other things, that the counter culture was not so much distinct group as a common vision for a "reappraisal of cultural values" that set the stage for the environmental revolution, the women's movement, and gay liberation (Roszak, xxvi-xxviii). In my thesis, I agree with this characterization and use the term "counterculture" to denote a broad shift in values rather than a distinct or organized subgroup.

One of Roszak's key arguments is that the counterculture was essentially a rebellion against technocracy, where the term denotes a society whose leaders justify their actions by appeal to technical experts who in turn "appeal to scientific forms of knowledge. And beyond the authority of science, there is no appeal."(Roszak, 8) It is interesting to consider this argument in light of the fact that

⁶⁵ The World Game, which Gabel developed with Fuller during the 1960s and 70s, was a multiplayer educational game that challenged players to come up with more equitable distributions of world resources. Currently, its direct descendant is the Global Simulation Workshop by osEarth. See also "The World Game," *osEarth*, <http://www.osearth.com/>>

Fuller himself often proposed what, according to Roszak's definition, could be considered technocratic solutions. However, Fuller's utopian ideals—his commitment to solving global human problems like poverty, hunger, and education—set him apart from the greedy politicians and power brokers that the counterculture so disdained. In short, Fuller provided a compelling vision of technology's humanistic potential that aligned with counterculture ideals. He also drew upon Transcendentalist ideas to establish common ground with the counterculture.

Were the counterculturists indeed successful in establishing alternate communities outside the traditional boundaries? An interesting sociological perspective is provided in Bennett Berger's *The Survival of a Counterculture: Ideological Work and Everyday Life Among Rural Communards* (Univ. of California Press, 1981.) Bennett concentrates on three sets of ideas that he considers key to understanding the commune movement of the counterculture: the decline of age-grading and the education of children; pastoralism, wariness of technology, and living off the land; and intimacy, coupling, and sexuality. The second of the previous sets relates most closely to R. Buckminster Fuller's work and its appeal to the counterculture.

Although the communards were generally negatively predisposed toward technology, they were willing to make accommodations for it depending upon the exigencies of the situation. Small-scale technologies that supported their survival—automobiles, farming equipment, even chain saws—were readily adopted as tools for self-sufficiency. Fuller's geodesic domes, which used material efficiently, were relatively easy to construct from scavenged materials, and

provided communal gathering spaces, fit in with this survivalist ethos. Fuller became, according to Berger, a “sort of folk hero,” and inspired a “fascination with dome construction” (Berger, 111).

F. Ecopolitics, Systems, and the Cybernetic Ecology View

In Chapter 7, I compared Fuller’s model of nature with alternate models of nature that I called the ecopolitical model of nature and the cybernetic ecology model of nature. The ecopolitical model of nature is best described in Kate Soper’s *What is Nature*, discussed above. The cybernetic ecology model of nature is discussed at length in a BBC three-part documentary series directed by Adam Smith called *All Watched Over by Machines of Loving Grace* (2011). The title from the series comes from a 1967 Richard Brautigan poem of the same name. I relied heavily on the second part of this series, “The Use and Abuse of Vegetational Concepts,” in which Curtis investigates how machine ideas such as systems theory and cybernetics were applied to natural ecosystems, with the idea that machines could keep the earth in a perpetual balance. A related notion was that formal control systems such as centralized governments could be foregone in favor of self-organizing networks that would reach a natural equilibrium. Although Fuller’s ideas overlapped with cybernetic thinking to some degree, there were also subtle differences with respect to the role of individuals in guiding technology toward ethical ends.

Curtis’ film incorporates interviews with Peder Anker, a design historian whose 2007 article entitled “Buckminster Fuller as Captain of Spaceship Earth” provides

some context as to how Fuller's thinking in the 1960s overlapped with the contemporary environmental and ecological thinking, and how Fuller's vision of the earth as a spaceship allowed him to see the earth as a technologically-enabled ecosystem with designers, not politicians, at the helm. Anker suggests that Fuller, and particularly his World Game, deserves a larger place in the history of environmental programming that has been recognized. I disagree with this point in Chapter 6, mostly because it disregards the considerable (and perhaps defining) contributions of Fuller's collaborators such as Medard Gabel to the World Game's development. However, this point alone should not detract from Anker's serious, detailed, and contextual article.

G. Limitations of the Literature on Fuller

Overall, there is a lack of critical literature on Fuller, which may be due to a number of factors. First of all, there was very limited access to Fuller's archive between 1983, the year of his death, and 1999, when the archive was acquired by Stanford University.⁶⁶ This necessarily limited the amount of historical research that could be conducted using archival materials.

Fuller's work touches upon architecture, science, geometry, poetry, cartography, metaphysics, and so on. Due to the sheer range of his activities, Fuller as a research subject has been entertained but never fully adopted by historians of art,

⁶⁶ From conversations with Roberto Trujillo, the Head of Special Collections at Stanford University, it appears the Fuller Archive prior to its acquisition was kept in a cramped, disorganized storage area in Southern California. The archive was closed to visitors unless by rare special arrangement. The majority of storage boxes were occluded by other boxes and had probably not been opened in decades.

architecture, technology, and so on. At some point, Fuller's work moves beyond the typical boundaries and methods of the disciplines. This makes it difficult to analyze his work using a single disciplinary framework.

Fuller was such a prolific writer and speaker that his own writings and speeches tend to be the basis of any study of Fuller. Yet Fuller was neither particularly clear nor particularly objective in his writing, which generally expounded upon his own work, philosophies, and conclusions. The reliance on Fuller's work as the primary research source serves to perpetuate the image that Fuller constructed of himself as an iconoclast, scientist, philosopher, and independent thinker.

Biographies such as Sieden's award Fuller a heroic status as latter-day genius whose ideas on efficiency and use of resources foreshadowed the sustainability movement. On the one hand, Fuller's lifelong concern for efficiency and judicious use of resources supports this reading. But Fuller's work also depended heavily upon the work of others, in some cases appropriating or duplicating it. Fuller's talented colleagues receive scant recognition for their contributions to the tensegrity structures, the geodesic dome, or even the Dymaxion Map.⁶⁷ Fuller was so successful in promoting himself, through publications and lectures, that he was generally given the sole credit for his 'inventions,' in some cases more than he deserved. The literature reveals a lack of understanding of the collaborative origins of his ideas, and of the historical context surrounding their development. The

⁶⁷ Michael John Gorman's 2005 book *Designing for Mobility*, discussed above, provides a welcome exception. Gorman does a good job of naming people who collaborated with Fuller on his various projects.

purpose of critical historical literature is to clarify some of these issues to arrive at a more nuanced understanding of Fuller's real contributions to design history.

Fuller's work is often supposed to be reflective of "nature's geometry." According to Sieden, Fuller's life goal was to discover the "experiential geometry employed throughout Nature." (34) Sieden asserts that, armed with an understanding of the sciences, Fuller "designed and built artifacts that supported our eternally regenerative Universe, just as Nature does." (97) Such descriptions assume an inherent connection to Nature, without specifying or proving it. How, *precisely*, did Fuller's projects reflect nature, and how did nature enter into the design process? Is there such a thing as "nature's geometry," as opposed to just "geometry?" What was Fuller's model of nature and how did that affect how or what he designed? In short, despite a widely-held assumption that Fuller's work was inspired by nature, there is a lack of understanding of Fuller's basic model of nature. In particular, I believe that the impact of 19th century Transcendentalist thought on his understanding of nature has been totally overlooked. The Transcendentalists saw nature and the natural world as evidence of natural laws, and in turn of God. To return to nature—to develop a spiritual oneness with of nature as Henry David Thoreau attempted to do—was to develop a more authentic connection with God. As a result, Fuller's nature-inspired architecture was not only geometrically correct, it was also spiritually correct and reflective of his intellectual understanding of nature's inherent design efficiency. This theme is treated in detail in the upcoming chapters.

Finally, as it relates to the subject of this research, there is a lack of understanding of how Fuller came to be known as a “designer inspired by nature.” Nature was not always a hallmark of his work; in the 1930s, for example, Fuller adopted a fairly technocratic viewpoint, as reflected in his writings and his self-presentation. During the 1950s, he promoted his geodesic dome and his Dymaxion Dwelling Unit to the military as mass-producible, air-liftable accessories to the national defense. In short, although Fuller is today characterized as a nature-inspired design science guru, this was not always the case. He gained this reputation largely in the 1960s, when there was widespread anti-establishment sentiment among the young generation. There was, by extension, a ready audience for alternative, organic and naturalistic ideas, and Fuller promoted this aspect of his work. Fuller also began writing about his life and career to cast his work in the glowing light of design science and to underscore how ethical design could make the world more peaceful, prosperous, and egalitarian. *Ideas and Integrities* and *Utopia or Oblivion*, published in 1963 and 1969, especially promote such ideas. History and historians have not quite come to grips with the fact that the Fuller that is described in popular biographies and Fuller’s own books is very much the product of Fuller’s own tireless self-promotion as a comprehensive anticipatory design scientist. His presentation was particularly successful during the 1960s, when Fuller found a new audience in a youthful generation disaffected with technology and the status quo. Fuller presented a vision of a technologically enabled utopia that could provide food, shelter, and education for all. This appealed to the countercultural youth’s values and ideals, which in turn cement

Fuller's contemporary reputation as a designer in touch with nature, a visionary, and a forward thinker ahead of his time.

In a critical historical sense, one must attempt to understand Fuller as he *was*, not only as he wished to be perceived. One must also investigate how the presentation and reception of his work changed over time, and how formed and colored our present day understanding of his contributions.

Introduction

"The innovative designs created by Fuller were greatly inspired by nature."¹

Fuller "was inspired by Nature's synergetic mechanisms."²

Fuller "created design solutions inspired by nature's structural principles."³

"Fuller was very vocally a nature-inspired designer."⁴

Fuller "emulate[ed] the design principles he observed in nature."⁵

"Fuller dedicated himself to exploring the principles working in nature."⁶

R. Buckminster Fuller (1895-1983) is frequently described as a designer "inspired by nature." But what do we mean by this phrase, in reference to Fuller or any other designer? Did Fuller take long hikes in the wilderness until he was struck by a flash of inspiration? Did Fuller peer through microscopes to probe the structures of tiny radiolaria? Did Fuller draw and redraw sunflowers in order to understand the principles of close packing? How, exactly, did Fuller combine the domains of nature and design? One of the overarching goals of this thesis was to add clarity to that vague phrase, "inspired by nature," which is so often applied to Fuller.

¹ "Buckminster Fuller," *KA Jewelry*, <http://www.ka-gold-jewelry.com/p-articles/buckminster-fuller.php>.

² Sebastien Roy, *The Omniverse Project*, <http://www.omniverseproject.org/biography/oc-r-buckminster-fuller-outlaw-designer/#more-3>.

³ Biennale de Lyon, http://universes-in-universe.org/ara/bien/biennale_de_lyon/2011/tour/bullukian/buckminster_fuller_1

⁴ Jer Faludi, *WorldChanging*, <http://www.worldchanging.com/archives/003625.html>

⁵ "Buckminster Fuller, *Panacea-BOCAF*, <http://www.panacea-bocaf.org/buckminsterfuller.htm>

⁶ Celeste Adams, "The Vision of Buckminster Fuller," <http://www.spiritofmaat.com/archive/apr2/bucky.htm>

I began by assuming that Fuller had a particular model of nature, conditioned by his education, cultural and temporal context, religious beliefs, and personal insights, and that this model affected his work in different ways. In Chapter 1, I attempt to characterize Fuller's model of nature, which brought together traditions from the past as well as ambitions for the present.

Fuller's ideas about nature were deeply influenced by Enlightenment ideas concerning Laws of Nature; as well as Transcendentalist ideas about nature as a representation of God, and experiences in nature as conduits to understanding God. Fuller had a direct relation to the Transcendentalists through his great-aunt Margaret Fuller, and seemed to have absorbed much of her Transcendentalist outlook, although they had never met in person.

But Fuller's view of nature was not solely rooted in the past. Coming of age during the Progressive era in the United States, Fuller had experienced firsthand the impacts of industrialization upon daily life. He became obsessed by the efficiencies afforded by mass manufacture and distribution, symbolized by Fordist production lines. Properly guided, he felt that technology and mass production promised universal prosperity and a higher standard of living for people not only in industrialized nations, but around the world. Fuller adopted a comprehensive model of nature, in which biology, humanity, and technology were wrapped together in a coevolving cosmic whole.

Fuller freely mixed ideas about biological and technological evolution. He saw technology as an outgrowth of human intellect applied to problems of survival. As such, technology was a 'natural' corollary to human evolution. Fuller believed that biological evolution, human evolution, and technological development were firmly linked together in a process he called "universal evolution," along somewhat the same lines as philosopher and paleontologist Pierre Teilhard de Chardin described in his 1955 opus, *The Phenomenon of Man*.⁷ In Chapter 2, I discuss Fuller's understanding of universal evolution, and compare and contrast it with the ideas of Teilhard to enrich our picture of Fuller's model of nature.

In Chapter 3, I investigate one of Fuller's signature works, the 4D (later, Dymaxion) house to see how Fuller incorporated natural analogies, such as the form of a tree and the idea of a self-sufficient body, into his design of the house on a pole. This chapter also draws heavily on Fuller's unpublished 1928 manuscript, *4D Timelock*, which sets down some fundamental ideas about how the efficiencies of mass production should be applied to home building. This invites a comparison with the work of Le Corbusier, the architect who described a house as a "machine for living in," and I describe in some detail the difference between their approaches.

Chapter 4 discusses the development of geodesic domes, starting with Fuller's interest in spherical geometries found in nature, moving through decades of development with military and academic partners, and culminating in the adoption of the geodesic dome as a symbol of countercultural values. This story

⁷ The text for Teilhard's *The Phenomenon of Man* was written during the 1930s, but it was only published posthumously in 1955. The English translation of the book was released in 1959.

presents a number of interesting twists: first, how a piece of military technology was reborn as a symbol of social dissent, and secondly how in the case of the geodesic dome, architecture prefigured nature rather than the other way around.⁸

I was also interested in how the presentation and reception of Fuller's work with respect to nature changed over time. When Fuller was partnering with the military, nature was not a prominent part of the geodesic dome narrative; it was not until the 1960s that nature-related readings of the dome, particularly the dome as "nature's geometry," began to take hold. I further discuss this transition in Chapter 5 by looking at emerging counterculture movement, which provided Fuller with new and particularly avid young audiences. I show how Fuller drew on his Transcendentalist roots to find common ground with the counterculture through the shared values of holism, individualism, and self-reliance. I also discuss how Fuller, with his humanistic messages about the power of small-scale technologies to change the world, helped the counterculture generation to find a much-needed accommodation for technology. In short, Fuller helped to "naturalize" technology for a generation that had felt alienated from it.

Fuller's popularity during the 1960s overlapped with the birth of the modern environmental movement. Some have called Fuller was an early environmentalist because of his deep interest in efficiency and "doing more with less," which Fuller himself called "ephemeralization." However, I argue that such ideas were really a

⁸ To explain: normally we might think that designers study biological forms in order to come up with architectural forms. In this case, however, Fuller's geodesic domes prefigured, in form, the structure of the Carbon 60 molecule, which was synthesized in 1985 by Harold Kroto and Richard Smalley. Because of its resemblance to a geodesic dome, Kroto and Smalley called the molecule a "buckminsterfullerene." This is how architecture prefigured nature in the case of the C60 molecule.

holdover from the Progressive era obsession with efficient manufacture. In reality, Fuller was purposefully vague when it came to discussing environmental issues, for both practical and personal reasons. Though Fuller was aware of environmental issues, he tended to promote his technological utopian visions rather than seeking practical, legislative solutions to pressing environmental problems.

In Chapter 7, I sketch out two “alternate” models of nature that were gathering speed from the 1950s-1970s, which I call the “eco-political model” and the “cybernetic ecology model.” The eco-political model depicted ‘nature’ as an innocent victim of human’s unbridled industrial activity. This allowed environmentalists to rally behind the cause of “saving nature,” and to press for landmark legislation to curb pollution, pesticide use, and so on. The cybernetic ecology model, by contrast, saw earth as a closed ecosystem of self-organizing and self-correcting networks that could be scientifically modelled and eventually controlled. Of the two models of nature, Fuller’s shared more in common with the second, and in this chapter I investigate the similarities and differences between Fuller’s comprehensive model of nature and the other two in order to situate Fuller’s thinking within a wider context. Chapter 8 is a simple concluding chapter, with a few final thoughts.

During the course of this research project, I was struck by a number of insights. First of all, I came to appreciate how very deeply Fuller’s worldview was grounded in history and religion, even though he is often considered, in the popular imagination, to be a futurist, untethered by the past. Fuller carried, with great care,

the family mantle of Transcendentalism and it gave him confidence in his own individualism. Fuller was, like the Transcendentalists, also deeply religious. At heart, his belief in the infinite wisdom of nature was really a belief in the infinite wisdom of God. *Nature* represented the sum total of all wisdom, experience, matter, and truth in the very same way that *God* did, and the natural world stood as material testament to God's creative wisdom.

I was also impressed at how the presentation and reception of Fuller's work changed throughout the decades, as touched upon above. During the 1930s—the era of Progressivism, Taylorism, and home economics—the 4D house was praised as the house of the future, whose built-in technologies promised an end to household chores. Fuller was presented as a scientist/inventor, inspired to design the home of tomorrow. During the 1950s, the geodesic domes were promoted as a lightweight military weapon that could be air-dropped to any location, from the Southeast Asian tropics to the Arctic Circle. Fuller presented geodesic domes as part of a worldwide defense system that could be deployed in response to any threat. Although Fuller actively drew upon his model of nature during these decades, his work was not presented with reference to nature, because his audiences were not particularly interested in it. It was only during the 1960s that the nature-inspired descriptions of Fuller's work touched a nerve in the pastoral and holistic yearnings of the counterculture. Fuller and his audiences together increasingly promoted nature-inspired readings of his work, which has led to his contemporary—and lasting—reputation as a designer inspired by nature.

Finally, the scope of Fuller's model of nature, bringing together humanity, biology, and technology in one harmonious whole, gives further evidence of his unparalleled talent for comprehensive thinking. Indeed, this comprehensivity had many advantages, giving Fuller an expansive and enduring vision of a utopian future in which technology would be harnessed to meet all of humanity's needs. Fuller argued that "it is highly feasible to take care of everybody on Earth at a higher standard of living than any have ever known," and that his proposed design science revolution would "joyously elevate all humanity to unprecedented heights."⁹ At the same time, his comprehensive approach could also be an Achilles heel, when things became so expansive as to lacked purpose, so limitless as to be anarchic, and so grandiose as to appear absurd. Fuller's visions knew no bounds.



Figure 1: Fuller's Proposed Dome over Manhattan, 1960. The dome as pictured would span across over 40 city street blocks. Fuller claimed that a dome like this would drastically reduce the city's heating, cooling, and snow removal costs, paying back the cost of its construction within 10 years.

⁹ R. Buckminster Fuller, *Critical Path*, 2nd Edition (St Martin's Griffin, 1982), xxv.

But there is value in vision. Howard Segal has called Fuller one of America’s last genuine utopians: one who engaged in utopian thinking for its own sake, and not for any promise of political, financial, or social gain. Indeed, there is value to those who present us with visions of a future unbound by the limitations, a future of infinite possibility. In addition, Segal notes that Fuller “had an ethical dimension all too rare among technologically oriented visionaries.”¹⁰

Some years ago, when browsing some odd files in the Fuller archive at Stanford University, I came across a manila folder labeled “INTEGRITY,” written in the elder Fuller’s spidery hand.¹¹ In it, Fuller had collected newspaper clippings of people who had acted with integrity, who had applied technology with foresight to improve humanity’s lot. It was a poignant testament to Fuller’s ever-hopeful outlook. In addition to being one of America’s last genuine utopians, I would also call Fuller one of America’s most incurable optimists; a person who believed—to the very end of his life—that humans would rise to the task of using technology in ethical ways to serve the greater good.

¹⁰ Howard Segal, “America’s Last Genuine Utopian?” in Chu, ed., *New Views on R. Buckminster Fuller* (Stanford, CA: Stanford Univ. Press, 2009), 39.

¹¹ Fuller died in 1983 at the age of 87. The articles in the “INTEGRITY” folder appeared to have been collected in the years and months leading up to his death, so it was likely an active folder in his office at the time Fuller passed away.

Contributions to Knowledge

This thesis makes a number of original contributions to knowledge about Fuller, beginning with methodological contributions discussed in the Research Methods Chapter.¹² First and foremost is the effort to establish Fuller's model of nature so that its influence upon his work can be assessed. This thesis links Fuller's model of nature with Transcendentalist thought, a connection that some scholars have suggested,¹³ but that has not been firmly established or elucidated, particularly with respect to nature. This research also attempts to situate Fuller's ideas about nature and his work within a broader (and constantly changing) historical context, including the Progressive-era technological context of the 1920s, which was so influential on Fuller's efficient 4D house designs; the 1950s military-industrial context, which provided financial support for Fuller's geodesic dome projects; and the more liberal counterculture context of the 1960s, which provided Fuller with new audiences and followers.¹⁴ As Fuller's context changed, so too did the presentation and reception of his work through his writings, speeches, and

¹² The main contribution is to suggest a simple framework for exploring the connection between design and nature; as that is thoroughly discussed in the Research Methods chapter, it will not be repeated here.

¹³ For example, biographer Lloyd Steven Sieden briefly mentioned Fuller's Transcendentalist heritage in *Buckminster Fuller's Universe* (Cambridge, MA: Perseus Publishing, 1989), page 3. David Nye also mentions the importance of Transcendentalism in *New Views on R. Buckminster Fuller* (Stanford, CA: Stanford University Press, 2009), page 80. Other scholars have similarly mentioned Transcendentalism without digging more deeply into the specifics of Transcendentalist thought and how it shaped Fuller's view of nature, which I have done here.

¹⁴ In particular, I am referring to audiences of college age students and followers of Fuller's design science approach. Fuller was a popular speaker at college campuses throughout the 1960s and 1970s and attracted a number of students both through his lectures and workshops as well as at Southern Illinois University at Carbondale where he was a research professor from about 1959-1970.

activities. These changes in presentation and reception have not been adequately described or appreciated in prior research on Fuller.¹⁵

This thesis explores the idea of universal evolution, assessing whether this notion of combined biological/technological/intellectual evolution was unique to Fuller or whether it had broader intellectual appeal, as is suggested by the work of Pierre Teilhard de Chardin in his 1955 book *The Phenomenon of Man*. To my knowledge, Fuller and Teilhard's ideas on universal evolution have not been compared or discussed together in any prior research in spite of considerable overlap between their metaphysical views.¹⁶

Finally, this thesis attempts to situate Fuller and his model of nature within a broader context of environmental and ecological thought.¹⁷ In Chapters 6 and 7, I investigate how, although Fuller shared some values with the modern environmental movement, there were also significant differences in their constructs of nature. In particular, the environmental movement adopted a construct of nature that could help to further its political goals. In Chapter 7,

¹⁵ One exception might be Alex Pang's article "Dome Days," which does show the changing context behind geodesic domes from the 1950s to the 1960s. See "Dome Days: Buckminster Fuller and the Cold War." In Frances Spofford and Jenny Uglow, eds., *Cultural Babbage: Essays in Science Studies* (London: Faber & Faber, 1996), 167-192.

¹⁶ A few scholars have noted that thinkers including Pierre Teilhard de Chardin, Buckminster Fuller, Vladimir Vernadsky, and/or Abraham Maslow seemed to share a belief in a *noosphere*, defined loosely as an evolutionary stage of conscious development. See particularly Michael E. Zimmerman, *Contesting Earth's Future: Radical Ecology and Postmodernity* (University of California Press, 1994), 71; and Barbara Marx Hubbard, "The Path of Social Evolution," in Thomas Zung, ed. *Buckminster Fuller: Anthology for a New Millennium* (MacMillan, 2002), 142. However to my knowledge there have been no serious attempts to compare Fuller and Teilhard's thinking about the noosphere and/or universal evolution.

¹⁷ Other scholars, especially Peder Anker and Timothy Luke, have tried to situate Fuller within the history of environmental thought. I offer an alternate view to the notion that Fuller was an early environmentalist. See Chapter 6, notes 2, 3, 4.

Fuller's ideas about nature are also compared with what I have called "cybernetic ecology" ideas that were percolating in a small branch of the counterculture during the 1960s,¹⁸ and similarities and differences are also explored. This contextual approach may lead to a better understanding of Fuller's proper place in the history of ecological thought.

¹⁸ The cybernetic ecology ideas of the 1960s were actually rooted in earlier models of systems theory and ecological systems, as discussed in Chapter 7.

Chapter 1

Introduction to Fuller's Model of Nature

R. Buckminster Fuller's model of nature combined ideas and philosophies from the past with hopes and ambitions for the future. This enabled Fuller to link the past with the present, and to maintain a broad worldview in which technology, far from being in conflict with nature, was actually the outcome of it.

Fuller's view of nature was deeply influenced by the philosophical, scientific, and religious traditions of the Enlightenment and the American Transcendentalist¹ movement. Both Enlightenment scholars and the New England

Transcendentalists saw nature as a divine manifestation of God and the ultimate source of all wisdom. The Enlightenment gave rise to the concept of divinely-authored laws of nature as the organizing principles of the universe.

Transcendentalists saw the natural world as evidence of God's sublime wisdom, and saw experiences in nature as fundamental to spiritual growth and one-ness with God.

Fuller's model of nature also embraced ideas about technology from the Progressive Era, which saw the rise of Fordism and Taylorism as industrial strategies for maximizing efficiency and production. Within his lifetime, Fuller had seen horse-drawn carriages replaced by automobiles; he had seen telephones and televisions coming into every household. Fuller was fascinated by technology and

¹ Fuller was the grand-nephew of (Sarah) Margaret Fuller Ossoli (1810-1850), a prominent New England Transcendentalist, and carried on in the Transcendentalist tradition. The connection to Margaret Fuller is discussed later in the chapter.

its rapid pace of change, and saw the potential to apply it to areas of human need such as shelter and better resource distribution.

Humanism, spirituality, and individuality were very important to R. Buckminster Fuller; so too were efficiency, technological progress, and economies of scale. Fuller's model of nature had to reconcile these two seemingly contrasting sets of ideas. What he devised is what I will refer to as a *comprehensive model of nature*, in which the natural world, spiritual development, and technological progress were all intimately intertwined, in fact inseparable. In this chapter, I will introduce Fuller's comprehensive model of nature and discuss the historical (Enlightenment and Transcendentalist) influences on it. I will also touch briefly on the importance of experiences in nature to Fuller for both scientific learning and spiritual development.

Comprehensive Model of Nature

The word *comprehensive* is not chosen lightly here; it refers to Fuller's unique ability to think expansively. Fuller referred to himself as a "*comprehensive anticipatory design scientist*"; his goal was to consider the biggest possible picture, and to seek design solutions that would address human needs at a global scale.

Fuller's broad outlook is highlighted by his biographer, Lloyd Stephen Sieden:

I have ... chosen to omit, as Fuller did, the commonly used article the in front of the word Universe. Fuller felt that there was but a single Universe, of which he and everyone else was a part, and he was not willing to separate himself from Universe or relegate it to a less significant status by the article the, which implies

that others also exist...Because Fuller perceived everything as being composed of energy experiences, his definition of Universe is all inclusive.

This is but one example of Fuller's comprehensive character. The difficulty for both scholars and individuals from all walks of life has always been categorizing Fuller's inclusiveness for easy comprehension. This book does not attempt any such classification.²

'Comprehensive' is thus not only *descriptive* of a model of nature expansive enough to include both philosophical and technical concerns; it is also *definitive*, in that it refers to a unique and essential aspect of Fuller's character.

Considering the Past

Historians and admirers alike often focus on Fuller's futuristic propositions for the cars, dwellings, and cities of tomorrow.³ However, the focus on Fuller's futurism has allowed some important points to be overlooked: Fuller was not only firmly rooted to tradition, but also a deeply religious individual. The past—more precisely the traditions that Fuller inherited—profoundly influenced his comprehensive model of nature. Fuller's understanding of nature rested upon an Enlightenment belief that the Universe ran in accordance with the laws of nature, created by God; and a Transcendentalist belief that the natural world was a manifestation of God. These ideas were firmly intertwined in Fuller's conception of nature. We will briefly

² Lloyd Steven Sieden, *Buckminster Fuller's Universe* (Cambridge, MA: Perseus Publishing, 1989.)

³ Obvious examples would include Fuller's futuristic Dymaxion House and Car (both developed in the late 1920s), as well as his propositions for floating tetrahedral cities, sometimes called "Triton cities," developed in the 1960s. For information on the latter, see R. Buckminster Fuller and Robert Marks, *The Dymaxion World of Buckminster Fuller*, (Anchor Books, 1973), 233. Indeed, Fuller's own self-identification as a comprehensive anticipatory design scientist underscores his forward-looking attitude.

separate the two ideas for the purposes of discussion, keeping in mind that they were complementary and overlapping in practice.

Laws of Nature

*Law of Nature: A stated regularity in the relations or order of phenomena in the world that holds, under a stipulated set of conditions, either universally or in a stated proportion of instances.*⁴

Fuller believed that the universe operated according to a set of immutable laws that had existed since time immemorial and had been created by a higher power, referred to here as *God*.⁵ This followed a tradition established during the Enlightenment and Scientific Revolution,⁶ which held God had created the cosmos in accordance with a system of natural laws, and that the purpose of scientific study was to discover these “laws of nature” through observation and reason.

In his writings, Fuller refers to laws of nature using a variety of terms. He writes, for example, about *God’s fundamental orderliness, general principles, fundamental*

⁴ “Law of Nature,” *Encyclopædia Britannica*, <http://www.britannica.com/EBchecked/topic/406522/law-of-nature>

⁵ Fuller referred to this higher power variously as: the Almightyness, the All Knowing, a Greater Intellect, universal omnipotence, and God. For the purposes of this discussion, we will generally use the term *God* as it is understood in the Western Christian tradition. The word is capitalized; consistent with how Fuller used the term God in his writings across the years. See R. Buckminster Fuller, “I Figure,” in James Meller, *The Buckminster Fuller Reader* (London: Jonathan Cape, 1970), 123.

⁶ With ‘Scientific Revolution,’ I am referring to a period lasting from the end of the Renaissance to the late 18th century in Europe that saw the emergence of modern science and was marked by major discoveries in various scientific fields. While some historians of science, such as George Sarton (1884–1956) and James Franklin (1953–) dispute the notion of a Scientific Revolution altogether, I find it to be a relevant concept. The important point, for this discussion, is that the modern scientific concept of laws of nature was elucidated, if not invented, during this period. In fact, the laws of nature concept had existed for many millennia before the Scientific Revolution.

*principles, patternings of nature,*⁷ and *generalized principles operative in Universe,*⁸ as well as *laws of nature.*⁹ Regardless of the term, these phrases all refer to an unchanging, fundamental set of principles created by a higher power that can be considered part of a laws of nature paradigm.

Laws of nature ideas had existed in religious, philosophical, and scientific circles for many centuries prior to the Enlightenment with differing interpretations on how to define a law of nature.¹⁰ With that said, the particular paradigm that Fuller subscribed to had been firmly established by Enlightenment scientists and natural philosophers. It generally held that God had created the laws by which the cosmos operated, and that mankind could attempt—however feebly—to understand these laws. Galileo Galilei (1564-1642), for example, wrote that the universe was an open book created by God, and that its workings could be understood using mathematics and geometry.¹¹ Rene Descartes (1596-1650) spoke of “certain laws

⁷ R. Buckminster Fuller, *Utopia or Oblivion* (New York: Bantam, 1969), 49.

⁸ R. Buckminster Fuller, *Synergetics* (1975), <http://www.rwgrayprojects.com/synergetics/print/pc.pdf>.

⁹ In *Operating Manual for Spaceship Earth*, (1963) for example, Fuller writes, “True democracy discovers by patient experiment and unanimous acknowledgement what the laws of nature or universe may be for the physical support and metaphysical satisfaction of the human intellect’s function in universe.” See R. Buckminster Fuller, *Operating Manual for Spaceship Earth* (1963), http://designsciencelab.com/resources/OperatingManual_BF.pdf.

¹⁰ Observations that certain principles held in nature have existed for millennia, and Roman texts by Zeno (300-260 BC), Seneca (1 BC-65 AD), and Pliny (23-79 AD) use the metaphor of law of nature. The modern ideas of laws of nature, and the idea of using the scientific method to elucidate them, took shape in 17th century Europe as reflected in the writings of Galileo Galilei (1564-1642) and Francis Bacon (1561-1626). Laws of nature ideas and philosophies have doubtless changed over time since the Enlightenment period, and have been discussed, categorized and debated. These are all interesting questions for historians of science and philosophy, but for the purposes of this research we will not address those here. For a readable summary of some of the philosophical debates, see “Laws of Nature,” *The Internet Encyclopedia of Philosophy*, <http://www.iep.utm.edu/lawofnat/#SH2b>.

¹¹ In his 1623 essay, “The Assayer” (*Il Saggiatore*), Galileo Galilei (1564-1642) wrote “the universe ... stands continually open to our gaze, but it cannot be understood unless one first learns to comprehend the language and interpret the characters in which it is written. It is written in the language of mathematics, and its characters are triangles, circles, and other geometrical figures...”

that God has so established in nature” that “are strictly adhered to in everything that exists or occurs in the world.”¹² In other words, God had created a set of immutable laws that made an impression on the world, and by studying these impressions, scientists could gain a clearer understanding of those enduring laws which formed the basis of all the sciences. These laws, in their perfection and stability, were evidence of God’s omnipotence and wisdom.

The laws of nature paradigm allowed Enlightenment scientists and natural philosophers to reconcile their spirit of inquiry with their religious beliefs: inquiry was seen not as a challenge to religion, but rather a means of better understanding God’s wisdom as evidenced through natural laws.¹³ Likewise for Fuller, the purpose of experimentation and inquiry was to discover universal principles, the foundations of a God-created universe.

Laws of Nature and Special Case Experience

Fuller believed that laws of nature could be discovered through aggregated experience. In particular, he frequently referred to “special-case” experiences, namely local and discrete events that paved the way toward understanding general principles. In the introduction to *Synergetics*, Fuller wrote:

See Galileo Galilei, “The Assayer,” as translated by Stillman Drake, *Discoveries and Opinions of Galileo* (Anchor: 1957), 237-8.

¹² Rene Descartes, *Discourse on Method and Meditations on First Philosophy*, translated by Donald Cress, fourth edition (Hackett Publishing Co., 1999), 23.

¹³ The Enlightenment and the laws of nature paradigm helped to support what is sometimes called the “watchmaker analogy,” a parable in natural theology used to argue for the existence of God. This analogy was propounded by William Paley in his 1802 book *Natural Theology or Evidences of the Existence and Attributes of the Deity*, and continues to be used today by some creationists to argue for intelligent design. According to the analogy, the universe with all its complexities necessitated an intelligent designer. The intelligent designer (God) created certain mechanisms, such as the laws of nature, and then allowed the universe to operate and evolve in accordance with these pre-established mechanisms.

Mind is the weightless and uniquely human faculty that surveys the ever larger inventory of special-case experiences stored in the brain bank and, seeking to identify their intercomplementary significance, from time to time discovers one of the rare scientifically generalizable principles running consistently through all the relevant experience set."¹⁴

In other words, Fuller suggests that one can derive general scientific principles from the data bank of special-case (discrete) experiences. More succinctly, Fuller is talking about an experiential understanding of the laws of nature.

An oversimplified example of how special-case experiences could lead to an understanding of laws of nature occurred when Sir Isaac Newton (1642-1727), in 1665, observed an apple falling from a tree. The apple's fall was one special-case experience. Newton realized through his aggregated experience that objects always fall downward, and found no examples to the contrary. This led him to identify gravity (a fundamental principle, i.e. a law of nature) and to develop the mathematical laws to describe it.¹⁵

For Newton, the apple's fall represented a law of nature at work. When Fuller observed complex naturally occurring geometries, he likewise saw the laws of nature at work. God had created what Fuller called the "fundamental orderliness,"¹⁶

¹⁴ R. Buckminster Fuller, "The Synergetics on the Web Project." *Robert W. Gray's Homepage*, N.p., 1997. <http://www.rwgrayprojects.com/synergetics/toc/toc.html>.

¹⁵ As mentioned, this is an oversimplified example. Many schoolchildren are told that an apple fell on Newton's head, leading to him having an epiphany about gravity. This is not exactly true, but there was an apple that he observed falling from a tree in his mother's garden in Cambridge, and it did get him to think about gravity and acceleration. Newton told this to his biographer during his lifetime. See <http://io9.com/did-an-apple-really-fall-onto-isaac-newtons-head-1025937883/all>

¹⁶ Please see Fuller's poem *No More Secondhand God*, reproduced in part in the text that follows.

the underlying organizational structure that allowed bees to build hives, mass to be conserved, and gravity to be constant. And for Fuller, it was nothing less than ignorance to believe anything else, expressed in his collection of poems, "No More Secondhand God":

*And he who is befuddled by self or
by habit,
by what others say,
by fear, by sheer chaos of unbelief in
God
and in God's fundamental orderliness
ticking along on those dials
will perish
And he who unerringly interprets those dials
will come through.*¹⁷

Fuller's belief that the universe operated according to a divine organizational system, and that the purpose of human scientific endeavor was to interpret this system, are part of a "laws of nature" paradigm reaching back to the Enlightenment period. At the core of his model of nature was a belief that the universe was a divine creation operating according to divinely inspired laws. The laws of nature were, for Fuller, a matter of science as well as a matter of faith.

In his time, Fuller was not unique in believing that the universe operated according to laws of nature. Indeed, this had been a staple of Enlightenment scientific thought, and had made a lasting impression on the Western Christian worldview

¹⁷ R. Buckminster Fuller, "No More Secondhand God), in *No More Secondhand God and Other Works* (New York: Anchor Books, 1971), 2. The poems in *No More Secondhand God* were written between about 1940 and 1962, with the first edition published in 1963.

that lasted into the twentieth century. Having said that, laws of nature paradigms today are generally debated and discussed in philosophical circles rather than in scientific ones. In the sciences, the terms *laws of science* or *scientific principles* have supplanted the *laws of nature* term, and refer to broad and narrow theories that describe and/or predict the behavior of things in the natural world.

Notably absent from the *laws of science* idea is any notion that those principles were created by God or a higher power. Laws of science in contemporary scientific thought are areligious.¹⁸ If Fuller were alive today, he might use the phrase *laws of science* interchangeably with *laws of nature* and *fundamental principles*. However, his understanding of these principles would remain contingent upon the idea that a higher power had created that “fundamental orderliness” and that the cosmos was ultimately a divine creation. In contemporary terms, Fuller might be called an “evolutionary creationist” or a “theistic evolutionist,” namely a person who believes in biological evolution, but also believes that the conditions for life were set in motion by God.¹⁹

¹⁸ Certainly some contemporary scientists with strong religious beliefs may continue to see laws of science as being divinely created, but that would be outside of the general definition.

¹⁹ Francis Collins describes theistic evolution as the position that “evolution is real, but that it was set in motion by God.” See Francis Collins, “Building Bridges” (*Nature* 442 (7099): 110), 2006. Evolutionary creationism or theistic evolution might be considered a compromise position between modern scientific theory and religious tradition. Fuller was not a creationist in the sense of rejecting the idea of biological evolution; on the contrary, he was quite fascinated by the many adaptations that organisms had evolved over time in response to environmental and natural conditions. He did, however, believe that the preconditions for life were created by a higher power. This compromise model, therefore, represented his dual interests as a scientist and a lifelong practicing Christian.

Transcendentalism

Fuller's comprehensive model of nature was also deeply influenced by American Transcendentalist ideas from the 1830s and 1840s. Although a link between Fuller and transcendentalism has been acknowledged, it has not been deeply explored, and particularly not with reference to nature.²⁰ Although transcendentalist ideas surfaced in different locations and in different ways over the course of the 19th century, in this section we will focus specifically on the New England Transcendentalists; hereafter, referred to simply as Transcendentalists.

Transcendentalism was a philosophical, literary, and religious movement that emerged during the first half of the 19th century in the Boston area. The Transcendentalists sought alternatives to what they saw as conformism and orthodoxy within the Protestant church, in particular the Unitarian church.²¹ "They were critics of their contemporary society for its unthinking conformity, and urged that each person find, in Emerson's words, 'an original relation to the universe.'"²² The Transcendentalists found ample inspiration in the European Romantics²³ and

²⁰ Some link between R. Buckminster Fuller and his great-aunt Margaret Fuller, a prominent Transcendentalist, has been acknowledged, for example in Lloyd Steven Sieden's *Buckminster Fuller's Universe* and in Scott Eastham's *American Dreamer*. However, this link has not been deeply or adequately explored. In particular, the connection between Fuller's view of nature and the Transcendentalists' view of nature has not been acknowledged or explored in the scholarly literature.

²¹ The earliest Transcendentalist leanings involved critiques of Calvinism, as evidenced by the writings and preachings of William Ellery Channing (1780–1842), a Unitarian preacher active in New England who spoke out against the orthodoxy of the church. A good summary of the origins of the Transcendentalist movement can be found in the *Stanford Encyclopedia of Philosophy*. See "Transcendentalism," *Stanford Encyclopedia of Philosophy* (Stanford University, 2011). <http://plato.stanford.edu/entries/transcendentalism/#1>.

²² "Transcendentalism," *Stanford Encyclopedia of Philosophy* (Stanford University, 2011). <http://plato.stanford.edu/entries/transcendentalism/#1>.

²³ The relationship between Transcendentalism and the Romantic tradition has been well established. Philosophical influences included Immanuel Kant, Friedrich Schelling, Thomas Carlyle, Auguste Comte. This connection should be assumed, but for purposes of time it will not be

particularly in the work of Immanuel Kant. “The divinity of nature, the glory of human aspiration and freedom, the power of intuition as opposed to reason, the creative energy of the poetic imagination—these are some of the themes imported into America by writers like Hedge, Brownson, Ripley, and [Margaret] Fuller, as well as Emerson.”^{24,25}

Family Ties

Fuller had an inherent connection to the Transcendentalists through his great aunt (Sarah) Margaret Fuller Ossoli (1810-1850), commonly known as Margaret Fuller. Although the two never met, he was fascinated by his illustrious ancestor; Fuller’s personal archive contains at least three boxes of material on Margaret, including essays, notes, and personal correspondence about her. She also figured prominently in an annotated family genealogy that Fuller began in 1929 upon the birth of his daughter Allegra and that he added to, here and there, until his death. Fuller referenced her several times in his books and lectures²⁶, devoting a chapter of *Ideas and Integrities*, for example, to “Margaret Fuller’s Prophecy.”

explored here. A good starting point would be Joel Myerson (ed.) *et al's The Oxford Handbook of Transcendentalism* (Oxford: Oxford University Press, 2010).

²⁴ Hochfield, *Selected Writings*, x.

²⁵ These individuals were well-educated members of established New England families, so laws of nature ideas in the sciences were likely familiar to them. However, the Transcendentalists were less interested in scientific enquiry and rationalism than they were in exploring individual spirituality. As such, although the Transcendentalists probably have accepted laws of nature to be a scientific given, they are not a common subject in their writings.

²⁶ Fuller devotes a chapter in *Ideas and Integrities* to Margaret Fuller’s prophecies, and he actively sought information about Margaret in compiling a genealogy of the Fuller family for his daughter Allegra.

During the mid-1970s, the high point of second-wave feminism in the United States, there was a resurgence of interest in Margaret Fuller as an early feminist.²⁷ At the time, Fuller collected essays and dissertations, book chapters, plays, decorative stamps, and photographs of Margaret Fuller. In Fuller's mind, she had not been awarded a properly large niche in history, overshadowed as she had been by Ralph Waldo Emerson and Henry David Thoreau. To this end, he expressed great interest in a possible movie on Margaret Fuller's life proposed by actress Ellen Burstyn. "I have confidence in Ellen Burstyn...I know her intimately enough to say she is mystically inspired by Margaret...I think Margaret would be happy," wrote Fuller to his cousin Elizabeth.²⁸ "It may well be that I am the most experienced of Margaret's descendants to serve in the capacity of Fuller family advisor to Ellenurstyn [*sic*], who has confidence in me," wrote Fuller to a friend.²⁹ The film was never realized.

As individuals, R. Buckminster and Margaret Fuller had several things in common. Both had expansive egos, and a somewhat grandiose sense of self-importance. "Poor Margaret," wrote Thomas Carlyle to Emerson "Such a predetermination to eat this big Universe as her oyster or her egg, and to be absolute empress of all height and glory in it that her heart could conceive..."³⁰ Fuller, for his part, had an "exquisite sense of self-importance," and "cultivated his personal narrative to what

²⁷ Feminists considered her to be an early advocate of women's rights, especially given the publication of her *Woman in the Nineteenth Century* (1843) in *Dial* magazine which argued for greater equality among men and women.

²⁸ R. Buckminster Fuller to Elizabeth Channing Fuller, Dec. 10 1976. Fuller MSS, Stanford University, Series 1 Box 5.

²⁹ R. Buckminster Fuller to Medard Gabel, Sept. 3 1976, Fuller MSS Stanford Universities, Series 1 Box 5.

³⁰ Thomas Carlyle to Ralph Waldo Emerson, May 7 1853, Fuller MSS Stanford University Series 1 Box 7.

can only be described as mythic importance."³¹ By all accounts, both had big personalities, and big ideas.

Another similarity worth noting is that both experienced, as young adults, an existential crisis followed by a life-changing personal epiphany. Fuller experienced a crisis on the shores of Lake Michigan in 1927, a story that he repeated over the years with increasing layers of embellishment. According to Fuller, he wandered to the shores of Lake Michigan on a dark and stormy winter's night in 1927. He had recently lost his first child and had a second on the way. Jobless, destitute and disillusioned, Fuller contemplated ending his life by jumping into the lake. As he was about to take the plunge, something held him back. Time stood still, and Fuller found himself suspended in midair³² while he was visited by an otherworldly voice that said "You do not have the right to eliminate yourself. You do not belong to you. You belong to the Universe."³³ Fuller was persuaded to live the rest of his life as an experiment dedicated to seeing what one individual could do on behalf of all humanity, and embarked on a period of intense creativity.³⁴ This topic will be taken up in more detail in Chapter 3.

Less well known is that Margaret Fuller experienced a parallel epiphany almost a century before. It was November of 1831—Thanksgiving Day—and the 21-year old Margaret was plagued by depression, migraines and loneliness. She found an

³¹ Katz, "1927" in *New Views*, 24.

³² Sieden, *Buckminster Fuller's Universe*, 88.

³³ *Ibid*, 88.

³⁴ Fuller told and retold this story in lectures and books. The details of the story vary somewhat; sometimes he is floating, sometimes not. Sometimes he is visited by a voice, other times not explicitly. The outline I have provided is a representative example of Fuller's 1927 crisis story. See also Chapter 5 of Sieden's *Buckminster Fuller's Universe*.

unexpected peace in nature as she “wandered alone in a deserted winter field that was transformed from a mirror of her tormented feeling into a ‘garden of God.’”³⁵

*I went on and on, till I came to where the trees were thick about a little pool, dark and silent. I sat down there. I did not think; all was dark, and cold, and still. Suddenly the sun shone out with that transparent sweetness, like the last smile of a dying lover, which it will use when it has been unkind all a cold autumn day. And even then, passed into my thought a beam from its true sun, from its native sphere, which has never since departed from me.*³⁶

Both epiphanies speak to a holistic or unified experience between the self and a force or forces greater than themselves.³⁷ In Margaret’s case, she sensed unity between the forces of good and evil, dark and light, masculine and feminine. This helped to ease some of the tension she felt concerning her relationships with her family and her place in society. She began to trust her intuitions, and formed ties with the young Transcendentalists shortly thereafter. Fuller saw his personal fears and self doubts subsumed into the cosmic whole as he was told that “you do not belong to you, you belong to the Universe.” He cast aside social pressures and devoted himself to personal projects, no matter how bizarre.³⁸ Incidentally, both Fullers also experienced their sublime awakenings in nature, in a deserted landscape by a dark body of water. Both Margaret and R. Buckminster Fuller were Christians, and we can liken their moment of spiritual awakening to an epiphany, a deeply felt religious experience.

³⁵ Kornfeld, *Margaret Fuller*, 15.

³⁶ *Ibid*, 15.

³⁷ *Ibid*, 16.

³⁸ For example, Fuller wrote 4-D Timelock, an eccentric meditation on time, shelter, light, technology.

Recent scholarship has cast doubt on whether Fuller's Lake Michigan crisis actually happened; a personal calamity is not evident in Fuller's voluminous papers³⁹, nor did his wife Anne register any noticeable change in her husband's comportment.⁴⁰

An alternate, entirely plausible explanation is that Fuller experienced a long and drawn-out period of confusion from which he eventually extricated himself.

Regardless of its veracity, the story of crisis and redemption became a staple in Fuller's repertoire. It was central to how he presented himself to the public, as an individual who had been touched and transformed by some almighty force.

Given the dubious nature of the Lake Michigan story, we might engage in some friendly speculation. Considering his reverence for his illustrious aunt, might Fuller have drawn inspiration for his own 'creation story' from her example? Perhaps. In any case, if we take Fuller and Margaret at their words, both experienced their exquisite moments of truth and unity with God in nature. In this sense they shared a spiritual kinship as well as a hereditary one.

Margaret Fuller and the Transcendentalists

Following her 1831 epiphany, Margaret Fuller joined inner circle of New England Transcendentalists that included Ralph Waldo Emerson, Henry David Thoreau, George Ripley, and Bronson Alcott, among others. She co-edited and contributed to the literary/philosophical journal *The Dial* with Emerson from 1840-1842. An

³⁹ Katz, "1927" in *New Views*, p.27.

⁴⁰ Fuller reported a long period of self-imposed silence after the event, which again is not substantiated in his papers per Katz's article.

accomplished female author and journalist in a time when the profession was almost exclusive to males, Fuller was an advocate for women's rights; her 1845 book *Woman in the Nineteenth Century* is considered an early example of feminist literature.⁴¹

The New England Transcendentalist movement was at heart a religious and philosophical dissent from the Unitarian Church. Unitarianism was a liberal Protestant movement that had enjoyed a strong foothold in New England since the arrival of the Puritans in the 1600s. Margaret's family was firmly Unitarian, and her brother Arthur was a Unitarian clergyman.⁴² Several prominent Transcendentalists, notably Ralph Waldo Emerson, Theodore Parker, and Orestes Brownson, were also Unitarian ministers prior to their spiritual 'reawakening' in the mid-1830s.

The Transcendentalists were becoming increasingly disillusioned with what they saw as an overly rational approach to religion at the expense of true spirituality. Emerson's described Unitarianism as "corpse-cold," and "an ice house,"⁴³ cutting to the core of their grievances. Over the course of the 18th century, the Unitarian church had methodically stripped away ritual and church dogma to expose "the

⁴¹ Actually, *Woman in the Nineteenth Century* was originally published as a serial in The Dial in 1843. It was later expanded and published as a book in 1845.

⁴² Margaret's father, Timothy Fuller, Jr. (1778-1835) had renounced Calvinism for Unitarianism while at Harvard College, and her parents were active members of the church in Canton, MA. Margaret's younger brother, Arthur Buckminster Fuller (1822-1862, R. Buckminster Fuller's grandfather) graduated from the then firmly-Unitarian Harvard Divinity School and became a Unitarian clergyman, active in the greater Boston area.

⁴³ Ralph Waldo Emerson, *Heart of Emerson's Journals* (Montana: Kessinger Publishing, 2003), 218, 181.

simple teachings of Christ."⁴⁴ However, this clinical approach reached a fundamental limit when it came to understanding the miracles of Christ, which could clearly not be explained in a rational way.⁴⁵

No matter how irrational, the miracles were nonetheless necessary to securing the authority of the Christian faith. "This argument acquired a painful importance because miracles increasingly seemed to mark the dividing line between a faith that was specifically Christian and a merely natural religion, or no religion at all."⁴⁶ As a result, the Unitarian church cleaved to an awkward compromise between rationality and miracles. On the one hand, humans should dispense with dogma and apply rational thinking and natural reason to their practice of religion. At the same time, the miracles of Christ were themselves evidence of His divine authority. This position was tenuous at best: Christianity should be interpreted in reasonable ways; yet the authority of Christ rests upon the existence of miracles, which reason itself is unable to verify.

The Transcendentalists rebelled against this weak-kneed compromise by reaffirming that, far from being circumscribed by rationality, Christianity was in its very definition sublime. "Christianity is not only confirmed by miracles, but is in itself, in its very essence, a miraculous religion," wrote William Ellery Channing in

⁴⁴ Hochfield, *Selected Writings*, xiii.

⁴⁵ The 18th century saw a lively debate on the subject of miracles, with Scottish skeptic David Hume calling miracles "a violation of the laws of nature." See David Hume, *On Miracles. Modern History Sourcebook* (Fordham University, 1997), <http://www.fordham.edu/halsall/mod/hume-miracles.html>.

⁴⁶ Hochfield, *Selected Writings*, xiii-xiv. This quote indicates a gap between Enlightenment scientific thought with its laws of nature, and religious thought that will be further discussed later in this chapter.

1821.⁴⁷ Furthermore, the issue of miracles was a red herring, because there was ample evidence of God's creative power in the natural world. "The word Miracle, as pronounced by Christian churches, gives a false impression; it is Monster. It is not one with the blowing clover and the falling rain,"⁴⁸ remarked Emerson in 1848. It was not by pondering or debating miracles, but rather by going to nature and experiencing to its greatness that one could truly come closer to God. Wrote Emerson in 1836,

In the woods, we return to reason and faith. There I feel that nothing can befall me in life, -- no disgrace, no calamity, (leaving me my eyes,) which nature cannot repair. Standing on the bare ground, -- my head bathed by the blithe air, and uplifted into infinite space, -- all mean egotism vanishes. I become a transparent eye-ball; I am nothing; I see all; the currents of the Universal Being circulate through me; I am part or particle of God.⁴⁹

⁴⁷ William Ellery Channing, *On the Evidences of Revealed Religion* (1821) in Hochfield, *Selected Writings*, 45.

⁴⁸ Ralph Waldo Emerson, *Harvard Divinity School Address* (1838), reproduced in *Ralph Waldo Emerson Texts*, <http://www.emersoncentral.com/divaddr.htm>

⁴⁹ Ralph Waldo Emerson, *Nature* (1836), reproduced in *Great Voyages: The History of Western Philosophy* (Oregon State University, 1997), <http://oregonstate.edu/instruct/phl302/texts/emerson/nature-emerson-a.html#Chapter%20I>.



Christopher Pearse Cranch, *Transparent Eyeball*, (from Emerson's "Nature"), From Cranch's "Scraps" book, Ink on paper - c.1839, 9 3/4 x 7 5/8 inches, Private collection

Figure 1: Christopher Cranch, *Transparent Eyeball* (c. 1839)

Experiences in nature were absolutely fundamental to the Transcendentalists in terms of developing their personal faith. For Emerson, Thoreau, and other Transcendentalists, there were no greater miracles than those to be found in nature. Indeed, God was revealed in the natural world, making communion with nature a type of experience of God. In *The Maine Woods*, Henry David Thoreau sensed that he was observing in nature the hand of God. "I looked with awe at the ground I trod on, to see what the Powers had made there, the form and fashion and material of their work."⁵⁰

Transcendentalist ideas about nature were deeply ingrained in R. Buckminster Fuller through his religious upbringing,^{51,52} his New England education,⁵³ and his

⁵⁰ Henry David Thoreau, *The Maine Woods* (1864), reproduced in *The Walden Woods Project*, Library, <https://www.walden.org/Library/Quotations/Nature>.

⁵¹ Fuller had a rigorous Christian upbringing in part through his mother's Episcopal church (see Sieden, 89) and Fuller and his wife Anne were both practicing Unitarians.

⁵² Fuller's grandfather (Margaret's brother), Arthur Buckminster Fuller (1822-1862), had been a Unitarian minister, although fairly open to liberal reforms of the church.

familiarity with and reverence for Margaret Fuller's work.⁵⁴ Like the Transcendentalists, Fuller saw in the natural world evidence of a higher power, as noted by Sieden:

*Examining the depths of his own experience and insight, Fuller was overcome by the massive amount of evidence that he felt supported the idea of a Universal Intelligence. His primary confirmation lay in the perfect design and orderliness he had found within every aspect of Nature. Everything he had studied seemed to be governed by an exquisite set of interaccommodative principles which he felt could only be the work of a Greater Intellect.*⁵⁵

Divine Creation

Enlightenment thinkers and the Transcendentalists had slightly different priorities with regard to nature. Enlightenment scientists sought to advance the state of scientific knowledge by investigating and cataloging the laws of nature. They achieved this through systematic enquiry and the collection of empirical evidence. The Transcendentalists, by contrast, were primarily concerned with spiritual experience: nature represented a vast and sacred space where they could renew their religious beliefs, and provided a retreat from the cultures of religious conformity. But Enlightenment and Transcendentalist ideas were compatible insofar as both understood the natural world to be a divine creation. Whether the source of scientific truths or spiritual ones, nature was in either case a direct manifestation

⁵³ Transcendentalist ideas had made a lasting impression in the curriculum of Harvard University, where Fuller studied as a freshman (1913-14) before being asked to leave in 1915. For example, Thoreau's *Walden* was one of the accepted texts for fulfilling the writing and literature requirement at Harvard College. See The Harvard University Catalogue 1913-14 (Harvard University), available digitally at <http://catalog.hathitrust.org/Record/006923722>.

⁵⁴ Fuller's reverence for Margaret Fuller has been noted by numerous biographers, including Lloyd Steven Sieden and Victoria Vesna. See Sieden (2000) and Victoria Vesna, "Introduction to Buckminster Fuller," Buckminster Fuller Institute website, <http://challenge.bfi.org/about-fuller/biography/introduction-buckminster-fuller>.

⁵⁵ *Ibid.*

of God. It was along this axis—the axis of divine creation—that Fuller intertwined the scientific and philosophical strands of these two traditions together. In Fuller’s model of nature, the universe was the source of all knowledge, scientific, spiritual, or otherwise. In simplest terms, nature was the physical manifestation of God.

Knowledge through Experience

For Fuller, the pathway to knowledge—both scientific and spiritual—was experience. Indeed, experiences in nature were a formative part of Fuller’s childhood. The summers he spent as a child, vacationing with his family on rural Bear Island off the coast of Maine, were critical to developing his problem-solving mind.

As a young boy on the island...[Bucky] began to develop a reverence for and appreciation of Nature. And it was in that Maine wilderness that he also came to appreciate Nature as something more than an entity to be tamed and dominated by human beings. Several months on the island each year provided Fuller with valuable experience living in nature and observing the elegant, simple technology of Nature itself as demonstrated through the island’s wild environment.⁵⁶

It is well known that the young Fuller was not an outstanding scholar⁵⁷; unable (or unwilling) to keep up with his classes, he was twice kicked out of Harvard for poor performance. Fuller was, by all accounts, not a book learner but an experiential one, as his summers on Bear Island made clear. He learned a great deal through

⁵⁶ Lloyd Steven Sieden, *Buckminster Fuller’s Universe: His Life and Work* (Cambridge, MA: Perseus Publishing, 1989), 9.

⁵⁷ Fuller attended Milton Academy in Milton, Massachusetts for secondary school. He did well enough to enter college, but he probably distinguished himself more athletically than academically.

physical and kinesthetic experiences; exploring the island, sailing, kayaking, and observing natural forces in action as Sieden indicates. These experiences gave him the knowledge and initiative to join the U.S. Navy in 1916 as captain of his own tiny boat, the *USS Wego*; to build his own canoes; and to repair equipment at his family's textile mill in Canada. Experiencing the real world—and in so doing, perceiving the laws of nature with the senses—was essential to his education.

His daughter, Allegra Fuller Snyder, eloquently expressed the importance of experience—specifically physical experience—to Fuller as an entry point to knowledge:

*I believe inherently Bucky's concept of mind has, at its base, mind processing through experience. What is so important to recognize is that this was physical experience. My father was a very physical person. By experiencing I mean involving one's whole self, not being present at, or observing something, but "doing" that thing. He loved our island in Maine because it was a physically involving place.*⁵⁸

Fuller's first design invention, in fact, came from observing how jellyfish propelled themselves through the water. This inspired him to develop a cone and sprit device, resembling an umbrella, to propel his rowboat through the water, which he aptly named the "mechanical jellyfish." (Figure 2) Fuller later recalled that his interest in design may have stemmed from "delighted watching in 1904 of the jet-propelled white jelly fish in the clear Maine water."⁵⁹

⁵⁸ Allegra Fuller Snyder, "Buckminster Fuller: Experience and Experiencing," *Dance Chronicle*, 19:3 (1996): 299-308.

⁵⁹ Fuller, *Ideas and Integrities*, 17.

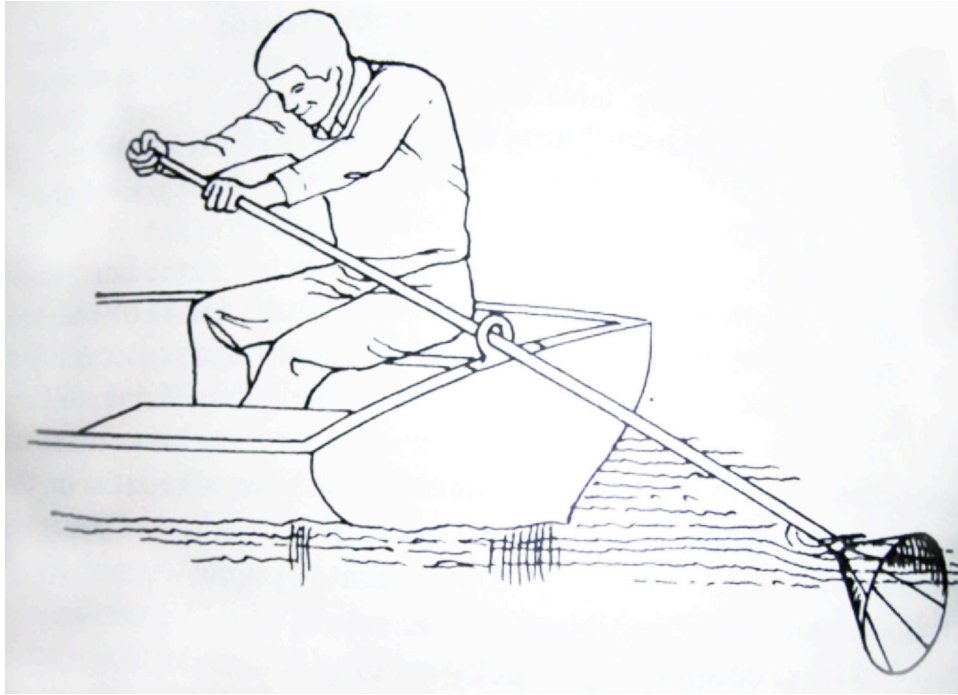


Figure 2: Mechanical Jellyfish (Sieden: *Buckminster Fuller's Universe*, 10)

Because experience—especially physical experience in nature—was so fundamental to Fuller’s learning about the world, he underscored the value of experience in the education of children. He felt that the educational system such as it was tended to overload and paralyze children’s natural faculties, to rob them of their innate curiosity and capabilities.⁶⁰ This hobbled their natural inquisitiveness and ability to think comprehensively. "Life, as born, is inherently comprehensive in its apprehending, comprehending, and coordinating capabilities. Every child is interested in the universe."⁶¹ Fuller also believed that children were natural scientists and observers. "Children are the only rigorously pure physical scientists...They accept only sensorially apprehensible, experientially remonstrable

⁶⁰ Fuller wrote that "what usually happens in the educational process is that the faculties are dulled, overloaded, stuffed and paralyzed so that by the time most people are mature they have lost their innate capabilities." R. Buckminster Fuller, *Education Automation*, (Carbondale, IL: Southern Illinois Univ. Press, 1962).

⁶¹ *Ibid.*

physical evidence."⁶² Indeed, Fuller needed objects, models, and physical experiences to make his own ideas come to life. He frequently used large models of tetrahedra and more complex polyhedra in his many lectures, whether speaking to young children or to PhD students. (See Figure 3). Likewise, he sought out a progressive school that promoted "learning by doing" for his daughter, Allegra, and encouraged her to explore her love of bodily expression through dance.⁶³



Figure 3: Fuller surrounded by models at Princeton University, c.1953. Princeton Univ School of Architecture Archive.

Experiences in nature were not only important for learning about the physical and natural sciences. Experiences in nature were also psychologically important to Fuller, because they provided quiet time for thinking and reflection. Bear Island, his family's rural island off the coast of Maine, was an important retreat for Fuller throughout his life. Even during the peak of his career in the 1960s and 1970s,

⁶² R. Buckminster Fuller, *Synergetics 2* (New York: MacMillan, 1979), 4.

⁶³ Snyder, 300.

Fuller still set aside the month of August to return to Bear Island to disconnect from his hectic schedule and to regroup.⁶⁴

Walking and rowing were two solitary experiences, often in nature or at least in the outdoors, that Fuller also greatly enjoyed. Noted Fuller's daughter, Allegra "My father was a walker. He once told me about walking an extraordinary number of miles, perhaps a hundred, to see my mother, during one of his weekend leaves from the Navy, just after they were married. This was his best thinking time. His thinking was connected to his body. It was an integration of his body and his mind."⁶⁵ Fuller also enjoyed rowing alone in his "rowing needle," presumably for similar reasons. (See Figure 4)

Nature and the Cosmic Order

Like the Enlightenment scientists, Fuller saw that natural world as a repository of scientific information. Experiences and observations in nature could lead to a better understanding of the laws of nature, which in turn would lead to new inventions and applications. But Fuller's beliefs about nature went far beyond the boundaries of science or engineering. To experience the natural world—fully, intimately, and with an open mind—was ultimately to approach a higher order of knowledge, a cosmic order. "The experience of life inevitably brings inspirational glimpsing of the cosmic orderly vectors, all of which point convergingly to the

⁶⁴ Sieden, *Buckminster Fuller's Universe*, 8-9.

⁶⁵ Snyder, *Dance Chronicle*, 299-308.

absolute.”⁶⁶ The “experience of life” went to the spiritual core of Fuller’s being, because physical experiences made manifest the very laws of nature, those principles that governed “the natural phenomena of the world.”⁶⁷ For Fuller, this was in itself a spiritual experience. Nature, as the manifestation of God, was for Fuller the ultimate source of both scientific and spiritual truth.



Figure 4: R. Buckminster Fuller in Rowing Needle, circa 1970. <http://dnvdk.tumblr.com/>

⁶⁶ Fuller, “Synergetics on the Web” section 986.086, <http://www.rwgrayprojects.com/synergetics/synergetics.html>

⁶⁷ “Laws of Nature” *The Internet Encyclopedia of Philosophy*, <http://www.iep.utm.edu/lawofnat/>.

Chapter 02

Universal Evolution: Accommodating Technology in Fuller's Model of Nature

Although Fuller's comprehensive model of nature incorporated Enlightenment and Transcendentalist ideas, it was not confined to the past alone. Indeed, what made Fuller's model of nature unique was his ability to combine deeply-held traditions and values with a progressive, twentieth-century view on technology. Unlike his Transcendentalist forbears—who, with their romanticized views of nature, tended to be wary of science and technology¹—Fuller himself was fascinated by technology and ever hopeful that, properly leveraged, it would improve the human condition.

Fuller saw in mass production the opportunity to improve the general standard of living. He looked forward to the day when Fordist production lines would efficiently manufacture identical homes and cars, delivering decent shelter and transportation to the masses at an affordable cost.² As a result, Fuller had to find ways to integrate technology into his model of nature. He did this by “naturalizing” technology, by arguing that technology was the inevitable outcome of human intellectual evolution. He brought technology under the umbrella of evolution

¹ Henry David Thoreau for example, wrote that “Men think that it is essential that the Nation have commerce, and export ice, and talk through a telegraph, and ride thirty miles an hour, without a doubt, whether they do or not... Why should we live with such hurry and waste of life?” On the contrary, Thoreau advocated for a simple, Spartan country life, similar to the life he himself lived in a rustic cabin on the shores of Walden Pond, Massachusetts from 1845-47. This wariness toward technological advance was typical of the Transcendentalists. See Henry David Thoreau, *Walden*, (1854), <http://thoreau.eserver.org/walden02.html#notes2>

² Fuller's well-known Dymaxion Car and Dymaxion House designs from the late 1920s-mid 1930s were intended to be mass-produced and delivered around the world at entirely reasonable costs. Fuller believed that the efficiencies of mass production and distribution, especially when applied to the housing industry, would lead to a higher standard of living for vast numbers of individuals.

using the term *universal evolution*, which referred simultaneously to biological evolution, mankind's intellectual evolution, and the attendant development of new technologies to assist in the survival of the species.

In this chapter, discussion will center on the ways in which Fuller combined the theistic ideas of nature described in the previous chapter with progressive ideas on the role of technology in advancing the human condition. It was this that distinguished his model of nature from that of the Transcendentalists. The concept of universal evolution will be explored in order to demonstrate how Fuller melded biological, intellectual, and technological progress into one. Possible relationships with Pierre Teilhard de Chardin's ideas on universal evolution will also be evaluated. This will help to situate Fuller's ideas about universal evolution within a broader context of intellectual history, particularly by comparing and contrasting his ideas with those expressed by Teilhard in his relatively well-known book, *The Phenomenon of Man* (1955).³

³ *The Phenomenon of Man* had sold 90,000 copies in France and 50,000 in the U.S. by 1961, according to the American Teilhard Association, and it is in this sense that it is called "relatively well-known." See American Teilhard Association, <http://teiharddechardin.org/index.php/forerunners-in-the-united-states>. Teilhard's *The Phenomenon of Man* has been criticized since its publication, in particular by Nobel prize-winning immunologist Peter Medewar in a scathing 1961 review of the book. However, Teilhard was and remains an influential figure not so much among scientists as among religious or proto-religious organizations. For example, the Episcopal Church in the United States has designated April 10 as "Teilhard de Chardin Day." Although his work was initially (during the 1930s-40s) considered heretical, Teilhard was rehabilitated into the Catholic Church in the 1960s and was written about approvingly by several cardinals as well as Pope Benedict XIV. See "Pierre Teilhard de Chardin," *Wikipedia*, http://en.wikipedia.org/wiki/Pierre_Teilhard_de_Chardin#Legacy. See also "Teilhard de Chardin Biography," American Teilhard Association, <http://teiharddechardin.org/index.php/biography>.

Transcendentalism for the 20th Century

Both Fuller and the Transcendentalists sought an authentic faith, one that was not ruled by habit or dogma. Fuller refers explicitly to this in *No More Secondhand God*, his 1963 collection of poems referenced in the previous chapter, noting that he who doubts “God’s fundamental orderliness ticking along on those dials will perish.”⁴ *No More Secondhand God* echoes Transcendentalists’ call for an authentic, personal faith rather than a religion of habit. This passage also touches on the concept of ‘God as watchmaker,’ described by William Paley in 1802.⁵ Although it is not entirely clear whether Fuller was intentionally referencing the so-called “watchmaker analogy,” his references to God and his use of the words “ticking” and “dials” certainly suggest such an interpretation.

No More Secondhand God also indicates an important difference between the Transcendentalists and Fuller where technology was concerned. Where Emerson saw God in the “blowing clover and the falling rain,” Fuller equally saw God in “the instruments and mechanisms that work reliably, more reliably than the limited sensory departments of the human mechanism.”⁶ God’s hand shaped the natural world, but equally touched the scientific one. Fuller’s embrace of technology is a dividing line between the Transcendentalists’ essentially romantic nineteenth century viewpoint and Fuller’s decidedly more modern, twentieth century one.

⁴ Fuller, *No More Secondhand God and Other Works, Works* (New York: Anchor Books, 1971), 5.

⁵ British philosopher William Paley (1743-1805) used the ‘watchmaker analogy’ in his *Natural Theology, or Evidences of the Existence and Attributes of the Deity collected from the Appearances of Nature*, published in 1802. The so-called ‘watchmaker analogy’ compares the complex mechanisms inside a watch to the complex workings of the universe, and suggests that both require an intelligent designer: a skilled watchmaker in the first case, and God in the second case. The watchmaker analogy is thus an argument for the existence of God and the intelligent design of the universe.

⁶ Fuller, *No More Secondhand God*, 4.

Universal Evolution

Fuller's model of nature had to accommodate the realities of technological progress in the new century. Unlike Transcendentalist Henry David Thoreau, who eschewed technology in his seminal texts *Walden* (1854) and *The Maine Woods* (1864), Fuller was not ready to retreat to a log cabin in order to live a considered life. He did not see technology as antithetical to human values;⁷ on the contrary, Fuller believed that the efficiencies of mass production and distribution could democratize access to shelter, food, transportation, and other goods. Indeed, he had witnessed the benefits of industrialization within his own lifetime. "When I was young going from a little town seven miles out of Boston...I saw that all the children in the street were in rags. No exceptions. People on the trolley really stank. Women of 26 years were hags with half their yellow teeth out. There was no dentistry for them. It is my own direct experience that life has changed very much for the better."⁸

Where Thoreau and his contemporaries were wary of change, Fuller belonged to a generation that had both acclimated to and benefited from the industrial age. Therefore, it was important that his model of nature reconcile the "nature vs. technology" divide, and align technological progress with human development.

⁷ Thoreau's wariness toward technological advance is most obvious in *Walden*, published in 1854 and cited above. In it, Thoreau suggests that the ethical life is the simple life. He criticizes the noisy trains, bells and whistles, and post offices that in his opinion only lead to anxiety and interrupt the solace that is to be found in unspoiled nature.

⁸ Fuller, *Utopia or Oblivion*, 141.

Fuller did this by bringing technological progress under the umbrella of evolution, using the term *universal evolution*.⁹ This term appears in Fuller’s writing beginning in the 1960s, although the general concept had existed in his mind for several decades prior to then. (Before the 1960s, Fuller just used the word *evolution*.) For the purposes of discussion in this thesis, the term *universal evolution* will be used to refer to Fuller’s unified theory of evolution, about which he wrote from the mid 1940s onward, with the understanding that he didn’t use that specific term until the 1960s.

Universal evolution referred simultaneously to biological evolution, the development of new technologies, and mankind’s intellectual development. In Fuller’s mind, these were inseparably linked. The diagram below presents a simple schematic:

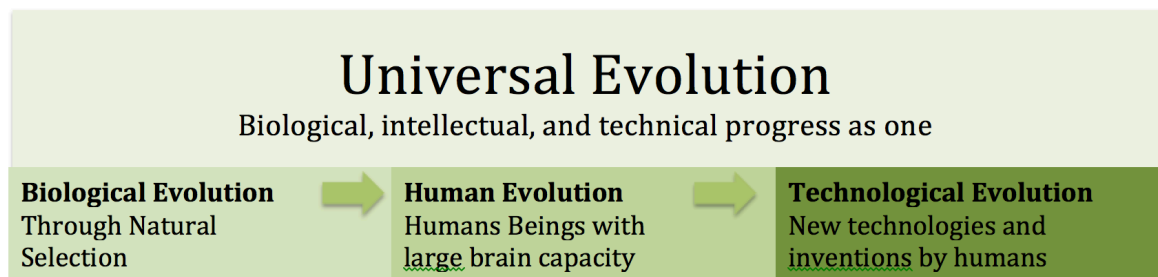


Figure 1: Universal Evolution Schematic (H. Chu)

⁹ Fuller used the term 'universal evolution' in writing starting in the 1960s. He may have used the term prior to that, but I have not found a clear reference to it. Universal evolution is discussed in *Education Automation* (Southern Illinois University Press, 1962) with Fuller stating “Education will then be concerned primarily with exploring to discover not only more about the universe and its history but about what the universe is trying to do, about why man is part of it, and about how can, and may man best function in universal evolution.” See excerpts from *Education Automation* in Maria Popova, “Buckminster Fuller Presages Online Education,” <http://www.brainpickings.org/index.php/2014/03/05/buckminster-fuller-education-automation-1962/>.

The diagram shows how (in Fuller's mind) biological evolution endowed humans with a large brain which allows humans to develop new knowledge, which in turn allows them to invent new technologies for survival. These three strands of evolution are inextricably linked together in universal evolution. Indeed, mankind's evolutionary destiny is to apply his brainpower to develop new technologies that will enhance the survival of the species.¹⁰ Mankind's superior intellect and awareness of his capabilities allows him to materially participate in his own evolution in a way that no other species can. "Man in degrees beyond all other creatures known to him, consciously participates—albeit meagerly—in the selective mutations and accelerations of his own evolution," wrote Fuller in 1949.¹¹

Teilhard de Chardin and *The Phenomenon of Man*

Fuller's concept of universal evolution bears many similarities to a unified theory of evolution of the same name developed by French philosopher, paleontologist, and Jesuit priest Pierre Teilhard de Chardin (1881-1955). Teilhard's universal evolution describes the "gradual development of the universe from subatomic particles to human society."¹² Teilhard saw evolution as a continuum with three distinct stages: *geogenesis*, or the creation of matter and the universe by God; *biogenesis*, the creation and development of life; and *noogenesis*, the creation of intelligent life

¹⁰ Although not indicated in the diagram, a precondition for evolution was the creation of the universe and the Laws of Nature by God or a Greater Intellect. This can be assumed from the discussions in the previous chapter.

¹¹ R. Buckminster Fuller, "Evolution" (1949), in *The Synergetics Dictionary Online*, <http://www.rwgrayprojects.com/SynergeticsDictionary/status.html>. This quote is believed to come from a 1949 speech given at Black Mountain College in New Hampshire.

¹² "Universal Evolution," Wikipedia, http://en.wikipedia.org/wiki/Universal_evolution

forms and the development of consciousness.¹³ He believed that humans had entered the third stage of evolution, noogenesis, and that they would eventually reach the pinnacle of transcendent consciousness known as the Omega Point. The theory in its entirety is explained in Teilhard's *The Phenomenon of Man (Le phénomène humain)*, published in 1955.¹⁴

It is difficult to establish whether Fuller was familiar with Teilhard's work during the mid-1950s, and this question will be discussed in detail below. Nevertheless, there is a surprising convergence between Teilhard's and Fuller's theories of universal evolution on several levels. First of all, both Teilhard and Fuller believed in a god-created universe in the Western Christian tradition, more or less according to the watchmaker analogy. Both believed in a Darwinian model of biological evolution, with natural selection as its basic mechanism. As such, both had theistic evolutionary beliefs.

Both Teilhard and Fuller wanted to extend the notion of human evolution past mere biology to include the evolution of the mind and consciousness, what Teilhard called noogenesis. This related to the notion of a noosphere, or a sphere of human consciousness and evolution, that Teilhard had posited in his 1922 book

¹³ There are other subphases of evolution as Teilhard describes them, such as *anthropogenesis* (development of mankind), and *Christogenesis*, spiritual evolution toward Christ and God. Here, I have included anthropogenesis as a subphase of biogenesis, and Christogenesis as a subphase of the noogenesis, for the sake of brevity.

¹⁴ Teilhard's theory was related to the work of Vladimir Ivanovich Vernadsky (1863-1945), a Ukrainian and Soviet mineralogist and geochemist who developed and popularized ideas about the geosphere (inanimate matter), the biosphere (living matter), and the noosphere (human cognition.) Teilhard used these three to define the major phases in his theory of universal evolution. A principal difference between Vernadsky and Teilhard was that Vernadsky was more interested in material developments, unlike Teilhard whose ideas of evolution included spiritual development.¹⁴ Although Vernadsky's ideas spread somewhat in the Soviet Union, he was not as well known in the West.

Cosmogogenesis.¹⁵ They also shared the notion that mankind has a special place in the universe because of his own intelligence and consciousness. Indeed, mankind has the mental and spiritual abilities to become a conscious participant in his own evolution, “a leading shoot of evolution.”¹⁶

What is less clear is how directly and to what extent Teilhard influenced Fuller in the development of Fuller’s ideas about universal evolution or in his use of the term. Fuller makes no reference to Teilhard in his key texts from the 1960s, including *Utopia or Oblivion* and *Ideas and Integrities*. Of course, that does not necessarily mean that Fuller had not read Teilhard. *The Phenomenon of Man* was reasonably popular in its day; between 1959 when it was first translated into English, and 1961, the book sold some 50,000 copies in the United States alone.¹⁷ As such, it is entirely possible that Fuller was familiar with Teilhard’s *The Phenomenon of Man*, having either read it or heard about it within his academic or social circles.

Unfortunately, it is difficult to know exactly what Fuller was reading during the late 1950s. His archive includes some notes about which books Fuller had on his

¹⁵ Teilhard de Chardin’s theory of a noosphere was shared with French philosopher Edouard Le Roy (1870-1954) as well as Vladimir Vernadsky as discussed in the above note. Although it is generally accepted that the term was coined in the early 1920s, it has not been determined which of these three thinkers were responsible for its coinage; one source attributes it to all three of them. See “History and Theory of the Noosphere,” *Foundation for the Law of Time*, <http://www.lawoftime.org/noosphere/theoryandhistory.html>.

¹⁶ Pierre Teilhard de Chardin, *The Phenomenon of Man* (Harper Perennial, 2008), 36. First published 1955.

¹⁷ Linda Sargent Wood, *A More Perfect Union: Holistic Worldviews and the Transformation of American Culture after World War II* (Oxford: Oxford Univ. Press, 2010), 113.

personal bookshelf, but Teilhard's is not listed not among them.¹⁸ This makes it difficult to confirm, one way or another, how familiar Fuller was with Teilhard's work. In either case, it is important to note that ideas about universal evolution¹⁹—similar if not identical to Fuller's—were percolating in the intellectual community, and that Fuller's work converged significantly with Teilhard's whether or not he had read *The Phenomenon of Man*.²⁰

As demonstrated, Fuller's familiarity with Teilhard's work is ambiguous. What is clear is that many of Fuller's ideas about evolution predated the publication of *The Phenomenon of Man* in 1955.²¹ For example, the notion that man "consciously participates" in his own evolution (as quoted above) dates from a 1949 speech at Black Mountain College. This is the notion of conscious participation in evolution that was a feature of both Teilhard's and Fuller's thinking. Fuller goes on to argue that it is mankind's responsibility to seek out the universal principles (laws of nature) operative in nature, and to apply them to realizing "comprehensive

¹⁸ I have come across two lists of Fuller's personal books in the Fuller Archive at Stanford University, one list from the 1950s and one from the 1970s. These lists focused on books about mathematics, geometry, and some cosmology and philosophy books. Neither included *The Phenomenon of Man*, nor any other books by Teilhard de Chardin.

¹⁹ It should be obvious by this point that these universal evolution combined the notion of biological evolution with that of human intellectual 'evolution' as well as the development of civilization and technology under one umbrella.

²⁰ It is interesting too to note that Fuller and Teilhard were more or less of the same generation (Fuller born 1895, Teilhard born 1881), and both were born into Christian intellectual families. Both were deeply interested in the sciences, as well as being lifelong believers. Perhaps the idea of 'universal evolution' had a particular appeal to both Fuller and Teilhard because it addressed both scientific (biological) and spiritual-intellectual evolution simultaneously. Speculation, but perhaps worthy of further consideration.

²¹ According to H. James Birx, Teilhard wrote his manuscript for *The Phenomenon of Man* between 1938 and 1940, but it was not published until after his death in 1955 because it conflicted with the teachings of the Catholic church. The first English edition of this book was published in 1959. Linda Sargent Wood writes that Teilhard circulated manuscripts surreptitiously prior to 1955, but they did not reach a wide audience. See H. James Birx, "The Phenomenon of Pierre Teilhard de Chardin," http://www.theharbinger.org/articles/re1_sci/birx.html. See also Wood, *A More Perfect Union*, 112.

advantage for his species, as a function of the universe."²² Fuller also discusses evolution in an article entitled "I Figure," written in 1942 and published in *Pencil Points Magazine*, in particular talking about mankind's cerebral advantage and the need to apply that advantage to developing new technologies.²³

Because Fuller expressed ideas about universal evolution a decade before the publication of Teilhard's *The Phenomenon of Man*, it seems likely that Fuller developed these ideas on his own. After the publication of Teilhard's book in English translation, Fuller probably realized the convergence between his ideas and Teilhard's and may have subsequently adopted the term *universal evolution* from Teilhard. This seems reasonable, since the term first appears in Fuller's work in the early 1960s after the 1959 release of Teilhard's book in English. In other words, it is proposed here that Fuller came up with his ideas of evolution independently, but that later—after encountering Teilhard's work around 1960—he incorporated some of Teilhard's terms and thinking into his theory of evolution. This is a conjecture, but a plausible one based upon subtle changes in Fuller's discussions of evolution before and after 1960, as well as the appearance of the term *universal evolution* in his writing after 1960.

Evolution of Technology

Fuller's and Teilhard's ideas about universal evolution were largely congruent, as discussed above. However, their views of the present stage of evolution differed in one important respect: where Teilhard mostly focused on spiritual development

²² R. Buckminster Fuller, *Ideas and Integrities* (New York: MacMillan, 1963), 227.

²³ The article "I Figure" is reproduced in Fuller's *Ideas and Integrities*, Chapter 5.

toward the attainment of the Omega Point, Fuller stressed the importance of *technology* as an outcome of the development of the human consciousness and intellect. In *Total Thinking* (1949), Fuller talks about mankind's ability to leverage technology to "realize comprehensive advantage of his species" and to become an "anticipatory designer of his own evolutionary mutations."²⁴ Mankind's intellect, his consciousness, and the application of knowledge toward the solution of problems was humanity's unique lever, allowing humans to not only survive but to consciously participate in evolution.

The incorporation of technology into the discussion was critical because it allowed Fuller to 'naturalize' technology. Fuller's concept of universal evolution saw technology as simply a consequence of human intellectual evolution. There was no dividing line between the 'natural' and the 'manmade': technology was the inevitable outcome of the 'natural' human intellectual ability to investigate the laws of nature and to manipulate naturally-occurring materials. In *Ideas and Integrities* (1963), Fuller wrote:

Even today...we speak erroneously of 'artificial' materials, 'synthetics,' and so forth. The basis of this terminology is the notion that Nature has made everything which we call natural, and everything else is 'man-made,' ergo artificial. But what one learns in chemistry is that Nature wrote all the rules of structuring; man does not invent chemical structuring rules; he only discovers the rules. All the chemist can do is to find out what Nature permits, and any substances that are

²⁴ Fuller, "Total Thinking," in *Ideas and Integrities*, 226-7.

*thus developed or discovered are inherently natural. It is very important to remember that.*²⁵

Fuller applied the same logic to technology as a whole. Scientific development and technological progress were testament to mankind's intellectual capacity. Man's evolutionary calling was to develop the mind and the technologies that resulted from it, and in so doing to make greatest use of this capacity. "We were given our faculties to permit and induce our progressively greater apprehension and comprehension of the universal phenomena,"²⁶ wrote Fuller. By faculties, Fuller was referring to mankind's most precious gift in the evolutionary rat-race: the mind.

The Importance of the Mind

*Mind, by which we mean both the moral and intellectual powers, is God's first end. The great purpose for which an order of nature is fixed is plainly a formation of Mind.*²⁷

The cultivation of the mind had been of paramount importance to the Transcendentalists, who felt that the well-tuned mind could perceive spiritual truths. "The idea was that consciousness itself is a reliable source of spiritual insight, that in man's mind, by virtue of its native, inherent capacities, the fundamental truths of religion can be found. Man possesses a faculty or a power—following Coleridge, they usually called it Reason—which can give him immediate access to

²⁵ Fuller, "The Comprehensive Man," in *Ideas and Integrities*, 75-76.

²⁶ R. Buckminster Fuller, *No More Secondhand God and Other Writings* (Carbondale, IL: Southern Illinois University, 1963), v.

²⁷ William Ellery Channing in Hochfield, *Selected Writings*, 48.

super-sensual knowledge."²⁸ This extended the boundaries of Reason beyond just what could be empirically observed, to what could be understood to be an *a priori* spiritual truth. "The intellectual eye of man is formed to see the light, not to make it, and it is time that, when the causes that cloud the spiritual world are removed, man should rejoice in the truth itself and that *he* has found it,"²⁹ said Sampson Reed.

The mind and consciousness were equally important to Pierre Teilhard de Chardin, who felt that the human mental capacity for reflection unequivocally set *Homo sapiens* apart from all the rest of the species. In *The Phenomenon of Man*, he suggests that "intelligence is the evolutionary lot proper to man and to man only,"³⁰ and that human evolution is engaged in a process of "cerebral perfecting"³¹ that will eventually lead to spiritual transcendence. Consciousness and reflection "raise [mankind] into a new sphere. In reality, another world is born. Abstraction, logic, reasoned choice and inventions, mathematics, art, calculation of space and time, anxieties and dreams of love—all these activities of inner life are nothing else than the effervescence of the newly-formed centre as it explodes onto itself."³²

Like both the Transcendentalists and Pierre Teilhard de Chardin, Fuller placed great importance on the cultivation of the mind. Like the Transcendentalists, Fuller saw the mind as the means to a higher understanding of a universe architected by a higher power. And like Teilhard, Fuller felt that "naked man had only one

²⁸ Hochfield, *Selected Writings*, xv.

²⁹ Sampson Reed, "On Genius," in Hochfield, *Selected Writings*, 68.

³⁰ Pierre Teilhard de Chardin, *The Phenomenon of Man*, 165.

³¹ Teilhard, *The Phenomenon of Man*, 170

³² Teilhard, *The Phenomemon of Man*, 165.

advantage over environment...this was his cerebral advantage,"³³ and saw mankind in an evolutionary stage of "cerebral perfecting." Cultivation of the mind was important to Fuller for both practical and metaphysical reasons. On the practical side, the mind would allow for the development of new technologies that would ensure that the species continued survive and thrive. "If man is to continue as a successful...function in universal evolution, it will be because...[of his] seizure of prime design responsibility and his successful conversion of the total capability of tool-augmented man from killingry to advanced livingry."³⁴ On the metaphysical side, the mind was the source of "that most precious of all characteristics of living man, the power of the selectively precomposing creative imagination, which, as Morley phrases it, is 'The Holiest Ghost we shall ever know.'"³⁵

The Sounds of Science

Fuller's model of nature used the notion of universal evolution to suggest a seamless coevolution of biology, humanity, and technology. It is telling that Fuller chose the word *evolution* instead of (for example) *development* or *advancement* as the basis of this phrase. *Evolution* connoted a biological process unfolding over time, something as natural and inevitable as the changing of the seasons. Universal evolution, as Fuller described it, brought technology under the umbrella of nature, effectively "naturalizing" technology and precluding any notions that it was outside of the natural order of things.

³³ Fuller, "I Figure" (1942), in *Ideas and Integritys*, 89.

³⁴ Fuller, "Prime Design," in *Ideas and Integritys*, 249.

³⁵ Fuller, "I Figure" (1942), in *Ideas and Integritys*, 89.

Fuller even went so far in his biological analogy as to suggest that technology be considered an extra-corporeal part of industrial man: "Industrialization [is] identifiable as an extra-corporeal universal chromosome common to all men's post-natal evolutionary transforming beyond the patterning corporeally induced by the integral genes and chromosomes."³⁶ (Translation: Industrial technology is the outward expression of the human genetic code.)

Using the idea of evolution to frame his ideas about human and technological development also achieved another goal for Fuller: it lent an air of scientific credibility to what was essentially a metaphysical proposition on his part. In short, Fuller piggybacked his ideas onto existing science in hopes that they might be similarly respected. The theory of evolution by natural selection was already firmly established in the scientific community, and brought to mind the work of such grandees as Charles Darwin and Gregor Mendel. Using the language of established science to describe Fuller's ideas lent a scientific air to what was, in actuality, an untested set of personal beliefs about how humans and technology were connected. In fact, universal evolution is not now—nor was it in Fuller's time—an accepted idea within the scientific community. Although Teilhard de Chardin's *The Phenomenon of Man* was a popular read in its day, it was considered a work of theology, not of anthropology. This tactic of wrapping his personal philosophies in the language of science was a fairly common one on Fuller's part.³⁷ He wanted to

³⁶ Fuller, *Ideas and Integrities*, 283.

³⁷ Another example of this is Fuller's two volumes of *Synergetics* published in the 1970s. He numbered these volumes according to scientific convention and presented them as establishing a new mathematical coordinate system. *Synergetics* was never taken seriously by the scientific or mathematical community, and is today considered a work of philosophy. Biographer Lloyd Steven Sieden, notes that Fuller "was a master at presenting a specific, purposeful persona to the public."

be taken seriously as a thinker; he wanted his ideas to feel like substantial scientific theories rather than wispy metaphysical notions. He used the language of science to give weight to his worldview, in which everything was connected, coevolving, unified, and harmonious. While pleasingly holistic as an idea, universal evolution—untested as it is—remains a metaphysical proposition rather than a matter of scientific fact.

This was no different in the presentation of his work. See Lloyd Steven Sieden, "The Buckminster Fuller Disciplines," *Buckminster Fuller's Synergy Solutions for Today*, <http://www.buckyfullernow.com/1/post/2011/10/the-buckminster-fullers-disciplines-why-he-quit-smoking-and-drinking-cold-turkey-in-1942-and-kept-his-commitment-for-43-years.html>.

Chapter 3

The Life of the 4D House

*Standing by the lake on a jump-or-think basis, the very first spontaneous question coming to mind was, "if you put aside everything you were asked to believe and have recourse only to your own experiences do you have any conviction arising from those experiences which either discards or must assume an a priori greater intellect than the intellect of man?"...I said to myself, "I have faith in the integrity of the anticipatory intellectual wisdom which we may call 'God.'"*¹

In 1927, according to his own accounts, R. Buckminster Fuller experienced an epiphany on the shores of Lake Michigan and resolved to devote the rest of his life to seeing what one individual could do to improve humanity. The above quotation, in which Fuller describes his Lake Michigan experience, ties together the ideas of individual experience, human intellect, and the Greater Intellect (God) that were so central to his worldview, as discussed in the previous chapters. Fuller's self-imposed charge as a comprehensive anticipatory design scientist² was to investigate the natural laws, structures, and phenomena that God has created—which are themselves evidence of God's anticipatory and all-encompassing wisdom—and to apply his findings to the design of new technologies for the benefit of mankind. In other words, Fuller intended to change the world by observing nature for possible models and inspirations, and using his intellect to

¹ Fuller, *Ideas and Integrities*, 45.

² Fuller did not coin the term "comprehensive anticipatory design scientist" in 1927. In fact, the exact year that Fuller coined this term in reference to his own activities is not known, although he probably began using it in the 1940s considering that he proposed a course in Comprehensive Anticipatory Design Science in the 1950s. See *Buckminster Fuller Institute Website*, <http://www.bfi.org/design-science/primer/eight-strategies-comprehensive-anticipatory-design-science>.

devise human centered technologies.³ It should be emphasized that this strategy related to Fuller's model of nature and universal evolution, in which nature, humanity, and technology were coevolving. In this chapter, against the backdrop above, I will discuss the design and thinking behind the 4D house, a technologically-enabled, autonomous dwelling that promised physical and spiritual comfort to the modern family.

Whether or not Fuller experienced an epiphany on the shores of Lake Michigan in 1927 (see Chapter 1), that year undoubtedly marked a creative turning point. Over the next two years, he went on to develop the core concepts of the 4D (later, Dymaxion) house⁴ and car, illustrating his visions of the future with dozens of sketches. Along with the sketches, he wrote and revised a manuscript called *4D Timelock* that he self-published and distributed to several dozen architects and acquaintances in 1928, among them Vincent Astor, Bertrand Russell, and Henry Ford.⁵ The manuscript illuminates Fuller's philosophies and preoccupations during this period and will be discussed throughout this chapter.

³ Sieden writes that "During his 1927 self-evaluation...he [Fuller] sought an operating strategy ...compatible with his innate talents and his observation of Nature's patterns." See Sieden, 96.

⁴ The original name of the 4D houses was "lightful houses." As discussed below, the designs for the Lightful and 4D houses are so closely related that we will consider them, for the purposes of this chapter, to be the same.

⁵ See Elizabeth Kolbert, "Dymaxion Man," *The New Yorker*, 9 June 2008, http://www.newyorker.com/reporting/2008/06/09/080609fa_fact_kolbert.

Faith in Time

"Judge live [sic] and industrial progress by their measure of these tokens; GOOD FAITH and TIME OR WEIGHT SAVING."⁶

Fuller was particularly obsessed by time when formulating his 4D concepts, as the name *4D Timelock* strongly suggests. Time was the mysterious and abstract fourth dimension of experience, and saving precious time for more self-fulfilling pursuits was the "true measure of an industrial society."⁷ Fuller was particularly impressed by concurrent theories of relativity, in which space and time are continuous, and the three-dimensional world is inextricably woven together across the warp of time; his fascination with relativity may explain in part his obsession. "No matter can exist without time, else it would not exist; and that [sic] the time dimension is the most important dimension of all matter; and all our industry is but a time saving institution,"⁸ wrote Fuller (emphases original).

Fuller was also impressed by the efficiencies in manufacture, embodied by Fordism and Taylorism. The application of mass production to industry had saved a great deal of time and eliminated a great deal of waste in the manufacture of automobiles, appliances, home furnishings, and so on. Consumer goods were becoming increasingly available and affordable, with one exception: the home. Why, Fuller wondered, were the efficiencies of industry not yet being applied to

⁶ R. Buckminster Fuller, *4D Timelock Manuscript* [1928], 3. Stanford University Libraries, Collection M1090 Series 8.

⁷ Although ostensibly a treatise about reforming the building trade, Barry Katz has called the 4D manuscript (1928) "a spiritual meditation on time, the supramaterial fourth dimension of experience and the true measure of industrial society." See Barry Katz, "1927, Bucky's Annus Mirabilis," in Chu, ed., *New Views on R. Buckminster Fuller* (Stanford, CA: Stanford Univ. Press, 2009), 29.

⁸ Fuller, *4D Timelock Manuscript*, 36.

the manufacture of homes?⁹ "The home being the greatest necessity of mankind, it is the most important product yet to be designed for industrial fabrication and distribution to individuals,"¹⁰ he wrote.

Fuller was hardly alone in thinking that mass production and prefabrication could lead to more affordable housing. The late 1920s saw the emergence of several progressive modernism municipal housing schemes in Europe along these lines. For example, the Deutscher Werkbund exhibition of 1927 sponsored the development of the Weisenhoff estate, a collection of modernist houses and apartment buildings, designed by European architects as models for affordable homes for industrial workers. Ernst May's *Siedlung Romerstadt* (1927-1929) in Frankfurt was a housing complex built for the working class as part of the New Frankfurt building initiative. Both of these projects used standardized, industrially produced parts to keep the cost of construction low. What distinguishes Fuller's 4D house from these municipal housing projects is the focus on the independent family, or, if you like, the complete lack of a socialist agenda. The 4D house did not rely on shared spaces, public lands, or cooperation of any sort between inhabitants for its success. The house was self-sufficient, with its own plumbing, energy hookups, bathrooms and ventilation. A second unusual feature of the 4D house was its mobility. It could be broken down and airlifted to a new location at will,

⁹ Fuller was not unique in this approach. In 1927, sixty dwellings designed by seventeen European architects were unveiled as part of the Deutscher Werkbund exhibition. The settlement came to be known as the Weisenhoff Estate. Many of the homes used industrial materials and prefabricated parts, to lower the cost of building so that they could eventually be built as worker's homes. In addition, companies such as Sears Roebuck Inc. were selling kit homes in the United States as early as 1906 at the affordable cost of about \$2500. For more on this, see Tiffany Connors, "How Prefab Houses Work," *HowStuffWorks.com*, 27 September 2007, <http://home.howstuffworks.com/prefab-house.htm>.

¹⁰ Fuller, *4D Timelock Manuscript*, 43.

even to remote “attractive and usually inaccessible points.”¹¹ The 4D house was meant to ensure the well-being and independence of the family unit, wherever they might settle, as opposed to the preserving the stability of the community. The mobility and independence of the house implicitly reflect the pioneer spirit, the lure of the open road, and the individualism characteristic of American culture.¹²

The 4D home would not only protect the family, but also allow individuals to flourish. The time saved on menial tasks, as well as in the fabrication and maintenance of the house itself, would afford more time for mental and physical self-improvement. “Creation will set in as never before... Time will be given to travel, research artistic creation and contemplation, and athletics as never before, not one of which is a time wasteful pursuit in itself.”¹³

But saving time was more than just convenience, or a question of economic sense for Fuller. In fact, he elevated it to a moral necessity of the twentieth century. Contemporary technologies in Fuller’s mind would eliminate much of the menial drudgery of the past; the modern future would allow ample time for self-improvement and reflection. Time-efficient homes, in effect, would facilitate moral progress and spiritual freedom. “Progress is merely transition from bestial, menial control where all is time to the mental, spiritual control where there is no time, through recognition of truth and harmonious application of it, ever approaching

¹¹ Fuller, *4D Timelock Manuscript*, 49.

¹² For more on this, see Joachim Krausse, “‘Spirit-House’ and ‘Steppenwolf’ Avant-Garde: American Origins in the Dymaxion House Concept,” in Chu, ed., *New Views on R. Buckminster Fuller* (Stanford, CA: Stanford Univ. Press, 2009), 76-85.

¹³ Fuller, *4D Timelock Manuscript*, 49.

the time when all temporal matter is completely controlled by the mind.”¹⁴

Relating this to the ideas of universal evolution discussed in Chapter 2, the 4D house would allow people to spend more time in what Pierre Teilhard de Chardin called the *noogenetic* phase of evolution, the phase concerning the development and perfecting of consciousness.

In design terms, Fuller automatically equated time-saving homes with material savings: “As time is saved by progress, and time is everything, all material products of industry must necessarily become lighter and lighter.”¹⁵ As a result, time and weight savings were two sides of the same coin, and were of primary importance in his 4D housing designs.

4D Sketches: Inspirations

In *Figure 1*, we see an early sketch in the 4D housing project. The odd-looking, fountain-like drawing relates earth, fire, sky (air), and time to different colors (yellow, red, blue, and grey). It is perhaps because of his concurrent obsession with time that Fuller substituted it for the fourth classical element of “water.” For Fuller, just as in classical thought, the elements represented the essences of the universe, the fundamental states of matter. The secondary colors—green, orange, and purple—are indicated at the center of the sketch. At the top left, white is related to the emotions of love and to God. Black is related to the words “selfish”, “unenlight”[sic], and “beast.” The exploding composition of the sketch symbolizes the rush of ideas and emotions that Fuller was experiencing at this time. Here,

¹⁴ Fuller, *4D Timelock Manuscript*, 25.

¹⁵ Fuller, *4D Timelock Manuscript*, 37.

Fuller seems to be connecting God with the creation of the universe (the beginning of the elements and time) as well as with morality. This dovetails with his overall comprehensive view of nature, in which science, religion, and humanity are intertwined.

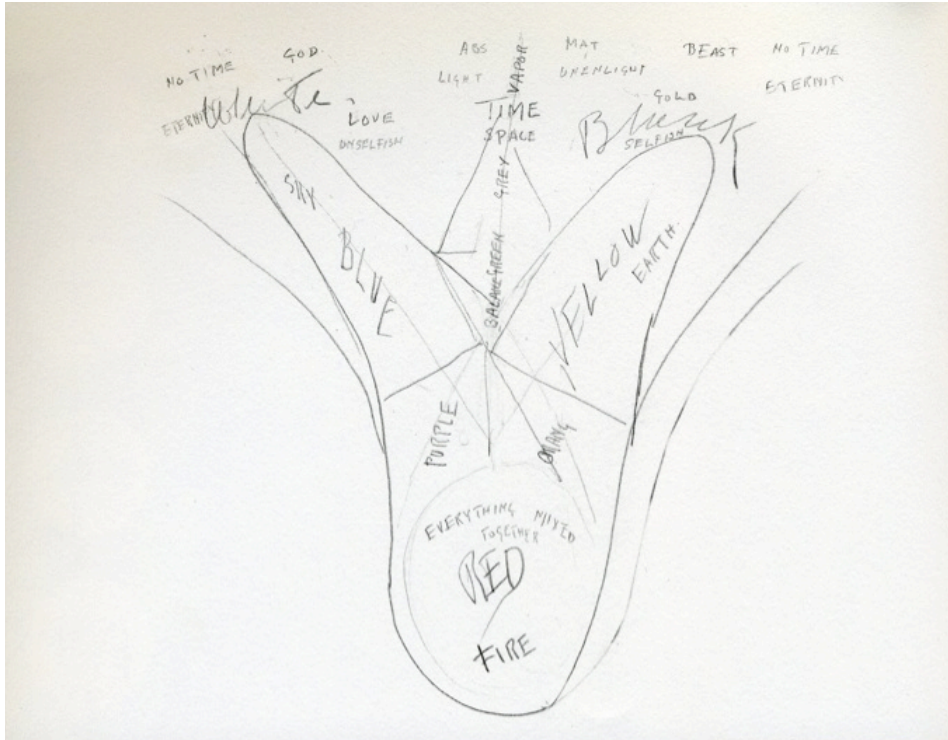


Figure 1: R. Buckminster Fuller sketch, early 1928 (Photo: H. Chu. Image Courtesy of Department of Special Collections, Stanford University Libraries)

In addition to hinting at Fuller’s model of nature, this sketch also says a great deal about Fuller’s state of mind in late 1927-early 1928 when in his early 30s. The period from 1922-1927 was a turbulent one for Fuller. He lost his first daughter, Alexandra, to spinal meningitis in 1922. Following her death, he fought often with his wife, Anne, usually over minor things. Over the next few years, Fuller drank a lot and “spent a great deal of his time in brothels.” “I’m sure that I went to over a thousand of them,”¹⁶ Fuller would later recount. He also failed as a businessman for Stockade Building Systems, a company founded by his father-in-law, James

¹⁶ Lloyd Steven Sieden, *Buckminster Fuller’s Universe: His Life and Work* (New York: Perseus Books, 1989), 83-84.

Monroe Hewlett.¹⁷ By 1927, Fuller was jobless, broke, and despondent. He had failed as a husband and a father, both morally and financially. His indulgences for alcohol and women were part of what Fuller saw as his “bestly and selfish” nature, driven by base passions and desires. This pathway ultimately led him to depression and, by his accounts, to near-suicide. By late 1927, Fuller had reached a breaking point, as so often recounted in his Lake Michigan story.

This early 1928 drawing allowed Fuller to reevaluate the nature of the universe and, by extension, his place in it. In Fuller’s view of nature, good and evil are in a cosmic balance, with God presiding over the good. He does not identify a force of evil (such as the devil) *per se*, although we might personify evil as the “beast.” This sketch is a starting point for Fuller to redirect his life in the direction of light, love, and God. That program of rebirth saw its creative expression in the design of a single family dwelling that would be “enlightened” in its design.

Part of this enlightenment, where the house was concerned, would be the alignment of technology with human needs so characteristic of Fuller’s work. In other sketches of the same period, Fuller begins to create a balance between the elements of nature, the demands of society, 20th century-technology, and emotional and spiritual needs. This reflected Fuller’s notion of universal evolution, in which nature, humanity, and technology are evolving together.

¹⁷ The Stockade Company sold lightweight, perforated bricks made of compressed excelsior (wood shavings) that could be reinforced with concrete and used to build walls and fences. Although the system worked fine, it suffered in part because the novel bricks did not conform to the building codes and standards of the time. See Sieden, *Buckminster Fuller’s Universe*, 83-84.

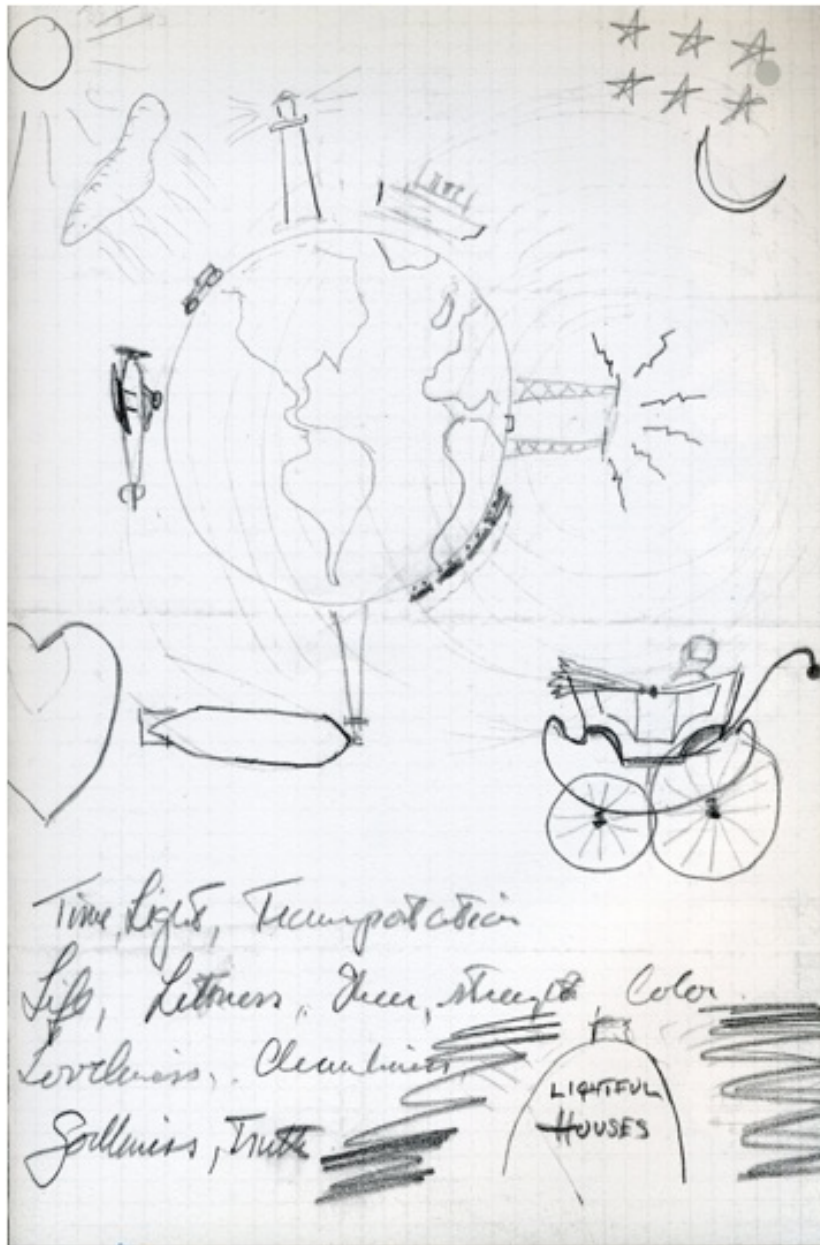


Figure 2: R. Buckminster Fuller Sketch, Early 1928 (Image Courtesy of Department of Special Collections, Stanford University Libraries)

Figure 2 depicts the Earth, bathed by the radiant energy of the sun, moon, and stars, and nourished by rain. The technologies of transportation (train, blimp, car, boat) that allow people to traverse the globe are also pictured. Looking up at the globe is a child in a perambulator, ostensibly depicting Fuller's own daughter Allegra, born in 1927. The words "Time, Light, Transportation, Liteness[?], [unreadable], Strength, Color, Loveliness, Cleanliness, Godliness, Truth," are written

across the bottom of the sketch. This echoes the fountain drawing (Figure 1) in bringing together the natural world, the elements, God, and morality—this time with the positive addition of human technologies. Fuller’s addition to technology is a small sketch of the “lightful houses,” which became the basis for his 4D house and tower designs. The lightful houses would be light in many senses of the word. They would be lightweight, utilizing contemporary industrial materials hung from a central mast; light-filled, meaning bright and airy on the inside. Furthermore, the houses would radiate a spiritual light of truth and beauty, born of the honesty and earnestness of the design. The lightful house became the centerpiece of Fuller’s 4D housing plan, which was more fully described in the *4D Timelock* manuscript. The lightful and 4D house designs were so closely related that we will consider them, for the purposes of this chapter, to be one.¹⁸

A key aspect of this sketch is the complementary relationship between nature and technology. From the global perspective, earth is bound by the natural cycles of the sun, moon, stars, clouds, rain and waves—the cycles that have eternally ruled the planet. Locally are the technological adaptations that inventive human beings have constructed over time to navigate the natural world: the ships, cars, airplanes, electric towers, trains, and blimps that respond to, and work within, the natural environment. The new frontier for technology and mass production, Fuller argues, is the dwelling, which has not evolved nearly as fast as these other technologies,

¹⁸ Joachim Krausse puts the development of the Lightful Houses between January and March of 1928. The 4D housing manuscript was developed over the next few months from his original texts for Lightful Houses. The 4D house was further developed and was renamed the Dymaxion house in 1929. See Chu, ed., *New Views*, 62.

and in fact remains hopelessly stuck in the past. The lightful (4D) houses are Fuller's venture into this territory.

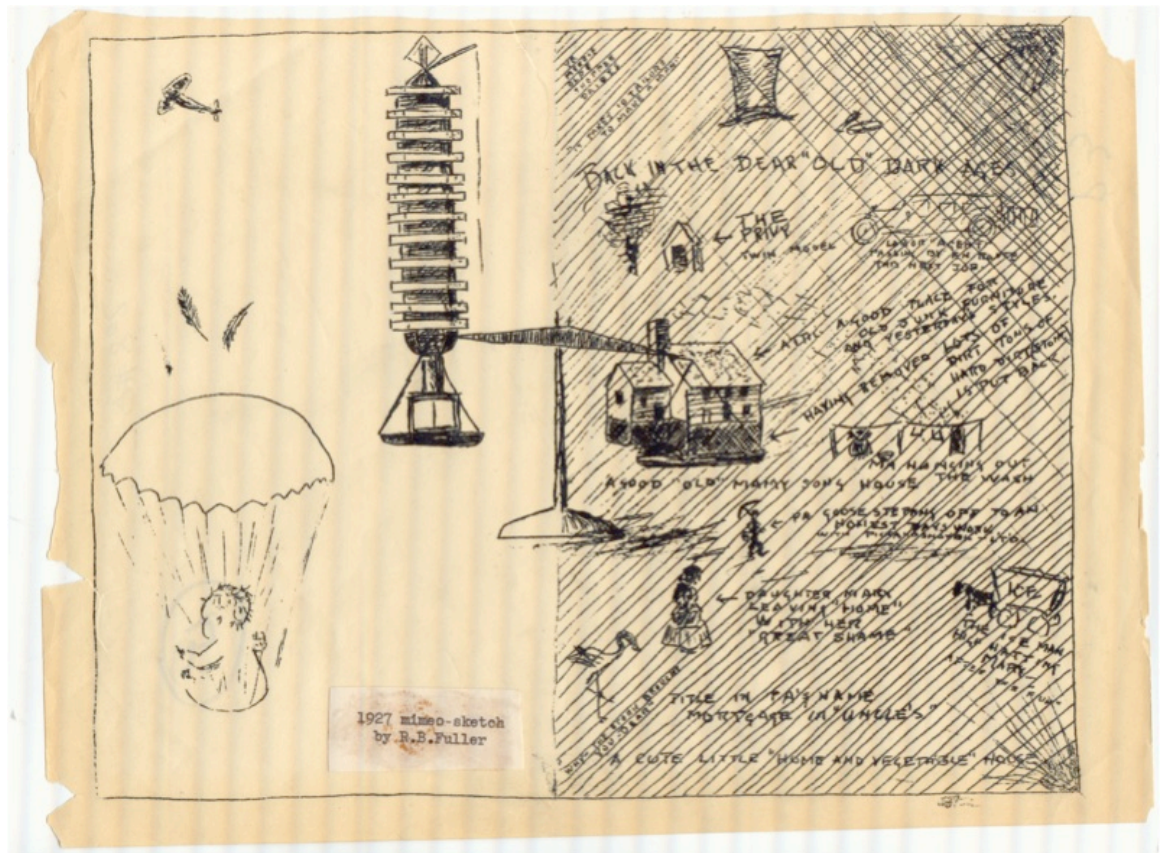


Figure 3: R. Buckminster Fuller mimeo-sketch, 1928 (predated by a later added inscription). (Image Courtesy of Department of Special Collections, Stanford University Libraries)

Figure 3 contrasts the lightful tower dwellings that Fuller envisioned with the houses of the “dear ‘old’ dark ages.” Fuller did not have even a drop of nostalgia for the heavy architecture, the privy, the antiquated ice wagon, hanging the laundry, or the “daughter Mary leaving ‘home’ with her ‘great shame.’” He had grown up in a rambling Victorian house and, after the death of his father in 1910, had been forced to share in the arduous housework. In his mind, there was no reason for living in such heavy, dark, inconvenient, inefficient, and outdated environments. It was simply a question of bringing the housing industry into the twentieth century, using lightweight industrial materials and mass production techniques. Again in

this sketch, we see a young baby, either depicting or inspired by Allegra, heralding a new era of modern housing, in which lightweight homes would be as nimble and technologically-advanced as the airplane.

In spite of what Fuller's sketches suggest, the homebuilding industry was not completely immune to industrial progress; homes built in the U.S. during the 1920s used new construction methods, mass produced materials, and had built-in plumbing and electricity. Such measures reduced the cost of the construction and made for more hygienic interiors.¹⁹ But unlike Fuller, the industry was not particularly concerned with minimizing the weight of the house or the time required to maintain it, and the new homes remained traditional in style.

A Machine for Living or a Living Machine?

Fuller's conviction that housing construction should move into the twentieth century recalls that of his contemporary, Le Corbusier, and other International Style architects such as Walter Gropius and Mies van der Rohe. There is evidence that Fuller was reading Le Corbusier around the time he made these sketches. His diary entry from January 30, 1928 reads "Called on Russell Walcott and borrowed Le Corbusier's 'Towards the New Architecture' [...] RBF read Le Corbusier until very late at night. Startled at coincidence of results arrived at in comparison to Fuller Houses but misses main philosophy of home as against house."²⁰ In an August, 1928 letter to his sister, Rosamund, Fuller called Le Corbusier:

¹⁹ See "1920s Residential Housing and Commercial Buildings," *1920s-30s.com*, <http://www.1920-30.com/architecture/>.

²⁰ R. Buckminster Fuller (1928), quoted in Loretta Lorange, "Buckminster Fuller – Dialogue with Modernism," *PART Journal of CUNY PhD Program in Art History*,

the great revolutionist in architectural design whose book should be read in conjunction with my 4D. My own reading of Corbusier's "Towards a New Architecture", at the time when I was writing my own, nearly stunned me by the almost identical phraseology of his telegraphic style of notion with the notations of my own set down completely from my own intuitive searching and reasoning and unaware even of the existence of such a man as Corbusier. Corusier [sic] was first called to my attention by Russell Walcott, the best of residential designers in Chicago, when I was explaining my principles to him last November.²¹

Both Fuller and Le Corbusier supported the industrialization of housing, and looked down upon the stylistic affectations of the past. Likewise, both were fascinated by industrial architecture and sought to bring the same material and structural efficiencies to the design of single-family dwellings. Corbusier's Maison Citröhan (1922) was a model for an affordable house made of industrial materials that might, Corbusier hoped, eventually be mass-produced, much like a car. Hence, the name was a clever play on the French automobile brand, Citroën.

In his 1923 book, *Vers une architecture* (translated to English in 1927), Le Corbusier declared that a "house is a machine for living in" (*une machine à habiter*). Its purpose was to sustain the lifestyles of its inhabitants efficiently, healthfully and reliably—effectively, to work *like* a machine. By contrast, in Fuller's 4D house proposal, Katz suggests that the house really *was* a machine; a self-contained, portable, self-sustaining unit that would practically run itself.²² Indeed, the 4D

<http://web.gc.cuny.edu/dept/arthi/part/part7/articles/loranc.html>. Note that the second part of the quote may have been written by Fuller's wife, Anne Hewlett Fuller.

²¹ Fuller, quoted in Lorance, "Dialogue."

²² Katz, *New Views*, 29. Keep in mind that the 4D house was never actually built, so most of these time-saving devices existed only according to Fuller's drawings and descriptions. Fuller did have the

house has a plethora of mechanical features. The engine of the house, so to speak, was the central mast that contained power and plumbing hookups that were designed to accept standard appliances. A compressed air and vacuum system, also built into the central column, would take care of all the vacuuming and dusting.²³ Radiating outward from the center would be the living room, bedrooms, and bathrooms fitted with water-saving fog gun showers. The roof could be raised and lowered to allow for passive cooling and circulation. The mass produced parts comprising the house could be broken down to fit into a tubular pod weighing about 3 tons (2.7 metric tons) that could be transported to any construction site. With projected efficiencies of manufacture, this machine-house would also be affordable; it was estimated to cost \$1500,²⁴ about twice the price of a well-equipped Chevrolet sedan in 1928.²⁵

What is striking about this house is not only how it functions like a machine, but also how much it resembles an organism. Although the means of operation are mechanical, the 4D house, as an architectural proposition, can also be seen as a self-contained body that breathes, generates its own energy, recycles its waste, and regulates its temperature. It is independent, self-supporting, mobile, and regenerative. Seen in these terms, Fuller's ability to blend technology and nature becomes more obvious. Conceived of as a self-reliant body, the 4D house

opportunity to work on prefabricated, stamped metal bathrooms when he worked for the Phelps Dodge company during the mid-1930s. These types of prefabricated bathrooms were later used in the "Wichita" house design, 1944-46.

²³ Although somewhat ineffective, the idea of a centralized vacuum cleaning mechanism was originally a 19th century idea with a number of echoes in the early 20th century. With thanks to Prof. Jonathan Woodham, Univ. of Brighton for the observation.

²⁴ Paul Taylor, "4D House", 2001, <http://www.nous.org.uk/4D.html/>.

²⁵ The online site *Nadaguides* puts the retail cost of a 1928 Chevrolet AB National 5-passenger car at \$675. A Model A Ford in the same year would have cost \$625. See *Nada Guides*, <http://www.nadaguides.com/>.

performs the bodily functions (respiration, energy metabolism, excretion) using mechanical means. Its organs are reproduced on the assembly line, but are no less vital to the operation of the whole. Where Le Corbusier's *Maison Citrohan* is a heroic statement on an architecture for the machine age, Fuller's 4D house is an mechano-organic pod for living in, self-reliant in its mechanical functions. With its blank white façade, horizontal perforations, and skinny piloti supports Le Corbusier's *Maison* is an aesthetic assault on the conservative architectural establishment. Fuller's house is aesthetically naïve; a hexagon with a pointed metal cap, tethered down by wire cables. Its visual appeal, if any, lies in its geometric simplicity. Conversely, one might consider "many aspects of Le Corbusier's and other Modernist architects of the interwar years to be technologically naïve,"²⁶ lacking a similarly integrated 'arterial' model of the plumbing and mechanical infrastructure.

Organic models

The conception of the 4D house as an organism may have had several sources²⁷, but one inspiration is found in a rough sketch, filed with other 4D drawings and notes, resembling a tree (Figure 4.) This sketch seems to predate the design of the 4D house and manuscript, but this inchoate scribble is central to understanding the later design. The heart of the tree is its solid trunk, rooted into the ground,

²⁶ This was pointed out to me by Jonathan Woodham in an electronic comment sent August 2014, from which the quotation here taken. It's an interesting point that could probably be developed further in a separate enquiry specifically aimed at comparing and contrasting Fuller's and Corbusier's approaches.

²⁷ The 4D house was not the first Fuller design to be inspired by nature. As a boy vacationing on Bear Island, Fuller had designed a mechanical sprit resembling an inside-out umbrella to propel his rowboat. It was modeled after the pulsing motion he observed in jellyfish. See Sieden, *Buckminster Fuller's Universe*, 9-10.

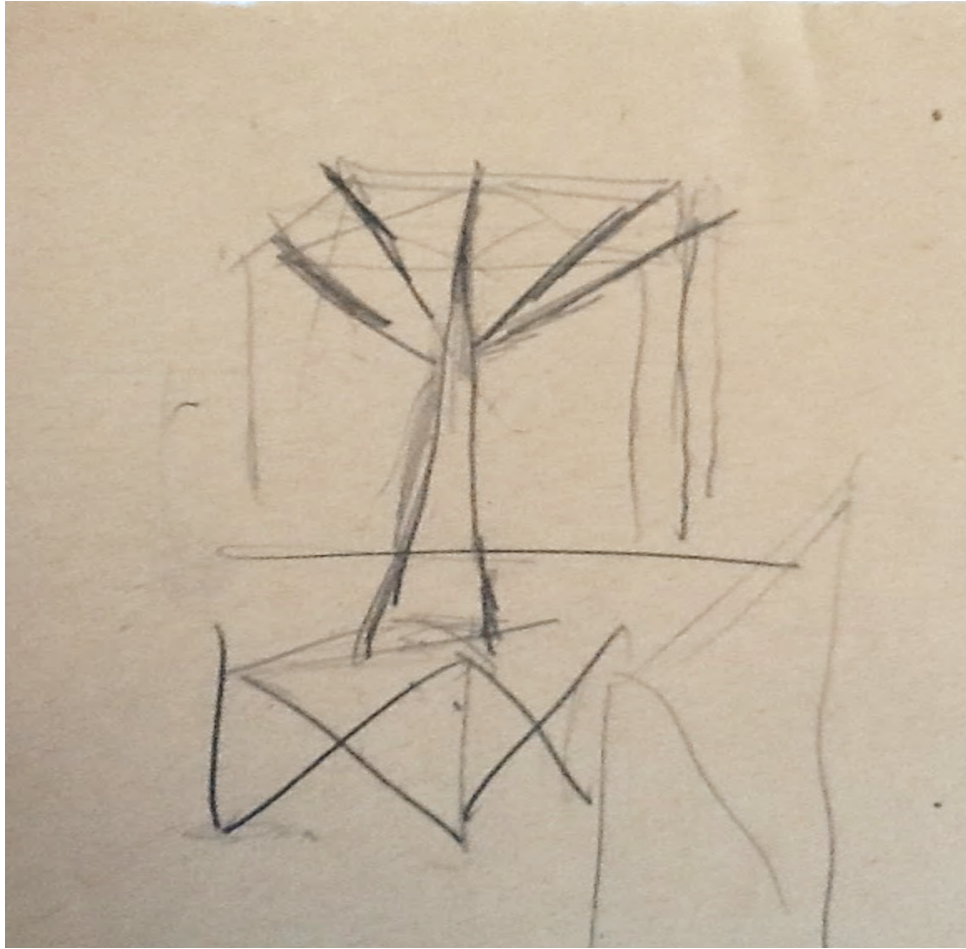


Figure 4: Tree Sketch, Early 1928 (Photo: H. Chu. Image Courtesy of Department of Special Collections, Stanford University Libraries)

which supports the branches and leaves, and transports water and nutrients from the roots to the leaves and back again.

The tree trunk becomes analogous to the central mast of the 4D house, which supports its weight and supplies energy, plumbing, and filtration. Rather than being tethered to the foundation, the ceiling, floor and walls are suspended from the mast by cables. Indeed, the central mast is the defining factor of Fuller's hexagonal house design, the great 'trunk' that allows it to radiate from the inside out. This immediately distinguishes it from the conventional house, built upon a rectangular frame and designed from the outside in. In *4D Timelock*, Fuller writes

"These new homes are structured after the natural system of humans and trees with a central stem or backbone, from which all else is independently hung, utilizing gravity instead of opposing it. This results in a construction similar to an airplane, light, taut, and profoundly strong."^{28,29} This quotation indicates that Fuller retained the tree analogy throughout the development of the design.

Further evidence of Fuller's use of organismic analogies is found in some later notes for the Dymaxion house. He refers to the infrastructure for air, water, light, electricity, sewage, and filterage as the "arterial system" of the house.³⁰ It's not clear whether he's referring to the arterial system of a tree specifically (he might also be referring to a human body), but in either case the analogy is clear. Just as trees and humans must circulate air, energy, water, and waste, so too the house must respire, nourish, and regenerate itself.

This brings us back to the quotation by Fuller, or perhaps by his wife, Anne. "RBF read Le Corbusier until very late at night. Startled at coincidence of results arrived at in comparison to Fuller Houses, but misses main philosophy of *home as against house.*" (italics added.) Where Le Corbusier's inspirations were revolutionary, and his house a manifesto for change, Fuller's deepest desire in 1928 may have been rather more prosaic; to provide a safe environment for a child, a clean and decent

²⁸ Fuller, *4D Timelock Manuscript*, cited in *Buckminster Fuller Institute* webpage, <http://challenge.bfi.org/about-fuller/big-ideas/geodesic-domes>.

²⁹ Elsewhere in *4D Timelock*, Fuller continues the tree analogy, writing "Nature didn't build trees with four legs...and then try to fit the branches of the tree and its other functionalism inside the frame." In this, he was referring to how the functional parts of the 4D house were located in the central mast, or "trunk." See Fuller, *4D Timelock Manuscript*, 21.

³⁰ R. Buckminster Fuller, "Topical Outline and Index of Dymaxion House." Undated, believed circa 1929-30. Stanford University Libraries Special Collections, Collection M1090 Series 8.

home. Many have commented that the death of Fuller's daughter, Alexandra, left him in 1922 with a great deal of guilt for failing to provide a better living condition for her and his wife. One biographer writes that Fuller "convinced himself that if he had only provided her (Alexandra) with a home that was not so damp and drafty, she would have survived."³¹ The birth of a new child, Allegra, in 1927 allowed him to revisit his earlier failures, and to address them with a passion. It was his pendulum swing back from the turbulent period, 1922-27 discussed above. His ideas for the house developed quickly in Fuller's mind, growing from an embryonic sketch of the cosmos (Figure 1), to an image of the twentieth century world (Figure 2), to a drawing of a tree (Figure 3), to designs for a lightweight, autonomous home which could actively support itself through its mechanical core.

The Independent Home

The autonomy of the house was not only to ensure ease of maintenance. As important, if not more important, was to provide for the independence of the individuals that inhabited it. "The home, the composite of closely related individuals, just like individuals themselves, should be absolutely independent and self-supporting, though subject to coordination and cooperation with others, where this is agreeable to the absolute individual, and at his own election," wrote Fuller in *4D Timelock*.³² Certainly the house is the means, but the end is to ensure the physical, financial, and spiritual independence of the individual. Seen in this

³¹ Sieden, *Buckminster Fuller's Universe*, 79.

³² Fuller, *4D Timelock Manuscript*, 16.

light, the 4D house embodies the American values of independence, individualism, and self-sufficiency, values that Fuller held dear.³³

Descended from five generations of independent-minded New Englanders, Margaret Fuller among them, Fuller prized independent thinking, even if that entailed flouting well-worn conventions. During his many public lectures in the 1960s and 70s, Fuller often exhorted students to “do your own thinking.” In addition, the affordable 4D house would offer financial independence, quite important to Fuller, who had been previously unable to afford the shelter he felt his family deserved.³⁴

Crazy house on a pole

Modernist architects and theorists such as Hermann Muthesius and Le Corbusier set a physical standard for twentieth century architecture that included functionality and visual cleanliness; this in turn gave modern architecture a moral superiority over what they saw as the decadent architecture of the 19th century. In *The English House* (1904), Muthesius praised the practicality and usefulness of the the English home.³⁵ In *Towards a New Architecture*, Le Corbusier proclaimed the

³³ It is not entirely clear what Fuller thought about the development of suburbs that were transforming the American landscape at this time. Fuller himself had grown up in a suburb of Boston himself, so he probably wasn't particularly concerned about the potential social impacts of the development of suburbs, as detailed by Gwendolyn Wright in *Building the Dream: A Social History of Housing in America* (1981). One might note, though that Fuller also intended for his 4D/Dymaxion houses to be portable and equally applicable to urban, suburban, and rural dwelling depending upon where the shelter was most needed. The social structure that Fuller appeared most concerned with was the nuclear family, as opposed to the surrounding community.

³⁴ We might also speculate that Fuller abhorred having to rely on the charity of others, as he and his wife occasionally did when he was financially insolvent.

³⁵ Hermann Muthesius, *The English House* (New York: Rizzoli International, 1987). Originally published in 1904-05.

age of "'House-Machine,' the mass-production house, healthy (and morally so too)."³⁶

The 4D house uses technology to live up to the modern moral and physical standards of the twentieth century, promising its inhabitants cleanliness, practicality, lightness of environment, and lightness of spirit. In addition, it also ensures the mobility and the mental and financial independence of the family, which distinguishes it from the European modernist program. It is just such a home—modern, light-filled, and essentially good—that Fuller wishes to provide for his innocent and unspoiled new daughter. It's an ethical house, a clean and modern house, a self-sustaining house, an American house, a safe place for a child, unlike the drafty Chicago apartment he had rented for his wife and first daughter during the early 1920s.³⁷ The 4D house is the answer to Fuller's deep-seated fears: fear of being a bad father, an inadequate provider, a Harvard dropout, a failure at business. It is in its own way a testament to Fuller's own spiritual and personal rebirth following his near-breakdown in 1927.

No matter how naïve Fuller's propositions for the 4D House, sprinkled with sketches of his baby, they were more than just technological flights of fancy. The technology reflected Fuller's personal convictions about what a modern house

³⁶ Le Corbusier, "Towards a New Architecture," in *Programs and Manifestoes on Twentieth Century Architecture* (Cambridge, MA: MIT Press, 1975), 62.

³⁷ Urban housing was limited, in both quantity and quality, during the 1920s. According to the Harry Ransom Center, "After World War I, great shifts occurred in where Americans made their homes. With increasing industrialization, many people moved from rural areas into cities for employment opportunities, resulting in an urban housing shortage. By 1930, 56% of Americans lived in urban areas, whereas only 45% had been urban in 1910." See "Teaching the American 20s, Harry Ransom Center, <http://www.hrc.utexas.edu/educator/modules/teachingthetwenties/>.

should provide. The 4D house was a regenerative unit, a mechano-organism symbiotically tuned to the needs of its inhabitants. What the 4D house lacked in aesthetic appeal, it made up for in thoughtfulness; the self cleaning system, the efficient and plentiful bathrooms, the built in ventilation. These amenities guaranteed the family a measure of comfort and freedom from drudgery.³⁸ But Fuller's ideas gained little traction with either architects or builders. In part, this was because of Fuller's painfully fervent and intensely personal promotion of his ideas. The oddly-written, messianic 4D treatise that he wrote and self-published was either rejected or ignored by the two dozen or so professionals that he sent it to in 1928.³⁹ The manuscript is difficult to read as it jumbles together technocratic ideas, meditations on the importance of time, insults lobbed at the architectural profession, and bombastic decrees. ("WE WILL HAVE ARRIVED AT OUR NEW ARTISTIC ERA OF ARCHITECTURAL EXPRESSION, WHEN OUR BUILDINGS HAVE LOST THEIR LAST TRACE OF FEUDALISTIC OPPRESSIVENESS; WHEN OUR BUILDINGS ARISE IN CONCENTRATED CENTRAL HIDDEN AREA OF COMPRESSION, IN OPPOSITION TO GRAVITY, BY MEANS OF MAST OF CAISON...")⁴⁰ (emphases original.) Most people didn't know what to make of the manuscript, and a few actually returned it to Fuller. To seasoned architects, Fuller—with his lack of experience and weird building schemes—came across as a bit of a crackpot.⁴¹

There was little incentive on the part of builders or developers to adopt any of

³⁸ Some of these amenities have been realized, albeit decades later and at comparatively greater cost. For example, central vacuum cleaning is available today, at a fairly steep initial cost.

³⁹ As mentioned, Fuller sent copies to prominent industrialists like Vincent Astor and Henry Ford, as well as to several architects in the New York area. For a good discussion of the *4D Timelock* manuscript, see Katz's article in *New Views*, cited above.

⁴⁰ Fuller, *4D Timelock Manuscript*, 33.

⁴¹ Albin Krebs, "R. Buckminster Fuller, Futurist Inventor, Dies at 87," *New York Times*, July 3, 1983, <http://www.nytimes.com/1983/07/03/obituaries/r-buckminster-fuller-futurist-inventor-dies-at-87.html>. See also "Dymaxion American," *Time*, Jan 10, 1964, reproduced in *Buckminster Fuller Institute Website*, <http://www.bfi.org/about-fuller/biography/dymaxion-american/>.

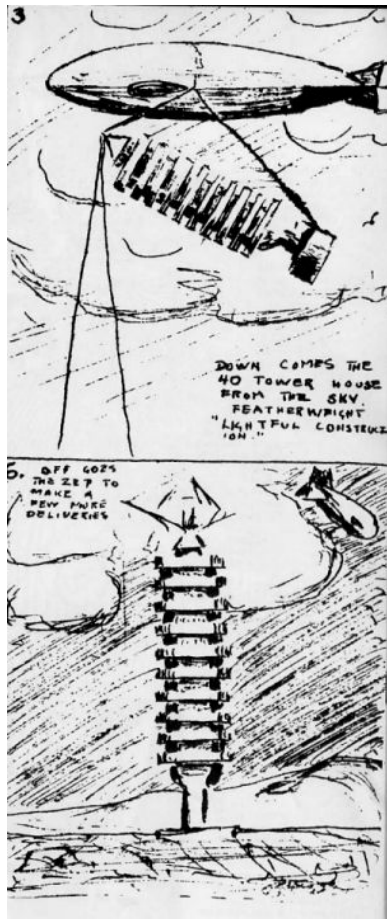


Figure 5 : 4D Multistory Tower, c. 1928
(adlbitumdreams.wordpress.com)

Fuller's novel propositions.⁴² In fact, his greatest supporters were laypeople, fascinated by popular articles about this crazy 'house on a pole.'

The 4D House thrived in Fuller's imagination, growing into air-liftable multistory towers that could be delivered by zeppelin (Figure 5). Zeppelin travel was becoming more significant at this time, so depicting the house traveling by zeppelin attached it to a contemporary technological context while at the same time underscoring its physical lightness. Fuller scribbled numerous pictures, and even had his wife Anne produce some color illustrations of the hexagonal tower. But neither the octagonal house nor the 4D towers were ever realized as such.

The 4D house as an architectural proposition was renamed the Dymaxion House in 1929. The name "dymaxion" is a portmanteau of the words *dynamic*, *maximum*, and *tension*. It was coined with the help of Waldo Warren, the public relations manager at Marshall Field's department store in Chicago,⁴³ where a model of Fuller's 4D (now, Dymaxion) house was being shown as part of a display on the

⁴² For example, the stamped metal bathroom that Fuller proposed would have put plumbers and tile-setters out of work. The house, which was supposedly lightweight enough to be put together by the homeowner without requiring heavy equipment, could likewise put builders out of work.

⁴³ Some scholars, including Lloyd Steven Sieden, have identified the three words as *dynamic*, *maximum*, and *ion*. I am relying on the interpretation of the Buckminster Fuller Institute, which seems more plausible, considering the importance of the tension cables in the house's design. See *Buckminster Fuller Institute* website, <http://bfi.org/about-bucky/buckys-big-ideas/dymaxion-world>.

house of the future. The Dymaxion house has been extensively studied as one of Fuller's signature works.⁴⁴ The early Dymaxion house, that of the late 1920s, was really the 4D house by another name.

Dymaxion Reborn?

After a decade or so of relative stasis, the Dymaxion concept would be revived and redesigned in the mid-1940s, with government support, as a prototype for affordable postwar housing. The redesign included switching from a hexagonal floor plan to a circular one, although the radiant design of the house was similar. Like the 4D house, the new Dymaxion house radiated from a central mast, had ventilation through its roof cap, and had prefabricated bathroom units. The exterior walls and domed roof were made of aircraft grade aluminum, carefully bent to shape by technicians from the Beech Aircraft company in Wichita, Kansas. (Figure 6) Although some critics commented on the inflexibility of the design, there was considerable public interest in the Dymaxion house. For example, Fortune Magazine published an article on the Dymaxion house in April 1946, suggesting that the dwelling machine was "likely to produce greater social consequences than the introduction of the automobile."⁴⁵ However, this widespread adoption of Fuller houses would not come to pass. In a surprisingly prescient tagline, *Science Illustrated* magazine in 1948 noted "Everybody loves

⁴⁴ See Joachim Krausse and Claude Lichtenstein, *Your Private Sky: R. Buckminster Fuller* (Zurich: Lars Müller Publishers, 1999). See also Sieden, *Buckminster Fuller's Universe*, Chapter 12.

⁴⁵ "AD Classics: The Dymaxion House/Buckminster Fuller," *archdaily*, <http://www.archdaily.com/401528/ad-classics-the-dymaxion-house-buckminster-fuller/>.

Fuller's incredible houses, automobiles, and bathrooms—but you can't buy them."⁴⁶



Figure 6 : Dymaxion (Wichita) House, Kansas, c. 1949. Constructed during the late 1940s and then purchased by William Graham. (www.wichitaphotos.org)

The greatest obstacle to the mass production of Fuller houses was Fuller himself.⁴⁷

Fuller had a particular vision of Dymaxion House in mind, and refused to bend to the exigencies of manufacture and distribution. Fuller fussed over the materials, insisting that the state-of-the-art materials required for the project (industrial plastics, etc.) would not be ready until 1952 at the earliest. The major hurdle came when it came time to recapitalize the company (which had been renamed Fuller Houses) in preparation for production. Fuller, who held a controlling stake in the

⁴⁶ Robert Marks, "Bucky Fuller's Dymaxion World," *Science Illustrated*, November 1948.

⁴⁷ This information is corroborated by a personal interview I conducted with Herman Wolf at his home in Connecticut in 2004. Wolf was the publicist for the Fuller Houses project in the mid 1940s and saw the project peter out due to Fuller's refusal to compromise. It was by his account a very frustrating experience.

Fuller Houses company, continuously vetoed the recapitalization. He insisted that time had not yet come to start production, wanting to wait until 1952. Eventually, his investors became so fed-up with Fuller's recalcitrance that they allowed him to buy them out, and the company quickly collapsed. The Fuller houses project folded in 1946, after only two prototype houses had been built.⁴⁸ Whether because of insecurity, fear of failure, over-protectiveness of his ideas, or some combination of unknown reasons, Fuller suffocated his project rather than letting it be born prematurely. In effect, it was the end of the 4D house dream.



Figure 7: Graham family home incorporating modified "Wichita House," c. 1950 (www.wichitaphotos.org)

⁴⁸ The two prototype houses were used for testing against the elements. After the failure of the Fuller Houses project, the prototypes were purchased by investor William Graham who constructed a hybridized version from the parts of the prototypes in 1948, which his family lived in until the 1970s. The house was later donated to the Henry Ford Museum. See James Ashby, "Preserving a Prototype: Buckminster Fuller's Dymaxion House," *Historic Preservation Education Foundation*, <http://hpef.us/publications/preserving-the-recent-past-publications/preserving-a-prototype>. See also Figure 7.

Chapter 4

Geodesic Domes: A recursive journey

Over the decades, the geodesic dome has emerged as the hallmark of Buckminster Fuller's work. Geometric, symmetrical, growing out of a calmingly repetitive triangular pattern, geodesic domes were lightweight and efficient to build. Fuller's geodesic dome patent was filed in 1951 and awarded in 1954, and tens of thousands of geodesic domes—from humble dome homes to the massive, 250-foot diameter Expo '67 dome in Montreal, Canada—were built in the subsequent decades. Indeed, Fuller's success as an architect and designer was so closely associated with domes that artist Boris Artzybasheff depicted Fuller's bald pate as a giant geodesic dome on a 1964 cover of *Time* magazine.

In his well-known biography of Fuller, Lloyd Sieden states that "Fuller learned to mirror Nature's ingenious yet uncomplicated principles and designs in increasingly more sophisticated inventions, such as the geodesic dome."¹ This represents what has become the conventional view of how the geodesic dome developed: it was a design plucked from nature and made useful through Fuller's ingenuity. This presents an overly-simplistic and erroneous picture of how the geodesic dome developed. In fact, it took several decades, multiple university partnerships, tens of thousands of dollars in military funding, and canny promotion on Fuller's part to realize the geodesic dome.

¹ Sieden, *Buckminster Fuller's Universe*, 9.



Figure 1: A partially covered geodesic dome

In this chapter, the complex and recursive process of dome development will be illuminated through discussion of two important but poorly appreciated topics: the dome's evolution over time, and changes in its public reception over time.

Regarding the first topic, the geodesic dome was less an architectural invention than the outcome of a lengthy process of investigation into structural geometry.

The process began with known polyhedral geometries that were developed, through a series of models, into architectural structures. From there, Fuller and his colleagues developed reproducible parts and systems that allowed them to construct domes with various sizes and purposes. The entire process unfolded over several decades with financial and intellectual support from various collaborators, including both university partners and the U.S. Military.

Regarding the second point, the geodesic dome today is seen as an icon of biomimetic design, a structure in harmony with nature; it is argued here that this was not always the case. Indeed, Fuller was interested in geometries found in nature, including geodesics—but he pursued the geodesic dome through any means necessary. As a skillful promoter of his own projects, Fuller changed the narrative of the geodesic dome to suit his audience and the cultural milieu. The “nature-inspired” reading of the dome came about during the 1960s, a point that has not been previously recognized.

Evolution of the Dome

Following the collapse of the Fuller Houses project in 1946, Fuller returned to the East Coast and began to focus on spherical geometry. Biographer Lloyd Sieden compares this withdrawal to the period of ‘retreat’ twenty years prior that led to the development of the 4D house. “The 1947 break was not as severe as his 1927 retreat. It did, nonetheless, signal a transition to a uniquely different period of activity for Bucky...the geodesic dome, along with mathematics and construction, dominated Fuller’s life from 1947 through 1970.”²

Fuller is often called the “inventor” of the geodesic dome, but this is a difficult claim to defend. A simple geodesic structure can be created by bisecting the edges of a polyhedron, such as an icosahedron, to create a triangular net roughly approximating a sphere (see Figure 2). The icosahedron was written about in

² Sieden, 295.

Euclid's *Elements* (c. 300 BC) and attributed to Theatetus of Athens (c. 419-369 BC).³

The underlying geometry of geodesy, in other words, has been known for a few millennia. Probably the first known geodesic structure in architecture was designed by engineer Walter Bauersfeld of the Carl Zeiss optical company to house a planetarium projector. The project was patented⁴ and constructed in Jena, Germany by the firm of Dykerhoff and Wydmann. The dome opened to the public in 1926, although its conception dated back to about 1912.⁵ Neither the Zeiss dome nor its patent were referenced in Fuller's 1951 patent application for geodesics.⁶

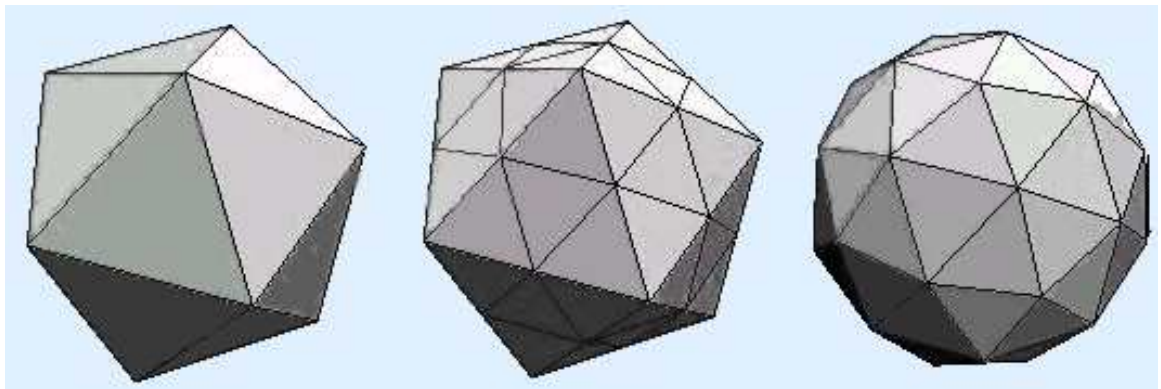


Figure 2: Development of geodesic net from icosahedron

Geodesics were also known to occur in nature, and had been illustrated or written about in Ernst Haeckel's *Kunstformen der Natur* (Art Forms in Nature), published between 1899-1904; D'Arcy Wentworth Thompson's *On Growth and Form* (1917), and in the research of H.S.M. Coxeter (1907-2003), a geometer to whom Fuller

³ John Baez, "Who Discovered the Icosahedron?" *University of California at Riverside*, 2009, <http://math.ucr.edu/home/baez/icosahedron/>.

⁴ An image of the patent can be viewed at this location: <http://www.physics.princeton.edu/~trothman/domes.html>.

⁵ The Jena Zeiss Planetarium website credits Oskar von Miller, founder of the Deutsches Museum in Munich, for the idea of the dome, and engineer Walter Bauersfeld for its basic plans. See *Jena Zeiss Planetarium Website*, <http://www.planetarium-jena.de/Geschichte.43.0.html>.

⁶ The actual patent was awarded in 1954 under US Patent number 2682235. Full text patents and images are available at the *US Patent and Trademark Office Website*, www.uspto.gov.

dedicated *Synergetics*. Fuller would have been familiar with all these works. Indeed, Fuller was interested in geodesics as naturally-occurring geometries. This was balanced by a geometrician's interest in elucidating spherical geometries, understanding their angles, connections, symmetries, and edges.

It may be noted that Fuller applied for a building construction patent, namely the method of constructing a geodesic dome, or a "framework enclosing space," as described in the patent, as opposed to a patent on the geometry itself. Rather than the inventor of the geodesic *structure*, therefore, Fuller could more accurately be called the inventor of "geodesic *structuring*," a point which he himself made in response to those who suggested his domes were merely "citations" of natural geometries.⁷ As Gorman successfully argues, self-supporting geodesic domes were ultimately useful inventions "rather than merely revelations of phenomena present in nature."⁸ As the sole patent holder of a successful geodesic structuring method, Fuller was also ultimately the beneficiary of its commercialization.

Relation to Dymaxion Air-Ocean Map

Although it has been insufficiently recognized, the geodesic dome was rooted in the geometric and geodesic knowledge Fuller gained while developing the Dymaxion Air-Ocean Map during the early 1940s. The latter was basically a world map that was projected onto a cuboctahedron or icosahedron and then unfolded. The Dymaxion Map showed the relative size of the land masses with far less

⁷ See Michael John Gorman, *Buckminster Fuller: Designing for Mobility* (Milano: Skira, 2005), 116-117 for a thoughtful discussion of this point.

⁸ Gorman, *Buckminster Fuller*, 122.

distortion than a traditional Mercator map. The map could also be unfolded and rearranged in different ways, allowing for entirely unconventional views of the world map. It appeared to the public in the March 1, 1943 edition of *Life* magazine as part of a photographic essay entitled "Life Presents R. Buckminster Fuller's Dymaxion World".

Indeed "it is difficult to overstate the importance of Fuller's Dymaxion Air-Ocean Map for the development of his structural experiments from the 1940s on."⁹ The map, which was intended to approximate a spherical globe, can itself be considered an early geodesic effort. Geodesic domes combined Fuller's interest in spherical geometry with his interest in efficient shelter. In terms of developing geodesic structures at the shelter scale, Fuller began to work on this in earnest around 1947 (again, after the Dymaxion House/Fuller Houses project had folded). A major boost came in the summers of 1948 and 1949, when Fuller was a visiting professor at Black Mountain College.

Black Mountain College (BMC) has been considered by many to be an influential if short-lived, progressive American school that operated from 1933-1957.¹⁰ Located in rural North Carolina, the experimental and interdisciplinary liberal arts college attracted such faculty as Josef and Anni Albers, Merce Cunningham, Walter Gropius,

⁹ Gorman, *Buckminster Fuller*, 87.

¹⁰ A small sampling of recent books concerning Black Mountain College's importance as a liberal arts institution includes Vincent Katz's, *Black Mountain College: Experiment in Art* (MIT Press, 2003); Martin Duberman's *Black Mountain: An Exploration in Community* (Northwestern University Press, 2009); and Mary Emma Harris' *The Arts at Black Mountain College* (MIT Press, 2002).

John Cage, and Willem de Kooning, along with R. Buckminster Fuller.¹¹ There, Fuller lectured on his recent experiments with geodesy and great circle geometry, and drew a willing crowd of student collaborators.



Figure 3: Fuller at Black Mountain College, surrounded by models (1948)

A 1948 photograph shows Fuller at Black Mountain College surrounded by geometric models, notably a half-sphere in the upper left hand corner made of arcs that trace out a network of pentagons and hexagons, and a half-sphere made of straight members on the floor. (Figure 3). Fuller and his students attempted to build a forty-eight foot diameter geodesic dome out of venetian blind slats in the summer of 1948. The slats were supposed to curve to follow the great circle geometry, but they eventually collapsed under their own weight, leading to its

¹¹ The list of people who studied at BMC includes Arthur Penn, Kenneth Noland, Robert Rauschenberg, James Leo Herlihy and Ruth Asawa. See the *Black Mountain College Project Website*, <http://www.blackmountaincollegeproject.org/>.

nickname of “supine dome.”¹² This experiment led Fuller to consider rigid, straight struts instead of curved ones, which resulted in more successful domes such as the Necklace Dome, built by BMC students when Fuller returned in the summer of 1949 (Figure 4).

This pattern of engaging eager students to develop his own projects was typical of Fuller’s working process, and led to the development of numerous full-scale domes and their component struts and connectors. “When Fuller was invited to MIT, North Carolina State, and other universities, he usually came with a specific project in mind. He would use his notorious “marathon” lectures to galvanize large numbers of students into working for him, with all materials and expenses subsidized by the university, which also provided its best workshops and technicians. In this way, Fuller could use universities as experimental testing grounds, and have access to some of the best available talent for free.”¹³ Fuller stringently guarded his intellectual property; students signed a waiver giving him credit for any discoveries made in the process of working with him.¹⁴ While generous in his thanks—in a 1953 address to North Carolina State University Architecture students, for example, he praised the contributions of students to research leading to greater “knowledge

¹² Dave Tabler, “The Supine Dome Flops in a NC Field,” *Appalachian History*, <http://www.appalachianhistory.net/2011/06/supine-dome-flops-in-nc-field.html>.

¹³ Gorman, *Buckminster Fuller*, 116. See also Alex Pang, “Dome Days: Buckminster Fuller in the Cold War”, in Francis Spufford and Jenny Uglow, eds., *Cultural Babbage: Technology, Time and Invention* (London: Faber and Faber, 1997), 167-192

¹⁴ Pang, “Dome Days,” 170-171.

of his[mankind's] evolutionary needs"¹⁵—Fuller was nevertheless stingy about sharing ownership of or eventual profit from that research.^{16,17}



Figure 4: Students building geodesic dome at Black Mountain College, 1949 (North Carolina State Archives)

¹⁵ R. Buckminster Fuller, "North Carolina State College, School of Design, Department of Architecture, Prototyping," 18 February 1953, *R. Buckminster Fuller Digital Collection*, Stanford University.

¹⁶ This tendency obviously conflicts with the popular notion of Fuller as a benevolent teacher, interested in developing knowledge for its own sake and committed to the fair distribution of worldwide resources.

¹⁷ Surprisingly few people have challenged Fuller's intellectual property rights. One notable exception is sculptor Kenneth Snelson (1927-), who was a student at Black Mountain College while Fuller was teaching there. Snelson has claimed that he invented the first tensegrity structures, made from a combination of rigid members and wires strung in tension, but that Fuller took credit for them. See Kenneth Snelson's website, <http://www.kennethsnelson.net/faqs/faq.htm>.

Support from and collaboration with the U.S. Military provided a major boost to the development of the geodesic dome during the 1950s. Domes provided a number of potential applications for the military, including temporary housing and shelters for expensive equipment. Small domes were light enough to be air-lifted to different places depending upon where they were needed. During the early 1950s, the U.S. Marine Corps Aviation Logistics and Materiel Branch successfully transported several domes, most about 36 feet in diameter, by helicopter from one location to the next. A final report (1954) concluded that geodesic domes would “offer phenomenal savings in weight, packaged volume, cost and man-hour erection time,” and the design was “far superior to presently used shelters.”¹⁸ With the support of the military and the collaboration of Bill Wainwright and MIT’s Lincoln Lab,¹⁹ from 1952-1957 Fuller developed fiberglass “radomes,” lightweight domes that would protect radar from the elements particularly in Alaska and Northern Canada. These were employed as part of a distant early warning system known as the DEW line, a radar and communications network that stretched across northern Canada. Given both the military work and civilian interest, the number of dome projects increased dramatically during the 1950s, leading Fuller to found two firms: “Geodesics Inc. to handle military contracts, and Synergetics Inc. for civilian/industry contracts.”²⁰

¹⁸ Henry C. Lane, “A Study of Shelter Logistics for Marine Corps Aviation,” U.S. Marine Corps (mimeograph copy), 1954, 113.

¹⁹ See “Early Warning Radars,” *MIT Lincoln Laboratory website*, <http://www.ll.mit.edu/about/History/earlywarningradars.html>.

²⁰ Gorman, *Buckminster Fuller*, 126. For more on military projects, including images, see Gorman 126-149.

In his biography of Fuller, Lloyd Sieden goes to some pains to explain why R. Buckminster Fuller, whom Sieden characterizes as both a “man of peace” and a humanitarian, would have so willingly joined forces with the Department of Defense and accepted their money to develop technologies for war. According to Sieden, this was simply “another opportunity to test the practical application of principles” that could eventually “be used to support the success of humanity.”²¹ Indeed, Fuller hoped that the technological gains made with military sponsorship would eventually trickle down to civilian applications, such as housing. But, contrary to Sieden’s overly-generous view of Fuller’s humanistic motivations, there is evidence that Fuller was both shrewd and bullish in his promotion of technologies for war, a point that will be discussed more thoroughly below. In either case, Fuller profited royally from his success securing military and industrial contracts; his income “skyrocketed to an annual sum of over \$1 million during the early 1950s.”²²

Structural Efficiency

Fuller’s primary interest in geodesic structures was their extreme resource efficiency. This represents a second parallel with the 4D house, which was always intended to be light, strong, and easy to construct. In both the 4D house and the geodesic domes, Fuller sought maximum performance from a minimal investment of materials. The self-supporting nature of the dome made it arguably even more structurally efficient than the 4D house, which still required a supportive central

²¹ Sieden, *Buckminster Fuller’s Universe*, 325.

²² Sieden, *Buckminster Fuller’s Universe*, 331. A generic inflation calculator equates \$1 million in the early 1950s to approximately \$9 million in today’s dollars.

mast and roof. Geodesic domes did away with vertical supports, since the interconnected struts supported one another and transferred the weight of the dome to the ground. (See Figure 1). A dome constructed of lightweight struts and connectors provided an extremely high strength to weight ratio compared a Cartesian building of comparable volume built with standard materials. The latter would require a foundation, vertical and horizontal members, framing, and interior and exterior walls. A geodesic structure, by contrast, could be built from a simple kit of identical struts and connectors and skinned with a lightweight material such as canvas, vinyl, or acrylic panels. Thanks to the modular parts, geodesic domes were also simple and easy to construct.



Figure 5: U.S. Information Agency Dome, Kabul, 1956

A case in point was the 100-foot diameter dome that Fuller designed for the U.S. Information Agency as an exhibition pavilion for the 1956 International Trade Fair in Kabul, Afghanistan (Figure 5). Measuring 35 feet high at its center, the building provided some 8000 square feet of display space. The framework consisted of 480

aluminum tubes weighing 9200 pounds, and the cover was a nylon skin weighing 1300 pounds that was suspended from the frame. The entire structure was transported from the United States to Afghanistan in a single DC-4 airplane, and was constructed in a matter of days by untrained, local Afghan workmen under the guidance of a single Fuller-appointed engineer.²³ It is difficult to assess exactly how much a traditional building of comparable volume would weigh at that time, but its component materials certainly would not have fit into a single airplane. Indeed, when Fuller received the gold medal from the American Institute of Architects in 1970, the geodesic dome was recognized as “the strongest, lightest and most efficient means of enclosing space yet known to man.”²⁴

Building from nature: a recursive process

Fuller’s geodesic domes, today, are seen as an example of natural geometries writ large. The structure of the C60 molecule, discovered two years after Fuller’s death in 1985, was so similar to a Fuller dome that it was named the “Buckminsterfullerene,” or “Buckyball” for short. During his lifetime, Fuller was aware of the natural geometries and symmetries found at the microscopic level through Ernst Haeckel’s *Kunstformen der Natur*, D’Arcy Thompson’s *On Growth and Form*, and the research of H.S.M. Coxeter (1907-2003), a geometer to whom Fuller dedicated *Synergetics*.

Many casual admirers of Fuller’s work might therefore assume that he purposely explored these geometries knowing that he would apply them to housing. In

²³ Sieden, *Buckminster Fuller’s Universe*, 307-8.

²⁴ Richard Guy Wilson, quoted in Gorman, *Buckminster Fuller*, 115.

Phillip Steadman's classification, this would put geodesics in the category of an organic analogy based on a geometric system found in nature, where the known geometry is applied to the design of architectural (or other manmade) forms.²⁵

However, Fuller's process with the geodesic domes was not so straightforward. If anything, the geodesic domes were an outcome of a recursive and longstanding fascination with spherical geometry and geometric models that was only later applied to housing. In other words, geodesic domes did not develop out of Fuller's knowledge of microscopic geometries and his desire to recreate them at a larger scale. Rather they grew out of a process that began with the Dymaxion Air-Ocean Map project, and continued with the development of dome structures at BMC. The Buckyball, discovered by chemists Harold Kroto and Richard Smalley in 1985, long after Fuller's geodesic patent had been filed, was a rare example of architecture prefiguring science, not science prefiguring architecture. In this sense, geodesic domes conform to Steadman's geometrical analogy²⁶—where recognizable and recurrent geometries can be extracted from nature and applied to art and design—but the process of getting there was hardly a straight line from nature to architecture. It was more like a backwards circle, moving from geometry to architecture, and finding reaffirmation in nature some forty years later.

Fuller abhorred labels, but in truth, where geodesics were concerned, he was a geometer first and an architect second. He had little trouble telescoping between icosahedral maps to microscopic radiolarians to 300-ft diameter domes; in his

²⁵ Phillip Steadman, *The Evolution of Designs*, revised edition (New York: Routledge, 2008), 15-16.

²⁶ See the Literature Review chapter for a more thorough discussion of the geometrical analogy.

universal outlook, structure was far more important than scale.^{27,28} It was geometry for its own sake that excited Fuller; the development of the geodesic dome came out of a commitment to elucidating that geometry rather than a desire to re-create nature on a human scale. In other words, Fuller accessed nature through geometry, which itself was bound by the laws of nature.

This hints at the meaning of the word *Synergetics*²⁹ as Fuller intended it: a study of spatial complexity. Unfortunately, in the popular understanding, the word has become synonymous with Fuller's eponymous tomes, *Synergetics* (1975) and *Synergetics 2* (1979), and is therefore incorrectly assumed to refer to a system of geometry based on triangles, as described in the books. But in broadest terms, *Synergetics* is not really a type of geometry; it is rather "the study of spatial complexity, and as such is an inherently comprehensive discipline. Its emphasis on visual and spatial phenomena combined with Fuller's holistic approach fosters the kind of lateral thinking which so often leads to creative breakthroughs."³⁰

Synergetics is thus an approach to exploring geometry, with an interest in understanding and applying it in different ways. Fuller defined *Synergetics* more explicitly with reference to nature: "*Synergetics* is the coordination of thought and

²⁷ Gorman notes that "Fuller's geometrical researches in this period oscillated between the world of the very large - the geometry of the terrestrial globe and large-scale patterns of human activity - and the very small - the structural properties of molecules and crystals." Gorman, Buckminster Fuller, 92.

²⁸ Steadman offers a critique of structures assumed to have similar properties at small and large scales, such as carbon molecules and geodesic domes. He points out that while the forces of gravity are negligible in tiny structures, they are considerable in large ones. In other words, what is a perfect geometry at the micro scale may not succeed at the architectural scale. See Steadman, *The Evolution of Designs*, 50-51.

²⁹ Here, the words *Synergetics* and *Synergetic* are capitalized in order to distinguish Fuller's particular approach from the common word *synergetic*.

³⁰ Amy Edmondson, *A Fuller Explanation* (Boston: Birkhauser, 1987), quoted on the Buckminster Fuller Institute website, www.bfi.org.

physical action, the genesis of geometry, system, and structure... Getting nature into a corner is the essence of synergetics' exploratory strategy."³¹ The development of geodesic structures—as applied to globes, domes, or whatever—provides an excellent example of Fuller's Synergetic approach. The discovery of the Buckyball in 1985 provided a posthumous validation of that approach.

From Geodesic Weapon to Hippie Homestead: An Evolving Narrative

The geodesic dome is commonly described as a structure inspired by nature³² or “based on natural patterns and systems.”³³ But the research underpinning this thesis, as described above, has shown that this process was not a straight line, but a winding one. With that said, as a geometer and designer, Fuller was definitely inspired by examples of geometric structures found in nature. His archive contains multiple copies of articles by geometer H.S.M. Coxeter who, among other things, studied honeycomb patterns. Fuller had numerous images of magnified cross sections of natural materials showing triangular or hexagonal structures. He would also have been familiar with the work of crystallographers, including his personal friend Arthur L. Loeb (1923-2002), who wrote the introduction to *Synergetics*. It is hardly a stretch to say that Fuller's model of nature as a cosmic system running in accordance with natural laws inspired his geometric explorations, and that his geometric explorations were validated when they led him back to nature.

Geometric explorations leading to geodesic structures leading back to microscopic

³¹ R. Buckminster Fuller, *Synergetics* (Section 261.01), online version, <http://www.rwgrayprojects.com/synergetics/synergetics.html>.

³² See Paul Miles, “Inspired, Naturally,” *Financial Times* (August 12, 2011), <http://www.ft.com/cms/s/2/37bb18a2-bea7-11e0-ab21-00144feabdc0.html#axzz2UiHjuSC3>

³³ Cathleen McGuigan, “Bucky's Very Large Dome,” *Daily Beast/Newsweek* (20 June 2008). <http://www.thedailybeast.com/newsweek/2008/06/20/bucky-s-very-large-dome.html>.

C60 molecules provided a poignant illustration of his comprehensive model nature, in which nature, technology, and human intellect were all intimately intertwined.

What is less clear, however, is the degree to which Fuller appealed to other people's understanding of nature in promoting his geodesic projects. It is argued here that the degree to which Fuller promoted a nature-inspired narrative of his work changed considerably over time according to the prevailing cultural sensibilities and to the interests of his audience. In general, nature was not a strong element in Fuller's narrative of his work during the 1940s and 1950s, particularly where the military was concerned. During the 1960s and 1970s though, when holistic thinking and back-to-nature ideals became popular among the counterculture generation, Fuller increasingly promoted the idea of nature's geometry and drew legitimacy from his supposed ability to understand it. The current popular understanding of Fuller is largely dominated by this latter reading of his work, and his own positioning of his work through writings and lectures from the 1960s onward.

Fuller's contributions—as a frequent speaker on college campuses on both sides of the Atlantic—to the intellectual landscape of the 1960s will be explored in more detail in the next chapter. Here, the focus is on comparing and contrasting the presentation and reception of domes from the 1950s to the 1960s, an exercise that highlights not only the importance of historical context, but also Fuller's skill in understanding his audience.

Courting the Military

As discussed above, the Department of Defense was a major supporter of Fuller's geodesic dome projects during the 1950s; military dollars largely financed the research and development of small- and medium-sized domes. Fuller's motivations were not entirely about supporting war efforts; he himself hoped that the military investment would help to spur advances in dome-building technology that would eventually trickle down to civilian housing applications, which in time did occur. Nevertheless, he understood his patrons well, and courted them with eloquence.

For the military audience, Fuller concentrated on the dome's efficiency of construction and manufacture and the ease with which it could be transported and deployed (Figure 6). He described the dome as a locus of environmental control, whether for housing or to protect supplies and equipment. In a 1956 letter to Major George King³⁴, he asserted that "the side which has the superior environment controls will win."³⁵ Fuller promoted the dome as a necessary part of the 20th century military arsenal, calling it the "'double-barreled geodesic weapon' that could win both hot and cold wars."³⁶ At the time, the military was under increasing pressure to be mobile and agile, and was covering areas in both the arctic and the tropics. The dome's ability to be air-lifted or transported in parts, its

³⁴ Major George King was one of Fuller's primary correspondents concerning military dome projects. Not much is known about the exact process of military financing for Fuller's projects. However, from the correspondence with King, one surmises that King's support of geodesic domes to his military superiors would help to secure funding for current and future dome projects with Fuller as a consulting engineer.

³⁵ Gorman, *Buckminster Fuller*, 125, citing Alex Pang, "Dome Days: Buckminster Fuller in the Cold War", in Francis Spufford and Jenny Uglow, eds., *Cultural Babbage: Technology, Time and Invention* (London: Faber and Faber, 1997), 167-192.

³⁶ Pang, in *Cultural Babbage*, 183. Gorman uses a similar phrase on page 125 of his *Buckminster Fuller: Designing for Mobility*.

resistance to the elements, and the ease of deployment were major selling points according to Fuller's military partners, Colonels Lane and Woodruff of the U.S. Marine Corps.³⁷ Fuller spent many hours discussing the details of dome construction and deployment with them; but concordance with nature or natural forms was notably absent from the discussion.³⁸

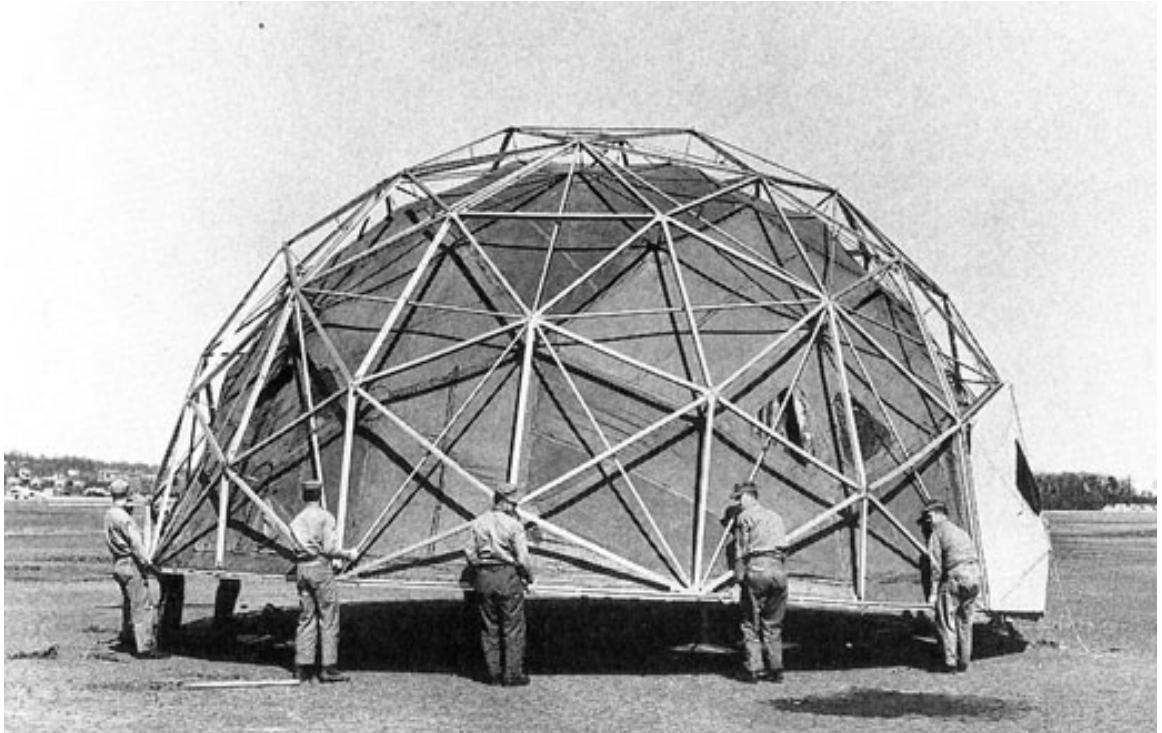


Figure 6: U.S. Marine Corps Dome Installation, 1954

The narrative that Fuller presented to the military was about applying American technological ingenuity to the new demands of 'hot and cold' warfare. It was about outsmarting the enemy with superior weapons, tactics, and logistics.

According to Pang, "Fuller predicted [that] the Marine Corps' adoption of the dome

³⁷ See "B. Fuller meets with Marine Colonels Lane and Woodruff; Raleigh, North Carolina," 08 Jan. 1954 (audiorecording), in *R. Buckminster Fuller Digital Collection*, Stanford University Libraries.

³⁸ The R. Buckminster Fuller Digital Collection contains almost four hours of recorded conversation between Fuller and Colonels Land and Woodruff. Nature is not a topic of discussion between them.

would pave the way to a global adoption of 'the American economy and the democratic processes which provide the synergetic strength of the USA'.³⁹

Fuller's remarks proved surprisingly prescient. Indeed, the geodesic dome took on a prominent symbolic role when one was built to house the U.S. Pavilion of the International Trade Fair in Kabul, Afghanistan in 1956 (see Figure 5). The Soviet Union and China had large pavilions that they had been planning for months; by contrast, the geodesic dome (as described above) was transported to the site in a single plane, and was constructed by ordinary Afghan workers in a matter of days. The dome thus "came to represent American efficiency, military might, technological know-how, commercialism, and popular appeal, hosting a record-breaking number of visitors."⁴⁰ The trade fair exhibits revolved around the theme of the "Fruits of Freedom," and included an exhibit called "America at Home." This featured live actors impersonating a typical American family in their well-appointed home, complete with sparkling appliances and a glowing television set. The geodesic dome thus became part of a propaganda front promoting both American "technological ingenuity" and the "vibrancy of American capitalism."^{41,42}

From Geodesic Weapon to Hippie Homestead

³⁹ Pang, in Spofford and Uglow, eds., *Cultural Babbage*, 183. The source of the quote by Fuller is not referenced in Pang.

⁴⁰ Peder Anker, *From Bauhaus to Ecohouse: A History of Ecological Design* (Baton Rouge: Louisiana State University Press, 2010), 72.

⁴¹ Pang, in Spofford and Uglow, eds., *Cultural Babbage*, 187.

⁴² Of course one can also look to parallels, such as the celebrated 'American Kitchen' at the American Exhibition in Moscow in 1959. With thanks to Prof. Jonathan Woodham for this observation.

But this image of the dome, as a symbol of both military agility and domestic prosperity, would change within the decade. The 1960s saw a major cultural shift with the rise of the counterculture movement. Cold War traditional values were increasingly challenged if not outright rejected by young people and civil libertarians in the United States and Western Europe. The 1960s saw plywood domes sprouting up like mushrooms on the rural communes of back-to-landers. Domes embodied countercultural possibility; they were a small-scale technology, crafted by hand, democratic in nature, and radically distinct from the suburban white-picket-fence home.⁴³ (Figure 7)



Figure 7: Drop City, a rural commune comprising a series of domes built in Trinidad, Colorado during the 1960s

⁴³ Pang, in Spofford and Uglow, eds., *Cultural Babbage*, 167.

The irony—that some ten years prior, domes had been used to promote the war effort and the material rewards of capitalism, the very values they abhorred—was all but lost on the dome-building communards. Although this may have been in part due to their youthful naïveté, it was also due to Fuller’s continued skill in tailoring his message to his audience in terms of their values.

Fuller’s speeches, as well as his personal story, appealed to the nonconformism and independence of thought that the young counterculturists⁴⁴ held so dear. He was constantly exhorting students to “do your own thinking,” and suggested that a brighter future would come, not through politicians but “from the blue sky of the inventor’s intellect.”⁴⁵ His own life story—that of a college dropout who had become a recognized architect through a wholly alternative path—gave him credibility with anti-establishment youth whose “turn on, tune in, drop out”⁴⁶ attitude saw society’s mores as anathema to individual expression.

Fuller wholeheartedly believed in devoting one’s self to the greater good. This appealed to the idealism and communal values of his young audiences. Speaking to students at the Illinois Institute of Technology in January, 1965, Fuller intimated that in the not-too-distant future, the preconceived notion of “earning a living” would become outdated. Mankind’s collective success would be ensured, if

⁴⁴ I will use the word counterculturist to describe a follower of counterculture ideals. An alternative term is counterculturalist. I have chosen the former term merely because it is a little shorter and hence more efficient. Note that I discuss my use of the word “counterculture” in more detail at the beginning of Chapter 5 in this thesis.

⁴⁵ R. Buckminster Fuller, *Utopia or Oblivion* (New York : Bantam, 1972), 6. Reprint of 1969 edition.

⁴⁶ This phrase is attributed to Timothy Leary in 1967. Leary was a psychologist and writer who was known to advocate the use of psychedelic drugs even as a possible aid to psychotherapy. He authored or co-authored over 20 books on psychotherapy and consciousness, and is considered an important figure in the counterculture movement.

individuals could address following questions: "What does nature seem to be trying to do? What are the tasks that need to be done to make man a further success in Universe? What ought man to be doing in Universe ... What can I contribute?"⁴⁷ Fuller continuously insisted that there were sufficient resources in Universe to support all mankind at a high standard of living, if only those resources could be efficiently used. Although, unlike some of his young acolytes, Fuller wasn't particularly interested in collective living, he was certainly interested in the communal and fair distribution of earth's resources, to which he felt all should have equal access. This overlapped with the growing mission of social justice among his audiences. "Malthus is wrong," Fuller asserted, "the physical resources of earth can support all of multiplying humanity at higher standards of living than anyone has ever experienced or dreamed."⁴⁸

In his speeches and writings, Fuller also appealed to the pacifism of his audience, suggesting that an intellectual revolution in the form of design science could accelerate world peace. In *Utopia or Oblivion* (1969) he wrote that the global youth were increasingly realizing that "world peace probably can be accomplished 20 years faster by a deliberate design science revolution than by waiting for the inadvertent 20-years-later fallout" of advanced technologies trickling down for the public good. "The world youth intuit that the 20-year difference could be the difference between humanity's success or extinction."⁴⁹ In this, he also gently

⁴⁷ R. Buckminster Fuller, "Graham Foundation Lecture," Illinois Institute of Technology, Jan 20, 1965 [audiorecording], *R. Buckminster Fuller Digital Collection*, Stanford University Libraries <http://collections.stanford.edu/>.

⁴⁸ Fuller, *Utopia or Oblivion*, 9. See also Chapter 6 of this work, p. 239-242.

⁴⁹ Fuller, *Utopia or Oblivion*, 8.

flattered his audience as being more enlightened and insightful than their parents' generation.

Finally, Fuller also spoke to the growing environmental consciousness of some members of his audience—not in terms of saving the songbirds (as did his contemporary Rachel Carson, author of *Silent Spring* [1962] and a major voice in the emerging ecological debate), but in terms of what he called “ephemeralization,” loosely defined as “doing more with less.” In a planet with limited resources, Fuller asked how humanity would “carry on when we run out of oil, coal, fresh water, and fresh air?”⁵⁰ Fuller was acutely conscious of how inefficiently the world's resources were being used, and how unfairly they were distributed. This serious ethical problem required a comprehensive design science solution. In particular, ephemeralization of the built environment would help to use precious resources more efficiently. Geodesic domes, with their strong and light crystalline frames, symbolized this efficiency.

The ways in which counterculturists ultimately adopted geodesic domes—as an architecture of transience and nonconformity—was not entirely according to Fuller's ideals. Drop City, an artist's colony in southeastern Colorado comprising a series of handmade domes, provides a good example. The colony was established in 1965; by 1967, it counted some 10 core members, and had many more transient visitors. By 1969, though, it had “slid into squalor,” and was abandoned by 1973.⁵¹ Where Fuller domes were beautifully faceted, crystalline forms, the “Dropper”

⁵⁰ Fuller, *Utopia or Oblivion*, 278.

⁵¹ Simon Sadler, “Drop City Revisited,” *Journal of Architectural Education* 58 (2006), 6.

domes were messy affairs cobbled together out of scrounged and stolen materials like old car tops, plywood and wire. The geometry was only approximate, and the resultant domes—far from being ephemeral—were relatively heavy. “Drop City provided the perfect illustration of bricolage, an emergent cultural paradigm quite different to design science.”⁵² The Droppers took refuge from industrialized society, using its detritus to fashion their own impermanent encampments, in a simultaneous gesture of self-sufficiency, protest, and appropriation. Fuller himself was initially guarded in praising the “poetically economic architecture”⁵³ of Drop City;⁵⁴ in later years, he distanced himself more firmly from the radical Droppers, focusing his attentions on large commercial projects and his continued schedule of lectures.

The prominent geodesic domes of the 1950s—the Marine Corps equipment shelters, and the Kabul exhibition hall dedicated to the material and technical wealth that democracy and capitalism could (supposedly) bring about—were a far cry from the ramshackle dome homes constructed by idealistic hippies and back-to-landers during the 1960 and 70s. Domes became emblems in both situations in part because of Fuller’s ability to skillfully adapt his message to his audience, which allowed them to read into the dome precisely what they wanted to see. In this effort, his greatest ally was the geodesic dome itself.

⁵² Sadler, “Drop City Revisited,” 8.

⁵³ *ibid.*

⁵⁴ In the early years of Drop City, Fuller and Dropper founder Peter Douthit exchanged a few letters. For example, in a 1966 letter to Douthit, Fuller’s assistant John McHale wrote “He [Fuller] is most sympathetic to your project and would like to be kept closely informed on its progress!” The relationship cooled rather quickly, though. See John McHale to Peter Douthit, November 9, 1966, *R. Buckminster Fuller Collection M1090*, Stanford University Libraries, Series 2 Box 145.

The dome's neutral geometry and inherently scalable form left it open to a variety of interpretations. Stated differently, the dome functioned as a blank screen for the projection of changing cultural values. Devoid of cultural markers—no fluted columns, pointed arches, or surface decoration—domes were acultural and ahistorical. Whether large or small, whether constructed from stainless steel or bamboo, the form of the dome remained essentially the same. To be sure, an enormous crystalline dome made of shiny aluminum might project an image of national prowess, while a lopsided dome made of car tops and scavenged wood might speak to a primitivist impulse and rejection of consumer values; but these express the values and intentions of the builders, rather than being inherent to the geometry itself. To the Marine Corps, domes were a "geodesic weapon"; while to the Droppers domes were an "emblem of countercultural communitarianism."⁵⁵ Fuller's own experience of the geodesic dome was considerably more pedestrian—it was his humble suburban abode while a college professor at Southern Illinois University at Carbondale from 1961-1970. (Figure 8).

Fuller was a skillful promoter of the geodesic dome, but in the end he was a geometer first, and sailed around the political debates whenever possible. He fanned the interest of the U.S. Military and several universities in order to continually refine domebuilding technology at little or no cost to himself. He believed in the geometry of the dome itself, in its lightness and efficiency of structure, its inherent logic of form. Whether a locus of environmental control or a visual statement of rebellion, Fuller didn't construct these narratives so much as

⁵⁵ Sadler, "Drop City Revisited," 6.

insert the geodesic dome into them. Provided that his patent was respected, Fuller was far less concerned with the many thousands of ways it was being applied, allowing his audiences to read into the dome whatever they wanted to see.



Figure 8: Fuller in his Carbondale Dome Home, n.d.

Chapter 5

The 1960s

Notes on Language: Counterculture and the Long 1960s

The word *counterculture* is used throughout this chapter in broad terms, referring to a diverse but largely youthful population with a shared vision of questioning and reappraising dominant cultural values. This is consistent with the view stated by Theodore Roszak in his book *The Making of a Counter Culture*:

We will never know how many people belonged to the counter culture. It may be wrong to speak of it as having a membership at all. Rather it was a vision that, to one degree or another, drew the attention and fascination of passing many. More important than the size of the dissent was its depth. Never before had protest raised issues that went so philosophically deep, delving into the very meaning of reality, sanity, and human purpose.¹

Hippies, rural commune dwellers, and Students for a Democratic Society² could— with this understanding—all be considered part of the counterculture, as all three subgroups questioned and rejected many of the conventional social norms of the 1950s. Such likeminded individuals will be referred to as *counterculturists*.³

¹ See Roszak, *The Making of a Counter Culture* (Berkeley: University of California Press, 1995), xxvi-xxvii. Roszak's book is a key text in this chapter, particularly because he discusses the counterculture's rejection of what he calls a technocratic society, dominated by corporate interests and run by so-called technical experts. This makes it particularly relevant to understanding Fuller, who generally promoted technology-driven solutions to social problems.

² Students for a Democratic Society (SDS) was a student activist organization in the United States that advocated participatory democracy, direct action, and radicalism that expanded rapidly during the mid-1960s. Although it was dissolved in 1969, during its time SDS was one of the main representations of the New Left in the United States.

³ In my research, I have found the words "counterculturalist" and "countercultural" used as a synonyms for "counterculturist." I have chosen "counterculturist" as my preferred term in this thesis in order to maintain some consistency.

During this chapter, *the 1960s* is used frequently to represent a period in which Fuller's influence as a public intellectual peaked, although Fuller actually retained this high profile into the mid-1970s. This periodization might be seen to represent what some historians have called *the long 1960s*, an era that began in the late 1950s and ended during the 1970s.⁴ For purposes of brevity, *the 1960s* is often used to imply *the long 1960s*.

An iconic image of the 1960s counterculture is the famous film clip of Mario Savio fervently addressing his peers at the University of California, Berkeley with the following speech:

*There's a time when the operation of the machine becomes so odious—makes you so sick at heart—that you can't take part. You can't even passively take part. And you've got to put your bodies upon the gears and upon the wheels, upon the levers, upon all the apparatus, and you've got to make it stop. And you've got to indicate to the people who run it, to the people who own it that unless you're free, the machine will be prevented from working at all.*⁵

"The machine" here is used as a metaphor on several levels. First, it represents the weighty bureaucracy of the University, which Savio and other students felt were unfairly restricting free speech on campus. More broadly, "the machine" represents the dominant institutions of government, industry, and capitalism that Savio feels stand in the way of self-expression and self-actualization.

⁴ See Arthur Marwick, *The Sixties: Cultural Transformation in Britain, France, Italy and the United States, c. 1958 - c. 1974* (Oxford: Oxford University Press, 2000).

⁵ An original video clip, which includes this passage, of Mario Savio addressing his peers is available on *YouTube* at this link. <<http://www.youtube.com/watch?v=PhFvZRT7Ds0>>

Savio's metaphor also points to an implicit wariness of technology, a generalized distrust of the industrialized and mechanized world—indeed of the industrialization and mechanization of politics and society itself—within the counterculture.⁶ The great maw of industrialism had created the affluence that they had enjoyed as children, but also the social strictures that, coming of age, they felt compelled to rebel against. *Technology* evoked a top-down, over-managed industrial society in which a circle of pseudo-scientists and social engineers “assume authoritative influence over even the most seemingly personal aspects of life: sexual behavior, child-rearing, mental health, recreation, etc.”⁷ This same circle of experts decided when to drop bombs, what the monetary policies would be, and which candidates to elect, all while the common man was being entertained by the media's parodies of “freedom, joy and fulfillment.”⁸ The counterculture's primary project was to rebel against this technocracy, to refute its claims of technical expertise by “proclaiming a new heaven and a new earth so vast, so marvelous that the inordinate claims of technical expertise must of necessity withdraw in the presence of such splendor.”⁹

The rejection of both technology and its attendant technocracy was most palpable in the rural commune movement, which saw pockets of like-minded individuals

⁶ Roszak, *The Making of a Counterculture*, 7-8.

⁷ Roszak, *The Making of a Counterculture*, 7.

⁸ Roszak, *The Making of a Counterculture*, 15.

⁹ Roszak, *The Making of a Counterculture*, 240. It should be noted that Roszak's book was not only a critique of the technocracy ; it was also a defense of the counterculture as more than just an upsurge of naïve, wayward youth. Roszak instead represents the counterculture as a movement of like-minded individuals that shared in a set of powerful alternative ideals. This is clear in his introduction to the 1995 reprint of this book.

starting alternative communities, where they could raise vegetables, livestock, and their children far from the cities. Although commune-dwellers represented only a portion of the counterculture, it was not insignificant; Judson Jerome has estimated that some 750,000 people lived in communes across the United States by the early 1970s, and other credible estimates range as high as one million.¹⁰ “We wanted to build a society from the ground up,” recounts Eugene Bernofsky, one of the founders of Drop City in Trinidad, Colorado. “We felt we couldn’t do it in the USA but needed a really remote place that hadn’t yet been impacted by human beings.”¹¹ The rural communards rejected the dominant society by opting out of it completely, living off the land in relative isolation with a handful of like-minded individuals.

Pastoralism

Bennett Berger corrals these counterculture ideas—the discomfort with technology, the return to the land, and the desire for self-sufficiency—under the header of *pastoralism*, as follows:

Pastoralism: Simple living in harmony with nature in the country; continuities with the “suburban” ideal; negative predispositions toward technology; pride in

¹⁰ Jade Aguilar cites two best-guess estimates as to the number of Americans who lived on rural communes prior to 1974 as between 750,000 and 1 million. The estimates were provided by Patrick Conover and Judson Jerome, who “found similar figures in their research work.” See Jade Aguilar, *Activism or Escapism: Making Sense of 21st Century Communes*, PhD Dissertation, University of Colorado, 2008 (Proquest/UMI no. 3354532), 3. See also Amy Azzarito, “Libre, Colorado, and the Hand-Built Home,” in *West of Center: Art and the Counterculture Experiment in America, 1965-1977* (University of Minnesota Press, 2012), 95.

¹¹ Mark Matthews, *Droppers: America’s First Hippie Commune, Drop City* (Norman, OK: University of Oklahoma Press, 2010), 49-50. According to Bernofsky, he and others originally intended to establish a commune at the headwaters of the Nile in Central Africa. However, this did not come to pass, and the commune was eventually established in Colorado.

*survival "on the land; pride in development of manual skills; frugality, ecological consciousness; apocalypse; impending doom for the cities.*¹²

While pastoralism, as Berger defines it, was most obvious in the rural commune movement, the sense that technology portended apocalypse and doom was fairly common among hippies, pacifists, and other members of the counterculture. Indeed, by the 1960s, the world had witnessed the bombing of Pearl Harbor, the decimation of Hiroshima and Nagasaki, the Cuban Missile Crisis, and the start of the Vietnam War. Technology, and the military-industrial juggernaut that was supposedly behind it, had taken on a decidedly sinister cast.

Although counterculture pastoralism had deep and varied roots in American history, to a large degree the counterculture (and especially the rural commune movement) "inherited much of the traditional romantic bias against and distrust of 'technology.'"¹³ Living authentically off the land represented an escape from, and a rejection of, the economic shackles and the spiritual poverty of urban industrial society. This transformed pastoralism from "something absurd and reactionary...into something 'meaningful' for the children of industrial affluence."¹⁴ And yet, technology—whether in the form of automobiles, chain saws, flypaper, or medicines—could not be entirely eschewed by even the most diehard of

¹² Bennett Berger, *The Survival of a Counterculture* (Berkeley: University of California Press, 1981), 19. Berger (1926-2005) was a sociologist whose research included youth culture, counterculture, and communes. *The Survival of a Counterculture* was an observational study of the activities, actions, and self-image of commune dwellers in Northern California.

¹³ Berger, *The Survival of a Counterculture*, 110. For a discussion of the historical roots of American pastoralism, see Berger, 93-107.

¹⁴ Berger, *The Survival of a Counterculture*, 111.

communards. They had to “cope with the discrepancies between their ideals and their practice by doing...remedial ideological work” to justify their actions.¹⁵

Fuller helped the counterculture generation to engage in precisely this kind of ideological remediation. He helped them to re-invest technology with purpose by pointing out its humanistic applications and its potential to serve the greater good. In his speeches, he not only aligned technology with the counterculture ideals of self-sufficiency and independence; he also conjured images of a utopic future in which technology, humanely applied, could ensure a higher standard of living around the world. This not only made Fuller a popular speaker among college students, but elevated him to the status of a design hero among a small subset of them, including Stewart Brand, Medard Gabel, J. Baldwin, Michael Ben-Eli, Norman Foster, and Joseph Clinton, among others.¹⁶

Before exploring these topics more fully, we might wonder how Fuller became such a popular speaker and author within the American counterculture in the first place. After all, he was considerably older, had participated materially in the military-industrial complex, was an endowed professor at a university, and a descendant of the Boston Brahmins. In many ways, he represented precisely the

¹⁵ Berger, *The Survival of a Counterculture*, 115.

¹⁶ Fuller’s influence was palpable in the founding of the Drop City commune; on Stewart Brand, who went on to found *Wired* magazine; in the work of World Game cofounder Medard Gabel and his collaborators; the work of architects and designers Shoji Sadao, Thomas Zung, Norman Foster, Michael Ben Eli, J. Baldwin Joseph Clinton, and David Johnston, among others. Foster, Ben Eli, and Johnston are noted for their contributions to sustainable design. The lectures that Fuller delivered were often transcribed and subsequently published in anthologies such as *Utopia or Oblivion*. Fuller’s *Ideas and Integrities* was sold via the Whole Earth Catalog (1968 edition.) Fuller’s *Operating Manual for Spaceship Earth* was purportedly also quite popular among the counterculture, although I have not been able to locate sales data for that book during the 1960s-70s.

types of traditional government, economic, educational, and social institutions the counterculturists found so stifling.¹⁷

Fuller's credibility and his popularity with the young generation had several important roots. Firstly, he understood and appealed to counterculture values of self-sufficiency, holism, and independence of mind and body. In this, he drew upon the legacy of Transcendentalist thought that was so central to his own ideals, as discussed in Chapter 1. He shared the counterculturists' concerns about global poverty, social injustice and war, and countered their disillusionment with a picture of a peaceful utopia that could be achieved through a bloodless design science revolution. He addressed their conflicted relationship with technology by reorienting the conversation away from "technology," and toward "tools," which represented small-scale interventions to ensure the well-being of the individual and community. In the following pages, these topics will be explored in detail.

Individualism: Selfhood, independence of the mind, and self-reliance

The counterculture generation came of age in an era of unprecedented prosperity¹⁸, in a child-oriented society with considerable disposable income.

Unlike their parents—many of whom had witnessed both the Great Depression and the Second World War, and had survived through a combination of frugality,

¹⁷ Fuller descended from a long line of Harvardians in the Boston/Milton Massachusetts area. Fred Turner describes Fuller in 1965 with his Phi Beta Kappa key "dangling from his waist [looking like] an early twentieth century plutocrat." See Turner in Chu, ed., *New Views on R. Buckminster Fuller*, 146.

¹⁸ It should be noted that the prosperity was most palpable in the United States. European countries were harder hit by the Second World War, although by the 1950s many of them were returning to prosperity, including the United Kingdom.

hardiness, and collective sacrifice¹⁹—the counterculturists were “a uniquely pampered generation of children”²⁰ with a sense of self-awareness and self importance. Particularly important to their rejection of the dominant culture was reasserting the power and passion of the individual. The 1960s saw a new age of independence and self-expression, when young people were encouraged to “do your own thing.”²¹ This meant different things for different people; experimentation with “sex, drugs, and rock-and-roll” were fairly common outlets for youthful rebellion.²² Radical fashions, exploring and practicing eastern religions,²³ and communal living were other means of challenging social mores. Politically, asserting one’s individuality might take the form of practicing free speech, marching for human rights, or burning one’s draft card, and such actions indeed disrupted the status quo. “They want to be recognized as individuals,” commented Senator Robert Kennedy with consternation, “but individuals play a

¹⁹ Indeed, as biographer Lloyd Steven Sieden points out, “Fuller himself was born into a generation in which there were not sufficient resources available to support everyone, and consequently, fighting for one’s own share could be considered acceptable.” His generation was more likely to be obsessed with efficiency than self-expression. See Sieden, *Buckminster Fuller’s Universe*, xi.

²⁰ Roszak, *The Making of a Counterculture*, xix.

²¹ This phrase is attributed to the *Diggers*, a San Francisco-based community action group of activists and actors active from 1966-68. The phrase is attributed to their publication, *The Digger Papers*, which also gave rise to the phrase “to is the first day of the rest of your life.” See *The Digger Archives*, <http://www.diggers.org/>

²² In the introduction to *American Counterculture* (Edinburgh: Edinburgh University Press, 2007) Christopher Gair points out that by the time they had reached college, the baby boomers had access to money with which to buy records, travel, and drugs for experimentation; in other words, the affluence of their parents and the relative affordability of college facilitated a period of experimentation and exploration. This differed from the experiences of their parents, who had often gone from secondary school straight into a full-time job, marriage, or the military.

²³ Eastern philosophies were particularly popular amongst the counterculture, and were introduced to a wider audience by philosophers like Alan Watts, who had a weekly radio show in the San Francisco Bay Area; Stephen Gaskin, professor at San Francisco State University and co-founder of *The Farm*, an intentional spiritual community in Tennessee; and others.

smaller and smaller role in society. This is a formidable and forbidding arrangement."²⁴

In order to fully assert the individual, the counterculture placed great importance upon intellectual and mental freedom. This was not surprising, considering that many were college-educated and from reasonably well-to-do backgrounds. Freeing one's mind from the strictures of convention—whether by exploring alternative philosophies, meditation, drugs, or even dropping out of school—was part and parcel of self-discovery. The use of psychedelics, in addition to liberating the normative visual field, was supposed to liberate the consciousness from the ego. In short, regardless of the means one chose on the path to self discovery, the alternative to this mental liberation was to remain a complacent automaton in a Kafkaesque "intellectual and moral wasteland,"²⁵ to passively accept the "straight" society's "lack of soul."²⁶

Individualism and independence of the mind were likewise cornerstones of American Transcendentalist thinking. The individual, apart from the corrupting influences of organized religion and politics, was considered to be the best interpreter of religious texts and practices. "A man should learn to detect and watch that gleam of light which flashes across his mind from within, more than the

²⁴ "The Hippies." *Time* 90, 1: 22 (1967). Academic Search Complete, EBSCOhost (accessed September 20, 2013).

²⁵ Mario Savio, "An End to History" (1964), in McWilliams, *The 1960s Cultural Revolution*, 133.

²⁶ "The Hippies" (1967).

lustre of the firmament of bards and sages," wrote Emerson in *Self-Reliance* (1841).

"Nothing is at last sacred but the integrity of your own mind."²⁷

The legacy of Transcendentalism, with its insistence upon individualism and independence of thought, gave Fuller common ground with the counterculture. In his addresses to college students during the 1960s and 70s, he often exhorted them to "do your own thinking." In a 1975 lecture, Fuller recounted his 1927 epiphany on the shores of Lake Michigan (also discussed in Chapter 3), when he stepped back from suicide and decided to devote his life to humanity, with the following realization; "Number one, you're going to have to do your own thinking...You've got to have absolute conviction that you will be able to carry through [with this project] for your full lifetime."²⁸ Fuller's words echo those of his great-aunt Margaret Fuller, Transcendentalist author and journalist, who wrote "No man can be absolutely true to himself, eschewing cant, compromise, servile imitation, and complaisance, without becoming original, for there is in every creature a fountain of life which, if not choked back by stones and other dead rubbish, will create a fresh atmosphere, and bring to life fresh beauty. And it is the same with the nation as with the individual man."²⁹ Fuller tellingly reproduced this passage in his 1963 book, *Ideas and Integrity*.

²⁷ Ralph Waldo Emerson, "Self Reliance," from *Essays: First Series* (1841), *Emerson Online*, <http://www.emersoncentral.com>.

²⁸ Buckminster Fuller, "Everything I Know" (Lecture recordings, 1975), *Buckminster Fuller Institute*, <http://bfi.org/about-fuller/resources/everything-i-know>.

²⁹ Margaret Fuller, reproduced in Buckminster Fuller, *Ideas and Integrity* (New York: Collier Books, 1963), 70.

Although the American Transcendentalists and the counterculturists were reacting to different things—the former opposing the intellectualism of the church, the latter rejecting the social and political strictures of a highly industrialized society—the rudimentary outlines of their reactions were surprisingly congruent. Both involved the rejection of a rational yet impersonal system via an expressive reclamation of the individual’s mind, soul and spirit, as the passages below illustrate: William Ellery

*I reverence human nature...[I see] divinity in its ordinary operations...To grow in the likeness of God we need not cease to be men...Our proper work is to approach God by the free and natural unfolding of our highest power—of understanding, conscience, love, and the moral will. (William Ellery Channing, *Likeness to God*, 1828)³⁰*

*I am ashamed to think how easily we capitulate to badges and names, to large societies and dead institutions...Whoso would be a man, must be a nonconformist... (Ralph Waldo Emerson, *Self-Reliance*, 1841)³¹*

*We regard men as infinitely precious and possessed of unfulfilled capacities for reason, freedom, and love...Men have unrealized potential for self-cultivation, self-direction, self-understanding, and creativity. The goal of man and society should be human independence: a concern not with image of popularity but with finding a meaning in life that is personally authentic; a quality of mind not compulsively driven by a sense of powerlessness, nor one which unthinkingly adopts status values... (Students for a Democratic Society, *Port Huron Statement*, c. 1962)³²*

³⁰ William Ellery Channing, “Likeness to God” (1828), in *Selected Writings of the American Transcendentalists* (New Haven, CT: Yale University Press, 2004), 64-5.

³¹ See *Emerson Online*, www.emersoncentral.com

³² “SDS: The Rise and Development of the Students for a Democratic Society,” *The Internet Archive*, http://archive.org/stream/SdsTheRiseAndDevelopmentOfTheStudentsForADemocraticSociety/sds_djvu.txt.

Besides the historical differences in writing style, it is striking how easily these points of view could be interchanged. Fuller's early writings and speeches, too, recall the Transcendentalist bent toward individualism, independence of thought, and the innate power of the human spirit. "People are now more deeply conscious than ever before...of the pervading, quietly counseling truth within each and every one of us...and—each man by himself—of his own developing, dynamic relationship with his own conception of the Almighty of the All-Knowing," wrote Fuller in 1942.³³

Fuller valued individual thinking throughout his career; this stance was only amplified during the 1960s in his public addresses to youthful audiences. Fuller championed the power of individuals to rise above restrictive social mores and ossified institutions:

*The things to do are: the things that need doing; that you see need to be done... you will conceive your own way of doing that which needs to be done — that no one else has told you to do or how to do it. This will bring out the real you that often gets buried inside a character that has acquired a superficial array of behaviors induced or imposed by others on the individual.*³⁴

And, in his keynote address to the *Vision 65 S.I.U* conference,³⁵ held at his home institution, Southern Illinois University, Fuller said:

³³ James Meller, ed, *The Buckminster Fuller Reader* (London: The Trinity Press, 1970), 123.

³⁴ Buckminster Fuller (1970), personal letter reproduced in *Critical Path* (New York: St Martin's Press, 1981), xxxviii.

³⁵ This conference, which included over 500 participants, met in late October of 1965 at Southern Illinois University. The goal of the conference, per its subtitle, was to explore "New Challenges to Communication" brought on by recent technological and social developments. For more information, see http://www.thisisdisplay.org/features/vision_65_world_congress_on_new_challenges_to_human_communication.

*I know that the group who have come together here are unique. They are of the one-in-one-hundred-thousand type of thinker, who is realistically earnest in trying to find ways of making humanity successful. They have learned how to take the initiative. They don't need or want to be told what to do.*³⁶

Obviously, Fuller counted himself in good company as an individualist and free-thinker.

The American Transcendentalists prized the individual as the best interpreter of religious texts, rejecting what they saw as overly-empirical, or what Emerson called “corpse-cold,” approaches to religion. They reclaimed the *a priori* existence of miracles as manifestations of divine agency, and proclaimed the divinity within the individual. “Like the romantic artists and poets of Europe, they emphasized the individual, the subjective, the imaginative, the personal, the emotional, and the visionary.”³⁷ The counterculture, speaking broadly, also valued the individual above institutions, personal freedom, self-expression, immediacy, and “doing one’s own thing.” Fuller was heir to the Transcendentalist mantle; although his goal was to use technology to improve the human condition, he nevertheless insisted that individuals with integrity—not institutions—should determine and invent the uses of those technologies. This made his thinking fundamentally different from the bureaucratic, top-down policies of the technocracy described by Roszak. Fuller’s message to “do one’s own thinking” resonated deeply with the counterculture’s insistence upon intellectual and creative freedom, rising above the stifling influence of the dominant culture and its institutions. A shared belief in

³⁶ R. Buckminster Fuller, “Summary Address at Vision 65,” in *Utopia or Oblivion*, 135.

³⁷ “American Transcendentalism,” *Digital History*, University of Houston, 2013, http://www.digitalhistory.uh.edu/disp_textbook.cfm?smtID=2&psid=3551.

individualism, brought forward from his Transcendentalist roots, was central to Fuller's popularity with his counterculture audiences.

Holism: Spiritual Oneness with Nature and Universe

Ralph Waldo Emerson's *Nature* (1836) summarizes the importance of a holistic worldview in American Transcendentalist thought. Emerson writes that man and nature³⁸, together, comprise the Universe; through quiet contemplation in nature, the divine essence of life can flow freely, uniting man with God. "Within these plantations of God, a decorum and sanctity reign... Standing on the bare ground, — my head bathed by the blithe air, and uplifted into infinite space, — all mean egotism vanishes. I become a transparent eye-ball; I am nothing; I see all; the currents of the Universal Being circulate through me; I am part or particle of God."³⁹ Communing with nature for Emerson meant contemplating the awesomeness of God's creation, and indeed one's own unity with that creation. Holism—in the form of oneness with nature and the unity of the spiritual and material worlds—was an essential theme in the Transcendentalist's reaction to the mechanistic and reductionist worldview they so opposed.

The counterculturists likewise reacted to a mechanistic system, namely the 'technocracy' described by Roszak; that vast, totalitarian system that seemed to control the economy, politics, culture, and even personal aspects of life, in the

³⁸ In Emerson's text, nature is referring broadly to the natural world, external from the self. This is further elaborated in his essay.

³⁹ Ralph Waldo Emerson, "Nature" (1836), *Emerson Online*, <http://www.emersoncentral.com/nature.htm>.

name of scientific efficiency and material comfort.⁴⁰ By linking the individual to a greater and more powerful whole, holistic thinking and practices provided individuals spiritual authority over the soulless bureaucratic systems that would seek to lull them into complacency. They also provided a partial antidote to the fragmentation of modern life.⁴¹

Counterculturists sought holism—both oneness with nature, and spiritual/material balance—through a number of practices. Oneness with nature might be achieved through rural or commune dwelling, gardening, macrobiotic diets, and even nudism.⁴² Holistic mind-body practices included yoga and meditation. “The universe and all creatures in it are intrinsically in a state of complete wisdom, love and compassion, acting in natural response and mutual interdependence,” wrote Gary Snyder in the counterculture *Journal for the Protection of All Beings*.⁴³ Roszak (1969) spoke of the need to reclaim a “magical vision” touched by ‘the beauty of the deeply sensed, sacramental presence...[like] the perception of the poet or painter in the presence of a landscape...we lose ourselves in the splendor or the terror of the moment and ask no more.’⁴⁴ Together these quotations reveal a potent yearning for wholeness.

⁴⁰ See Roszak, *The Making of a Counterculture*, 1-29.

⁴¹ It might seem at first glance that holism would be incompatible with the individualism described in the previous section. In reality, they were quite compatible. Individualism was about affirming one’s uniqueness and being self-expressive. Holism was about appreciating the interconnections between entities, such as the individual and the community, the mind and the body. Being a confident individual did not preclude holistic thinking, and vice versa.

⁴² Some of the naturalistic roots of the hippies are traced in Gordon Kenney and Cody Ryan’s “Hippie Roots & The Perennial Subculture,” *Hippy.com*, <http://www.hippy.com/modules.php?name=News&file=article&sid=243>.

⁴³ Gary Snyder, “Buddhist Anarchism,” *Journal for the Protection of All Beings* 1 (City Lights, 1961). See <http://www.bopsecrets.org/CF/garysnyder.htm>.

⁴⁴ Roszak, *The Making of a Counterculture*, 253.

Roszak, Linda Sargent Wood, and others have also pointed to the popularity of Gestalt psychology among counterculturists. Essential to gestaltism is the notion of a holistic brain that perceives the whole before it perceives the parts. Abraham Maslow (1908-1970), a prominent Gestalt psychologist whose books⁴⁵ were widely read by professionals and laypeople alike, was an influential and attractive writer to the counterculture. Maslow's approach emphasized the wholeness of the individual (self-actualization) as well as oneness with the environment. "His holism did not stop with the individual. Maslow's ultimate goal was communal wholeness, both in terms of a practical social oneness with others and in terms of a vague, transcendent cosmic oneness with the universe."⁴⁶ Interestingly enough, Maslow also profiled Ralph Waldo Emerson as one of a select list of self-actualized individuals, fully realized as an outwardly-directed "whole person."⁴⁷ This belies not only Maslow's admiration for Emerson, but also the essential compatibility between their holistic worldviews.

The Esalen Institute, founded in 1962 in Big Sur, along the northern California coast, gives further evidence of the holistic bent of the counterculture. Esalen organized retreats, workshops, and lectures that "promoted a fusion of science and faith, cross-cultural exchanges, environmental responsibility, and an end to racism, sexism, and the cold war...Speakers and participants, many of whom were

⁴⁵ For example, Wood reports that Maslow's *Towards a Psychology of Being* "appealed to college students, counterculture members, and mainstream audiences. It sold 200,000 copies even before it was reissued in 1968." See Linda Sargent Wood, *A More Perfect Union* (New York: Oxford University Press, 2010), 159.

⁴⁶ Wood, *A More Perfect Union*, 158.

⁴⁷ Wood acknowledges the conflict between individualism and holism in Maslow's work, and notes that Maslow was never able to fully reconcile the contradictions between individualism and communal interests in his own work. See Wood, *A More Perfect Union*, 154.

disgruntled with Western rationalism and dualistic separations of mind and body, human beings and nature, religion and science...experimented with a variety of holistic rituals."⁴⁸ In addition to hosting thousands of alternative-minded adults, Esalen also attracted celebrities such as Joan Baez, Bob Dylan, George Harrison, Ringo Starr, David Crosby, Stephen Stills, Graham Nash, Ravi Shankar, Paul Simon, Art Garfunkel; and Harvard LSD researchers Timothy Leary and Richard Alpert. As such, Esalen was more than just an eclectic seaside retreat; it was a cultural center, attracting some of the counterculture's most influential minds. Both Fuller and Maslow were invited speakers at Esalen.

Fuller's comprehensive model of nature, which linked mankind, the natural world, and technology in an ongoing process of evolution, represents his entirely holistic view of the universe.⁴⁹ (Although Fuller referred to himself as a *comprehensivist* rather than a *holist*, one could easily substitute these terms and call his *comprehensive* model of nature a *holistic* model of nature without any significant loss of meaning.) Everything was interconnected—God, the laws of nature, the universe, the animal and plant worlds, human intellect, technological development—in Fuller's mind, these phenomena were not separate, but woven together at the cosmic scale.⁵⁰ Fuller's holism necessarily included technology, which distinguished it somewhat from the holism of the Transcendentalists or the mind-body holism that became popular in the counterculture. Fuller's holism was

⁴⁸ Wood, *A More Perfect Union*, 170.

⁴⁹ These subjects subject, namely Fuller's model of nature and universal evolution, were discussed in detail in Chapters 1 and 2.

⁵⁰ See especially the discussion of Universal Evolution in Chapter 2. See also Sieden, *Buckminster Fuller's Universe*, xv.

the unity between cosmology, biology, and technology operating interdependently.

Fuller's holistic view found its fullest expression in the 'sweet spot' where what Fuller called "nature's coordinate geometry" seemed to overlap with human need. Geodesic structures in particular were nature's answer to the human need for shelter. Here, the universe seemed to have provided a strong, lightweight, self-supporting structure that could be infinitely scaled, from small hut to a massive dome over Manhattan. The dome with its sacred geometry linked nature, mankind, and technology in a harmonious whole, providing visible proof of universal evolution in action. Fuller's vision of utopia saw families around the world roaming home to a dome,⁵¹ perhaps even viewing the stars through its transparent skin. Technology was really nothing more than a means of realizing nature's design.

The holism of the domes was not only about uniting natural geometry with human need. It also extended, in Fuller's conception, well into the metaphysical realm. Fuller attributed to domes in particular a spiritual and cosmic significance reaching deep into human prehistory. He literally implied domes in matters of life and death:

So important have domes been through man's total experience that the roots of the word for God, home and dome are the same—domus, domicile, and dome...The D was interchanged with the T in designation of the dome as a mortuary shrine and with a W as the gestation or pre-nativity shrine. Thus man went from W-OM-B to T-OM-B via the H-OM-E. Even the B-OM-B is a derivative of

⁵¹ This phrase comes from a song, "Roam Home to a Dome" that Fuller sang, for fun, to the tune of "Home on the Range." See <<http://www.youtube.com/watch?v=B09PFhTlazU>>

*dome....In ecological patterning, [the hunter's wife became] the dome-man, the home-man, the w-om-man...[man] became H-OM-O sapiens, domo sapiens.*⁵²

Setting aside, for purposes of argument, Fuller's outlandish etymological claims,⁵³ he was really grasping at the same things as the counterculturists: a sense of a larger purpose, an ability to envision and participate in a greater whole as an antidote to the fragmentation of modern life. For Fuller, geodesic domes achieved that total integration. Fuller spoke so passionately about his domes that he transformed them from a pile of sticks and connectors into something far greater: a future in logic and harmony with nature and the universe, a world where technology represented intellectual understanding rather than alienation from nature.⁵⁴

From the Transcendentalists, Fuller inherited a belief in the vital union between God, mankind, nature, and the universe. Fuller integrated technology, in the form of technical adaptations of nature for the human good, into this holistic worldview. By focusing on areas where nature seemed to offer an answer to human need, as in the geometry of geodesic domes, Fuller maintained a holistic vision where man, nature, and technology stayed in cosmic balance. Like Buddhism, psychotropic drugs, gestaltism, and Esalen, Fuller spoke to the counterculture's deep yearning for a larger meaning that would transcend the mundane, and knit the material and

⁵² Fuller, *Ideas and Integrities*, 148.

⁵³ Etymology is a science in and of itself. Although *dome* and *domicile* are indeed related through the Latin word *domus* (house), the words *home* and *women* are derived from the Old English words *ham* (dwelling, house) and *wimman* (woman), which are unrelated. Fuller's claims for the links between these words are therefore specious at best.

⁵⁴ Because of Fuller's deep-seated religious beliefs, one-ness with nature also implied oneness with God, as it had for the Transcendentalists. For more on that, please refer to Chapters 1 and 2.

spiritual worlds—which industrialization had so rudely rended apart—back together again.

Pastoralism: Authenticity in Nature

In this section, “pastoralism” is used broadly in the sense that sociologist Bennett Berger defined it:

Simple living in harmony with nature in the country; continuities with the “suburban” idea;’ negative predispositions toward “technology”; pride in survival “on the land”; pride in development of manual skills; frugality, ecological consciousness; apocalypse: impending doom for the cities.⁵⁵

Pastoralism also implies a fairly common understanding of nature in which “nature” connotes the natural world, unblemished by technology and human intervention.⁵⁶ American Transcendentalists and counterculturists were both strongly attracted to pastoral ideals, even though relatively few actually returned to rural living. The overarching thought was that living closer to the land, respecting the cycles of the seasons and the whims of the elements, had inherent dignity, authenticity and value. It was precisely this authenticity and honesty of purpose that they found lacking from contemporary religion and urban life, respectively.

As Berger has pointed out, the idea that the rural life was more noble and desirable ignores the very harsh realities of rural existence, exposing the fallacy of

⁵⁵ Berger, *The Survival of a Counterculture*, 19.

⁵⁶ See Kate Soper, *What is Nature*, 19.

the pastoral myth. Yet, the myth remains deeply rooted in American history and is central to a pastoral tradition. For the Transcendentalists as well as the counterculturists, returning to the land, or at least pining for such a simple, self-sufficient rural life, offered a “transcendent myth to ennoble [and enrich] their own daily lives.”⁵⁷

Among the Transcendentalists, Henry David Thoreau’s *Walden* (1854) exemplifies the enlightened pastoral life to which they aspired. Thoreau wrote *Walden* while living for two years, two months, and two days in a simple log cabin near Walden Pond, Massachusetts (which, in reality, was only about 3 km from his family’s home.) “I went to the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived,” wrote Thoreau. Pastoralism was also a driving force behind the establishment of Brook Farm, a communal living experiment started by Transcendentalists George and Sophia Ripley in Massachusetts during the 1840s. “What absurdity can be imagined greater than the institution of cities?” wrote Elizabeth Palmer Peabody in 1841, commenting on Brook Farm. “In order to live a religious and moral life worth the name...They have bought a farm, in order to make agriculture the basis of their life, it being the most direct and simple in relation to nature.”⁵⁸

⁵⁷ *ibid*, 101. See also Berger, 91-100.

⁵⁸ Elizabeth Palmer Peabody, “Plan of the West Roxbury Community” (1841), reproduced in George Hochfield, ed., *Selected Writings of the American Transcendentalists* (New Haven: Yale University Press, 2004), 391. Fuller was very interested in the Transcendentalists, particularly his aunt Margaret Fuller. Fuller grew up in Milton, MA, about 7 miles (11km) from Brook Farm.

A century later, the countercultural movement revived the pastoral tradition in the form of the rural commune movement. Though the context clearly differed, the idea that a life “closer to nature” would be more wholesome and authentic was certainly shared between Transcendentalists and communards. Berger goes one step further, calling pastoralism “something of [a] religious dedication” among some commune dwellers who became “almost competitive in their desire to demonstrate their commitment to the natural and the unvarnished.”⁵⁹ To live off the land to the communards was to be self-sufficient; to demonstrate survival skills in the face of urban apocalypse; to eschew material luxury; to thwart social conventions; to replace big technology with craft; and to demonstrate ecological awareness.⁶⁰ And, although only a portion of counterculturists actually lived on communes,⁶¹ their ideals and actions represented a radical and particular form of countercultural protest with which their city-dwelling peers generally sympathized. The communards embodied the counterculture in their desire for authenticity, their willingness to challenge the status quo, and in their concerns for ecology and the environment.

Fuller’s writing reveals less of a romantic pastoral bent than that of the Transcendentalists or the rural communards. But nature for Fuller still represented an arena to develop the authentic self; retreating to nature promoted self-

⁵⁹ Berger, *The Survival of a Counterculture*, 92.

⁶⁰ For a discussion of some of these ideals, see Berger, *The Survival of a Counterculture*, 105-113.

⁶¹ As noted at the beginning of the chapter, Judson Jerome has estimated that some 750,000 people lived in communes across the United States by the early 1970s. (See footnote 8). This seems like a high number, and it probably includes both transient commune dwellers as well as permanent ones. That said, I have not been able to find a consistent statistic for how many Americans lived on communes in total during the 1960s-1970s or how the numbers varied over the years. Berger, in his introduction, writes that “the commune movement never attracted more than a small percentage of its potential constituency, even at the height of its appeal between 1968 and 1971.” See Berger, *The Survival of a Counterculture*, 9.

sufficiency and also provided time for creative reflection and close observation of the natural world. It was in these senses that Fuller shared in the pastoral tradition.

Though Fuller lived in cities and suburbs for most of his life, periodic retreats into the wilderness were essential to his development as a scientist and designer from an early age, as discussed in Chapter 1. Living under primitive conditions stimulated the young Fuller to devise new tools such as the mechanical jellyfish propulsion device; and as an adult, the rural island remained a favored annual retreat that afforded physical and mental regeneration.

R. Buckminster Fuller has long been described as a futurist, a forward thinker, and a man ahead of his time.⁶² Ironically, it was not Fuller's ability to see ahead, but rather his ability to channel the past that made him such a success with the counterculture. Fuller brought the legacy of Transcendentalism into the twentieth century, albeit melding it with his own ideas about the importance of technology. Transcendentalism, with its emphases on individualism, holism, and pastoralism, aligned with some of the key ideals of the 1960s counterculture movement. His familiarity with this tradition—indeed his deep and demonstrated connection to it—gave Fuller a legitimacy with the counterculture shared by few of his peers.⁶³

⁶² The title of Fuller's obituary, published in the *New York Times*, read "R. Buckminster Fuller, Futurist, Inventor, Dies at 87." (*New York Times*, July 3 1983). The *Encyclopedia of the Future* (1996) listed Fuller as the most influential futurist in the world, according to a survey of professional futurists. See Medard Gabel, "Buckminster Fuller and the Game of the World," in Thomas Zung, ed., *Buckminster Fuller: Anthology for the New Millennium* (St Martin's Press, 2001) 122. These are but two examples of Fuller's reputation as a futurist.

⁶³ When I use the word "peers," I mean people of Fuller's generation with a similar status. Fuller was a septuagenarian college professor during much of the 1960s; there were few such individuals that were such popular speakers at universities, or such popular authors with the counterculture. Authors and academics including Alan Watts (1915-1973), Timothy Leary (1920-1996), and Theodore Roszak (1933-2011) might be considered Fuller's peers, although all were considerably

Modern Youth: A New Audience

Until the early 1960s, Fuller's reputation varied, both among his professional peers and in the popular press. He had enjoyed considerable success working with military and industrial partners, and was considered an inspired, if non-traditional, inventor. His reputation in the architecture and design professions remained on the fringe, and Fuller was not really claimed by those professions until decades later. The media often portrayed Fuller as the somewhat bizarre designer of futuristic prototypes such as the Dymaxion House. The *New York Times* described improbable fantasies that "emanated from Mr. Fuller's dream castle."⁶⁴ And while not entirely dismissing his domes as "crackpot schemes," the *Times* did suggest that Fuller would have to wrestle with significant "esthetic and philosophical questions" if his work was to pass from "building" to "architecture."⁶⁵ Fuller "schemes" for the Dymaxion car and house had piqued the public's curiosity over the years, but he was seen more as an eccentric inventor than a serious architect or intellectual.

The larger-than-life reputation that Fuller enjoys today—as a forward-thinking inventor, philosopher, Renaissance man, and proto-environmentalist—was largely forged during the 1960s through a combination of serendipity and self-promotion. Serendipity came in the form of the considerable confluence between Fuller's Transcendentalist ideals and those of the counterculture. Fuller's ability to speak

younger than Fuller who was born in 1895. Nor did his peers use Transcendentalist ideas to establish common ground with the counterculture.

⁶⁴ Brooks Atkinson, "Critic at Large." *New York Times*, Apr. 05 1963: 33. ProQuest. 12 Sep. 2013.

⁶⁵ Aline B. Louchheim, "New Ways of Building," *New York Times*, Aug. 31, 1952: X6. Proquest, 12 September, 2013.

to these ideals gave him a unique spiritual and intellectual authority. The unusual picture—Fuller with his bald pate, addressing crowds of admiring student and/or disheveled hippies —became fairly common during this time.⁶⁶ The “modern youth listened raptly as the somewhat disheveled, stockily built Mr. Fuller, his arms waving excitedly, his eyes flashing behind thick glasses, told of his dreams of a better tomorrow.”⁶⁷ The idealism and hope that young people invested in Fuller’s vision of the future inflated his reputation as an omniscient, nature-inspired designer. Fuller also fanned the flames of his popularity, parlaying lectures into books, and charging substantial fees for his speaking engagements.

Fuller used his platform to promote the same basic message that he had in the past: that technology, properly applied, could lead to a higher standard of living around the world. However, during the 1960s, Fuller’s message was particularly potent because it addressed two of the counterculture’s outstanding needs. Firstly, Fuller conjured a vision of a brighter future that was particularly attractive to a generation that notwithstanding their disillusionment knew no real alternative. This gave them a place to invest the hope that they had willfully withdrawn from the present reality. Secondly, Fuller provided them with a sorely-needed accommodation for technology within a world that was fully industrialized with no signs of turning back. Fuller addressed the negative predisposition toward

⁶⁶ Starting in the 1960s, Fuller maintained a grueling travel schedule. Former archivist Bonnie De Varco wrote: “On just one page of the last fifteen years of his life you can see a jaunt from Philadelphia to Canada to Chicago to Italy and then to Israel in less than a week, each stop involving some meeting, lecture or project he was working on. Bucky was a consummate “world citizen” and his itinerary shows it.” Many of these were lectures at colleges and universities including MIT, Yale University, Harvard, University of British Columbia, North Carolina State, the University of Minnesota, and others too numerous to mention. See Bonnie De Varco, “Life, Facts, and Artifacts,” *WNET American Masters* website, <http://www.thirteen.org/bucky/devarco.html>.

⁶⁷ Albin Krebs, “R. Buckminster Fuller Dead: Futurist Built Geodesic Dome,” *New York Times*, July 2 1983: 1.

technology by helping the counterculture to define the conditions under which technology, ethically and judiciously applied, could advance their ideals of world peace, economic justice, and so on. Fuller promoted technology as a natural outgrowth of human intelligence, according to his theory of universal evolution (discussed in Chapter 2). This provided a naturalistic way to re-incorporate technology into the discussion while keeping the countercultural ideals intact.

A vision of tomorrow

Historian Howard Segal has placed Fuller within the tradition of technological utopianism; a line of visionaries⁶⁸ who believed technology would be a panacea for society's ills. Moreover, Segal also calls Fuller "the last popular American utopian who engaged in utopian thinking, speaking, writing and building for their own sake rather than, as is common today, for commercial reasons."⁶⁹ Fuller's utopian visions were forged in the 1920s, closely associated with the "Machine Age," when there was considerable popular enthusiasm for new technologies, transportation, and scientific management.⁷⁰ Fuller saw industry's potential for revolutionizing housing as a worldwide service system of affordable single-family homes, as expressed in the 4D housing project. Every family would have an affordable, lightweight home made of mass-produced component parts, shippable to any corner of the globe. A 4D house would furnish all the modern conveniences at a

⁶⁸ This line, according to Segal, includes Auguste Comte, Charles Fourier, Karl Marx, and Friedrich Engels, among others.

⁶⁹ Howard Segal, "America's Last Genuine Utopian?" in Chu, ed., *New Views on R. Buckminster Fuller* (Stanford: Stanford Univ. Press, 2009), 39.

⁷⁰ Some examples of new technologies that were being adopted and welcomed by the public included radio, film, mass-produced automobiles and other commodities, electricity and electrical appliances. Magazines such as *Popular Science* and *Scientific American* fed the public interest in invention and technology.

fraction of the cost and weight of a traditional home. Although over time, the boxy 4D house was supplanted by the Dymaxion house and geodesic domes, the basic outlines of Fuller's utopia remained the same: efficient use and distribution of resources and featherweight shelters for all would put an end of poverty and war. "War...has been occasioned always throughout the ages by the fact that there is not enough to go around."⁷¹

Counterculture youth were looking for a radical break with the status quo, and Fuller's utopia—however improbable to its critics—offered an alternative. The way this new world would unfold, as Fuller described it, was equally appealing: warmongers, politicians, and greedy capitalists would be left behind while a small cadre of design scientists would invent their way to a peaceful intellectual revolution.⁷² Fuller advocated "taking away all the politicians and all political ideologies," and letting the design scientists "take care of 100% of humanity" by employing the world's resources effectively "without any man enjoying life around the earth at the cost of another." Fuller insisted that this was possible, based upon changes he had seen in his own lifetime. Since 1900 (according to Fuller) people had tripled their lifespan, and an advanced standard of living had increased "from 1% in 1900 to 40% of all humanity in 1966." Design scientists would help to get humanity "from 1966 to Utopia."⁷³

⁷¹ R. Buckminster Fuller, *Utopia or Oblivion* (New York: Bantam, 1969), 251. Note: Unless otherwise indicated, most of the references to *Utopia or Oblivion* in this chapter relate to the 1969 edition of this book.

⁷² Ironically, it seems that Fuller's utopia would simply replace one set of technocrats with another set, the appointed design scientists. Fuller never explains why the design scientists would be any less prone to corruption and power politics than the politicians.

⁷³ Fuller, *Utopia or Oblivion*, 346-348.

Fullerian inventions, of course, helped to illustrate this vision. Single family dome homes were only the beginning of a world-around revolution in mobile climate control. Fuller foresaw “floating tetrahedral cities, air-deliverable skyscrapers, submarine islands, subdry-surface dwellings, domed-over cities, flyable dwelling machines, rentable, autonomous living boxes, that man may be able to converge and deploy at will around the earth, in great numbers, without further depletion of the productive surface of the earth.”⁷⁴

Fuller chided the counterculture youth for their naïveté in expecting politicians to respond to their cries for world peace. “Most of the young idealists are naïve [by turning to politicians]...there is nothing anywhere in politics per se, political mandates, political activity that can in any way up the performance per pound of the world’s resources and thereby make the resources take care of 100% instead of only 44%.”⁷⁵ His design science revolution, with engineers and scientists bringing their technological know-how to world problems, was the only viable solution. Ironically enough, Fuller’s utopia still seemed like a technocracy as defined by Theodore Roszak, with politicians and social engineers being replaced by design scientists who would control the distribution of world resources—although the latter would ostensibly be more humanistic, egalitarian, and incorruptible than the former. This point was all but lost on his youthful followers, who cleaved to the vision of a brave new world to replace the soulless and corrupt one they believed they had inherited.

⁷⁴ Fuller, *Utopia or Oblivion*, 357.

⁷⁵ Fuller, *Utopia or Oblivion*, 250-251.

Whereas the U.S. Military was a major sponsor of Fuller's geodesic dome projects during the 1950s, from the 1960s onwards speaking fees at universities provided a major source of income. At the height of his popularity from the late 1960s to early 1970s, Fuller commonly charged \$5000 for a single lecture engagement, which translates to some \$30,000 in today's dollars.⁷⁶ He courted this young audience, suggesting that they alone were uniquely open-minded and farsighted enough to make a difference. "The successful transition of world society to the new 'norm' of man as physical and intellectual success can, and we hope will, be realized on spaceship *Earth* through the idealism of youth..." wrote Fuller.⁷⁷ It would be a design science revolution with Fuller at the helm.

Ideological Accommodations for Technology

Technology had always played a central role in Fuller's work and his vision of the future depended upon it. As a speaker, Fuller performed a unique balancing act; he managed to ardently promote technological progress while simultaneously keeping the pastoral ideals of the countercultural youth intact. A first order of business was to neutralize the counterculture tendency to equate technology with greed and apocalypse. Fuller pointed out that technology, in and of itself, was neither inherently good nor evil. The question at hand was its ethical or unethical application. Technology, applied with foresight according to the outlines of

⁷⁶ The \$5000 speaking fee is reflected in correspondence with universities found in the R. Buckminster Fuller Collection at Stanford University. Although the exact proportion of his income that came from speaking engagements is not known, one might be able to estimate this by reviewing various business documents in the Collection. Calculating all the sources of income might be difficult, as Fuller was also receiving a salary, royalties for books and geodesic domes, and some income from companies that he co-owned. I have not attempted to do that here.

⁷⁷ Fuller, *Utopia or Oblivion*, 305. (emphasis original).

“design science,”⁷⁸ could lead to a higher standard of living for all inhabitants of Spaceship Earth. Conversely, applied in a shortsighted manner, technology could equally be a force for destruction. It was imperative, therefore, to ‘produce ever more advanced livingry artifacts instead of the killingry weapons of world war gaming.’⁷⁹ This was a frequent theme in his lectures, as well as in his books *Ideas and Integrities* (1968), *Utopia or Oblivion* (1969), and *Critical Path* (1981).

Fuller’s own architectural work spoke to the importance of ‘livingry’. What was the Dymaxion House if not a proposal for a cost-effective, comfortable dwelling to ensure the physical well-being of a family of modest means? What were domes if not efficient shelters for autonomous living, devoid of class markers, and equally useful in the deserts of Afghanistan or the hills of California? By focusing on the ethical applications of technology, Fuller appealed to the counterculture ideals of equality, world peace, self-sufficiency, and economic justice. He painted a vision of the future where design science interventions such as these would convert “the world’s resources from the service of only 44% of humanity to the service of 100% of the world’s population –a facile matter...”⁸⁰ Design science would, in Fuller’s

⁷⁸ “Design Science” is the term that Fuller used to refer to design that intelligently anticipated human needs, and addressed those needs efficiently and effectively with an understanding of the world resources available. The *Buckminster Fuller Institute* defines design science as “a problem solving approach which entails a rigorous, systematic study of the deliberate ordering of the components in our Universe. Fuller believed that this study needs to be comprehensive in order to gain a global perspective when pursuing solutions to problems humanity is facing.” See the *Buckminster Fuller Institute Website*, <http://www.bfi.org>.

⁷⁹ R. Buckminster Fuller, *Critical Path* (St Martin’s Griffin: 1982) 203.

⁸⁰ R. Buckminster Fuller, *Utopia or Oblivion* (Zürich: Lars Müller, 2008) 248. This quote regards specifically the use of metals, although it is clear that Fuller believe that design science will reach similar efficiencies with other resources. Fuller’s contention throughout *Utopia or Oblivion* was that the world’s metal supply was sufficient to support only 44% of humanity’s needs. These numbers were ostensibly based on metal industry statistics, although Fuller does not cite his sources. Throughout the rest of *Utopia*, Fuller uses the numbers 44% and 100% to represent the present efficiency of resource use (44%) compared with the potential efficiency of resource use (100%, employing design science approaches).

words, make it possible to support “100% of humanity’s increasing population at higher standards of living than any human minority or single individual has ever known or dreamed of...”⁸¹ Although from a critical standpoint, the spatial solutions that Fuller was proposing were unlikely to satisfy 100% of humanity, the grand vision that he painted of an end to world poverty, a widely shared prosperity and a roof over every head appealed to counterculture idealism and showed how technology could be applied for the greater good.

Technology to Tools

In addition to coining the term “design science,” which denoted the judicious use of resources toward humanitarian ends, Fuller also reoriented the conversation away from “technology” and toward “tools.” This was related to a larger movement—promoted by economist E.F. Schumacher, philosopher Ivan Illich, and others—to move toward smaller-scale, decentralized, and locally-controlled technologies that they believed would more directly benefit individuals. Schumacher, in his influential book *Small is Beautiful*, wrote “we can interest ourselves in the evolution of small-scale technology, relatively nonviolent technology, ‘technology with a human face.’”⁸² This was in line with Fuller’s calls to move technology from “killingry to advanced livingry.”⁸³ Both Fuller and Schumacher presented at the Aspen Institute during the 1960s; and it is quite possible that Fuller was familiar with Schumacher’s work and his writings.⁸⁴

⁸¹ Fuller, *Utopia or Oblivion* (2008 edition), 359.

⁸² E.F. Schumacher, *Small is Beautiful: Economics as if People Mattered* (Harper Collins, 2010) 22. (First published 1973)

⁸³ Fuller, *Ideas and Integrities*, 249.

⁸⁴ See Jurgen Schmandt, *George P. Mitchell and the Idea of Sustainability* (Texas A&M University Press, 2010), 30. Ernest Friedrich (E.F.) Schumacher’s influential book, *Small is Beautiful*, first published in

Technology with a capital *T* continued to connote something wide-reaching, sinister, and uncontrollable. It represented the military-industrial complex, atomic weapons, polluting factories. *Tools*, on the other hand, connoted manual skill, craftsmanship, small-scale extensions of human capabilities. Atomic bombs and pharmaceutical labs were technology; hammers, hoes, and sewing machines were tools.⁸⁵ This viewpoint helped to justify the use of 'technology' at a small scale, in service of human survival, and was part of the "remedial ideological work"⁸⁶ that counterculturists had to engage in to accept technology, and the very real benefits it promised, into their lives. For better or worse, technology was firmly embedded in everyday life and a necessary part of survival for even the most dedicated anti-establishment communards.⁸⁷ "For the young people who flocked to [his] lectures...[Fuller offered] an entrepreneurial, individualistic mode of being that was far from the world of the organization man—and yet a mode in which they still didn't need to give up the stereos and automobiles and radios that industrial society had created."⁸⁸

1973, contains essays regarding his philosophies of appropriate technology. It is not clear that Fuller and Schumacher presented at the same conferences at the Aspen Institute, or indeed whether or not they were personally acquainted. I have not been able to find correspondence between Fuller and Schumacher in the Fuller Archive. However, it seems plausible that the two would have crossed paths through Aspen and/or that Fuller had read Schumacher's book. This is why I say it is "quite possible" that Fuller was familiar with Schumacher's work. Indeed the way that Fuller began to speak of technology as tools suggests that he was aware of and following this trend.

⁸⁵ Yet another example: A chainsaw in the hands of a logger, paid by a logging company to clear-cut acres of trees was evil "technology"; a chainsaw in the hands of a rural comunard building a log cabin for his family was a "tool" for survival, in line with the pastoral ideal of self-sufficiency. See Berger, *The Survival of a Counterculture*, 115.

⁸⁶ See Berger, *The Survival of a Counterculture*, 113.

⁸⁷ Berger describes "The Ranch," a 140-acre commune in rural California that he studied for six years during the 1970s, as having a restaurant-sized gas range, two large gas refrigerators, sinks with running water, kerosene lamps, wood burning stoves, and several cars and trucks (not all of which worked.) See Berger, *The Survival of a Counterculture*, 25-27.

⁸⁸ Fred Turner, *From Counterculture to Cyberculture*.

This characterization of small scale technologies as “tools” had a profound effect on a small number of counterculturists. It made it much easier to see technology as ‘natural’ outgrowth of human evolution, in line with Fuller’s theory of universal evolution. While counterculturists continued to despise Technology⁸⁹ as represented by big corporations and the military, technology in terms of “tools” for survival took on a noble role in terms of ensuring individual self-sufficiency. Most visibly, Fuller’s influence was seen in the *Whole Earth Catalog*, a counterculture do-it-yourself serial published from 1968-1972 and intermittently thereafter. The *Catalog*, founded by Stewart Brand with the subheader “Access to Tools,” promoted a do-it-yourself, anti-establishment ethic. Its first issue was prominently dedicated to Fuller, reading “The insights of Buckminster Fuller are what initiated this catalog...Fuller’s lectures have a raga quality of rich nonlinear endless improvisation full of convergent surprises.”⁹⁰ Also featured in the first issue were excerpts from Fuller’s writings and poetry; selections from D’Arcy Wentworth Thompson’s *On Growth and Form* showing tetrahedral geometries found in nature; notes on raising honeybees; and manuals for building everything from tipis to geodesic sun domes.⁹¹

⁸⁹ I have used capital T to denote “big technology” from small-scale technology.

⁹⁰ Stewart Brand, *Whole Earth Catalog* (Fall 1968). Available online at <http://www.wholeearth.com/>.

⁹¹ The experimental, do-it-yourself ethic that the *Whole Earth Catalog* represented prefigured the “hacker mentality” and flat organizational structures that led to the computer revolution in Silicon Valley. This has been investigated at length in Fred Turner’s *From Counterculture to Cyberculture* (Chicago: University of Chicago Press, 2008) and other recent publications, and will not be investigated at length here. See also John Markoff, *What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry* (Viking, 2005); William Harold Bryant, *Whole System, Whole Earth: The Convergence of Technology and Ecology in Twentieth-century American Culture* (ProQuest, 2006); and the reprinted edition of Steven Levy’s *Hackers: Heroes of the Computer Revolution* (O-Reilly Media, 2010).

Fuller actively promoted this view of small scale tools with his counterculture audiences. A 1967 film clip shows Fuller addressing a crowd of young acolytes at Hippie Hill, a popular gathering spot in San Francisco. When an audience member expressed his sense of alienation by technology, Fuller countered by stating that “Every tool we have is an externalization of the original integral function of man... Do you feel alienated when you have a spoon in front of you instead of using your hands [to eat]?”⁹² He also sympathized with both the disillusionment and the idealism of counterculture youth, stating “I feel that your kind of disconnect has to do with the fact that the young world really intuitively feels that the older world...are actually preoccupied with shortsightedness with the world.” Instead, Fuller offered them a vision of a design science utopia where all would live harmoniously and with a high standard of living. “[We can] support all the life on earth at higher standards of living than we have ever known [so that] any man can enjoy the whole earth.”⁹³

Fuller became something of a folk hero to the counterculture, an iconoclast whose personal biography suggested he was not one of *them*, but one of *us*. “I...was ejected so frequently from the establishment that I was finally forced either to perish or to employ some of those [intellectual] faculties with which we are all endowed. His history of being kicked out of Harvard in 1912, a source of

⁹² R. Buckminster Fuller, *Fuller Addressing a Crowd at Hippie Hill* [film], San Francisco, CA, 1967. (producer unknown)

⁹³ In this same address on Hippie Hill, Fuller also said “I’ve now visited 264 universities around the world, primarily because I’ve been invited there by the students, not by the faculty.” This is important because it shows just how popular a speaker Fuller was with these young audiences.

considerable embarrassment during the first half of his career,⁹⁴ suddenly became a featured part of his story and one that garnered admiration with the “turn on, tune in, drop out” crowd.

Fuller’s domes, as discussed in Chapter 4, held both practical and symbolic value for counterculturists in general and communards in particular: “Geodesic domes were cheap, mobile, and relatively easy to build—in short the very kind of high-concept, utterly practical tool an enterprising individual might need for building a different sort of relationship with the planet.”⁹⁵ Communes such as Drop City (Colorado), and The Ranch paid homage to Fuller, building geodesic domes as homes and communal gathering places. As late as 2004, *The Farm*, an intentional community in Tennessee established in 1971, built a 14-foot geodesic called the Wholeo Dome as an artistic installation; the plans for the dome dated back to 1974. A number of Fuller’s students or followers even went on to found dome-building companies, although many were short-lived and not particularly profitable.⁹⁶

Roaming home to a dome?

In spite of Fuller’s popularity as a public intellectual and his publication of several influential books, the outcome of Fuller’s activities during the long 1960s was not

⁹⁴ In his correspondence during the 1920s and 1930s, for example, Fuller often signed his business correspondence as “R. Buckminster Fuller, Esq.” Since Fuller had no legal training, it can be speculated that the “Esq.” was supposed to add gravitas to his signature. [Wasn’t it fairly widespread at the time – I remember being and “Esq.” at a comparatively early age!] He also occasionally referred to himself as “Harvard Class of 1917” although he never graduated from Harvard. Notwithstanding his lack of a bachelor’s degree, Fuller was awarded 47 honorary doctorates over the course of his lifetime, according to the *Buckminster Fuller Institute Website*(www.bfi.org).

⁹⁵ Bryant, *Whole System, Whole Earth*, 124.

⁹⁶ One of the more successful dome-building companies was *Zomeworks*, founded by Steve Baer whose early experiments at Drop City in Colorado led to the invention of different space-frame systems and so-called “zome” domes.

ultimately the widespread adoption of dome homes nor an end to world hunger. As the counterculture waned, so too did the prospects for a design science revolution. But the decline of the counterculture itself was only part of the reason why Fuller's utopia was not more fully realized by the generation most likely to support it.

As described above, the legacy of Transcendentalism created considerable common ground between Fuller and the counterculturists. But there was an incomplete overlap in their resultant visions of the future, both in terms of technology and in terms of social change. Fuller was able to reorient the conversation away from technology and towards "tools." Even so, there remained a fundamental gap between Fuller's wholesale embrace of industrial technology and the counterculture's limited reception of it. Although "tools" could be embraced in a limited fashion, the kind of mass-produced, standard issue housing that Fuller proposed could not.

Fuller's utopia bore all the hallmarks of the industrial age: he envisioned identical housing pods, shipped around the world along existing distribution networks. Dymaxion houses, for example, would contain two bedrooms, two bathrooms, an ample living room, and a modest kitchen to house two parents, two children, and one family car. They would be inexpensive to produce, and would be "machines for living" in, rather than sources of class distinction or personal expression. With their mass-produced stamped bathrooms and standard-issue parts, Dymaxion

homes would be have been impossible to produce without industrial machinery.

(Figure 1)

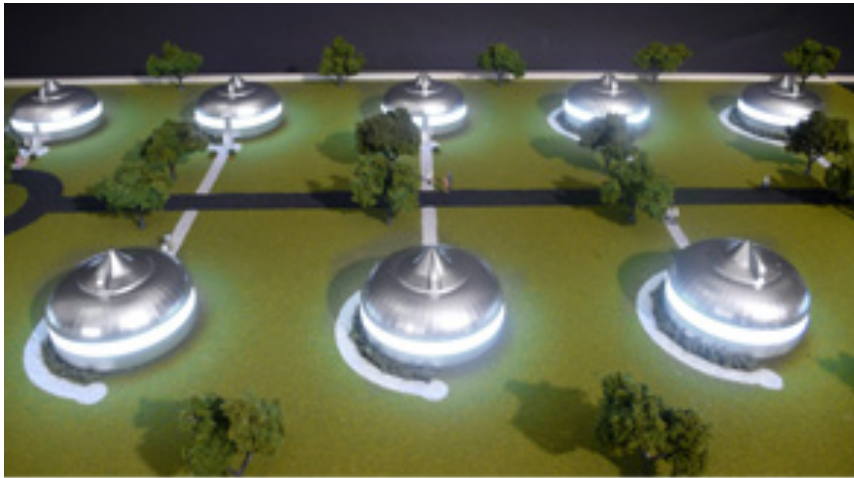


Figure 1: Dymaxion Homes, model community (Whitney Museum Exhibition, 2008)

A vision of so many neat rows of Dymaxion homes was a far cry from the ramshackle domes built by the Droppers at Drop City, Colorado (Figure 2). The Droppers scavenged building materials from junkyards and their domes were nothing if not self-conscious expressions of social and political dissent. Domes for Fuller were perfect geometries: clean, lightweight, crystalline, air liftable. The Dropper domes were heavy, cobbled together affairs, material symbols of anarchy that were almost vulgar by comparison.

Where Fuller found solace in the universal truths of science and mathematics, the counterculturists were obsessed with self-exploration, finding their own personal truths. Although Fuller courted a youthful audience, their willful self-indulgence bewildered him; he seemed perplexed by their lack of discipline, “aimless drifting,” and anarchic tendencies.⁹⁷

⁹⁷ Felicity Scott, “Fluid Geographies: Politics and the Revolution by Design,” In Chu, ed., *New Views on R. Buckminster Fuller*, 170-171.



Figure 2: Drop City, Trinidad, CO (date unknown)

From the 4D house to the Dymaxion home, indeed to his own dome home in Carbondale, Illinois, Fuller's intentions for housing remained decidedly middle-class. Although his dwellings were novel in their form, his visions of home life were decidedly prosaic. Photographs of the Dymaxion Dwelling Unit (c. 1940) and Dymaxion house (Figures 3, 4) comprise a pastiche of middle-class values: a car in the garage, the wife and kids, and all the modern conveniences. This kind of conservatism was antithetical to countercultural youth and commune dwellers in particular, who were open to different gender roles, communal marriages, bisexuality, and other arrangements that necessitated alternative communal structures.

Although he kept an open mind toward other cultures and religious practices, Fuller showed little interest in exploring social issues like feminism, sexuality,

gender, or race whether in his public or private life. He was neither engaged, nor particularly interested, in addressing the ardent social struggles of the decade. In part, this was because he felt—as did many of his contemporaries—that that was

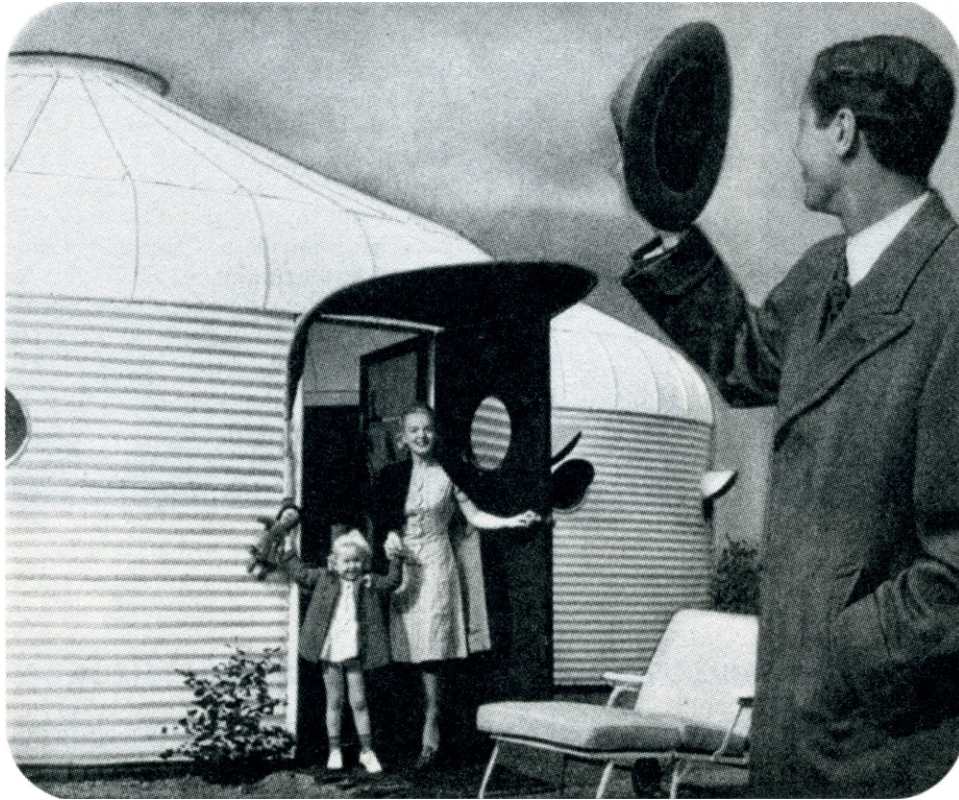


Figure 3: Dymaxion Deployment Unit, 1940 (www.cjbuildsllc.com)

the province of the young. In part it was also because his design science program—dependent as it was upon systems thinking, applied geometry, resource allocation, and worldwide distribution networks—was ill-equipped to grapple with the very real social inequities that caused world poverty and hunger in the first place. Fuller continued to speak at universities and institutions throughout the 1970s. But as the decade wore on, so did the potency of his design science scenarios. “We bought enthusiastically into the exotic technologies of the day, such as Fuller’s geodesic domes and psychoactive drugs like LSD,” recalled Stewart



Figure 4: Wichita House (1948), period interior (Henry Ford Museum)

Brand in 1995. “We learned from them, but ultimately they turned out to be blind alleys.”⁹⁸ By the 1980s, Fuller and his small band of remaining followers, with their “kits of jargon” and their “groaning board of geodesic paraphernalia”⁹⁹ were largely written off as incurable technological optimists at best, soporific relics at worst.

⁹⁸ William Harold Bryant, *Whole System, Whole Earth: The Convergence of Technology and Ecology in Twentieth-century American Culture* (ProQuest, 2006), 198.

⁹⁹ Frances X. Clines, “Conventioneers Look to the Future,” *New York Times* July 23, 1982.

Chapter 6

Technocrat or environmentalist?

Context

R. Buckminster Fuller was clearly aware of the finite resources on planet earth and the need to use them efficiently. Some¹ have argued that Fuller's "doing more with less" approach was an early form of environmentalism. But, over the course of his career, Fuller counted among his clients some of the largest industrial giants in the world—among them Ford, Alcoa, Union Carbide, and Monsanto—with little apparent concern for the environmental damage caused by their activities. He also scoffed at concerns that the world's burgeoning population was causing irreparable damage to the planet. Given this dichotomy, where along the environmental spectrum did Fuller lie? Was he a technocrat at heart, or an environmentalist? In this chapter the question will be explored from a number of points of view.

Contemporary conversations about nature and design often head in the direction of sustainable or green design. Sustainable design, broadly speaking, refers to design that seeks to decrease or eliminate adverse environmental impacts throughout the cycle of the design and consumption process. Sustainable design is practiced across a broad spectrum of architecture, industrial, and graphic design. Although "nature" and "the environment" are not the same thing, a connection between environmentally sensitive design and nature is often made, in the sense

¹ Scholars such as Peder Anker and Fuller's biographer have made such claims, discussed in further detail below.

that “the environment” represents the natural world; green design is intended to protect the environment and hence the natural world.

R. Buckminster Fuller has been called by some an early environmentalist, a designer ahead of his time who sought to minimize environmental damage through careful stewardship of resources. This notion is prevalent in the scholarly community as well as in the public consciousness. Peder Anker notes that Fuller “is portrayed as providing designers and environmentalists alike with tools to better life”; that Fuller’s domes have been recognized as metaphors for “spiritual ecological ‘earth-consciousness,’” and that his “‘World Game’ may also deserve a place within the history of environmental programming.”² Anker also posits that Fuller’s *Synergetics* (1975) “laid the foundations for an ecological design revolution based on geometric and energetic principles.”³ Timothy Luke (2010) argues that Fuller “anticipated much of contemporary environmental thought and practice,” and that his obsession with materials efficiency was part of a radical rethinking of environmentalism during the 1960s.^{4,5} In the popular realm, the website Wikipedia plainly states that “Buckminster Fuller was an early environmental activist.”⁶ Lloyd

² Peder Anker, “Buckminster Fuller as Captain of Spaceship Earth,” *Minerva* (2007): 45, 217.

³ *Ibid*, 433. It should be noted that Anker offers little to no evidence to substantiate this claim. *Synergetics* had relatively little effect upon the community of mathematicians and scientists of the late 1970s, much less upon leaders of the emerging environmental movement.

⁴ Timothy Luke, “Ephemerization as Environmentalism” *Organization Environment* 2010:23, 355.

⁵ Jonathan Massey has also called Fuller “[the most] important precursor to today’s sustainable design movement.” However, it should be noted that Massey is referring to Fuller as a precursor to sustainable design, rather than an ecological or sustainable designer by definition. For this reason, Massey is annotated here but not added to the list. See Jonathan Massey, “The Sumptuary Ecology of Buckminster Fuller’s Designs, in A. Braddock and C. Irmischer, eds., *A Keener Perception: Ecocritical Studies in American Art History* (Tuscaloosa: University of Alabama Press, 2009), 218-36.

⁶ “Buckminster Fuller,” *Wikipedia*, http://en.wikipedia.org/wiki/Buckminster_fuller, Accessed 4 November 2013. Although Wikipedia as a crowdsourced reference is considered somewhat unreliable in academic circles, it is nevertheless a widely consulted online reference and its article on Fuller reflects a popular public view of his environmental importance.

Steven Sieden in the *Examiner* goes even further, calling Fuller “the first environmentalist.”⁷ The latter sources reflect a popular view of Fuller that has taken root in the public consciousness.⁸

In this chapter, I will challenge the widespread notion that Fuller was an prescient environmentalist, and argue that he was in fact staunchly loyal to a techno-utopic worldview forged during the height of American industrial progress. His obsession with ephemeralization grew not out of concern for a “silent spring,” but out of a deep admiration for Frederick Taylor, Henry Ford, and other doyens of industrial efficiency who sought to extract the maximum value out of every pound of material and minute of time invested in the industrial process.

Fuller was aware of the growing environmental movement, but he was mostly a bystander and not a participant. Starting in the mid-1960s, Fuller’s acknowledgement that human behavior and consumption of material goods might adversely impact the environment was tentative at best, spineless at worst. His career, after all, had coincided with the spectacular rise of Fordism as a valid industrial and social system that led to economic growth and provided affordable goods for the masses. Fuller’s own ceaseless technological optimism and dedication to the modernist ideals of progress were testaments to that system.

Fuller called industrialization “a world-around means of regeneration of enough

⁷ Lloyd Steven Sieden, “Seattle celebrates Earth Day but few remember Buckminster Fuller, the first environmentalist,” *Examiner* 22 April 2010, <http://www.examiner.com/article/seattle-celebrates-earth-day-but-few-remember-buckminster-fuller-the-first-environmentalist-video>.

⁸ Additional popular sources that identify Fuller as an early environmentalist include *Audobon Magazine* and *Environment Canada*. See “Green Before His Time,” *Audobon Magazine*, <http://archive.audubonmagazine.org/>. See also “Richard Buckminster Fuller: A Visionary Architect,” *Environment Canada*, <http://www.ec.gc.ca/biosphere/default.asp?lang=En&n=30956246-1>.

wealth to support all humanity at an as-yet–undreamed-of advance in standard of living.”

The notion that technological progress might cause irreparable damage to the environment nagged away at the very foundations of Fuller’s techno-utopic worldview. Rather than wrestling with this possibility, Fuller evaded it. He used language to obfuscate and mask his own uncertainties about the potentially negative long-term impacts of industrialization. When faced with ecological debates from the 1960s onwards, Fuller generally reiterated his ethics and his concern for mankind and nature rather than taking an environmental stand. His solutions for dealing with threats to the environment were vague at best; Fuller assumed that humans and the environment would coevolve past any short-term problems, and that intellectual integrity would in the end prevail. The notion that Fuller was an “environmental activist” ignores considerable evidence to the contrary, and detracts attention from the very real contributions of the environmental movement’s true activists and leaders.

The notion of “ephemeralization” epitomized by Fuller’s 4D house and Dymaxion car projects of the 1920s and 1930s was discussed in earlier chapters (see especially Chapter 3). Ephemeralization involved doing ever more and more with ever less and less inputs of time and material. Fuller’s calls for ephemeralization were preceded by Henry Ford’s (1922) equally strident calls for increased material efficiency. “There is no more sense in having extra weight in an article than there is in the cockade on a coachman’s hat...Some day we shall discover how further to

eliminate weight...There must be some method by which we can gain the same strength and elasticity without having to lug useless weight. And so through a thousand processes."⁹ Although Fuller coined the term "ephemeralization" somewhere in the mid-1930s¹⁰ to represent the process by which manufactured goods would become lighter while performing better, the idea was hardly a new one within the manufacturing world. What Fuller did was to apply the same notions of industrial efficiency to architecture, such as the featherweight 4D house and, later, the geodesic domes. Fuller's interest in extreme efficiencies in building grew out of his admiration for industrial giants like Frederick Taylor and Henry Ford, who had applied scientific methods to perfect and streamline industrial production, until the entire assembly process for a Model T car had been whittled down to a mere 93 minutes.¹¹ Like Le Corbusier, Fuller imagined similar mass-production methods being applied to the construction of single family homes.

In 1971, the *American Scholar* published the article "Planetary Planning," in which Fuller devotes almost two full pages to describing Henry Ford's accomplishments and innovations, and to awarding him a key role in the history of human development:

Henry Ford was inaugurating the mass use of the invisible and ever-higher performance per pound alloys and the invisible controls of ever-closer measuring of invisibly operating parts of the machinery, structure, and production tooling of his automobiles... By the mid-twenty-first century with the perspective advantage of time, it may come to pass that Henry Ford will have become recognized by

⁹ Henry Ford and Samuel Crowther, *My Life and Work*, (New York: Doubleday, 1922), 14-15.

¹⁰ Fuller wrote about ephemeralization in Chapter 33 of *Nine Chains to the Moon*, published in 1938. Fuller is supposed to have coined the term, and I have not found any evidence to the contrary.

¹¹ See "Highland Park Ford Plant," *National Park Service*, <http://www.nps.gov/nr/travel/detroit/d32.htm>.

*world-around society as the Leonardo of the twentieth century, for it was Henry Ford, Sr., who first organized the mass-production effectiveness of science and technology and its comprehensive logistical revolution, as well as evolving the supporting new economics and world mass-distribution of the high performance products of mass-production industry.*¹²

Fuller's 4D house was designed to be a mass-produced, single family housing kit that could be shipped around the globe, inspired by industrial examples such as Ford's Model T.¹³ Fuller's foundational *4D Time Lock* manuscript argued directly for mass-production efficiencies to be applied to the housing industry. More telling still, Fuller sent a precious copy of the *Time Lock* manuscript to Henry Ford, although it is not clear that he received any reply.¹⁴

In Chapter 3, it was proposed that the 4D house was informed by Fuller's model of nature, and that the house was described in organismic terms as a body with a circulatory and respiratory systems that would ensure the well being of the family inside. Pointing out the industrial inspirations behind the 4D project is not an attempt to negate the ways in which the 4D house expressed Fuller's personal model of nature. Rather, it is seeking to establish that Fuller's interest in *efficiency* derived from the era of industrialism and scientific management and was not, in its first instance, about saving natural materials in order to avert environmental collapse, as some have suggested.

¹² R. Buckminster Fuller, "Part Two: Planetary Planning," *The American Scholar* 40:2 (1971), 297.

¹³ This is similar to Le Corbusier's *Maison Citrohan* (1922) that was inspired by the industrial production of Citroën cars.

¹⁴ Sieden, *Buckminster Fuller's Universe*, 131. I have not found any indication that Ford acknowledged receipt of the manuscript either in Sieden's book or in other sources. Fuller sent personal copies of the manuscript to a few dozen individuals whom he felt would sympathize with his ideas, including Vincent Astor, Bertrand Russell, and Harvard's President Lawrence Lowell.

This stands to reason: in 1928, neither Ford nor Fuller had even an inkling of the long-term environmental damage caused by industrialization. Industrial and economic progress was the goal, and the natural world seemed to offer ample materials to feed the cycle of production and consumption. "Every one of us is working with material which we did not and could not create, but which was presented to us by Nature,"¹⁵ wrote Ford in *My Life and Work*. He admired nature, but as a participant in, not a victim of, the industrial equation. Indeed, the scope and severity of the damage to the ecosystem as a result of industrialization would not be fully understood until the 1960s and later.

For Fuller, and probably for Henry Ford, technology and nature were entirely compatible. Technology was actually an outgrowth of nature, since nature had endowed mankind with the rare intellectual capacity to adapt and develop tools to survive. Technology thus was the tangible outcome of human intellectual achievement. The development of ever more sophisticated tools and technologies—from steamships to automobiles—indicated the continuous development and adaptation of the species to thrive in the environment, what Fuller called universal evolution. "The designing and building of a hydroelectric dam or development and production of an antibiotic constitute conscious participation by man in evolutionary pattern transforming of universe," wrote Fuller in *Utopia or Oblivion* (49). Developing new technologies was an inevitable part of participating in human evolution. Fuller supported the development of

¹⁵ Ford, *My Life and Work*, 9.

new technologies, such as solar-powered instruments, that would take advantage of renewable resources such as solar energy as opposed to non-renewables like petroleum. But again, his attitude derived from a faith in technology to evolve continuously when faced with a limited resource, not from a desire to protect the natural resources *per se*.

'Nature'

In *What is Nature* (1995), Kate Soper discusses the role of nature within the ecological discourse. She argues that 'nature' (which she keeps in quotation marks to distinguish from the general word nature) is often a cultural construct used by eco-politicians to advance their causes and goals. This construct, broadly speaking, valorizes 'nature' as an unspoiled, rural, diverse, and aesthetically-pleasing entity in need of saving by those who appreciate such traits, and vulnerable to those who don't.¹⁶ Its popularity as a construct is evidenced by the common slogans and catch phrases shared among environmental protection groups: 'Save Nature', 'Save the Earth', 'Protect the Environment', 'Save Our Planet', and so on.¹⁷ Soper discusses the political purposes, the drawbacks, inconsistencies, and limitations of the 'nature' construct even while acknowledging its *raison d'être*.

¹⁶ Soper actually discusses the construct of 'nature' in much greater detail, and points out that the specifics of that construct differ somewhat among environmentalists. For the purposes of brevity, a summary has been made of some of the principles that are used by environmentalists as identified by Soper. Her argument is far more nuanced and points out the tensions between competing understandings of nature within the environmental discourse. See Soper, *What is Nature*, 149-257.

¹⁷ Hundreds of organizations use similar catchwords and slogans, including Greenpeace, the World Wildlife Federation, the Environmental Protection Agency, the Save Our Planet Foundation, the Save the Earth Foundation, and so on.

Rather than attempting to summarize Soper's arguments any further, the key point is that the 'nature' construct that she outlines is relatively new in public discourse.¹⁸ The idea of 'nature' she describes was built up and strengthened as part and parcel of the modern environmental movement, which itself began in the second half of the twentieth century and continues to evolve today. This construct of 'nature' has assumed a place in the public consciousness, and is frequently invoked by environmentalists in their calls for greater ecological protections and regulations. However, this was not always the case.

Fuller and Ford belonged to an earlier historical era in which nature was not something *to be saved*, but an available resource *to support human and industrial evolution*. If Fuller supported the sparing use of natural resources, which in principle he did, it was primarily because he believed that the more efficient use of those materials would support more widespread progress of all humankind. It was not because he sought to protect unspoiled resources from the talons of industry. On the contrary, he called industrialization "the primary survival-amplifying mechanism" which would eventually displace "all incoherent systems."¹⁹ Fuller had a model of nature, as established in earlier chapters and discussions; it simply predated the "save nature" variety. And Fuller was just not willing to trade his own firmly-embedded ideas about nature and progress—which had served him well for six decades—for those proposed by the next generation of environmentalists. Nor was he willing to risk his good standing and relationships with industrial partners

¹⁸ There were antecedents to the 'nature' construct that Kate Soper describes, of course, including Romantic and other pastoral ideas about nature. We are talking specifically about the construct of 'nature' commonly used in the discourses of the modern environmental movement.

¹⁹ Fuller, *Ideas and Integrity*, 286.

by engaging in politically sensitive conversations about the impacts of industrialization on the environment.²⁰

Of course, as an academic, lecturer, and world traveler, Fuller was aware of the nascent environmental movement, and—insofar as he was concerned about the future of humanity and the conservation of nature—he was sympathetic towards it. However, Fuller did not really subscribe to the idea that environmental damage, such as it was, was irreparable. Rather, he seems to have acknowledged that a course correction was in order, but that mankind would ultimately invent its way out of the problem using, for example, design science strategies.²¹ Furthermore, Fuller was resistant to the notion that modern industry and technology had contributed to this global problem. His entire career had been marked by ceaseless technological optimism and dedication to progress. An attack on technology and industry by the environmental movement jeopardized the very foundations of Fuller's techno-utopic worldview.

At the same time, Fuller realized that many of his most ardent followers, including young hippies, back-to-landers, counterculturists, and college students, were becoming increasingly environmentally-minded. The commune-dwellers and the hippies, for example, were quick to include environmental activism as a part of their rejection of the techno-industrial order. Historian Jean-Daniel Collomb notes

²¹ One of the contemporary strategies for climate change denial is the notion that "technology will save us," in other words that humanity will "invent its way" out of the climate change problem. Fuller's views resemble this strategy. Of course, it should be noted that Fuller was active 50 years ago when the outlines of the environmental problems were not as well known. See "The Death of Environmentalism in the Age of Denial," *Global Comment*, May 15, 2014, <http://globalcomment.com/the-death-of-environmentalism/#>.

that, “Embracing nature could be a way for American radicals to escape the supremacy of technological progress and the belief in man’s ability to control and direct natural processes and resources at will.”²²

This put Fuller in something of a bind: his message that design science would lead to a better world depended upon continuous technological progress, and he successfully promoted this to countercultural audiences by reorienting the conversation away from technology and towards ‘tools’.²³ At the same time, he risked alienating his most ardent supporters if such technology-forward messages appeared to conflict with their environmental beliefs. In order to avoid any potential conflict, Fuller either evaded the subject completely, or offered only hazy comments on it.

Fuller’s weak and indistinct responses to environmental debates reflected a growing tension between his firm support of industrialization and the mounting evidence of its negative impacts. He danced around the problem, but offered little practical advice, and never aligned himself with the environmental movement or its leaders. There is ample evidence of this approach within Fuller’s speeches and writings of the 1960s and 70s. For the purposes of discussion, a few devices that Fuller used to evade or obfuscate considerations about the environmental impacts of technology have been categorized below. In reality, these devices are not so

²² See Jean-Daniel Collomb, “New Beginning: The Counter Culture in American Environmental History”, *Cercles* 22 (2012), 54-69. Collomb is a historian of American environmentalism in the twentieth century.

²³ In the previous chapter, I discussed at length how Fuller moved the conversation from technology and toward small-scale tools for living. This helped him to integrate technology into the conversation in terms that his countercultural followers could accept.

distinct and tend to overlap; but treating them separately helps to identify some common themes. These are characterized as spiritualization of the problem; pseudoscientific jargon; intellect will prevail arguments; and regenerative earth arguments.

Spiritualization of the problem

Fuller's article *Planetary Planning* (1971) provides a good example of how he elevated any discussion of the environment or environmental impact to a spiritual level, which automatically precluded any hope of practical, earthbound solutions. In the second installment of this two-part article, Fuller subsumed any discussion of the environment within a discussion of what he saw as a new age of intellectual integrity on the horizon. Fuller identified the present²⁴ as the "tenth period" of human evolution, marked by a flowering of integrity and self-awareness.²⁵ "[human] integrity seeks to understand and appreciate the great dedications of the past, and to offset the errors of yesterday with ever greater fulfillment of humanity's conscious, metaphysical functioning in the evolutionary events of macro-medi-micro Universe."²⁶ The "errors of yesterday" might include, for example, inefficient use of natural resources. However, Fuller took it as a matter of faith that humanity in its infinite wisdom would prevail. He stated that "the god function in all humanity of the capability to think and act with teleologic integrity will ever approach, but never quite attain, the perfection of absolute integrity that

²⁴ By this, I mean Fuller identified "the present" from his point of view, i.e. 1971.

²⁵ This tenth phase is somewhat analogous to Pierre Teilhard de Chardin's third phase of evolution, *noogenesis*, which was discussed in Chapter 2.

²⁶ R. Buckminster Fuller, "Part Two: Planetary Planning," *The American Scholar* 40:2, Spring 1971, 285-304

we now identify in utter abstraction as truth or god."²⁷ This notion that human integrity, guided by an invisible, absolute truth, will rise up to right the temporary wrongs of human civilization might come across as attractively utopian to some readers, or patently ludicrous to others. Regardless of one's opinion, assigning a spiritual answer to environmental problems, as Fuller did in this case, was a way of evading the need to wrestle with real-world problems.

Pseudoscientific Jargon

Fuller also used convoluted, pseudoscientific language to obscure his comments about the environment. Starting around the 1970s, Fuller began using the term "cosmic costing" to indicate that people needed to more thoroughly account for their actions on earth; what were not only the immediate, local costs of their actions, but also the long-term, global costs. Embedded within the "cosmic cost" of human activity was also the cost of the resources used up in that process. In his 1973 article, *Cosmic Costing*, Fuller pointed out that using petroleum was a fairly wasteful practice, as the energy is not used efficiently and the petroleum itself is a limited resource. A gallon of precious oil, synthesized over millions of years, should probably cost much more than 50 cents. "Scientific calculation shows that the amount of time and energy invested by nature to produce one gallon of petroleum, "safety deposited" in subterranean oil wells, when calculated in foot-pounds of work and chemical time converted into kilowatt-hours and at the present commercial rates at which electricity is sold, amounts to approximately \$1 million per gallon of petroleum as cosmically developed prior to its discovery and

²⁷ *ibid.*

exploitation by humans."²⁸ Fuller's argument, at first glance, might seem to foreshadow some of the contemporary environmental thinking that the cost of a product should be proportional to its damage to the environment. But Fuller was really only making a statement about how energetically inefficient it is to use petroleum, rather than considering the environmental impacts of using petroleum. In this case, Fuller retreats behind a string of pseudoscientific language in order to suggest that his assessments have some scientific status; without actually taking an environmental stance. Fuller was thus a commentator rather than a participant.

Fuller often used convoluted language, but the levels of pseudoscientific jargon around this subject reached new heights. He opined that "[o]nly cosmic costing properly accounts for the entirely biological evolution and cosmic inter-transformative regeneration in general, as well as for the parts played gravitationally and radiationally in the astro-totality within which our minuscule planet Earth and its minuscule star, the Sun, are inter-functionally secreted."²⁹ The labyrinthine language seems purposely aimed at obscuring the issues and, in so doing, to mask Fuller's own insecurity and unwillingness to enter into contemporary debates about the environmental impacts of human activity in real terms.

²⁸ R. Buckminster Fuller, "Cosmic Costing," *Saturday Review*, Feb. 1973. Reprinted in *Trimtab, Bulletin of the Buckminster Fuller Institute*, Vol. 5 no 3, Autumn 1990.

²⁹ *ibid.*

Intellect Will Prevail

Fuller refused to adopt a sense of urgency and doom about the impending threats to the ecosystem. He rejected doomsday scenarios about population bombs and energy crises with an alternate prediction: human intellect will ultimately prevail. Earlier discussion addressed Fuller's notion of the impending 'tenth period' of human development in which the mistakes of the past would be righted as the supreme spiritual force guided humans to a higher plane of integrity. In addition to being a spiritual argument, this notion also encompassed the intellect argument because it assumed that ever-higher levels of intellectual evolution were possible. "The great aesthetic that will inaugurate the twenty-first century will be the utterly invisible quality of intellectual integrity," wrote Fuller. "In this tenth period, all of humanity will find itself intellectually empowered to teach itself through individual thought."³⁰

Indeed, achieving these higher levels of consciousness during the "tenth period" would liberate humankind from the mistakes of the past. "In his unconscious participation in the past he [mankind] has carelessly ruptured the earth, polluted his air and water, corrupted his children in order to sell any kind of toy guns, dope, smut, and anything that would make money, and has made all money-making sacrosanct...There are many indications, however, that man is just about to begin to participate consciously and more knowingly and responsibly in his own evolutionary transformation."³¹ In other words, Fuller acknowledged that mistakes had been made in the past and attributed them to short-term profit motives.

³⁰ R. Buckminster Fuller, "Part Two: Planetary Planning," 303.

³¹ Fuller, *Utopia or Oblivion*, 145.

However, over the coming decades he felt that humanity would become wiser, more enlightened, and less hasty as part of the inevitable forward march of evolution.

Regenerative Earth

Fuller was fond of restating two particular scientific laws: the law of conservation of mass, which states that matter cannot be created or destroyed; and the first law of thermodynamics, which states that energy cannot be created or destroyed. These represented, to Fuller, a universe in cosmic and eternal balance. The earth, as a closed system, was continuously recycling its elements and transferring its energies from one form to another. "Every atom and electron is an essential part of the eternally regenerative, ergo totally inexhaustible, (but always locally ebbing and flooding), pulsative Universe," wrote Fuller in *Cosmic Costing*.

The presence of such scientific laws such as these, which suggested a universe always tending toward equilibrium, led Fuller to believe that the planet would ultimately rebound from any temporary environmental distresses created by mankind. "Our spaceship is so superbly designed as to be able to keep life regenerating on board,"³² wrote Fuller in *Operating Manual for Spaceship Earth*. The regenerative properties of the earth are a frequent theme in this text, with Fuller marveling at its "complex life-supporting and regenerating systems."³³

³² R. Buckminster Fuller, "Operating Manual for Spaceship Earth" (1968), reproduced on *Design Science Lab* website, http://designsciencelab.com/resources/OperatingManual_BF.pdf.

³³ The laws of conservation of energy and mass themselves do not actually preclude environmental damage from occurring, as indicated by contemporary environmental research. For example, global warming may be occurring independently of whether or not mass and energy are conserved. This may not have been as obvious in Fuller's time as it is today.

Fuller acknowledged that there had been abuses and misuses of this system, for example the wasteful burning up of fossil fuels. However, Fuller restated the idea that mankind will be able to adapt and evolve, and apply intellectual integrity to the problems of wastefulness and destruction. Earth, destined to keep its matter and energy in balance, would rebound and continue apace. The most profitable course for mankind, according to Fuller, would be to evolve more efficient ways of using the earth's abundance so that all humanity could benefit.

Debunking Malthus

The publication of Paul Ehrlich's *The Population Bomb* in 1968 provided a major impetus for the environmental movement and even influenced environmental legislation in the United States. The book, which sold over two million copies, predicted increasing levels of starvation due to rampant population growth, combined with a stressed and damaged ecosystem unable to support their food needs. Ehrlich wrote in his prologue: "The battle to feed all of humanity is over. In the 1970s hundreds of millions of people will starve to death in spite of any crash programs embarked upon now."³⁴

Ehrlich's ideas on population were related to those of Thomas Malthus, the 18th century demographer who predicted that catastrophes of famine and disease would ensue once populations outgrew agriculture's capacity to feed them. This

³⁴ Paul R. Ehrlich, *The Population Bomb*, (Riverville, MA: Riverville Press, 1971), xi. First published in 1968, New York: Ballantine Books. Although Ehrlich has since been criticized for his alarmist predictions and population-control prescriptions, his book did underscore the importance of environmental protection.

mismatch between mouths to feed and available food would keep populations perennially in check, grimly precluding any hope of achieving a bountiful utopia. Ehrlich credited his Malthusian beliefs to a lecture he had attended during the 1950s by William Vogt, an ecologist, population control advocate, and author of *Road to Survival* (1948). Fuller himself had first been exposed to the ideas of Thomas Malthus as a young man, when his rich “uncle” assured him that “the golden rule doesn’t work,” and that “if you are going to survive...you’re going to have to do it at the expense of five hundred others. So do it as neatly and cleanly and politely as you know how.”³⁵ Clearly, this “you or me” thinking was antithetical to the design science ethic that Fuller established over the decades, and also to his attendant vision of utopia.

From the mid 1960s onwards, Fuller took special pains to debunk Malthusian and neo-Malthusian predictions. He was at once aware of the growing popularity of this idea within environmental debates, and also utterly annoyed by how it flew in the face of his central argument of humanity’s ultimate redemption through design science. Fuller’s outlook depended upon a bright vision of better living through intellectual adaptation and new technologies; ever higher performance per pound of raw materials; continuous progress toward a utopian future. The population bomb idea was an unwelcome specter, an interloper on the design science horizon, and Fuller made it his business to banish it.

³⁵ Fuller, *Utopia or Oblivion*, 121-22.

Fuller used his platform, as a writer, a speaker, and public intellectual to directly challenge the idea that humanity was on the brink of mass starvation. Rather than naming his contemporaries Vogt or Ehrlich, Fuller set his sights on debunking

Malthus:

Malthus is wrong, and...the physical resources of earth can support all of a multiplying humanity at a higher standard of living than anyone has ever experienced or dreamed.

We now know that Malthus is wrong and that there can be enough to go around if we up the performances per pound of the world's resources...this can only be realized through a design science revolution of spontaneously coordinated university-aged youth.

The old economics accounting... starts with Malthus' assumption that there is and always will be only enough of the essentials of life to support a minority of mankind. This view made failures normal. This concept is now acknowledged to be invalid.

The potential success of all humanity which we have now is a new challenge utterly unforeseen by Malthus...we now have to divide up the success to be produced by the automated augmentation of wealth.³⁶

This is only an indicative sampling of dozens of attacks on Malthusian ideas and the assumptions of resource scarcity they implied. Fuller's objections depended, of course, upon his own assumptions about as-yet-unrealized efficiencies in the production and distribution of food and other resources. Nevertheless, he was confident that the "Design Science Decade approach to attaining Utopia" would

³⁶ Fuller, *Utopia or Oblivion*, 9, 155, 225, 260.

lead to “supporting 100% of humanity’s increasing population at higher standards of living than any minority or single individual has ever known or dreamed of.”³⁷

Fuller’s attacks on Malthusian ideas were really thinly-veiled defenses of his own design science credo, which formed the core of his lectures and writings from the 1960s onward. The two sets of ideas—population growth leading to resource scarcity and starvation versus ever-increasing efficiency leading to ever-higher standards of living for all—were simply mutually exclusive. Therefore, anybody who subscribed to Ehrlich’s ideas could not take Fuller seriously, and vice versa. Unfortunately, Fuller’s compulsion to take down Malthus meant that he categorically denied any ecological arguments tied to population growth which, as established, were both popular and influential during the late 1960s and 1970s. Rather than engaging in discussion about how expanding populations might impact global resources, Fuller turned a deaf ear to this significant theme in the nascent environmental movement.

Fuller’s fealty to the modern movement, combined with the platform of design science that had become the hallmark of his thinking and teaching by the 1960s, made it difficult for him to engage with the environmental thought leaders of the 1960s and 70s. Fuller’s vision of the future was based upon continuous technical and intellectual progress, and a fulsome and resilient earth. Environmentalists, by contrast, were wary that technologies (such as industrial chemicals, factory production, and industrial agriculture) had already gone too far.

³⁷ Fuller, *Utopia or Oblivion*, 291-92. The “Design Science Decade” Fuller relates to was 1965-1975, and was marked by a series of publications and events related to the design science approach.

Unlike Fuller with his notion of a resilient earth, environmentalists depended heavily upon a construct of 'nature' in need of saving, as discussed above, to rally attention around their cause. They employed a variety of narratives—including overpopulation, species destruction, resource scarcity, and long-term damage to the ecosystem—to give a sense of urgency to their political demands. And these tactics proved to be quite successful, as indicated by the passage of landmark environmental legislation in the United States during the 1970s, including the *Clean Air Act* (1970), the *National Environmental Policy Act* (1970), the *Endangered Species Act* (1973), and the *Clean Water Act* (1977), amongst others. The dystopian narratives promoted by the environmental movement and its emergent leaders, Rachel Carson, and Paul Ehrlich among them, were apparently paying off.

In this chapter, an argument has been mounted against the notion that Fuller was a prescient environmentalist, pointing out his firm industrial-era roots as well as his dependence upon a worldview of continuous technological progress and assumptions that the earth would 'bounce back' from any temporary stressors. His views were fundamentally incompatible with the 'save nature' and doomsday narratives of the modern environmental movement. He did not use his platform as a public speaker to engage in environmental themes or activism. This is not to say that Fuller was wholly unsympathetic to environmental concerns. Indeed, he remained very concerned about inefficiencies in building and manufacture,

because this implied wasting resources that could better be used elsewhere, to somebody else's benefit.³⁸

World Game: Industrial Systems, not Ecosystems

The World Game, a multiplayer educational game developed by Fuller and his students (especially Medard Gabel) during the early to mid-1960s,³⁹ was an attempt to address inefficiencies in the use and distribution of resources. The object of the Game was for players to work cooperatively to help balance global resources (natural, manmade, etc.) in order to achieve higher standards of living for a majority of the world's population.⁴⁰ It was played on a Dymaxion Map, and was accompanied by inventories of global resources and populations.⁴¹

Because the development of the World Game overlapped with the countercultural movement and because the Game promoted resource management, some have concluded that the World Game was Fuller's answer to the environmental

³⁸ It is difficult to say, whether Fuller's concern about efficiency was an outgrowth of his interest in industrial efficiency à la Henry Ford; or as a primarily environmental strategy. I tend to think it was primarily the former. In addition, Fuller thought it was unethical to waste resources when there were people in need on the planet.

³⁹ Fuller had other students and collaborators working on the World Game Project, but Medard Gabel was most central to its development and implementation.

⁴⁰ A concise (and, it is posited, accurate) summary of the world game, as provided by *Wikipedia*: "World Game, sometimes called the World Peace Game, is an educational simulation developed by Buckminster Fuller in 1961 to help create solutions to overpopulation and the uneven distribution of global resources. This alternative to war games uses Fuller's Dymaxion map and requires a group of players to cooperatively solve a set of metaphorical scenarios, thus challenging the dominant nation-state perspective with a more holistic "total world" view. The idea was to "make the world work for 100% of humanity in the shortest possible time through spontaneous cooperation without ecological damage or disadvantage to anyone", thus increasing the quality of life for all people." See "World Game," Buckminster Fuller Institute, <https://bfi.org/about-fuller/big-ideas/world-game>. See also "World Game," *Wikipedia*, http://en.wikipedia.org/wiki/World_Game.

⁴¹ By inventories, Fuller was referring to amounts of available resources. Maintaining reliable inventories of world resources (mineral resources, industrial resources, food production, educational capacity, and so on) proved to be quite difficult. The hope was that inventories of world resources could be updated automatically and fed into the World Game; this was not a possibility during Fuller's lifetime. See Buckminster Fuller Institute, "World Game," <https://bfi.org/about-fuller/big-ideas/world-game>.

problems on the horizon.⁴² However, this supposition ignores a few critical facts. First of all, the World Game was an outgrowth of Fuller's interest in inventorying global resources since the 1950s, when he became interested in systems theory in general and industrial systems in particular. Having a good understanding of where the world's resources were most abundant could lead to more efficient systems of manufacturing and distribution. Fuller was intrigued by the possibility of inventorying and tracking all these resources around the globe, as a "stocktaking of what man has to do and what he has to do it with!" A comprehensive stock of world resources represented design science's larder, a "supra-national planning effort" that would act "as a catalytic agent towards the world [design science] students' direct implementation of the planned use of these resources."⁴³ He collaborated with students and faculty at Southern Illinois University at Carbondale and other universities to begin compiling this data, and a preliminary report called the *Inventory of World Resources* was published in 1963.

The key point here is that the *Inventory*, which provided the source data and the conceptual basis for the World Game, was collected not for its value in prioritizing environmental concerns, but rather for its value to a "supra-national" planning group of self-appointed design scientists in determining their global building and infrastructure goals.

⁴² See Anker (2007) and Luke (2010).

⁴³ R. Buckminster Fuller and John McHale, *Inventory of World Resources : Human Trends and Needs* (Southern Illinois University at Carbondale, Carbondale, Ill, 1963), preface.

Secondly, the World Game was developed with significant input from Medard Gabel, a graduate student at Southern Illinois University at Carbondale and the co-founder, with Fuller, of the World Game Institute. Considerably younger than Fuller, Gabel was personally dedicated to environmental protection, as indicated by his contributions to the *Environmental Design Science Primer*⁴⁴ (1975) and his later founding of *Big Picture Small World*, a company whose educational games and learning labs take on environmental issues such as climate change. Gabel was engaged in environmental debate and action, and attempted to articulate how design science principles could be applied to environmental ends. Fuller was not a contributor to the *Environmental Design Science Primer*, nor did any of Fuller's own books deal with environmental issues or strategies. Any discussion of the World Game's orientation, if any, toward environmental protection should begin with a thorough assessment of Gabel's contributions, which has not been addressed to date.⁴⁵ In short, although the World Game offers the opportunity to engage in environmental thinking, this was not its original goal, nor did Fuller provide particular leadership toward that end. Those who have assumed that the World Game was Fuller's answer to environmental issues (see note 40) have failed to look deeper into the Game's origins and/or to recognize Gabel's imprint on the World Game project.⁴⁶

⁴⁴ Medard Gabel et al, *Environmental Design Science Primer* (New Haven, CT: Advocate Press, 1975).

⁴⁵ Gabel worked with Fuller for approximately 12 years to develop the World Game and the World Game Institute, and continued throughout his career to develop cooperative systems-oriented educational games with the company *Big Picture Small World*. He remains active as the company's CEO in the Philadelphia area.

Saving humans vs. saving the planet

In the discussions above, it has been argued that Fuller was aware of the growing environmental movement, but was not himself an active participant in it. His fealty to the industrial age, his faith in technology to solve problems of human concern, and his sense of the earth as an essentially homeostatic system that would rebound from any temporary imbalances, made Fuller unwilling to engage in environmentalism per se. Because an anti-technology stance was a common feature of the environmental movement, Fuller had to be careful to continue to promote his technologically progressive ideas while not alienating his countercultural base of support. One way to resolve this was to avoid discussing environmental issues or to obscure those issues, which was Fuller's preferred approach.

Having covered all these points, it should not be concluded that Fuller was inherently anti-environmental or that he lacked a conscience in the face of growing evidence of man-made damage to the earth. Fuller was certainly concerned about the flagrant waste of natural resources, and extreme efficiency had been a major feature of his architectural designs since the late 1920s. However, he remained loyal to a progressive, modern, technology-forward, industrial age worldview, and was unsympathetic toward the negatively-focused and techno-wary views of the emergent environmental movement.

Fuller's primary focus was on the salvation of humanity, not the salvation of the earth. The earth, Fuller felt, would go right on ticking; it was mankind whose fate

hung in precarious balance, and it was the future of humanity that was really at risk. “Within decades we will know whether man is going to be a physical success around earth, able to function in ever greater patterns of local universe, or whether he is going to frustrate his own success with his negatively conditioned reflexes of yesterday and will bring about his own extinction around the planet earth.”⁴⁷ This quotation clearly indicates that planet earth will survive quite handily, whereas mankind’s imminent success or failure is very much in his own hands. Fuller’s moral fibers were bound primarily around humanistic rather than ecological concerns. He was worried about the passengers first, and Spaceship Earth second. Design science’s moral stance was against poverty, human suffering, and unfair distribution of resources; it was not a moral stance on behalf of a tattered “nature” in need of saving.

In hindsight, Fuller’s constant vagueness concerning environmental issues proved beneficial to his legacy. By avoiding specific comments on the environment, he maintained a politically neutral stance and avoided alienating himself from either the military-industrial complex, which had supported him well over the years, or the countercultural youth, who made up his greatest audience from the 1960s onward. By focusing on effective use of resources to benefit mankind using design science techniques, Fuller left ample room for interpretation where environmental issues were concerned. Many of his followers or collaborators, including Medard Gabel, Norman Foster, and Peter Pearce⁴⁸ did indeed move in the direction of

⁴⁷ Fuller, *Utopia or Oblivion*, 362-3.

⁴⁸ Medard Gabel was Fuller’s student and the co-founder of the World Game Institute. Sir Norman Foster is a Pritzker prize-winning architect whose London-based design firm, Foster + Partners, has designed numerous high-profile projects, many of which have obtained LEED and BREEAM

environmental sustainability. By exploring how design science principles of efficiency and comprehensive thinking could be applied to environmental sustainability, this new generation forged a link between design science and the environment in a substantive way that Fuller had not.

Over the years, the association between Fuller and a new generation of sustainably-minded designers like Gabel and Foster has led some to grant Fuller more credit than he is due for environmental design. Fuller was conscious of resources, respectful of nature, and interested in efficiency; but he was not a green architect, an environmental activist, or a self-appointed protector of the earth. Those that mistakenly call Fuller “an early environmental activist,” or even “the first environmentalist” are not only ignoring ample evidence to the contrary; they are also denying the creative innovations of the next generation of architects, and the legislative victories of the environmental movement’s true leaders.

sustainability accreditations. Foster credited Fuller as having been “a guiding spirit” in his Pritzker Prize speech (1999). Peter Pearce worked with Fuller on illustrations for *Synergetics*, and became a respected structural designer and green architect whose *ecohouse* design was featured in *Dwell* magazine (Dec/Jan. 2010). Pearce was not quite a follower of Fuller’s although there is some overlap in their interests in geometries found in nature.

Chapter 7

Eco-Politics, Ecosystems, and Cybernetics: Fuller's Response

The mid twentieth century saw the development of new models of nature: new ways of conceptualizing the natural world, and the place of humans within it. In particular, I would like to discuss two important models of nature that are sometimes associated with Fuller's work. I call these the "eco-political model" and the "cybernetic ecology model," as detailed below. To what degree, if any, did Fuller's comprehensive model of nature overlap with these two particular concepts? To what degree was it different from them? This chapter will provide a comparison of Fuller's model with concurrent models of nature, and an exploration of the similarities and differences between them.

I. The Eco-Political Model

Kate Soper describes an eco-political model of nature as one that tends to view the natural world as an entity threatened by unbridled human activity; that adopts a romantic and aestheticized view of unspoiled nature; and that is characterized by an "uncritical ecological naturalism."¹ She points out that this eco-political view is in fact a cultural construct that—broadly speaking—helps to advance the political aims of the environmental movement.² The eco-political model of nature "emerged in response to ecological crisis, is critically targeted on its [nature's]

¹ Soper, *What is Nature*, 149. See also Soper, 149-179. The term *eco-politics*, referring to policy or political action motivated by environmental concern, seems to have been in use since the early 1970s, although I have been unable to locate its origin. An alternate spelling is *ecopolitics*. I have chosen the hyphenated spelling because that is the treatment that Soper uses.

² Soper refers to the Green Movement; I use the term "environmental movement" interchangeably.

human plunder and destruction, and politically directed at correcting that abuse."³

This model dates back to the 1960s and the birth of the modern environmental movement,⁴ but it remains fairly common in the contemporary ecological discourse; and has become part of the "rhetoric of ecological politics."^{5,6} In this chapter, I will focus on Rachel Carson (1907-1964) as a key representative for the eco-political model of nature, but it should be noted that other environmental leaders, including Ralph Nader and Paul Watson, adopted similar stances in pressing for environmental legislation.⁷

Rachel Carson (1907-1964) was a marine biologist, conservationist, and journalist whose book, *Silent Spring* (1962) brought national attention to the issue of manmade environmental destruction.⁸ Carson's descriptions of the natural world as the ultimate victim of the chemical industry typify an eco-political model of nature, as follows. On the one hand were the 'innocent' songbirds, the insects and animals, the forests, fields and streams. On the other hand were the industrial

³ Soper, *What is Nature*, 3.

⁴ Certainly the idea that the natural world might be threatened by human activity was not a new one. Conservation societies and conservationists existed even in the latter half of the 19th century. However, the model of nature in which nature is portrayed as a victim in order to advance a political agenda is a hallmark of the modern environmental movement.

⁵ Soper, *What is Nature*, 9.

⁶ Vance Packard's book, *The Waste Makers* (1960), may represent a more populist presentation of the idea of humans as avid consumers whose gluttony and wastefulness is taking a toll on natural resources.

⁷ Ralph Nader (1934-) is a political activist, consumer advocate, and politician whose activism has included environmental advocacy. Paul Watson (1950-) is a Canadian activist who was an active member during the founding of Greenpeace, an organization that continues to promote an eco-political viewpoint. Greenpeace advocates for "protecting our oceans...protecting forests...defending our whales...saving the arctic..." All these phrases point to a nature in need of saving through political action. See *Greenpeace*, <http://www.greenpeace.org/usa/en/>.

⁸ There are numerous sources on Rachel Carson, including the website www.rachelcarson.com. For a discussion of the impact of *Silent Spring*, see Eliza Griswold, "How 'Silent Spring' Ignited the Environmental Movement," *The New York Times*, 21 Sept. 2012. Rachel Carson's work, including *Silent Spring*, has not escaped criticism—some have argued that the numbers in her book were inflated or unreliable, and/or that she overstated the potential impacts of chemicals on humans. A summary of critiques is found at *The Competitive Enterprise Institute Website*, <http://rachelwaswrong.org/critiques/>

'poisons' spread by profit-seeking chemical companies and the industries they served. She called these chemicals "death-dealing materials,"⁹ and pointed out how easy-to-obtain and ubiquitous they had become.

Love of Nature

Central to Carson's depiction of nature was a Romantic image of a wild nature unblemished by human intervention. Within her lifetime, she had seen her bucolic hometown of Springfield, Pennsylvania transformed into a "grimy wasteland" due to the expansion of iron and steel production in the region.¹⁰ In the first chapter of *Silent Spring*, Carson describes a rural landscape untouched by the industrial revolution, thriving with diverse plants and animals. The traveler is welcomed by vibrant birdsong, sparkling water in the rivers, and puffy clouds overhead. All too quickly, this landscape comes under violent attack by evil chemicals, which pollute and destroy this natural paradise.

Fuller's model of nature overlapped with Carson's insofar as both shared in the Romantic tradition of venerating nature, standing in awe of her sublime and extraordinary creations. This was the same tradition that animated the American Transcendentalists, most notably Henry David Thoreau, in their quest to find God in the natural world.¹¹ The Transcendentalists held up the natural world, in all its

⁹ Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 2002) 174-5.

¹⁰ Linda Lear, in Carson, *Silent Spring* (2002), xiii.

¹¹ Thoreau wrote, "My profession is always to be on the alert to find God in Nature, to know his lurking-places, to attend all the oratorios, the operas, of nature," and also "Heaven is under our feet as well as over our heads." See Helen Bowdoin, "Thoreau and the Environment," *The Walden Woods Project*, https://www.walden.org/Library/About_Thoreau's_Life_and_Writings:_The_Research_Collections/Thoreau_and_the_Environment.

variety and glory, as evidence of God's enduring wisdom. As the heir to the Transcendentalist tradition, Fuller likewise venerated the natural world and the natural laws that governed it. In particular, Fuller was fascinated by naturally-occurring geometries, and his goal was to elucidate these structures and to apply them to areas of human need. Fuller on some basic level revered nature, just as Carson did.

Attitudes toward technology

The principle difference between Carson, with her eco-political view, and Fuller, with his comprehensive model of nature, lay in their vastly different attitudes toward technology. For the former, nature and technology were mutually exclusive. She was "forever suspicious of promises of 'better living through chemistry' and of claims that technology would create a progressively brighter future."¹² The natural world, she felt, had taken millennia to achieve a proper equilibrium that was now being deeply threatened by the "impetuous and heedless"¹³ advancements of the modern world. Carson wrote about technology as something that could "easily and irrevocably disrupt the natural system,"¹⁴ an alien force that threatened the overall health of the ecosystem. Technology and nature were not aligned, but in constant conflict. She suggested that unbridled technological progress constituted a "war" against nature that, if unchecked, could have disastrous consequences. "Man's attitude toward nature is today critically important simply because we have now acquired a fateful power to alter and

¹² Ibid, xiii.

¹³ Carson, *Silent Spring*, 7.

¹⁴ Eliza Griswold, "How 'Silent Spring' Ignited the Environmental Movement," *New York Times*. N.p., 21 Sept. 2012.) Web.

destroy nature,” commented Carson. “But man is a part of nature, and his war against nature is inevitably a war against himself?”¹⁵

Carson talked about the “barrage of poisons” used in commercial agriculture, and the “chemical death rain” that was poisoning humans and animals alike. “Elixirs of death” were causing “sickness and death among cows, goats, pigs, deer, fishes, and bees.”¹⁶ Behind this sinister destruction was the chemical industry, which had made science and technology into its handmaidens in its “rush for profits and control of markets.”¹⁷ In short, Carson portrays ‘nature’ as the hapless victim of human industrial progress, urgently in need of protection from chemical assaults. Indeed, Carson’s language in these selections is fairly florid, which reflects both her awareness of her audience and her eco-political aims. Her writing was intended for the general public: her goal was to rouse awareness and even alarm at the potential long-term consequences of the use of industrial chemicals. But the colorful language alone should not detract from Carson’s qualifications as an experienced researcher and trained scientist: *Silent Spring* was based on some four years of extensive research into the impacts of agricultural chemicals on animal populations, in which Carson compiled data from previous and ongoing scientific studies, from the National Cancer Research Institute, and other U.S. government agencies.¹⁸ In other words, there were reams of investigative research and scientific data behind her eco-political viewpoint.

¹⁵ See “The Story of Silent Spring,” *National Resources Defense Council*, <http://www.nrdc.org/health/pesticides/hcarson.asp>.

¹⁶ Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin, 2002) 8, 11, 17.

¹⁷ Linda Lear, in Carson, *Silent Spring*, xv.

¹⁸ See Mark Stoll, “Rachel Carson’s Silent Spring: The Book that Changed the World,” *Environment and Society Portal* (2012), www.environmentandsociety.org.

Fuller took no such stance, for both philosophical and political reasons. On the one hand, he welcomed industrialization as the key to doing more with less. If the efficiencies of mass production could be properly applied to areas of human need, Fuller imagined a more prosperous and egalitarian future, where natural and technological resources would be more equally shared, leading to less poverty, less starvation, and a higher standard of living worldwide.

Politically speaking, Fuller was not in a position to attack industry; indeed his lucrative consulting work as an architect and engineer depended upon good relations with industry. Fuller was involved in dozens of projects throughout the 1950s, 60s, and 70s with major industrial and military partners, among them the Ford Motor Company, Kaiser Aluminum, the Union Tank Car Company, the U.S. Military, and the Monsanto Chemical Company.

Monsanto manufactured DDT, polychlorinated biphenyls (PCB's), and Agent Orange. These chemicals, which Rachel Carson called "elixirs of death,"¹⁹ made Monsanto her arch-enemy in the environmental war. Fuller, by contrast, had collaborated with Monsanto since the 1950s. His contributions to fiberglass reinforced polymer domes, which were jointly developed with MIT's Lincoln Laboratory during the early 1950s, led to the development of Monsanto's polymer "house of the future" in 1954.²⁰ He collaborated with Monsanto on the design of domes; he delivered a lecture at Monsanto in 1972; he used polymers developed

¹⁹ Carson, *Silent Spring*, 15.

²⁰ Jan Knippers et al, *Construction Manual for Polymers and Membranes* (Basel: Birkhauser, 2011), 13.

by Monsanto and other industrial giants in the design of the Fly's Eye Dome.²¹ In short, it would have been a reckless career move for Fuller to attack industry in the way that Rachel Carson did. Therefore, in spite of the mounting evidence of industrialization's negative and widespread impacts on the environment, biodiversity, and public health, Fuller handily avoided this topic of conversation and instead focused on industry's potential for efficient manufacture and distribution. "Industrialization is inexorably replacing all incoherent systems as primary survival-amplifying mechanism," wrote Fuller.²²

Biological Evolution vs. Universal Evolution and the Prime Design Initiative

Carson and Fuller also differed with respect to their views on evolution. Rachel Carson defined evolution as Darwin had; as a slow, deliberate process of natural selection that had been unfolding for eons. This natural process was being threatened by the cascade of manmade technologies brought on by the industrial revolution. "It took hundreds of millions of years to produce the life that now inhabits the earth...The rapidity of change and the speed with which new situations are created follow the impetuous and heedless pace of man rather than the deliberate pace of nature."²³

²¹ Fly's Eye Domes were geodesic domes made of interlocking plastic panels that could be used as autonomous dwellings. Several prototypes of the Fly's Eye Dome were constructed during the early 1970s.

²² Fuller, *Ideas and Integrities*, 286-7.

²³ Carson, *Silent Spring*, 6-7. Since the early 1970s, biologists such as Steven Jay Gould have proposed alternate theories of evolution to the "slow and steady" gradual model that Rachel Carson described. In particular, the theory of *punctuated equilibrium* holds that there are relatively long periods of species stasis (minimal change) punctuated by occasional periods of rapid evolution. In either case, evolutionary time is measured in hundreds of thousands to millions of years, rather than the decades used to measure modern industrial progress.

Fuller had quite a different view of evolution, in which biological evolution, technological evolution, and mankind's intellectual evolution were all part of the same forward march. He used the term "universal evolution" to describe this process.²⁴ Fuller saw technology as the natural outgrowth of human intellect. The modern era saw mankind essentially speeding up his own evolutionary advantage by supplanting natural selection with technology. "Amongst all the species of life on earth, none of them, other than man, has consciously participated in the fundamental alteration of their lifetime, ecological sweepout," wrote Fuller. "The designing and building of a hydroelectric dam or development and production of an antibiotic constitute conscious participation by man in the evolutionary pattern transforming of universe."²⁵ In other words, biological evolution and technological evolution were simply manifestations of the overarching process of universal evolution.

Universal evolution appears most prominently in Fuller's writings and speeches starting in the 1960s, although it was foreshadowed in his earlier writings. The universal model achieved a number of aims; most importantly for our purposes, it allowed Fuller to "naturalize" technology. This was particularly useful during the 1960s and 70s in light of the anti-technology sentiment of environmentalists and counterculturists alike. Fuller evaded debates about the relative value or danger of technology to humanity or to nature by suggesting that they were all inextricably bound together in the same forward-moving process. Natural selection gave

²⁴ Universal evolution is described in detail in Chapter 2 of this thesis. Here, the concept is briefly reviewed.

²⁵ Fuller, *Utopia or Oblivion*, 49.

human beings large brains with great intellectual capacity; humans used that intellect to develop better technologies to survive (survival of the fittest); it followed, therefore, that technology was the result a wholly 'natural' process of human development.

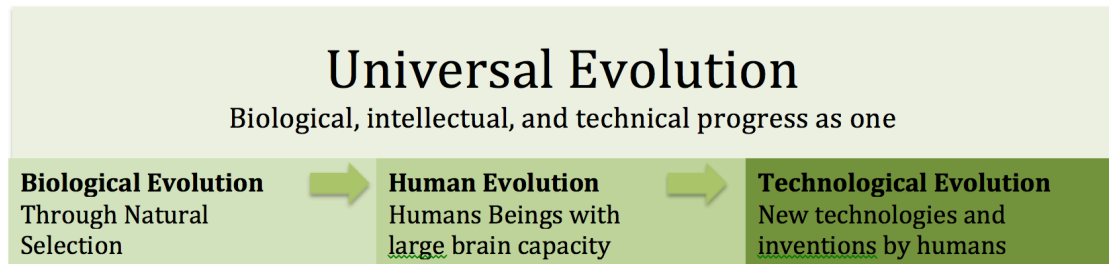


Figure 1: Universal Evolution Schematic (See also Chapter 2, Figure 1)

Universal evolution was not a matter for debate for Fuller; it was a given. Biological, human intellectual, and technological evolution had always been interconnected, and would always continue to develop in tandem. Technology, as such, was neither good nor bad; it was simply part of the whole process. What *was* new, however, was mankind's consciousness about his role, however small, in directing universal evolution. Fuller believed that mankind was at a great turning point, where industrialization and technology had reached a high point, and where mankind would have to make conscious decisions about how to apply those technologies. Taking responsibility for his own part in evolution was what Fuller called the "prime design initiative," or the "prime design responsibility."²⁶

"Man, in degrees beyond all other creatures known to him, consciously participates—albeit meagerly—in the selective mutations and accelerations of his

²⁶ This is closely related to the notion of "integrity," which is more fully discussed later in this chapter, in the sense that an individual with integrity would take on the initiative to steer technologies in directions that would ultimately benefit the human condition.

own evolution,"²⁷ wrote Fuller. "If man is to continue as a successful pattern-complex function in universal evolution, it will be [because of] the artist-scientist's spontaneous seizure of the prime design responsibility and his successful conversion of the total capability of tool-augmented man from killingry to advanced livingry—adequate for all humanity."²⁸ Properly guided, technological evolution promised great prosperity for all; poorly stewarded, it could lead to ruin. This sentiment is echoed in the very title of his 1969 book, *Utopia or Oblivion: The Prospects for Humanity*.

The prime design initiative was, of course, another way of advocating for design science. In Fuller's writing, the prime designer is the comprehensively educated, "free-wheeling artist-explorer, non-academic, scientist-philosopher, mechanic, economist-poet"²⁹ who can anticipate human need without being beholden to shareholders or political parties, or trapped by pedantic academic thinking. It's easy to see how Fuller was playing to the counterculture audience with such descriptions, enticing idealistic yet disaffected college-aged students to join his design science revolution. He gave them a cause, a vision whereby their intellect and energy could be applied to the greater good.

The prime designer among prime designers was, of course, Fuller himself, the multifaceted "scientist-philosopher" bent on improving the world. In his own words, Fuller was intent on "doing that which is compatible with what universal

²⁷ Fuller, *Ideas and Integrities*, 225.

²⁸ *Ibid*, 249.

²⁹ *Ibid*, 249.

evolution seems intent upon doing...I am doing what God wants to be done, i.e. employing my mind to help other humans' minds to render all humanity a physically self-regenerative and comprehensively intellectual integrity success..."³⁰ Fuller's concepts of "universal evolution" and "prime design initiative" allowed him to sidestep, by and large, the environmental debates that were unfolding around him. He avoided the very real question of whether manmade technologies were damaging the ecosystem by lumping technology and biology together under the header of Universal Evolution. This, to some degree, absolved mankind of the need to take responsibility for the negative outcomes of technology on the natural world. Yet one could hardly deny technology's destructive abilities, as evidenced, for example, by the two World Wars Fuller had lived through.

There was a gap between technology's destructive past and its potential to act as positive force that Fuller filled by advocating that individuals take the prime design initiative to ensure that technology be used toward ethical ends. Ostensibly, that would also include using materials efficiently so as to minimize waste and environmental damage.³¹ But ultimately, the design science revolution that Fuller so ardently promoted never came to pass. Therefore, the very real damages to the environment continued apace, and design science did relatively little, in real terms, to stem them. On the contrary, it was the political engagement of individuals like Rachel Carson, Ralph Nader, and Paul Watson and the direct activism of non-profit

³⁰ Fuller, "Guinea Pig B," in Zung, *Buckminster Fuller: Anthology for the New Millennium*, 309.

³¹ This is part of Timothy Luke's argument, namely that Fuller's quest for efficiency indicates a positive route for environmentalism worthy of revisiting today. See Timothy Luke, "Ephemeralization as Environmentalism" (2010), 354-362.

groups like Ecology Action (founded 1970) and Greenpeace (founded 1971) that led to new legislation to protect the environment.³²

Although Fuller has been called an early environmentalist by some historians³³ and many of his admirers,³⁴ in truth he neither participated in nor provided leadership to the environmental movement during its seminal decades. (This was discussed in detail in Chapter 6). He had considerably different ideas about the role of technology in the future, which related back to his own comprehensive model of nature. He sidestepped debates about technology's potentially negative impacts upon the environment by trying to naturalize technology under the header of universal evolution; insisting that technology and biological evolution were intimately related. He also avoided criticizing industry directly, perhaps because of the negative repercussions it might have on his professional relationships and his research contracts. Fuller made vague suggestions that design science would help to correct the course of industry, without squarely pointing to environmental damage as one of the issues in need of correction.

³² I realize that this is an oversimplification of the history of the environmental movement, which comprised diverse points of view and methods of action. I am using this simplification in order to focus the argument and to contrast an eco-political view with Fuller's substantially different outlook on industry and the environment. In the U.S., the legislative gains of environmental activists included passage of the *National Environmental Policy Act* (1970), the federal *Clean Air Act* (1970), and the *Clean Water Act* (1972). A good summary of the history of the environmental movement in the U.S. is Benjamin Kline's *First Along The River: A Brief History of the U.S. Environmental Movement*, 4th Ed. (Rowman & Littlefield Publishers, 2011), especially Chapters 6-7.

³³ As previously discussed (See Chapter 6), historian Peder Anker has called Fuller an environmentalist; so has Timothy Luke, in his 2010 article cited above.

³⁴ In popular media Fuller is often called an early environmentalist, chiefly because of his interest in the efficient use of natural resources. Several examples are given in the text and footnotes of Chapter 6.

Fuller was caught in what was ultimately an unsatisfying compromise; he clearly valued the natural world as the ultimate source of vibrant life and perfect geometry, while woodenly refusing to acknowledge that industry represented any threat to it. For these reasons, it is difficult to accept that Fuller contributed significantly to the environmental movement that was unfolding around him, much less the notion that he was a leader in this area.

II. The Cybernetic Ecology View

Starting in the late 1950s, a strand of thought began to emerge in which technology, nature, and mankind would meld together in a seamless and mutually beneficial whole. At its heart was the notion of the earth as a closed ecosystem of self-organizing and self-correcting networks that could be scientifically modeled and eventually controlled. This particular view is detailed in Adam Curtis's documentary series *All Watched Over by Machines of Loving Grace* (2011), which aired on the BBC Network.³⁵ For the purposes of discussion, I have chosen to refer to this as a *cybernetic ecology*³⁶ model of nature³⁷, following precedents set by poet Richard Brautigan's 1967 poem (discussed below) and the *Whole Earth Catalog*.

³⁵ Of particular interest is the second episode, entitled "The Use and Abuse of Vegetational Concepts," which describes how this view came about during the 1950s and 60s.

³⁶ Although *cybernetic ecology* is not a formally established term within the scholarly discourse, there are precedents for its use. First is Richard Brautigan's 1967 poem "All Watched Over by Machines of Loving Grace," which uses this phrase. The poem is discussed later in this chapter. A related use of the term is found in the *Whole Earth Catalog* webpage, which describes the concept of "A cybernetic ecology" as follows: "Whole systems theory provided the conceptual framework for the ecosystem. As an ecosystem, nature was a self-regulating system comprised of living and nonliving parts that facilitated the movement of energy. Cybernetics then established a model for human manipulation of the ecosystem through the control of information, or the data (e.g. water, carbon, animal populations, chemical waste) coming in and going out of the system." See "A Cybernetic Ecology," *Whole Earth Catalog*, <http://thewholeearthcatalog.tumblr.com/>.

The basic idea behind the cybernetic ecology model was that humans, natural systems, and machines coexisted in a vast interconnected network of matter and energy, which was ever evolving and adapting through its own feedback loops. The model combined ideas about an earth in equilibrium with newer ideas about machine control through feedback loops. The notion that the earth is a closed system that tends to equilibrium was promoted by Arthur Tansley (1871-1955), an English botanist who coined the term “ecosystem” in 1935.³⁸ According to Curtis, Tansley became convinced that all natural beings (plants, animals, humans) were part of a vast system of shared energy. These massive, interconnected energy networks were what he called “ecosystems,” and they could be thought of as being analogous to electrical circuits. The job of modeling nature in this fashion was taken over by Howard T. Odum (1924-2002) and Eugene Odum (1913-2002), ecologists and brothers who used electrical circuits to model complex ecosystems.³⁹ Their work attempted to show that ecosystems depended upon feedback loops to self-correct and find a balance. (See Figure 2) As computers began to emerge on the horizon during the 1960s, these ideas about ecosystems as self-correcting systems began to fuse with cybernetic ideas, where cybernetics is defined as “the science of communications and automatic control systems in both

³⁷ At first glance, it may be considered a stretch to call the cybernetic ecology viewpoint a ‘model of nature,’ but I have done so for two reasons. First of all, it aids in comparing the cybernetic ecology viewpoint with Fuller’s comprehensive model of nature, which is a major goal of this chapter. Secondly, as described in this chapter and in Adam Curtis’ (2011) BBC documentary *All Watched Over by Machines of Loving Grace*, the cybernetic ecology point of view was largely based on the notion of self-correcting ecosystems found in nature. As such, it is not entirely a stretch to call the cybernetic ecology view a particular model of nature.

³⁸ A good deal of biographical information on Tansley can be found on the website of the *New Phytologist Trust*, including information on the concept of ecology. See, for example, John Sheail, “A.G. Tansley: The founding figure of British ecology,” *New Phytologist Trust*, www.newphytologist.org.

³⁹ A contemporary criticism of the circuit-like models of the Odums is that they oversimplified scientific data in order to get it to conform to their models.

machines and living things."⁴⁰ If the world was indeed a great self-regulating ecosystem (Tansler), and if that ecosystem and its feedback loops could be modeled by machines (Odum), then it followed that computers could calculate the effects of different feedback parameters to predict the behavior of systems.⁴¹ Once the computers had found the optimal feedback parameters, then local ecosystems, economies, and even society could be balanced by applying proper feedback into the systems.

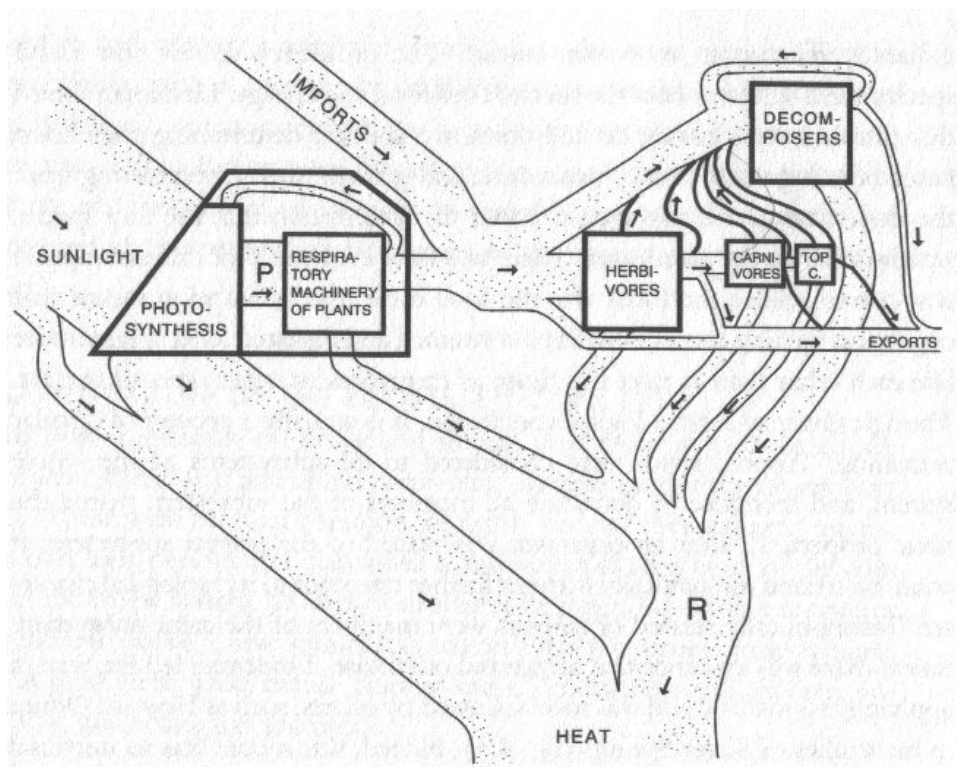


Figure 2: A diagram representing the Silver Springs, Florida ecosystem (Adapted from Odum, 1957). From Wikimedia commons.

⁴⁰ "Cybernetics," *Oxford Dictionaries*, 2013, <http://www.oxforddictionaries.com/>

⁴¹ The computers and computer models at the time could not possibly have analyzed a myriad of competing and changing inputs in a given system. This is why Odum relied upon oversimplified models, which were later criticized. See also Note 38. The notion that systems theory and feedback loops could predict the behavior of ecological or social systems, as Tansley and the Odums imagined, is today basically dismissed. According to Roland Scholz and Claudia Binder, "In summary, abstract systems thinking is not sufficient to gain insight into the dynamic structures of our material and social environments." See Roland Scholz and Claudia Binder, *Environmental Literacy in Science and Society: From Knowledge to Decisions* (Cambridge: Cambridge Univ. Press, 2011), 441. See also pages 429-442.

By the late 1960s, Curtis says that “our modern idea of nature—the ecosystem—and cybernetic theories about computers had fused together. Out of it had come an epic new vision of how to manage the world without the old corruption of power. It was a vision that seemed to be different from all past political attempts to change the world, because it was based on the natural order...Computer networks would allow for global, self-organizing communal societies unburdened by social and political hierarchies...Computers would liberate society.”⁴²

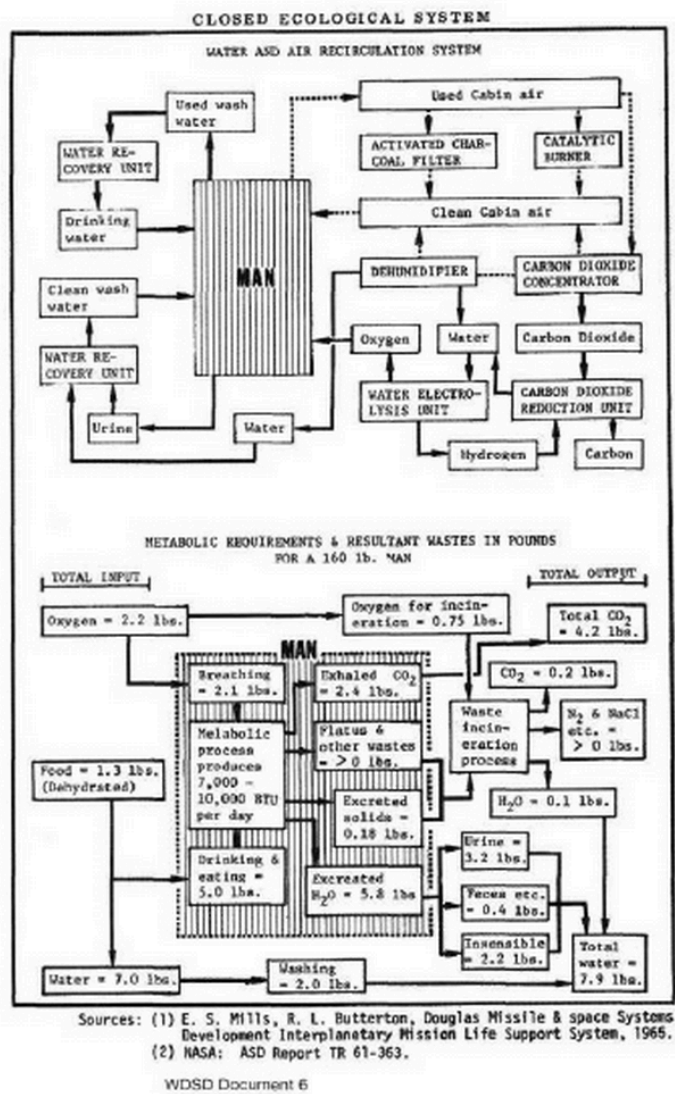


Figure 3: “Closed Ecosystem” and “Metabolic Requirements” diagrams, *Whole Earth Catalog* (Fall 1968)

⁴² Adam Curtis, “All Watched Over by Machines of Loving Grace: The Use and Abuse of Vegetational Concepts,” BBC, 2011.

The cybernetic-ecological point of view was particularly attractive to a small subset of the counterculture that—unlike the eco-politicians—tended to be interested in technology and its potential for liberating the individual.⁴³ Chief among these was Stewart Brand (1938-), founder of the *Whole Earth Catalog* and an avid admirer of R. Buckminster’s ideas and writings. To Brand and other technophiles within the counterculture, Fuller (as discussed in Chapter 6) offered ideological accommodations for technology, as long as it was used in service of their values and ideals. Likewise, the cybernetic ecology model offered the potential for a holistic synthesis, whereby new technologies would bring power to the people by helping them to self-organize and evolve their own communities as ‘ecosystems.’ Systems theory would help people to model and tune these new communal ‘ecosystems’ to reach a harmonious and stable balance. (See Figure 3) Eventually, with enhanced communications and information technologies, these human ecosystems would render politicians and power-mongers obsolete. Furthermore, machines would reduce the need for labor and allow more leisure time for self-realization. This sentiment was clearly echoed in Richard Brautigan’s 1967 poem, “All Watched Over by Machines of Loving Grace,”⁴⁴ (reproduced below) from which Curtis’ film derives its name. (See Figure 4, p. 272.) Brautigan (1935-1984) was an

⁴³ The development of this viewpoint has been related to the subsequent personal computer revolution and the flat organizational culture of Silicon Valley companies. See Fred Turner, *From Counterculture to Cyberculture Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (Chicago: Univ. of Chicago Press, 2006).

⁴⁴ “All Watched Over by Machines of Loving Grace” was also the title of the poetry anthology that Brautigan published in 1967, which contained the poem reproduced below.

active member of the San Francisco counterculture scene throughout the 1960s, participating in community activism, performance, and writing.⁴⁵

*I like to think
(it has to be!)
of a cybernetic ecology
where we are free of our labors
and joined back to nature,
returned to our mammal
brothers and sisters,
and all watched over
by machines of loving grace⁴⁶*

-Richard Brautigan, 1967

Because of Fuller's popularity (as a speaker and author) with the counterculture and his deep influence on Stewart Brand and the founding of the *Whole Earth Catalog* in particular, there has been a tendency to link Fuller with the cybernetic ecology model of nature. Indeed, there were many areas in of overlap between this emerging view of the world and Fuller's own orientation, which I will discuss below. Briefly stated, they overlapped with regard to: an openness toward new technologies; an interest in systems and in systems control; and a global utopian vision that would bring political power-mongering to an end.

Openness to Technology

Fuller's career was marked by an openness toward new technologies, and indeed his popularity with the counterculture depended upon his ability to create new

⁴⁵ Brautigan participated in numerous activities organized by *The Diggers*, a radical community action and activist group, and wrote articles for *Change*, an underground newspaper. See biographical information on website BRAUTIGAN.net

⁴⁶ Richard Brautigan, "All Watched Over by Machines of Loving Grace," 1967, BRAUTIGAN.net

technological utopian visions of a future made better with technology. Fuller's interest in technology was cemented during the Progressive era, when he became obsessed with the efficiencies of scale that Taylorist and Fordist methods of mass production could attain. "He adapted their [Taylor and Ford's] shared idea that the rationality of the scientific and managerial elite could liberate humanity from its sufferings with machine technology."⁴⁷ Likewise, individuals like Stewart Brand welcomed new technologies as having the potential for individual liberation. Prominent scientists including the Odum brothers, and cyberneticians Norbert Wiener (1894-1964), Heinz von Foerster (1911-2002) and others were also interested in using technology and mathematical modeling to optimize natural systems, economic systems, and even social systems.⁴⁸ In terms of openness to technology, Fuller had a great deal more in common with the cybernetic ecologists than he did with the eco-politicians of the day.

Systems Thinking

A related area of overlap was an interest in systems: ecosystems, social systems, economic systems, and the eventual control of systems through feedback loops. Fuller was familiar with the principles of *general systems theory* (GST) developed by Ludwig von Bertalanffy (1901-1972) and others between the end of World War II and the mid 1960s. Bertalanffy's 1968 book, entitled *General Systems Theory: Foundations, Development, Applications*, argued that the world was organized according to different types of systems that cut across all fields of science. He

⁴⁷ Peder Anker, "Buckminster Fuller as Captain of Spaceship Earth," *Minerva* 45:4 (2007), 420. This sentence is potentially confusing because of the placement of the word "sufferings." Here, "sufferings" relates to "humanity's sufferings" as opposed to "sufferings with machine technology."

⁴⁸ See Norbert Wiener, *Cybernetics: Or Control and Communication in the Animal and the Machine*. Paris, (Cambridge, MA: MIT Press, 1948, 2nd revised ed. 1961.)

stressed the need to elucidate and understand systems of all types—whether biological, physical, mathematical, or manmade—in order to understand the common principles they shared. It should be noted that systems theory and cybernetics are closely related, and in fact the two terms are often used interchangeably. Alternatively, cybernetic systems may be considered a subset of general systems, distinguished by the use of feedback loops.⁴⁹

Fuller had met von Bertalanffy in the early 1960s, and saw a correspondence between the Bertalanffy's systems theory work and his own attempts to create an integrated living system in the Dymaxion House many years earlier.⁵⁰ Indeed, Fuller was fairly obsessed by systems of production and distribution, and in analyzing and optimizing these systems to work as efficiently as possible. This was certainly a major impetus behind the development of the World Game: to understand the availability of resources around the world, and to optimize their flow through global transportation networks to provide more resources where they were needed. Fuller's utopian vision involved supplanting the existing systems, developed for military purposes, by design science systems organized around humanitarian goals. He envisioned a day when "killingry systems, or weaponry systems" would be replaced by "the new, architect-designed, world-around, livingry systems" which would distribute "world energy, materials, and money resources" to support world society.⁵¹

⁴⁹ See "Defining Cybernetics," The American Association for Cybernetics, <http://www.asc-cybernetics.org/>. See also "Cybernetics/Systems Theory," *Wikibooks*, http://en.wikibooks.org/wiki/Systems_Theory/Cybernetics

⁵⁰ Joachim Krausse, "Key Concepts in Lightful Houses," in Chu, ed., *New Views on R. Buckminster Fuller* (Stanford, CA: Stanford Univ. Press, 2009), 72-73.

⁵¹ Fuller, *Ideas and Integrity* (1963), 277.

The End of Politicians

Fuller distrusted politics and politicians in general. He felt that they were inherently power mongers, whose insatiable greed to amass power and resources inevitably led to conflict and war. "If man is going to stay on board our Spaceship Earth, it can't be done by politics because politics is so inadequate...All he [the politician] can do is give you war."⁵² Fuller's ideas about a world without politicians resonated with the counterculture generation, which had become similarly disillusioned with politics and politicians.⁵³ Fuller offered a different paradigm for seeing the world. Rather than a collection of individual nations, organized into classes and hierarchies, the earth should be seen as a spaceship, "Spaceship Earth,"⁵⁴ a closed ecosystem in which the activities of all human beings affected the success of the endeavor. This became an organizing principle of the rural commune movement; to establish cooperative communities without defined power structures that would reach a natural balance through their own systems of feedback. The introduction to the first issue of the *Whole Earth Catalog* echoed this view that individuals working cooperatively would succeed where political systems had failed. "Government, big business, formal education, church—has succeeded to the point where gross obscure actual gains. In response to this dilemma...a realm of intimate, personal power is developing."⁵⁵ The *Catalog* offered the educational

⁵² This quote is taken from an interview with Fuller that appears in Adam Curtis' *All Watched Over By Machines of Loving Grace*, Episode 2 (2011). The date of the interview is not clearly indicated, but it appears to have been filmed during the late 1960s or early 1970s.

⁵³ Curtis, Episode 2 (2011).

⁵⁴ Fuller began giving lectures using the term "Spaceship Earth" in 1964. He was not alone in the use of the spaceship metaphor; since the early 1960s, ecologists had been using a space cabin metaphor to describe earth. See Anker (2007), 426.

⁵⁵ Stewart Brand, *Whole Earth Catalog*, Fall 1968, www.wholeearth.com

and practical tools to empower the individual, and ultimately communities of like-minded individuals, to find their own natural balance.

The Rugged Transcendentalist

There were significant areas of overlap between the cybernetic-ecological viewpoint that was percolating within the scientific/counterculture community during the 1960s and Buckminster Fuller's comprehensive model of nature. However, there existed a key difference between the two with respect to the machine control of human systems. Taken to its ultimate conclusion, the cybernetic-ecology model saw a future in which humanity would indeed be "all watched over by machines of loving grace." In other words, there existed some ideal parameters for the smooth and efficient functioning of systems—including human systems—and computers could ostensibly calculate these parameters and tune the feedback loops until these systems reached a perfect balance. This would represent the triumph of science over politics, a techno-utopia where computers liberated humanity from war, poverty, political corruption, and human error.⁵⁶ This was an attractive proposition to cybernetic ecologists, who envisioned a world free of political and economic bureaucracies, where they would have more time for individual, creative pursuits. Machine control would also liberate them, one notes, from the need to think about strategies for growth, to solve disputes, or to make ethical judgments. In a world functioning under ideal parameters (in theory), such

⁵⁶ This can also be related to the concept of singularity, or "the singularity," which refers to a supposed moment in time in which artificial intelligence outstrips human intelligence, rendering human history from that point forward unpredictable. This idea dated back to the late 1950s and the work of mathematician John von Neumann (1903-1957), but it was popularized by science fiction and popular science writers including Ray Kurzweil in his 2005 book, *The Singularity is Near: When Humans Transcend Biology* (Viking Press).

problems would never come up in the first place. These cybernetic ecologists found solace in their “machinelike fantasy of stability,”⁵⁷ where conflicts were solved by computer and individuals were free to roam amongst “cybernetic forest[s]/filled with pines and electronics/where deer stroll peacefully/past computers/as if they were flowers.”⁵⁸

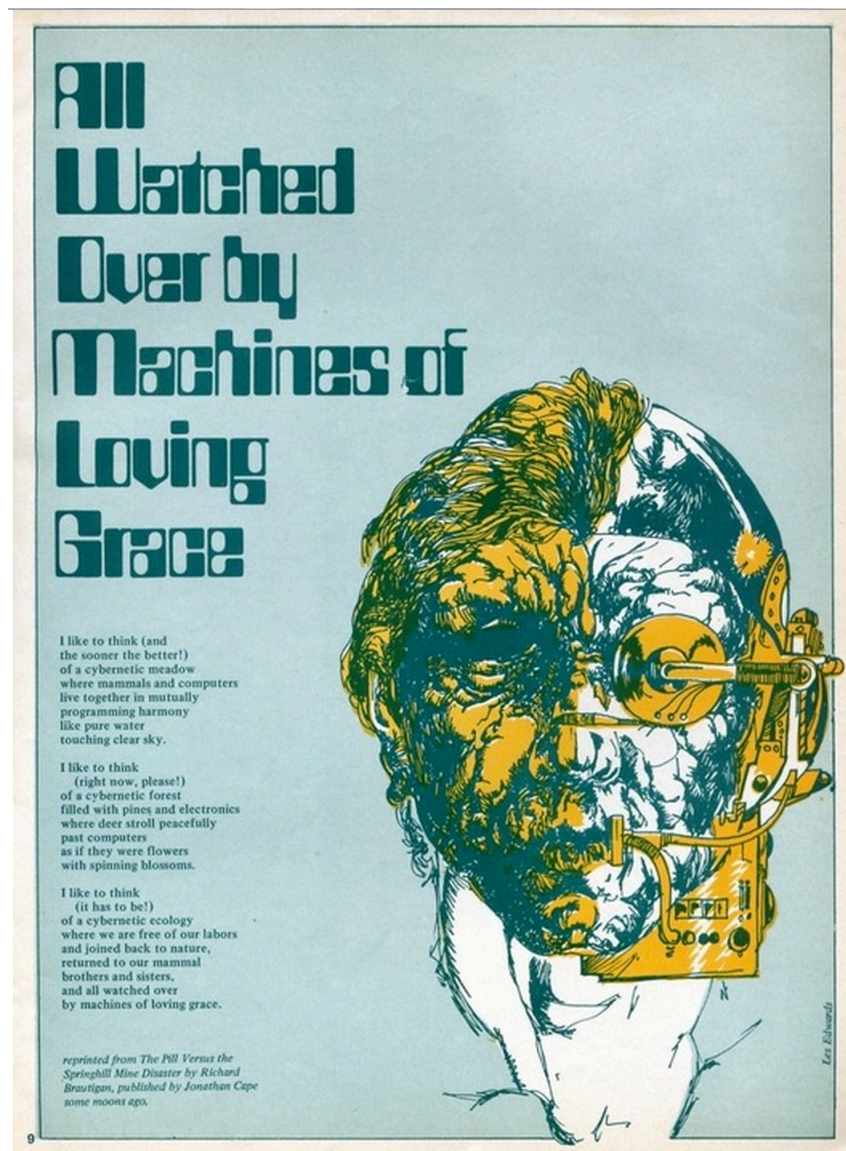


Figure 4: Page from Oz no. 34, April 1971. Poem by Richard Brautigan. Illustration by Les Edwards

⁵⁷ Curtis, Episode 2 (2011).

⁵⁸ Brautigan, “All Watched Over” (poem).

This was the point where Fuller diverged from the cybernetic-ecological train of thought. Like the counterculturists of the 1960s, Fuller was an individualist, but formed from a different set of molds. Fuller's individualism was compatible with that of the counterculture along some lines, yet not identical to it. Fuller's incorporated elements of the American Transcendental tradition, with the individual being the best interpreter of religion; as well the "rugged individual" tradition described by Hoover in 1928.⁵⁹ The counterculturists, although they incorporated some of the same elements,⁶⁰ had a more self-centered, self-actualizing, and hedonistic individualism. In particular, Martinez (2003) has spoken of the "unbridled, decadent" nature of counterculture individualism, as well as the "call for the creation an individualist space protected from the demands of others."⁶¹

Buckminster Fuller's own life story was that of the rugged individual, the one who had succeeded in life against all odds and without any help, through a combination of ingenuity and sheer willpower. He bullishly stuck to his ideas, held firmly to his principles. This was what Fuller described as *integrity*; never compromising certain principles, whether mathematical or ethical ones, and

⁵⁹ This phrase is attributed to presidential candidate (and later U.S. President) Herbert Hoover in campaign speeches from 1928 onward. Hoover's "rugged individualism" speech is widely reproduced on the internet. See, for example, "Herbert Hoover, "Rugged Individualism" Campaign Speech, (1928), <http://www.digitalhistory.uh.edu/>. Rugged individualism implies that individuals should be able to help themselves, to bootstrap their way out of economic troubles using their own willpower and ingenuity, without needing handouts or other interference from the government. American individualism during the 1960s and 70s was not entirely devoid of the "rugged individualist" ideal; for example, the rural communards saw themselves as part of this tradition.

⁶⁰ Manuel Martinez points out that the 1960s—with its emphasis on social and political change—saw a new discourse on how to define citizenship, democracy, and racial justice, and civic duty, as well as individualism. He also points out that this neoindividualism incorporated elements of the rugged individualist tradition. See Manuel L. Martinez, *Countering the Counterculture* (Univ. of Wisconsin Press, 2003), 6-9.

⁶¹ Martinez, *Countering the Counterculture*, 7-9.

working ceaselessly to promote those principles.⁶² Unlike the counterculturalists, Fuller was far too busy changing the world to indulge in “finding himself.” Fuller was certainly open to using technology to inform the design of more efficient, optimal systems, as discussed above. He believed that design scientists, informed by data and analysis of resources and situations, would be far better equipped to make global decisions than politicians. However, the existence of science and technology alone did not absolve individuals from the need to make critical decisions about the issues. One could not just assume that computers could find the best solutions to the problems, as some systems theorists did; nor simply tune out from society like some of the communards did; nor navel-gaze about wandering through cybernetic forests as Brautigan did. It was individuals acting with integrity who would ultimately provide the solutions to global problems. “It is this matter of the integrity of the individual, the courage, the courage to go along with the truth as you personally really see it.”⁶³ In Fuller’s case, the solution with integrity was the design science revolution; informed by science, but ultimately steered by a cadre of individuals of strong moral and ethical fiber. In the spirit of individual integrity, Fuller often exhorted young people to “do your own thinking.” It was not enough to follow the thought patterns of others, whether politicians, one’s peers, or the parameters set by computers. “Each one of us has something to contribute. This really depends on each one doing their own thinking, but not following any kind of rule that I can give out, any command. We’re all on the frontier, we’re all in a great mystery--incredibly mysterious.”⁶⁴ Fuller

⁶² R. Buckminster Fuller, “Excerpt from Interview of February 26, 1983,” *Buckminster Fuller Institute*, <http://bfi.org/about-fuller/>.

⁶³ *Ibid.*

⁶⁴ *Ibid.*

welcomed the information that science and technology could provide; but ultimately, like the Transcendentalists, he believed it was up to the individual to interpret that information. Individuals, acting with integrity on behalf of humanity, would direct technology away from unethical ends (what Fuller called “killingry”) and toward humanitarian ends (“livingry”). The individual’s responsibility to chart this course, to use information wisely, could never be entrusted to machines. “Humanity [must] make some of its own decisions in relation to its own information. That’s why we’ve come to a new moment of integrity.”⁶⁵

Conclusion

Fuller did not subscribe to the eco-political model of nature represented by environmentalists such as Rachel Carson; their fundamentally different views on technology created a rift too deep to overcome. Doubtless many individuals⁶⁶ who attended Fuller’s lectures during the 1960s and 1970s admired his humanitarian views and his interest in efficiency as a strategy for conservation. But ultimately Fuller never overtly engaged in environmental action, directed his resources toward it, or risked his lucrative partnerships by taking a critical view of industry. He focused instead on industry’s potential to improve the human condition through better housing and distribution of resources.

⁶⁵ Fuller, “Excerpt from Interview of February 26, 1983.”

⁶⁶ It is very difficult to estimate how many that attended Fuller’s lectures during the 1960s and 1970s self-identified as environmentalists. I am not aware of any data that exists about this point. However, we can identify students and ‘followers’ of Fuller who actively involved in the back-to-the-land movement, including Stewart Brand and Peter Douthit, founders of the *Whole Earth Catalog* and the *Drop City* commune, respectively. Sir Norman Foster (b. 1935), founder of Foster and Partners, a sustainable architecture and design firm in London, credits Fuller for inspiring him in the direction of lightweight and sustainable design. This is further explored in Carlos Carcas’ 2010 documentary film, *How Much Does Your Building Weigh, Mr. Foster?* (Aiete-Ariane Films).

Fuller's thinking was much more closely aligned with the cybernetic ecology model that grew out of ecological and systems theory ideas, the model that found voice in the *Whole Earth Catalog*. He believed that systems tended to balance, and he longed for the day that design scientists would displace politicians. But in the end, he diverged on the question of machine control versus individual integrity. Fuller could not accept the idea of a techno-utopia operating on a computer's brain; ultimately, Spaceship Earth required a human being at the helm.

Insert 2 (After Page 276)

Expanded Discussion of Contributions

This thesis makes a number of distinct contributions to our understanding of R. Buckminster Fuller's life and work and to the broader field of design history. These include both methodological contributions and historical ones. The contributions may be considered in light of the research questions identified in the Research Approach and Methods chapter, page 6.

Models of Nature

The use of *models of nature* to describe an individual (or group's) mental construct of nature has been used, borrowing from social sciences research. This is a new application of the idea of mental models, yet a very valuable one in discussing a topic as ambiguous as nature. Further, this framework was used to establish R. Buckminster Fuller's model of nature, which I have termed a *comprehensive model of nature*; also a new idea, but not unprecedented given Fuller's demonstrated interest in broad, comprehensive thinking (see Research Approach and Methods chapter, Chapter 1).

The models of nature approach can be considered a methodological contribution to discussions concerning nature and design, which as discussed in the Research Approach and Methods chapter, lacks a consistent or reliable methodology. For example, this method was successfully used to compare and contrast Fuller's model of nature with alternate views of nature in Chapter 7 of this thesis.

Direct Links to Transcendentalism

A direct link has been American Transcendentalist views of nature and Fuller's own model of nature, primarily through the influence of his Aunt Margaret Fuller. Although many people have cited in passing some connection with Margaret Fuller, there have been no specific investigations into how their philosophies resembled one another with respect to nature (see Chapter 1, especially pp. 99-109). A deeper historical connection with Enlightenment thinking, particularly the notion of the natural world as evidence of natural laws, has also been made with Fuller's thinking, a tradition that was also shared by the Transcendentalists.

Universal Evolution and Relation to Pierre Teilhard de Chardin

The theme of *universal evolution* has been explored as it unfolded in Fuller's writing from the late 1920s onward; this is the first time this notion has been explored and related to the wider intellectual context of his times. In particular, universal evolution has been described as a combination of biological, technological, and intellectual development over time that helped to 'naturalize' technological change under the context of biological evolution in Fuller's worldview (see Chapter 2, pp. 118-120). Fuller's ideas about universal evolution are further compared to those of Pierre Teilhard de Chardin (1881-1955), the philosopher and paleontologist whose influential book, *The Phenomenon of Man* (manuscript completed in 1941, translated into English in 1955) had strikingly similar ideas about universal evolution. Whether or not Fuller was directly influenced by Teilhard de Chardin (see Chapter 2, pp. 120-124), in either case this helps to situate Fuller's work within a broader context of the history of ideas.

Contextual Approach

Fuller's work has been described contextually as unfolding against a larger context of technological and social change. For example, the 4D House was developed against Taylorist and Fordist production context of the 1920s and 1930s, rife with the spirit of the American Progressivism (See Chapter 3); whereas the geodesic domes found an audience with the 1960s counterculture (See Chapter 5).

Changes in Presentation/Reception of Work

Describing Fuller's work within context (as noted above) allows for a better understanding of changes in the presentation and reception of his work, changes that—as a public intellectual—Fuller was himself aware of (see Chapters 2-5, especially pp. 172-182). For example, I have discussed how nature itself became an increasingly important feature in the presentation of Fuller's work during the 1960s and beyond, when Fuller wished to establish common ground with countercultural audiences with particular interests in holism and naturalism. Furthermore, Fuller drew upon his model of nature and Transcendentalist thought to find common ground with countercultural audiences and to provide them with much-needed accommodations for technology. (See Chapter 4, especially pp. 171-182; and Chapter 5, pp. 182-200).

Was Fuller an Early Environmentalist?

Many scholars have argued that Fuller was an early environmentalist, particularly given his interests in efficient design and use of materials (see Chapter 6, pp. 224-225). By contrast, I have argued that Fuller's obsession with efficiency was really a holdover from the Progressive era production context, which sought to wring maximum profits from time and materials invested (see Chapter 6, pp. 226-230). I have also argued that Fuller evaded direct questions about environmental damage using a variety of mostly obfuscatory techniques (see Chapter 6, pp. 232-242).

Fuller's Model of Nature versus Eco-Political and Cybernetic Ecology Models

In order to establish the uniqueness of Fuller's model of nature, it has been compared to two alternate models of nature that existed alongside it, namely the eco-political model of nature (see Chapter 7, pp. 250-264) and the cybernetic ecology model of nature (see Chapter 7, pp. 262-276). Comparing and contrasting Fuller's model of nature with others helps to clarify where (if at all) Fuller's thought coincided with these two alternate models respectively, and where—and why—it diverged. This further helps to contextualize Fuller's work within the history of environmental and intellectual thought.

Taken together, these contributions take the popular assumption that Fuller's work was "inspired by nature," and make that notion concrete (see Introduction). I have discussed what nature meant to Fuller; what the origins of his model of nature were; how it affected his worldview and design process; how it was manifested in his work; how Fuller related to others through the theme of nature; and how his model of nature was unique in the history of environmental thought. A thorough, nuanced understanding of Fuller's model of nature, grounded by examples, discussion and analysis, is thus the major outcome of this work.

Chapter 8

Conclusion

R. Buckminster Fuller is known in the popular imagination as a designer inspired by nature, but until now there has been no serious investigation into how nature affected Fuller's design work, nor indeed what the term 'nature' represented to him. In this thesis, the outlines and origins of Fuller's model of nature have been traced, allowing for a more thorough assessment of how Fuller's understanding of nature impacted his design work, his attitude towards technology, and his worldview. In short, this thesis dug deeply into what the phrase "inspired by nature" really means in relation to Fuller.

Fuller was a radically comprehensive thinker with a cosmic vision wherein the natural world, human civilization, and technology were all woven together in seamless coevolution under the benevolent watch of God.¹ This has been described in Chapters 1-2 as Fuller's comprehensive model of nature, with universal evolution as its engine.

Fuller's comprehensive model of nature served him well in many respects. It allowed him to apply natural metaphors to manmade things, as in the 4D house project of the late 1920s. It allowed him to understand how scientific phenomena could be applied to practical concerns: to see how spherical geometries might lead to more accurate maps, as in the Dymaxion Map (1943); or how domes could

¹ It should be clear from the beginning chapters of this thesis that the description represents Fuller's personal vision rather than anybody else's.

provide lightweight, self-supporting shelters, as in the geodesic dome (patented in 1954). Technology to Fuller was entirely natural in that it represented the application of human intelligence to problems of survival. This allowed him to consider unconventional design solutions that combined an understanding of human survival needs with efficient technical solutions to those needs.² At a fundamental level, he believed that humanity and technology could not only coexist, but that indeed they were interdependent and continuously coevolving in a process of universal evolution.³

Fuller's understanding of nature drew upon centuries of religious and intellectual traditions, some absorbed through education and upbringing, others inherited. It incorporated Enlightenment ideas about the laws of nature; Transcendentalist ideas about holism, individualism, and nature as evidence of God; a Progressive era fascination with efficiencies of time and material; and Fuller's own ideas of universal evolution. His model of nature was rooted in history, but animated by Fuller's own vision of a techno-utopian future where technology would be leveraged towards humanitarian ends.

During the 1960s, this powerful humanitarian vision allowed Fuller to provide ideological accommodations for technology to a whole generation of youth that had become wary of technology, disillusioned with government, and in search of

² A good example of this would be the 4D/Dymaxion house, discussed in Chapter 3. The design of the house considers the needs of the inhabitants, from climate control to ease of cleaning. At the same time, Fuller proposes a mechanical core fitted with plumbing and electrical hookups, so the latest technologies will always be close at hand. In Fuller's mind, the use of time-saving technologies will give inhabitants more time for education, creative and leisure pursuits.

³ We could go one step further, and say that in Fuller's mind, humanity's existence depended upon the continuous application of technology to problems of survival.

direction. His Transcendentalist beliefs about individualism, holism, and naturalism allowed Fuller to find common ground with the counterculture, which shared these values. His powerful message of a future where technology would be applied toward humanitarian ends helped to *naturalize* technology, inspiring a generation of creative countercultural thinkers to see technology as a potential solution to the problems facing humanity as opposed to a part of the problem itself.

Although the bloodless 'design science revolution' that Fuller envisioned never came to pass, it did encourage grassroots, small-scale innovations that would lead directly to the founding of the *Whole Earth Catalog* (1968), and indirectly to the computer revolution of the late 1970s and 1980s. Design science would also inspire a small but interesting band of designers, among them Norman Foster, Peter Pearce, and Medard Gabel, to apply design science to problems of sustainability in the subsequent decades. Indeed, Fuller's ability to reinvest technology with meaning for a generation that had become disillusioned by its negative outcomes should be considered a major achievement of his career.

Fuller's model of nature also had its limitations, as any worldview might. It was firmly wrapped around a Western Christian worldview, combining a Christian understanding that God had created the cosmos and its operating system with a Darwinian understanding of evolution by natural selection. This can be considered a theistic evolutionary (or evolutionary creationist) viewpoint, which has certain limitations in the contemporary scientific discourse. Since it was Fuller's worldview and no one else's, this may be a moot point. In any case, Fuller's model of nature

was really a metaphysical one more than a scientific one, in spite of Fuller's use of scientific-sounding terms to describe his ideas.⁴ Faith and religion were fundamental to Fuller. His belief in a higher power provided him with great strength over the years, giving him courage even when he had all but given up on himself, as the Lake Michigan story of 1927 illustrates.

Fuller's model of nature was also somewhat limited in situations where the natural world and manmade technologies came into direct conflict, as when confronting the realities of environmental damage caused by industrialization. Because Fuller's model of nature posited that technology as an outgrowth of human intellectual endeavor was entirely *natural*, it was difficult for him to accept that any limitations on industrial achievement might be in order. That would be tantamount to curbing human ingenuity, restraining the application of knowledge. Rather, Fuller posited that humanity would continue to evolve and would invent its way out of environmental problems. In the contemporary environmental discourse, this might be likened to a "technology will save us" strategy of climate change denial, as discussed in Chapter 6. In terms of advocating for environmental protection and achieving the necessary legislation to curb industrial pollution, the eco-political model of nature adopted by the environmental movement proved far more effective than Fuller's comprehensive one. Of course, Fuller was not politically active as an environmentalist, so again this did not present a significant problem for Fuller as an individual.

⁴ See Chapter 2, pp. 128-130.

Fuller's model of nature had an internal consistency over the years, rooted as it was in well-formed ideas about laws of nature, nature as God, and God as the ultimate source of wisdom. Fuller had no occasion to doubt his understanding of nature, because it rested on a bedrock of faith and tradition. His views on nature and evolution were more metaphysical than scientific, and as such not subject to the scrutiny or testing of others. Of course, this in itself can be considered a limitation, as Fuller developed his own kind of dogma around his beliefs. That dogma had several familiar refrains: technology is natural and beneficial; technology can solve human social problems; the world would be a better place if politicians were replaced by design scientists; human intellect and integrity will prevail. At his most persuasive, Fuller sounds like an inspired utopian, a committed technological visionary, and an incurable optimist. At his less convincing, he comes across as a zealot for his own brand of design science technocracy, or what Lewis Mumford called "that interminable tape recorder of salvation through technology."⁵

This observation should not detract from the fact that, when it comes to nature, Fuller had a comprehensive, intricate, expansive, heroic, fervent and consistent vision. Nature was a source that he returned to again and again to provide conceptual and formal inspiration for his architectural projects; confirmation of his religious faith; and a way of understanding the role of technology in human civilization. In the end, the flimsy phrase "inspired by nature" can hardly contain the immense ocean of possibilities that nature represented to R. Buckminster Fuller over the course of his lifetime.

⁵ Lewis Mumford, *Findings and Keepings* (New York: Harcourt Brace Jovanovich, 1975), 373.

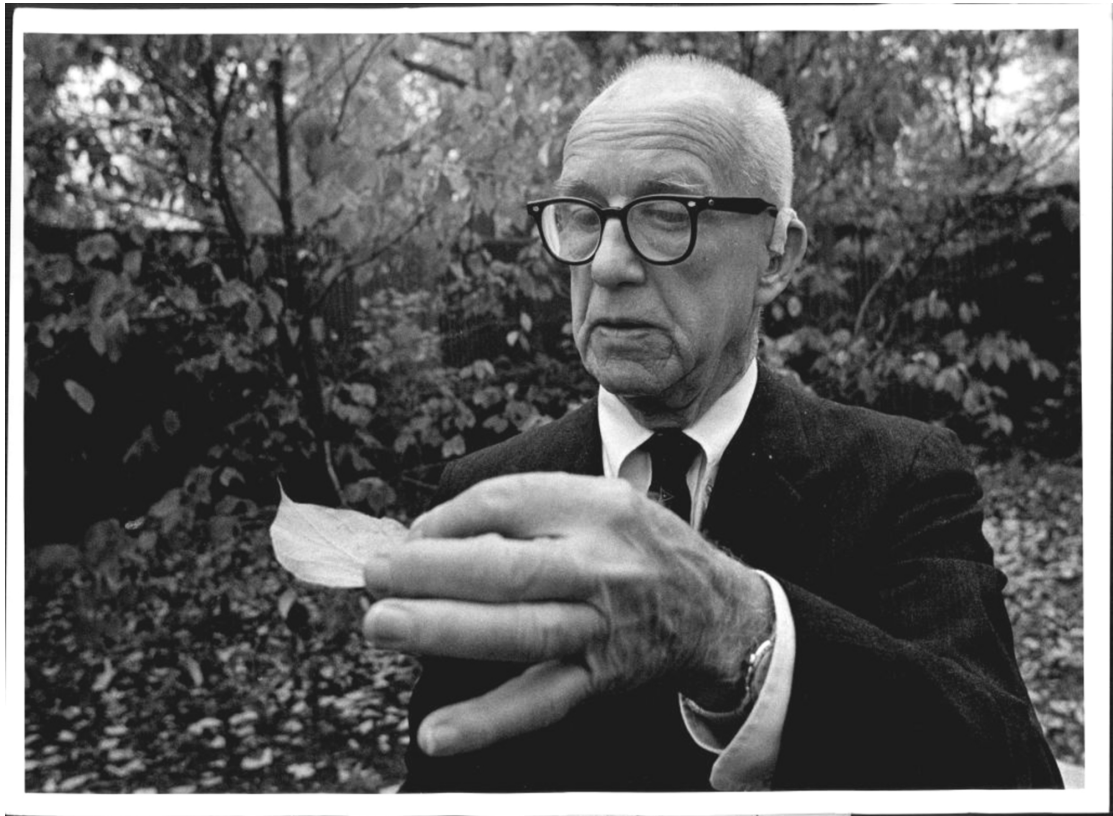


Figure 1: Buckminster Fuller in backyard with leaf (from Buckminster Fuller Future Organization Website)

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