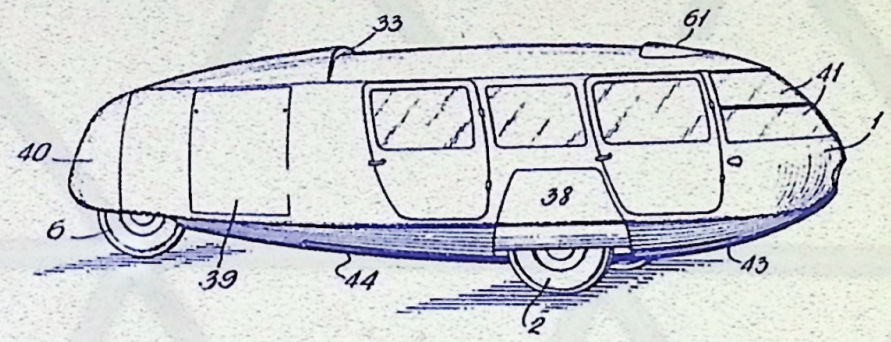
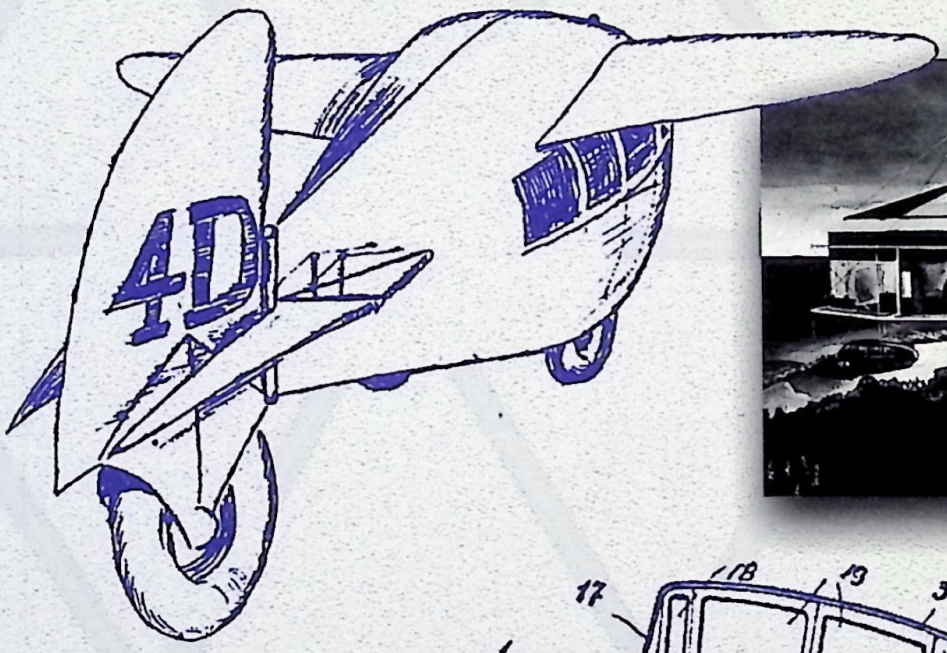
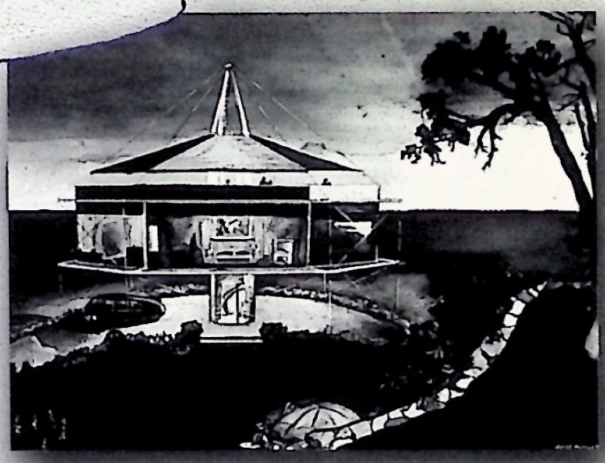
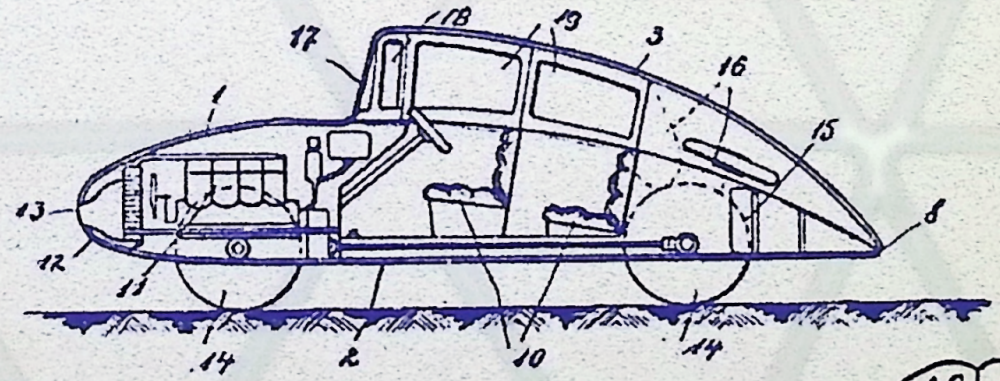
Fuller Speak

Rebecca Dalvesco









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Contents

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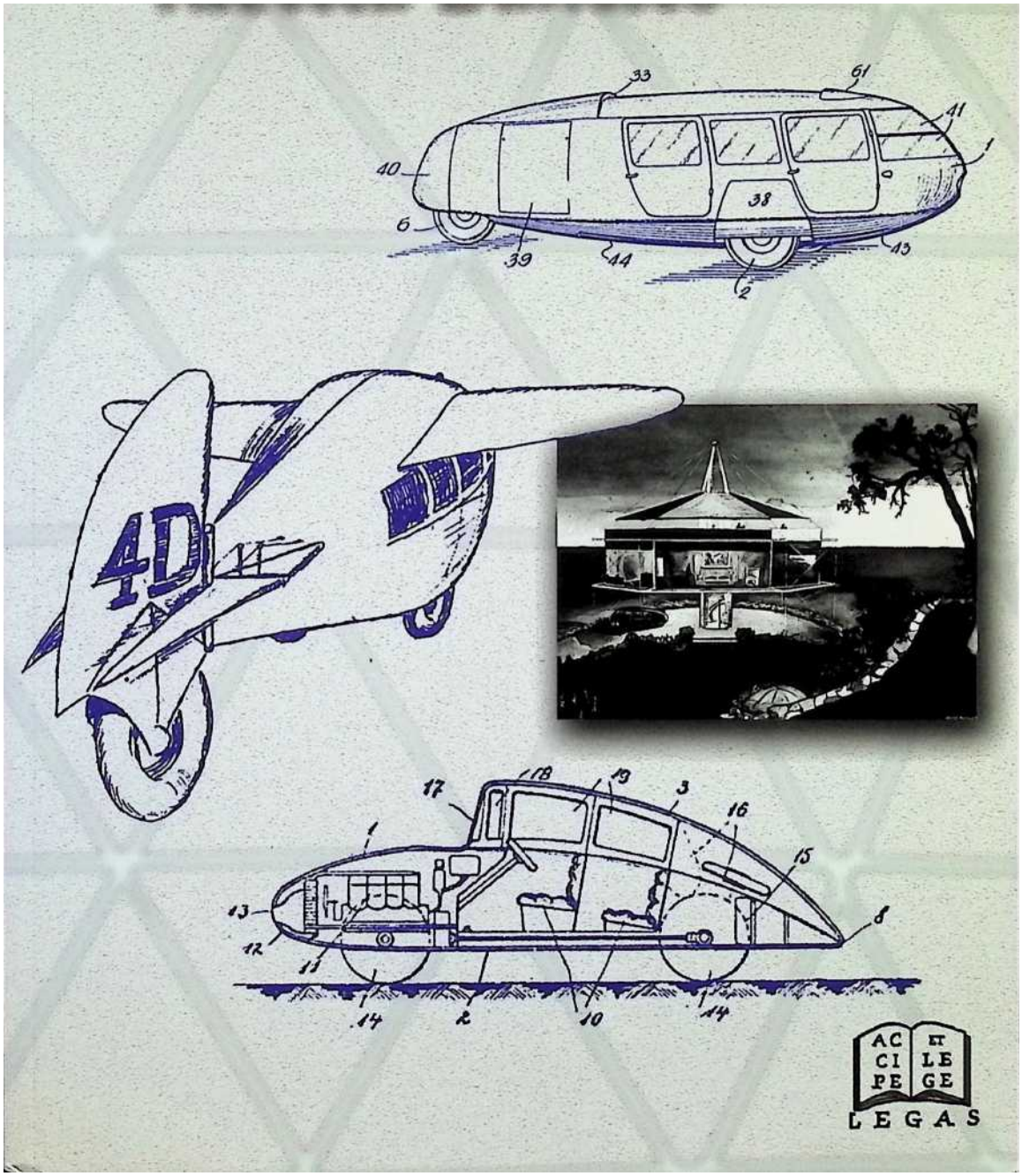

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To the memory of my father

Rudy Dalvesco

Contents

1 Introduction

The American designer, Richard Buckminster Fuller (1895-1983), created a new sign system for industrial design products and texts early in his design career.

His system reflects the concerns and aspirations of American culture from the recession of 1927, through the economic crash of 1929, and into the Depression and fitful recovery of the 1930s. His design methodologies and philosophies were pragmatic insofar as he sought to make design an objective rather than a subjective discipline. His method incorporates both text and object, language and form.

The pragmatic principles that Fuller used in his designs and language are similar in content to the ideas put forth by the American pragmatic philosopher Charles Sanders Peirce (1839-1914), who developed a science of signs known as semiotic. This science was based upon the logical signification (Deely 1990: 106), interpretation, and production of the sign (Innis 1985: viii).

Peirce's semiotic theory has impacted anthropology, literary criticism, and has influenced contemporary twentieth-century architectural design theories. These contemporary theories have often been given the name *semiotics.* This term has frequently replaced Peirce's initial term of *semiotic.* The term *semiotics* incorporates aspects of the European study of linguistics, known as *semiology.* In this study, the term *semiotic* is used to differentiate the ideas established by Peirce from the sign system created developed by the Swiss linguist, Ferdinand de Saussure (1839-1914), a system more widely accepted in Europe.

Fuller created a streamlined vehicle design known as the Dymaxion Vehicle. He derived his idea for the streamlined Dymaxion Vehicle from his sketches of the “4D Auto-Airplane” described in his 1928 book, *4D Time Lock.* Fuller proposed in the sketches a three-wheeled teardrop aircraft fuselage with an inverted-vee “hull,” recessed front wheels, inflatable wings, rear steering, and an aerodynamic rudder. His

Dymaxion Vehicle was to be the test platform for the ground-based automotive performance of the “4D Auto-Airplane.” Although he never developed the Dymaxion Vehicle into an airplane, it was a dramatic advance over the traditional vehicles of the day. Fuller produced three prototypes of the Dymaxion Vehicle between 1933 and 1935.

Fuller believed in learning from experience and observation.His ideas had their beginnings in logic and can be compared with those of Peirce. To gain an understanding of the similarities between Peirce and Fuller's logic, we first need to investigate Peirce's logic. This investigation will involve an examination of Peirce's philosophical categories of phenomenology and epistemology.

Peirce's Phenomenology

> Peirce's philosophical category phenomenology was not dependent upon logic. On the contrary, Peirce believed that logic was dependent upon phenomenology (Peirce 1958/8: 205). Peirce's definition of phenomenology differs slightly from the traditional meaning of the term that was expressed in the eighteenth-century writings of Johann Heinrich Lambert (1728-1777) and Immanuel Kant (1724-1804). These philosophers sought `` ...to denote the description of consciousness and experience in abstraction from consideration of its intentional content'' (Blackburn 1994: 284). The meaning was solely based upon the experience that the object under investigation produced, and it did not include the object, itself, as an aspect of the experience (Ree and Urmson 1995: 233).

Peirce adheres to a broader definition of phenomenology:

> ...Phenomenology, or the Doctrine of Categories, whose business it is to unravel the tangled skein [of] all that in any sense appears and wind it into distinct forms; or in other words, to make the ultimate analysis of all experiences the first task to which philosophy has to apply itself. (Peirce 1978: 71)
>
> Peirce's definition is closer to Hegel's, who claimed that phenomenology was a study of `` ...the evolution of self-consciousness, developing from elementary sense experience to fully rational, free thought processes capable of yielding knowledge'' (Blackburn 1994: 284--5). Sentiment and intuition, according to Hegel, were to be approached through rigorous

conceptual thinking, similar to the discipline of a science (Ree and Urmson 1995:127). Ideas were to function as scientific hypotheses. Hegel wanted to end romanticism in philosophy by elevating philosophy to the stature of a science. (Ibid: 126)

Similar to Hegel, Peirce believed that ideas function as scientific hypotheses. (Ibid: 228) However, Peirce's phenomenology goes beyond Lambert's, Kant's and even Hegel's definition. Peirce pronounced that:

I will so far follow Hegel as to call this science Phenomenology although I will not restrict it to the observation and analysis of experience but extend it to describing all the features that are common to whatever is experienced or might conceivably be experienced or become an object of study in any way direct or indirect (sic). (Peirce 1960/5: 27)

Experience, according to Peirce, was the main attribute of his philosophical definition of phenomenology. The meaning of experience included the object —the idea or thing observed—that was the motivation for the experience. He claimed:

What is the experience upon which high philosophy is based? For any one of the special sciences, experience is that which the observational art of that science directly reveals. This is connected with and assimilated to knowledge already in our possession and otherwise derived, and thereby receives an interpretation, or theory. But in philosophy there is no special observational art, and there is no knowledge antecedently acquired in the light of which experience is to be interpreted. The interpretation itself is experience. Even logic, however, the higher of the two main branches of philosophy, draws a distinction between truth and falsehood. But in high philosophy, experience is the entire cognitive result of living, and illusion is, for its purposes, just as much experience as is real perception. (Peirce 1958/7: 314)

According to Peirce, the process of interpretation is the experience, logic, and observation[1] that are responsible for creating the interpretation. He also stressed that the idea, as well as the actual object creating the experience, functioned as an aspect of experience: thus, an illusion could be considered an aspect of reality.

Peirce thought of logic as being a system of signs based upon both phenomenology[2] and mathematics.[3] He claimed that "logic is the theory of self-controlled, or deliberate, thought; and as such, it must appeal to ethics for its principles. It also depends upon phenomenology and upon mathematics. All thought being performed by means of signs, logic may be regarded as a science of the general laws of signs" (sic) (Peirce 1978: 62). Peirce thought the terms 'semiotic' and 'logic' were synonymous in character.

> In his article ``Ground, Object, and Interpretant,'' he noted the following: ``Logic, in its general sense, is, as I believe I have shown, only another name for semiotic, the quasi-necessary, or formal, doctrine of signs'' (1960/2: 134). This doctrine of signs, known as semiotic, is based on Peirce's concept of semiosis.
>
> Semiosis was comprised of the action among various entities, called signs, and consisted of icons, symbols, and indices. These three types of sign were in a direct relationship with his triadic relata of the sign, the object, and the interpretant. The relationships, or the interactions, among these signs became known as the process of semiosis (fig. 1) (Peirce 1960/6: 236--237).

Peirce's Epistemology and the Concept of Worldview

1 Peirce defined the word *observation* as: "Not,...an External observation of the objects as in Induction, nor yet an observation made upon the parts of a diagram, as in Deduction; but for all that just as truly an observation. For what is observation? What is experience? It is the enforced element in the history of our lives. It is that which we are constrained to be conscious of by an occult force residing in an object which we contemplate. The act of observation is the deliberate yielding of ourselves to that force majeure—an early surrender at discretion, due to our foreseeing that we must, whatever we do, be bome down by that power, at last. Now the surrender which we make in Retroduction (abduction), is a surrender to the Insistence of an Idea." Our present discussion of the notion of observation refers to this definition by Peirce. For further explanations of Peirce's term observation, see "Methods for Attaining Truth: The First Rule of Logic." *{Collected Papers.* Vol. V.: 399–413).

2 Phenomenology to Peirce dealt with appearances and did not focus upon any notion of truth. See Peirce, "Why Study Logic?: The Pre-Logical Sciences." *{Collected Papers.* Vol. II.: 67–69).

3 Peirce thought mathematics was deductive logic, when it dealt with mathematical hypotheses. See Peirce, "Categories of Experience." *{Collected Papers.* Vol. VII.: 313–325).

Peirce endorsed the idea of Wissenschaftslehre[4] expressed in the writings of the German philosopher, physiologist, and psychologist Wilhelm Max Wundt (1832-1920), particularly in his work entitled Logic.[5] According to Peirce, this concept investigates the methods and results of the special sciences with particular focus on the formation of a metaphysics known as Weltanschauung. Weltanschauung, or worldview, was synonymous with the notion of conceptual knowledge (Peirce 1958/2: 33--34).

The works that come under these two terms regard ``logic either as consisting in, or as deduced from, a branch of knowledge which the Germans call Erkenntnisslehre, the doctrine of cognition, or from a closely allied science which they call Wissenschaftslehre, the doctrine of science, or epistemology...`` (Peirce 1960/2: 33).

A person's cultural worldview, according to Peirce, is the critical and logical study of knowledge. This study became known as epistemology, derived from the Greek term episteme, meaning knowledge.

Worldview and Culture

It is possible to use the idea of Weltanschauung, or worldview, in the analysis or interpretation of a given culture (Merrell 1985:42). To know is to become conscious of our own knowledge and therefore of ourselves.

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4 Wissenschaftslehre is the German doctrine of science which the philosopher Fichte developed into a critical philosophy. This idealistic, scientific system of knowledge brought the principles and methodology of all the sciences and avoided any factual content. See Runes, 1983: 353.

5 Wundt's book *Logik* written in 1880–3. See Runes, 1983: 353.

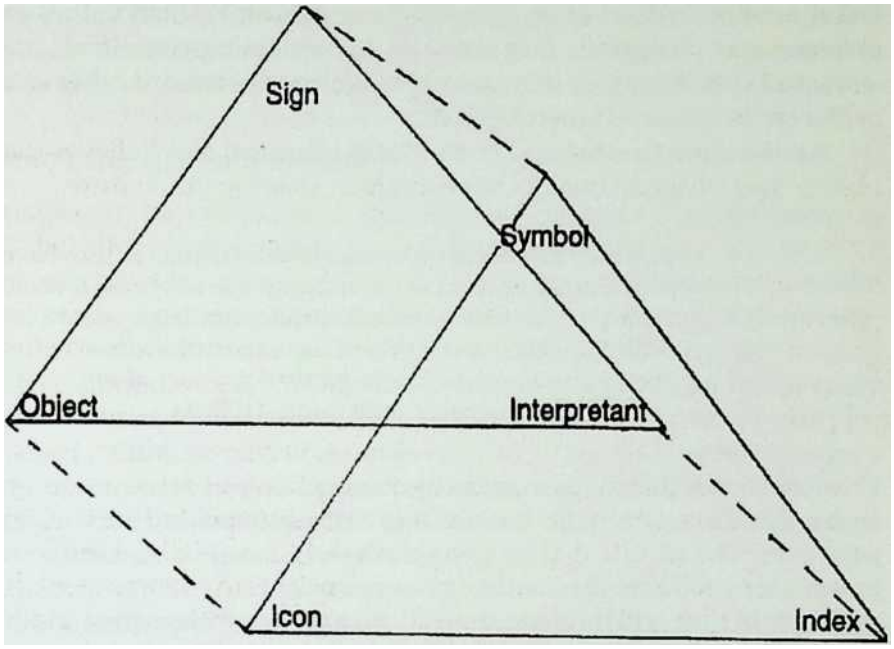

Figure 1: Diagram of Peirce's process ofsemiosis. Author's collection.

The self is not entirely capable of transcending that of which it is an aspect. Every person's worldview is incomplete insofar as it is an “incomplete representation of a/the world” *(Ibid: 72).* It is a representation of knowledge because humans have the capacity to transcend that which is known to other individuals. Knowledge is an essential aspect of the human being *(Ibid:* 72). The American semiotician Floyd Merrell notes:

> Looking to the past, every philosophy, scientific theory, advanced culture which has fallen into decay, social, political, or economic system, can be demonstrated to contain somewhere, at some point in time, a flaw-at least from our present, and biased, view. Future civilizations will certainly look upon us in their own ``prejudiced'' way as well. (Ibid: 72)

Every culture will have its own worldview, separate and distinct from that of any culture that existed before it.

Culture, Design, and Semiotic

Designed objects are a reflection of our cultural beliefs. Although these beliefs differ as to how they are expressed in verbal and behavioral modes, they usually do not differ in character or content. The cultural linkages of an artifact or design object are values. Human values can be material and utilitarian; they can also be aesthetic or spiritual, as with icons and cult objects, or they can express attitudes toward other humans or the environment (Frown 1982: 3).

Architecture theorist and critic Donald Preziosi also believes that the objects that a human invents have a role in shaping our culture:

> Not only do we use and make objects; objects in turn have, in a sense, made us what we have become as a species. It seems evident that we have evolved ourselves in large part to interact with this artifactual world of sign-formations-in other words, that human evolution is in part the product of our long interaction with systems of built forms. (1979:1)

Preziosi argues that all designed objects function as part of a sign system that exists in a symbiotic relationship with humankind's evolutionary processes. The objects that humans create will have a direct influence on any future products that make up our constructed environment. These products in turn will influence how humankind perceives past and future generations.

Jules David Prown, like Preziosi, believes that objects have an influence on our cultural environment. In his article, “Mind In Matter: An Introduction to Material Culture, Theory, and Method,” interpretation is viewed as the knowledge that objects are “cultural releasers.” Prown discusses how the cultural values of a perceiver of an object might be similar to or different from those who produced the object, even though both groups may live in the same society. This explains why some objects are viewed favorably and others neglected; it is also the reason why an object may be “in fashion” one moment, and “out of fashion” the next. The object, in form and function, remains essentially unchanged; it is the consumer or perceiver of the object whose cultural values change. He declares: “From the time it is created, an artifact can arouse different patterns of response according to the belief system of the perceiver's 'cultural matrices' (1982: 6). In the process of the interpretation of objects, information external

to the artifact, such as the designer's purpose or intent, plays an important role in how the object will be interpreted by the consuming society. According to Prown, culture and society, belief and behavior, are connected; this connection determines the manner in which a society will view its objects *(Ibid:* 6).

The architectural theorist Juan Bonta establishes a link between culture, architecture, and semiotics. He believes that the science of semiotics should involve the interpretation of *how*[6] the design object means the particular things it does to a certain culture. The science of semiotics should investigate how expressive systems convey meanings through certain forms and how these relationships originate and change (1979: 211).

Culture, Language, and Semiotic

Language can be viewed as a sign system. Umberto Eco, for instance, notes that dictionaries and cultivated language must take into account that words function as signs (1984:16). According to anthropologist John Deely, language not only denotes the words a culture uses but also everything that makes humans understand each other, including all imagery used to communicate (1990: 73). Deely, like Eco, argues that the imagery and words used to communicate effectively must be a part of that person's own culture or part of a similar culture. The worldview of a sign's creator or any user of that sign is connected with his or her structure of language. The anthropologist and semiotician Mieczyslaw Wallis claims that "...there are connections between the structure of language and the worldview" (1975: 18). Language directly influences the worldview of both the creator and the reader of a text by virtue of the use of grammatical conventions. In every text there is a style of language that is repre-

6 This term relates to Peirce's notion of inductive reasoning. Inductive reasoning, Peirce wrote, "...consists in starting from a theory, deducing from it predictions of phenomena, and observing those phenomena in order to see *how* nearly they agree with the theory. The justification for believing that an experiential theory which has been subjected to a number of experimental tests will be in the near future sustained about as well by further such tests as it has hitherto been, is that by steadily pursuing that method we must in the long run find out how the matter really stand. The reason that we must do so is that our theory, if it be admissible even as a theory, simply consists in supposing that such experiments will in the long run have results of a certain character. But I must not be understood as meaning that experience can be exhausted, or that any approach to exhaustion can be made." See Peirce, "Three Types of Reasoning." *(Collected Papers.* Vol. V.: 94–111).

sentative of a certain era. There is a certain language style for every period. As a form of communication, language has a direct influence on the formulation and transfer of knowledge. Language is also a special feature of humankind. A person uses language to express his or her beliefs *(Ibid:* 36).

Literary semiotics, according to the Peircean semiotician John Sheriff, analyzes " the system of conventions which enable literary works to have the meanings they do for members of a given culture" (1981:51). Semiotic investigations study the language conventions that enable texts to produce meaning for the reader.

Peirce's Semiotic Applied to an Investigation of the Meaning of Fuller's Designs and Language

Using Peirce's semiotic theories, I will investigate how Fuller's Dym- axion Vehicle achieves *meaning,* or a "logical comprehension" (Peirce 1978: 235). The cognitive characters that allow us to understand its meaning are contained within each object.

Peirce's semiotic will also be used to inquire[7] into the meaning of the language of Fuller's Dymaxion Vehicle patent text, *4D Time Lock* and other writings of the cultural milieu from 1928 to 1935. This analysis will, to some extent, be American culture-bound, Weltanschauung-grounded and English-language bound.

I will discuss the cultural conventions within Fuller's language,[8] in his *4D Time Lock* aesthetic text, Dymaxion patent text, and in his Dymaxion Vehicle designs.

As Floyd Merrell states in his book *A Semiotic Theory of Texts,* "Literary texts as well as scientific texts portray particular perspectives of the world or of a world: world models ..." (1985:101). He also claims that " ...all scientific texts, like literary fictions, embody,...an imaginary construct" *(Ibid:* 101). A semiotic analysis of Fuller's patent text as well as his aesthetic text *4D Time Lock* is possible because there exists an "imaginary construct" within the language structure of these texts. This imaginary construct is an aspect of the author's cultural worldview or internal vision.

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7 The definition of the term *inquiry* in this sentence refers to Peirce's definition, which notes that inquiry "...begins with pondering these phenomena in all their aspects, in the search of some point of view whence the wonder shall be resolved. See Peirce, "A Neglected Argument for The Reality of God: Pragmaticism." *(Collected Papers.* Vol. VI.: 326–332). He also noted that inquiry brought about unlimited interpretations in the following: "...that inquiry of every type, fully carried out, has the vital power of self-correction and of growth." See Peirce, "Methods For Attaining Truth: The First Rule of Logic." *(Collected Papers.* Vol. V.: 399–413).

8 Peirce noted that "logical icons" are present in the syntax of every language and that these are the product of conventional rules. See Peirce, "The Icon, Index, and Symbol." *(Collected Papers.* Vol. IL: 156–173).

Fuller's writing style is as exceptional as his designs, and, unlike many designers, he readily put his ideas into print. Some scholars have compared his later writing style to that of James Joyce (1882-1941) (Kenner 1973: 311) because of his propensity to create new compound words. However, while Joyce sought to obscure language intentionally (Schlauch 1973: 13), Fuller wanted to emphasize a precise meaning and sought to write in a clear and concise manner (Antoniades 1990: 59), one that adhered to the linguistic conventions governing patent writing at the time.[9]

When Fuller wrote the utility patent for the Dymaxion Project, he used the unique conventions of American patent writing during the 1930s. His Dymaxion Vehicle patent text has a specific meaning for the "semantic reader." [10] These conventions include the conventions of American culture, which are based upon the patent or sign definition in patent writings. Official patent language is a specialized language whose styles and standards are defined by a specific codebook.[11] In the patent text, the inventor has to describe the invention in a "full, clear, concise and exact" manner that would allow any person skilled in the inventor's art or science to construct or use it in the same manner as the inventor (Geier 1934: 13). The claim portion of the patent text specifies all functions, operations, features and advantages that the invention has, and describes every *new* idea implied in the invention (Lamas 1930: 236). According to patent attorney Oscar Geier, the main purpose of the claims is:

> ...to define the exact limits of an invention. No matter what has been described in the body of the specification or illustrated in the drawing, the invention patented is the invention set forth in the claims, nothing more or less. The patentee is bound by his claims and the scope of these claims will not be enlarged by reference to the specification. (1934:14)

9 The author Schlauch describes Joyce's language as containing "polysemantic verbal patterns," that are similar to the polyphonic interweaving of themes in music. Joyce's use of verbal polyphony is incorporated into his texts, although not to aid the reader's comprehension. In fact, he did not want the average reader to understand his writings. He incorporated ideas that stemmed from medieval romances, classical sources of myths and history, as well as the ancient Irish language of Finn. His verbal distortion, the number of linguistic variants, were introduced in his work for pure sound effect. Contrary to several experts, I believe that Fuller wanted to write in a style that was concise and understandable to the average reader.

10 The author Umberto Eco defines the semantic reader as the addressee of the text who interprets the text with a certain given meaning by the author. The reader is instructed by the author as to defining the meaning of the text. See Eco, *Limits of Interpretation* 1990: 54–55.

11 For further investigations of the various specified codes in patents, see Lamas (1930) and also Geier (1934).

The diagrams of a patent must display all of the claimed features of the invention. If the invention is an improvement over an older invention, the patentee has to display the improvements in one or more views in a separate drawing. All devices and articles must be shown in sectional as well as frontal views *(Ibid:* 16).

> Fuller follows the concise codes of the patent book in the patent text to convey the principles of his Dymaxion Vehicle invention. However, there are certain language and diagrammatic codes in the Dymaxion Vehicle patent that promote the myth of functionalist design.[12] The following questions arise: Does Fuller's language in his book 4D Time Lock and other writings from this era reflect the rules in the patent codebook? Is his language therefore a patent language?

12

> According to the industrial design theorist Michael McCoy McCoy, the modernist designers sought a universalist approach that excluded the idea that the object conveys information about designers and their role as myth makers. McCoy quotes Adrian Forty's view: ``Unlike the more or less ephemeral media, design has the capacity to cast myths into an enduring, solid and tangible form so that they seem to be reality itself.'' See McCoy, 1990:19. The architect theorist Juan Bonta also acknowledges the role myth has in analyzing a design object and the designer's written language. He argues: '' ...the traditional communication theory model implies that a designer has some 'supernatural power' to predict all the interpretations that might arise for generations to come. In this view, the communication process is focusing upon historical change and promotes the existence of a 'mythical, unchanging architectural language.'' See Bonta, 1979. To the philosopher Peirce, mythology was composed of inferences that depended on resemblances. See Peirce, ``Association: Uncontrolled Inference.'' (Collected Papers. Vol. VII.: 273--275). The philosopher and critic, Georges Bataille believed that there was a falseness in rationalism's ideological notion and the true definition of what reality was. Michael Richardson, the editor and translator of Georges Bataille's book, The Absence of Myth, states: ``A society that denies its mythical basis therefore denies part of its essence, and is living a lie. The crucial point here is that everything about the concept of reality is mythical. Nothing solid responds to this state: the only reality we can know is defined by the use we make of myth to define our ontological principles.'' See Bataille, 1994:14. The term myth in this study will follow the ideas mentioned above.

It is vital to understand how Fuller's language was incorporated into his functionalist worldview.[13] Does Fuller's unique writing style constitute a lexicon that more precisely conveys a specific meaning? Does his language in 4D Time Lock and other writings of the era correlate with his functionalist thought?;[14] is his language a functionalist language per se,[15] conveying more meaning with fewer words or written symbols? How does Fuller incorporate, in a pragmatic framework, iconic metaphors that convey specific meanings that he thought would be understood by the majority of readers? These questions direct the present study.

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13 Fuller's functionalist worldview incorporates his critieria of design, which revolve around the notion of function: the aesthetic as well as moral aspects of design become elements of function. See Kruft, 1994: 349--353.

14 Functionalism promoted a reduction in ornament as well as simplicity of form. Functionalism as a style tried to express the ideal and democratic viewpoint. It also promoted the necessity of construction, to type and a new notion of beauty and aesthetics that relied upon technological faith. These ideas were incorporated into Fuller's Dymaxion philosophy, which was to do more with less. See Kruft, 1994: 438--446.

15 l The design historian Meikle notes that ``Franklin E. Brill of General Plastics referred to 'a new functional language-a language of geometry, spheres, cubes, cones, squares, triangles'...'' These forms were to be an expression of the machine-age that was responsible for their creation. I believe that there is such a thing as a ``functionalist language'' that refers to the textual style of a concise syntax that is conveyed through grammatical codes.

This study examines how Peirce's semiotic can be used to interpret Fuller's designs. Fuller's past experience, including observation, trial —and—error[16] and logic, along with his use of deductive logic,[17] will be applied in this investigation of meaning. How are Fuller's thoughts and experiences communicated in the Dymaxion Vehicles, patent diagrams, 4D Auto-Airplane, and in his writings from this era? In order to understand Fuller's Dymaxion Vehicles and writings, one must understand Fuller's ideas, a process that will involve: 1. the mind's interpretation of sign processes; 2. the mind of the interpreter; and 3. the mind of Fuller. Peirce's three types of reasoning —inductive, deductive, and abductive—will also be used in this investigation in order to gain an understanding of the relationships that occur within Fuller's ideas.

Also incorporated into Peirce's logic, or the science of signs, was Peirce's logical triad of the sign, object, and interpretant. This study will determine how the Dymaxion Vehicles and writings stand for the sign, object, and interpretant. Peirce also included into his science of signs the icon, the index, and the symbol which depended on the sign, object, and interpretant to produce meaning for the interpreter (Peirce 1960/6: 233–237).

Peirce, like other pragmatic philosophers of his time, believed in Charles Darwin's theory of evolution. Pragmatism is a post-Darwinian philosophy in which the idea of experience can be interpreted as involving an organism and its environment. The pragmatists sought to define the basis " of human experience and *how* the human mind, knowledge, selfhood, and morality, were to be interpreted within Darwin's evolutionary theory" [italics mine] (Morris 1970: 7–10).

16 The author Hatch quotes Fuller, who responded to the suggestion that his Dymaxion Vehicle was a failure in the following terms: 'It was not a failure. It was a resounding success in proving my principles and teaching me what I wanted to learn from it.' See Hatch, 1974:133. It is clear here that Fuller's designs of the Dymaxion Vehicles were created out of a trial-and-error process.

17 The definition of deductive logic used in this sentence refers to Peirce's definition according to which: "Deduction, of course, relates exclusively to an ideal state of things. A hypothesis presents such an ideal state of things, and asserts that it is the icon, or analogue of an experience." See Peirce, "The Logic of Drawing History From Ancient Documents: Abduction, Induction, and Deduction." *(Collected Papers.* Vol. VII.: 121–125).

For Peirce, Darwin's theory was used to define how ideas evolve. Ideas, to Peirce, were always changing and therefore evolving. The pragmatists embraced Darwinism, which provided them with an empirical scientific theory to analyze human intelligence, and an evolutionary orientation that approached tire study of intelligence in relation to problems of acting in an environment. Humankind was therefore capable of directing its own future by using intelligence *{Ibid:* 11).

> This study will also detail how Fuller's beliefs were Darwinian in motivation and how these beliefs affected his designs and writings. The role of Darwinian evolution and the artifact, the Dymaxion Vehicle, will be a part of this analysis. It is also important to examine the impact of Fuller's beliefs on the meaning of the Dymaxion Vehicle in terms of its iconic, democratic, capitalistic, or socialistic meaning.
>
> Since culture is a sign-driven activity (Eco 1976: 67), the American culture of the 1930s will be examined for its historical significance. The values, symbols, and ideology of this era will be interpreted against the social and economic plight and the spiritual malaise of the era.
>
> A product design's meanings, as with language, are cultural constructs. Fuller's cultural and philosophical background will therefore be important when analyzing his designs and language. Fuller's spiritual, aesthetic, and functionalist views also have to be investigated.

Peirce's Semiotic as a Method for the Interpretation of the Industrial Object

> This study explores the possibility of a semiotic theory of design. I will not survey the complete history of semiotic texts and design theories and their various methods. Peirce's semiotic must be related to current theories concerned with its application to the design object; it must also be related to the text or texts by or about the designer or the design object in question. In order to provide a methodological perspective for the design object, Peirce's classical semiotic will be linked with contemporary Peircean semioticians. A com-

> parison will be made using Peirce's semiotic and the current semiotic theories of design and text that are an expansion of his classical semiotic. When it is appropriate, this investigation will leave the contemporary Peircean theorists and return to Peirce.
>
> The current Peircean semiotic theories and methods will be placed alongside Peirce's own semiotic theories and methods. Both Peirce and the current theorists and methodologists will be used and expounded upon throughout this investigation. It will be shown that these are complementary rather than contradictory. Whether their models and methods differ radically is not at issue here: the focus is on these semiotic theorists' respective inquiries into Peirce's theoretical foundation of semiotic.
>
> Vincent Colapietro states that Peirce's theory of signs incorporates much of what is known in semiological terms as a code. A code functions, according to Colapietro, as ``a set of correlations providing the means for generating correlations at a different level (or of a different nature) than those making up the code'' (1995: 41). These correlations comprise the codes that describe how acculturated organisms act and react in the presence of other organisms that have undergone the same or a similar acculturation. The code or codes exemplified in an artifact, therefore, are dependent upon these acculturations (Ibid: 41).

The role of the code in Peirce's semiotic needs to be briefly addressed. The term code has often been used in Saussurean linguistics. The semi- otician Roland Barthes' work is an example of this tendency. In Peirce's semiotic theory, which transforms logic into a sign theory, the concept of code appears to be nonexistent. Peirce rarely used the term code and his followers have tried to remain faithful to his terminology. Peirce's concept of habit, however, is the same as Saussure's notion of code *(Ibid:* 41).

Colapietro's example of codes highlights the correlations that exist among words or concepts and the sentences that these words make possible. Sentences then make possible such ideas as arguments or texts. He notes: “In all situations involving communication, one or more codes can be supposed to underlie the possibility of our communicative successes and practices. These codes are explicable in terms of habits” *(Ibid:* 41–42).

Peirce's semiotic can provide an adequate model for the analysis of the industrial design object as well as for the text or texts in question. Recent design theories based on Peirce's semiotic have not included the sign, object, and interpretant or the icon, index and symbol as among the main elements of his concept of semiosis.

The major distinction between current design theories and the one proposed in this investigation is the use of Peirce's semiotic in text and design analysis using his concept of semiosis. This study will also examine semiotic aspects that are found in all written texts, scientific as well as aesthetic.

Peirce's semiotic offers a method, a way of analyzing characteristics common to all texts, including metaphors, similes, tropes, and analogies, while the European semiological model does not. The European model discloses binary, classificatory schemes (Merrell 1985:2). Peirce's semiotic offers a more broadly based logical approach for the interpretation of a text and a design object. This study focuses upon the interpreter of the text and the object as well as the creator of these forms of communication. It establishes a method for determining *hoiv* the reader of a text or object derives meaning from these forms.

Some scholars believe that art or design cannot be compared to language (Wollheim 1980:137). This study, however, is based on the premise that design can be compared to a language. The comparisons investigated in this study are between the processes that explain the origins and use of a certain language style and those that are used in the creation and signification of a certain designed object. For example, the similarities between the processes involved in developing a functionalist language are similar to the processes involved in developing a functionalist, designed object.

Floyd Merrell states that it is the use of language in a text that communicates ideas. He notes:

> Language is the medium, it is not the text. Texts make use of language to convey, at conscious and unconscious levels and by some as yet undefined capacity, novel ideas, concepts, opinions, desires, emotions, ...about the world and about other texts. To do this inevitably entails also the abuse of language: The creation of new meanings and new figurative modes of expression. (1985: 5--6)

This statement affirms the idea brought forth in this study, namely that design can be interpreted through the medium and processes of language. Product designs may be analyzed by similar grammatical terms and codes that are usually applied to analyze a text.

I will attempt to construct a semiotic model that can be used to analyze not only any design object but also texts that the designer wrote at the time he or she created the design object. Using Peirce's semiotic, I will also examine historical writings concerning the design object under investigation.

This study uses Peirce's semiotic to focus upon the process of interpretation. The overall purpose of this investigation is to provide a discussion that will contribute to the existing gap in current semiotic theories of the design object. It will be shown that a Peircean approach can provide the framework for the logical interpretation of the design object.

The theory presented here is an extension of Peirce's classical semiotic. The contemporary semioticians used in this investigation, along with Peirce's classical sign system, will be used to create a model for reading the industrial design object. This model discloses the significance of the design object and the reason behind its production. This reading of the design object is partially based on Peirce's notion of unlimited semi- osis.

A Resemantization of the Dymaxion Vehicles

Peirce's semiotic sign system can be used to reinterpret, or resemantici- cize Fuller's Dymaxion Vehicles, patent text, and book *4D Time Lock.* Fuller's unique dual form of expression/communication provides an opportunity to test some of Peirce's principles, and thereby correlate the text with the design object.

There are infinite potential interpretations of the Dymaxion patent text, the *4D Time Lock,* and the Dymaxion Vehicle. This case study is one of many. The cyclical process of interpretation is constantly evolving. In the process of interpretation, differing perceptions of knowledge can be deduced and disclosed. Hopefully the results of this study will not only provide researchers more insight into Fuller's philosophy and theory of design, but also outline a semiotic methodology that is applicable to design objects in general.

2 Fuller's Biography

Richard Buckminster Fuller (1895-1983) was born in Milton, Massachusetts. He was not professionally trained as an architect, although his work and ideas were discussed in the architectural profession for a large portion of his life. The prestigious American Institute of Architects rejected Fuller's gift of the patent rights for his Dymaxion prefabricated house. However, over the next fifty years, he was awarded numerous honorary architectural degrees and professional fellowships (Pawley 1990: 12).

In 1927, at the age of thirty-two, Fuller undertook an experiment entitled *Guinea Pig B,* (the “B” stood for “Bucky” , his nickname), which he hoped would help him discover what an individual could provide for all humanity (Fuller 1983: xiii). In 1972, he claimed:

> I am also a living case history of a thoroughly documented, half-century, search-and-research project designed to discover what, if anything, an unknown, moneyless individual, with a dependent wife and newborn child, might be able to do effectively on behalf of all humanity that could not be accomplished by great nations, great religious or private enterprise, no matter how rich or powerfully armed. (Ibid: vii)

This experiment continued until his death at age eighty-eight *(Ibid.:* vii).

Fuller attended Milton Academy when he was a boy, and received a theoretical education as well as athletic training. He believed that athletics were an important aspect in the development of his design philosophy, and he asserted that “athletics greatly heightened what I call the 'intuitive dynamic sense,' a fundamental, I am convinced, of competent anticipatory design formulations” (Fuller 1969: 12). After Milton Academy, he attended Harvard University but was dismissed for not attending classes *(Ibid:* 12).

Fuller defined the word “teleologic” in the following terms:

By ``teleologic'' I mean: the subjective-to-objective, intermittent, only-spontaneous, borderline-conscious, and within-self communicating system that distills equatable principles-char- acterizing relative behavior patterns-from out pluralities of matching experiences; and reintegrates selections from those net generalized principles into unique experimental control patterns-physically detached from self-as instruments, tools, or other devices admitting to increased technical advantage of man over environmental circumstance, and consciously designed to permit his modification of forward experiences in preferred ways (sic). (Ibid: 9)

Fuller was an avid believer in teleologic inspiration. Fuller's teleologic interest, tire process of studying the rational principles exhibiting order, design and purposes of phenomena (Angeles 1981: 290), came from his boyhood experiences on Bear Island in Penobscot Bay, Maine. Fuller would often take his rowboat four miles each day to the island to collect the family mail. He claimed that his first teleologic design inventions were envisioned during these trips. One was a mechanical jellyfish in which a ``web—and—sprit cone'' (Fuller's term) was attached to the end of the pole, resembling ``an inside-out umbrella'' that was to be submerged. When pushed by the pole, ``the cone opened and gave inertial advantage, almost as though touching bottom, to push-pole the boat along far more swiftly and easily than by sculling or rowing'' (Fuller 1969:10). This enabled the person manipulating the pole to see in front of him or her while traveling through the water. The island also provided Fuller with beach-dried driftwood, which he used to carve some miniature and full-size experimental boats, houses, and air transport devices (Ibid: 10). He claimed that teleologic thought was to be obtained by examining the processes of nature and could be used to gain control over the environment. The design principles of nature could be harnessed and used by the designer to develop artifacts that would give humans an advantage over their sometimes harsh environment.

> After attending Harvard University, Fuller apprenticed at a cotton mill in the machine-fitting department, where he learned the mechanics of machinery (Ibid: 11). The machinery parts were mostly shipped from Europe and, if they arrived damaged, it was Fuller's responsibility to find replacements. This taught him the principles of engineering concerning the functioning and stresses of parts (Ibid:12).
>
> Fuller felt that technology should be applied and improved over time. He used technology with a combination of experience and knowledge and stated:
>
> But I could also see that this magnificent reorientation was occurring only through knowledgeful, and experience-rich competence in teleologic designs, integrating transcendentally man's conscious planning, but by virtue of physical laws, as an organic workable complex-industrialization (sic). (Ibid: 12)
>
> He was interested in how technology could bring about the most benefits for humanity, and he derived this notion of technology from his own understanding and application of the laws of nature.
>
> During the time at the cotton mill, Fuller kept a sketchbook and notebook of his experiences. He was readmitted to Harvard but was again dismissed for his lack of interest in the classes. He then acquired a job at the Armour and Co. meatpacking plant, where he loaded beef onto export ships. Fuller joined the Navy during the First World War and learned shipbuilding techniques and navigation skills (Ibid: 13).

His military experience included naval aviation and he was assigned to a unit providing safe escort for underwater sea-craft. The crash of seaplanes occurred frequently during his naval duty. Fuller designed a seaplane rescue mast and boom to help retrieve downed planes from the sea. This invention helped to save many pilots who would otherwise have drowned. Because of this invention, he was transferred to the special course at U.S. Naval Academy in 1917. In the same year, Fuller was married to Anne Hewlett, the daughter of a prominent New England architect *(Ibid:* 16).

Fuller noted that while he was in the Navy he "...learned the process of conscious self-attunement toward the understanding of principles and their subsequent teleologically translated anticipating effectiveness, as demonstrated in: navigation, ballistics, logistics, ship-squadron and fleet handling (at sea and in port),..." *(Ibid:* 14). According to Fuller, teleology could be applied to the design of navigational and nautical devices and principles.

In 1919, Lieutenant Fuller was discharged from the Navy. He returned to the Armour Co. in New York as assistant to the transport manager. Two years later, he left to become the sales manager at the Kelly-Springfield Trucking Co., which soon went bankrupt. He re-enlist- ed in the Navy as a temporary reservist and was given command of the patrol boat *Eagle.* He left the Navy permanently in the fall of 1922 (Pawley 1990:35–66).

Shortly afterwards, his four-year-old daughter, Alexandria, died of influenza. The death of his young daughter affected Fuller tremendously. He became obsessed with trying to design a home unlike the damp dwellings in which most Americans lived in. These cold, damp houses facilitated the spread of the influenza epidemic in the United States. He soon went to work for his father-in-law, James Monroe Hewlett. He was made President of Hewlett's Stockade Corporation, which promoted a method of building walls out of cement and compressed wood shavings, known as the Stockade Building System *(Ibid:* 36).

Hewlett and Fuller ran five factories from New Jersey to Illinois promoting this new product. As the chief salesman, Fuller spent long, isolated periods traveling from state to state during which time he developed a drinking problem. After three years of this difficult lifestyle, he moved to Chicago to supervise a Stockade factory in Joliet, Illinois. His wife, Anne, joined him there in 1926.

Many architects and contractors were skeptical of the Stockade technique. Fuller's profit was often marginal because he had to perform fullscale fire tests on the Stockade blocks. Often the results of these tests were not accepted by many architects (Fuller 1969: 36). When Hewlett needed money during the Depression, he sold his share of the company to the Celotex Corporation. Fuller, as President, was in constant conflict with the Celotex management because of low profit margins. He resigned in the summer of 1927. In August of that same year, his second daughter, Allegra, was bom (Pawley 1990: 36).

After his resignation, Fuller contemplated suicide along the Lake Michigan shoreline, thinking that his life insurance policies would be more valuable to his family than he was. It was then that he experienced a ``private vision'' that provided him with the idea that he did not have the right to eliminate himself. At the age of thirty-two, he began a new life.

He moved from an expensive home in Joliet to a lower-class apartment at Belmont Harbor. Over the next two years, he refused to speak to anyone, even his wife. He read and sketched profusely (Ibid: 37).

In his biography, Fuller stated:

I really did stop all sounds, and then gradually started wanting to use a particular sound. I was finally pretty sure I would know what the effects would be on my fellow man if I made a particular sound. I wanted to be sure that when I did communicate that I really meant to communicate thusly and that this was me communicating and not somebody else. 'Out of all your experience what kinds of things do you know?' (1969: 47--8)

Fuller thought it was important that he convey his thoughts precisely, and he chose particular words in order to convey these concise meanings to his fellow human beings.

He used the metaphor of language as a instrument or tool to make his point:

I know of people inventing words, but most of the words were here before me and they are tools. They are obviously tools, and I'm enough of a mechanic to know that you can use tools in the wrong way. It seems to me that the facility with which we can make these sounds, as a parrot can copy a sound, is possibly one of the ways in which the trouble starts. (Ibid: 47)

During the two years that Fuller held a moratorium on speech, he read magazines and books on mathematics, science, and architecture. Like many engineers of the ``Technocracy'' movement, he believed that the United States should be run like a machine and its currency replaced with units of energy (Meikle 1979: 69). He concluded that human beings could go against the

> traditional American beliefs of limited resources and poverty by designing artifacts that had a potential gain over the raw resources that nature provided. By combining technology with the laws of nature, humankind could have a chance to create a better lifestyle.

Fuller believed that scarcity was a conspiracy lead by financiers and businessmen who wanted a "more for less" technology to create profits instead of benefiting humanity. As a reaction to this kind of thinking, Fuller gave the title "4D" to the inventions he created in order to reverse what he felt was a negative balance. The term "4D" meant "fourthdimensional thinking" , adding time to the dimensions of space to ensure gains for humanity instead of personal gains only. He promoted the artifacts he produced, though not for commercial gain. His "design science" was developed in order to obtain maximum human advantage from minimum use of energy and materials. The first patent on the 4D designs was a mass production house (Pawley 1990: 39).

In 1917, while in the Navy, Fuller conceptualized "...a wingless, amphibious "jet-stilts" aircraft which would plummet aeronautically in tetra-vector guidance. This aircraft would be powered by twin *combination plants,* consisting of gas turbines, jets and rocket assist thrusts" (Fuller 1969:18). According to Fuller, each thrust was to be angularly orientable throughout a "spherical-tetrant sector: vertically, outwardly, forwardly, backwardly, inwardly, with the geometrical degrees of freedom" similar to a duck's maneuvering range *(Ibid:* 18).

This aircraft was the impetus for his jet-stilt flying design with inflatable wings, modeled and drafted in 1927. However, Fuller did not have the financial means to create a working prototype of his novel plane, which he called the "Zoomobile" (Bush 1975:108). Another problem was that the limited metallurgy of the era offered no alloys capable of resisting the high degree of heat given off from the gases of a jet engine. Fuller was forced to develop a ground model of the Zoomobile, which later became known as the "4D Transport" (Hatch 1974:122).

Fuller began production on the first "4DTransport" after working as publisher of his *Shelter* magazine, which he published from 1930–32. He then went to Bridgeport, Connecticut, where he and his assistant Starling Burgess developed the ground taxiing capabilities of the vehicle or "wingless fish" (Fuller 1969:19). The "4D Transport" was later named the "Dymaxion Vehicle." Henry Ford gave him a 70 percent discount

on any automotive equipment he could use. Fuller thought that by using Ford's V-8 engine people would think he was associated with the Ford company, and that “4D” was another way of saying “Ford.” He changed the name from “4D,” because he did not want to be associated with the Ford Motor Company (Ben-Eli 1972: 755).

Fuller and Burgess opened the abandoned Locomobile Co. Dyno- meter plant in Bridgeport, Connecticut, in March, 1933 to build both cars and Burgess's racing yachts (Hatch 1974: 124). Theodore Roosevelt was president at this the time and the economy was in distress. Over one thousand men applied for the twenty-eight jobs opening at the plant. The “4D Dymaxion” team completed the prototype of the Dymaxion Vehicle Number One in only four months, on July 12th 1933. It was sold to Gulf Oil and was used as their promotional vehicle. The Dymaxion Vehicle Number One was involved in a fatal accident at the 1934 Chicago World Exposition. This vehicle was repaired and fitted with a new faceted windscreen, and was again used by Gulf until it was destroyed in an accidental garage fire at the National Bureau of Standards in Washington, D.C.. The Dymaxion Vehicle Number One became the basis for the United States patent for which Fuller applied in October 1933. The patent was finally granted in 1937 (Pawley 1990: 62). After developing and demonstrating three Dymaxion Vehicles that he termed “technically first-class prototypes” , Fuller closed the operation in 1936 because he finished what he had set out to do (Ben-Eli 1972: 755). Fuller did not design the Dymaxion Vehicles for mass production or to make a fortune. The purpose of these vehicles was to put his theories, beliefs, and principles to the test (Hatch 1974:134).

Along with the Dymaxion Vehicles, Fuller invented the Dymaxion Bathroom of 1927 for the Dymaxion 4D House. Conceived as a single form in electroplated copper, it was not until 1930 that Fuller created a prototype of this bathroom for the American Radiator Company's Pierce Foundation. This prototype was never publicly displayed. However, in 1936 the Phelps-Dodge copper mining corporation helped Fuller to put a working prototype of the bathroom into production.

The Dymaxion bathroom, consisting of a tub and shower unit and a lavatory-toilet unit, (Marks 1960: 33) differed from most bathrooms of the era. It could be installed as a unit into any house in a short period of time. It had a prefabricated intake manifold, vent and waste pipes, and electric harness terminals. As the historian Robert Marks notes: These bathrooms "were not marginal sanitary utilities, but luxury bathrooms, equipped with all usual facilities and some new ones, such as air conditioning" *(Ibid:* 33).

Both the Dymaxion Vehicles and Bathroom were designed to function as part of the Dymaxion Housing system. Fuller conceived the Dymaxion House as a shelter that could be airlifted to any location on the globe. The house was to be mass-produced and constructed in a factory just as automobiles and airplanes were. He wanted to produce a maximum strength dwelling with the minimum of weight. Using the analogy of airplane technology, he chose materials such as steel alloy cables and an inflatable Duralumin mast located in the center of the unit. The Dymaxion House designs were completed in 1928 and a patent was filed *(Ibid:* 21).

Fuller also invented the Dymaxion Deployment Unit, a lightweight corrugated steel shelter made from modified grain bins. The United States Army Air Corps bought thousands of these units for use as flight crew quarters. The Dymaxion Deployment Unit became the basis for Fuller's 1946 Wichita House. These houses were intended to be used as full-size family dwellings, weighed four tons each, and were to be assembled on aircraft production lines built during the war. The design historian Martin Pawley suggests that the Wichita House was the ...most important prefabricated house design of the 20th Century, and certainly the greatest lost opportunity of the years of post-war building recovery (1990:13-14). The Dymaxion House reflects Fuller's continuing concern for lightweight structures.

Another of Fuller's inventions was the Dymaxion Airocean Map. This map transferred the spherical data of a globe into a two-dimensional surface (Fuller 1969: 140). This map had its beginnings in his *4D Time Lock* book of 1927, which he entitled the "Dymaxion Traffic Chart" *(Ibid:* 127). The conventional spherical globe makes it difficult to view the world in its entirety, but the Dymaxion map enables the viewer to see all of the earth's surface at once. The map is composed of a series of twenty triangular sections with two of the triangles dissected to keep the continents of Australia and Japan intact. According to Fuller, the Dymaxion map "...describes the earth's surface

with the minimum total score of distortions from the many well-known geometrical processes inherent in translation of the angle and scale information from a spherical to a flat surface" *(Ibid:122). Life* magazine published a copy of the map in its March 1943 issue.

The Dymaxion concept, according to Fuller, brought about the most advantages for humankind. He used technological knowledge to convey and produce the most with the least (Hatch 1974: 163). Fuller incorporated this concept in all of the Dymaxion products as well as in his later inventions.

Fuller, however, is best known for inventing the geodesic dome: "...a triangulated space-enclosing technology that was domical in shape in order to enclose the maximum internal volume with the minimum structure" (Pawley 1990: 14). The design was patented in 1954 and approximately three hundred thousand geodesic domes were built over the following thirty years. These domes, which were conceived of as part of Fuller's engineering associations, incorporated the alloys, structures, mechanics and processes that were capable of producing for society predictable and behavioral characteristics based upon "competent experience" (Fuller 1969:191). Engineering, according to Fuller,"...consolidates the net gains of science and design in the industrial complex" *(Ibid:* 191). These designs are based upon his concept of synergy, which is "...the essence of those great changes of man in respect to his *a priori*[1] environment" *(Ibid:* 65).

The impetus for these domical structures stemmed from his ideas concerning nature and its connection with mathematics. He claimed in his biography:

> The mathematical patterning and inter-transformability of Nature's geometrical structurings are the only reality of universe. The infinitely regenerative dynamism, always potential in the fundamental relationships of the principles, in itself constitutes the intellectually tunable and ever inescapable reality (sic). (Ibid: 147)

1 Peirce noted that the concept of *a priori* is representative of a truth. This truth is not brought about by reasoning but through its own valuation without any criticism.See Peirce, "How to Make Our Ideas Clear." *(Collected Papers.* Vol. V.: 248–271).

For Fuller, the mathematical metaphor was an essential component of the physical environment, and indeed encapsulated his. This metaphor was Fuller's vision of what constituted that environment.[2] His beliefs and values were based on mathematical principles and philosophies which influenced his dome designs.

His dome structures were based upon the tetrahedron and the polyhedron. He stated that the geodesic domes were a combination of these two forms. Fuller noted: "The regular six-chord-edged tetrahedron encloses (defines) the minimum volume with the most surface of all 'geometric' polyhedra or structural systems, whereas the sphere encloses (defines) most volume with least surface" *(Ibid:* 166). His domical structures exemplified his Dymaxion concept, which was to do the most with the least. This is known as the process of "ephemeralization," an aspect of what Fuller referred to as "synergy" *(Ibid:* 179).

His mathematical inferences[3] rely upon the dynamism[4] contained within the structures of mathematical forms and expressions. This explains why, in the construction of his domes, he focused upon such mathematical and engineering principles as:

> ...sets of dynamic associations by contraction, expansion, spin, orbit, torque, push and pull and precession. This all brings us by progressive collections of thoughts into a fundamental twoness of dynamic reciprocities which, internally paired, ultimately become one with outwardly paired principles of reciprocity (sic). (Ibid: 236)

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2 Metaphors are iconic in nature. Peirce points this out in the following: "The utility of likeness to mathematicians consists in their suggesting in a very precise way, new aspects of supposed states of things..."See Peirce, "The Icon, Index and Symbol." *(Collected Papers* Vol. II.: 156–173). This statement in the study suggests that Fuller's reality is based upon induction-deduction, in that the author of this study utilizes Peirce's idea concerning reality which states that "...though a synthetic inference cannot by any means be reduced to deduction, yet that the rule of induction will hold good in the long run may be deduced from the principle that reality is only the object of the final opinion to which sufficient investigation would lead. That belief gradually tends to fix itself under the influence of inquiry is, indeed, one of the facts with which logic sets out." See Peirce, "The Probability of Induction: The Rationale of Synthetic Inference." (Co//ecfed *Papers.* Vol. II.: 430–432).

3 To Peirce, inference referred to an aspect of the matter of thought. He thus claimed that any argument that can be applied to matter can also be applied to the notion of inference. See Peirce," Pragmatism and Abduction: Abduction and Perceptual Judgments." *(Collected Papers.* Vol. V.: 113–120).

4 Dynamism is the philosophy that emphasizes that the theory of matter or mind are created through the action of forces as opposed to motion or material. See Allen and Hawkins,1991: 447.

This notion of dynamism is also expressed in his definition of the environment. He notes that:

> Man, in degrees beyond all other creatures known to him, consciously participates-albeit meagerly-in the selective mutations and accelerations of his own evolution. This is accomplished as a subordinate modification and a component function of his sum total relative dynamic equilibrium as he speeds within the comprehensive and complex interactions of universe (which he alludes to locally as environment). (Ibid: 225)

The human being plays a part in the evolution of the species, which is dependent on the dynamic processes occurring within the cosmos or universe. This action, he defined as *environment.*

Semantics was of interest to Fuller, from 1928 throughout the remainder of his life. The domes were no exception. Fuller also drew upon the Judeo-Christian myth of God[5]in these designs as well as in the Dymaxion projects. He reinforced this attitude in the following: “So important have domes been throughout man's total experience that the roots of the word for God, home and dome are the same-domus, domicile and dome” *(Ibid:* 148).

> The domes also encompassed mathematical formulae related to such forms as the tetrahedron, octahedron, and icosahedron (Ibid: 219). According to Fuller, these all represent ``closed systems'' that are defined by compression encompassed by tension (Ibid: 219). Fuller brought to the dome structure ideas concerning its tensile ability. He introduced a new structural geometry and advanced mechanics into the dome form. He tried to emulate in structure the atom's form, including the compound curvature trussing of its dynamic structure. The domes, like the atoms, were comprised of great structural forces. Fuller stressed that, while this domical design was not new in its elementary form, it was new in its manner of employing the way it employed these principles in a manmade structure (Ibid: 216).

5 Fuller believed that all thought and form are bom of God. See Fuller, *4D Time Lock,* 1970: 32. Fuller, like many other Modernists, believed that metaphorically, God is the Great Architect. This analogy views architecture in a religious and theological light and imbues it with a cosmic function. The metaphor functions because of the architect's commitment to faith. See Hollier, (1993: 33–34) for further discussion of the metaphorical analysis of God and architecture.

All of his designs were based upon an engineer's value system. In his biography he claimed that:

Engineering is the judicial authority that never assumes the initiative but decides and proves the assertions of science and design. Engineering thus establishes reliable data on the failure limits of complex associations and also measures the new synergetic behavior characteristics discovered by design initiative. Thus, engineering rapidly places on inventory comprehensive data pertaining to the known behavior characteristics of complex associations previously undertaken by design.

These complex associations may be broadly defined as alloys, structures, mechanics, processes and services. It is a function of engineering to provide society with reliable predictions as to the behavior characteristics of complex designs predicated on competent experience. Engineering, then, consolidates the net gains of science and design in the industrial complex. Gains are design intuited synergies (sic). (Ibid: 191)

Fuller's designs reflect an engineer's values and beliefs. Fuller claimed that scientific engineering principles can create designs that can dictate the behavior of the materials, structures, and processes involved in the design process. The use of engineering in the production of designs supports his Dymaxion philosophy of obtaining the most gains for humankind through the use of technology. This idea is exemplified in his domes and Dymaxion designs.[6]

Some of the domes Fuller created were the Kaiser Dome in Honolulu, Hawaii; the Travillon in Winrock, Arkansas; the Radome on the Arctic DEW line; the Radome Octetruss in The Musetun of Modern Art's garden; the Kaiser Dome in Moscow; the Graham National Foundation dome roof structure in Pryor, Oklahoma; the Anheuser-Busch Aviary in Tampa, Florida; the Miami Seaquarium; the Kaiser Dome over a Lutheran church in Florida; the U.S. Pavillion, Expo 67; the Climatron in St. Louis, Missouri; and his dome residence in Carbondale, Illinois.

6 For a more detailed explanation, see Fuller, *Ideas,* 1969:170.

Fuller also became interested in megastructures. These megastructures, or large architectural and engineering structures listed below, were projects that Fuller began but never completed (Pawley 1990: 154). The Triton City Project, a floating city designed to accommodate 100,000 inhabitants, was to be composed of a tetrahedron, a four-faceted structure, and was intended to promote "the most surface with the least volume of all polyhedra" (Ben-Eli 1972: 762). This Tetrahedral City, he noted, could be floated out into the sea and anchored. His City of Floating Spheres, measuring a hundred feet in diameter, was to weigh three tons and enclose seven tons of air *(Ibid:* 763).

Fuller also worked on The Old Man River Project, a communal city envisioned for East St. Louis, Missouri. This project was never completed *(Ibid:* 769). At the time of his death, Fuller was working on the development of the "Fly's Eye Dome" , which was intended to be an inexpensive dwelling unit (Pawley 1990: 14).

3 Semiotic: A Science of Signs

The problem of linguistic meaning in the elements of language, the signs that express our thoughts, is as old as ancient Greece. There, the Stoic philosophers (200 BC-3rd c. AD) investigated the semantics of language. Their writings evolved into the doctrine of signification or *semiotike,* a word whose root, "sema," means "sign" (Sebeok 1986: 255). It was not until the seventeenth-century that this doctrine of signs was given the scholarly attention it deserved. Antoine Amauld (1612-1694), following the traditions put forth by the Stoic philosophers, noted that non-verbal signs used as a means of communication are iconic in character: they include objects, maps, and portraits (Clarke 1990: 4). In 1632, the Iberian philosopher John Poinsot's *Treatise On Signs* established a link between the term "sign" and natural phenomena. Poinsot argued that semiotic conveyed an action between signs found in nature and signs found in human experience or levels of human consciousness, such as sensation, perception, and "intellection" (Deely: 1990:113).

The Realist philosopher, Thomas Reid (1710-1796), argued that the icon, or the sign's connection with what it signified, was established by nature and discovered by experience (Clarke 1990: 51). Philosophy, Reid thought, could be reduced to general rules. All that was known of mechanics, astronomy, and optics was established, according to Reid, by nature and disclosed by either experience or observation and the ideas that were deduced from them. He proposed to make philosophy a science by observing data, and then deducing general rules that would aid in a final conclusion. Natural causes were to be termed natural signs, and the effects these signs created were to be known as the signified (Ibid: 52).

The signs of natural language were iconic representations, so called because they resembled the objects they stood for. An example of an iconic sign, according to Reid, would be "sensations" or "sensory images" that he classified as natural signs. It was through "a natural kind of magic" that a relationship between the object and the cause

of its existence was established. The relationship between the sensation and the object under investigation was established by some prior experience in which certain ideas had been associated. As a result, the objects resemble certain sensations that they created in the interpreter's mind (Ibid: 47–48). According to Reid, this class of signs, known as icons, included evidential signs that had a connection with the object signified by means of rules that are established by nature and disclosed by experience. The sensation produced by an object had to be established by previous experience in which ideas were associated *{Ibid:* 47).

Another Realist philosopher, John Locke (1632 -1704), reintroduced the term 'semiotike' in his 1671 *Essay Concerning Humane Understanding,*

> in which he questioned the nature of human understanding and declared semiotike as a doctrine of signs that combined the sciences of logic, physics, and ethics (Sebeok 1986: 255).
>
> It was not until the nineteenth century that Locke and Poinsot's ideas of the sign were taken up by the American pragmatist philosopher Charles Sanders Peirce (1839-1914), who adopted their notion of the semeiotike as a doctrine of signs. He termed the doctrine semeiotic or semiotic (Ibid: 256). Peirce defined semiotic as ``...the doctrine of the essential nature and fundamental varieties of possible semiosis.'' Peirce's semiotic is based upon the idea of semiosis, that is, the action of a sign (Peirce 1960/5: 335).
>
> Charles Peirce was the founder of Pragmatism,[1] and was trained as a chemist. He spent most of his life as a successful and esteemed scientist (Corrington 1993: 4). Pragmatism, according to Peirce, offered a method of conveying ideas in a clear and concise manner. To accomplish this, Peirce sought to define the very nature of meaning (Peirce 1960/5: 248).

1

> Peirce used the term pragmaticism to distinguish between his notion of pragmatism and William James' definition. See Peirce, ``Issues of Pragmaticism: Characters of Common- Sensism.'' (Collected Papers. Vol. V.: 293--305).

The Pragmatist (or Pragmaticist) theory of meaning is a doctrine that inquires into the meaning of a sign created by a sequence of its interpre- tants occurring in the process of semiosis and consisting of abstractions produced by the ``quasi-mind'' [2] of a ``quasi-interpreter'' [3] of the sign. This logical interaction between the sign, its object, and the interpretant can be expressed as follows within the sign-triad: the sign S, or representamen, corresponds to the object O, and the interpretant I. The interpretant I of the sign S is in itself a sign, with representamen-S-O, and so on into other triadic relations. Peirce thought that the effects produced by a sign upon the abstract mind of the quasi-interpreter brought about semiosis.[4] The sign's meaning was treated as a dynamic process connected with mental activity. His semiosis includes all kinds of signs and sign users, with particular emphasis given to human beings and all types of meaning (Sebeok 1994: 505).

2

Peirce interpreted the quasi-mind as one of the three elements of reality. It is through these elements that ideas are created. Within these ideas other ideas are concealed. Thus, ideas are dependent upon each other; it is this force between ideas that ``edits'' the ideas and focuses upon the ones that strengthen the main idea. This force is the quasi-mind. It makes the ideas seem reasonable. The quasi-mind anticipates future thoughts in of which the consciousness is at first not aware of. See Peirce, ``Telepathy and Perception: The Percipuum.'' (Collected Papers. Vol. VII.: 359--397).

3

The quasi-interpreter, to Peirce, refers to the person behind the quasi-mind. This interpreter predicts future interpretations through reason. See Peirce, ``Telepathy and Perception: The Percipuum.'' (Collected Papers. Vol. VII.: 378--394).

4

Peirce explains this notion of semiosis involving the sign, object and interpretant in the following statement: ``In consequence of every sign determining an Interpretant, which is itself a sign, we have sign overlying sign. Unlimited interpretants, ideas lead to other ideas into infinity.'' See Peirce, ``Partial Synopsis of a Proposed Work in Logic: Originality, Obsistence, and Transuasion.'' (Collected Papers. Vol. II.: 42--52).

The American behaviorist Charles Morris (b. 1901) believes that meaning is determined by the reference to the action among signs (Morris 1970: 16). Morris, using Peirce's concept of the sign and its relationship with the object and interpretant, renamed this triadic interaction among Peirce's icon, index, and symbol: semantics, pragmatics and syntactics[5] (Kutschinski-Schuster 1990: j2).

Semantics is the theory of meaning in which the following condition exists: someone interprets an object or idea as representing something. A physical object, to which a meaning has been assigned, becomes a sign (Sebeok 1994: 857). Pragmatics is the manner in which the sign is used. Syntactics can be defined as how signs are formally structured in order to convey meaning *(Ibid:* 856).

Morris's concept interpretation of the stimulus-response theory of meaning had its beginnings in the neurophysiological research conducted by Ivan Pavlov (1951) and his followers. In the stimulus-response theory of meaning, a conditioned stimulus acts a signal, while the unconditioned stimulus is the meaning of the sign (Sebeok 1994: 504).

Semiotic and Design Criticism

The late 1930s brought about a reactionary criticism of the functionalist approach to architecture (Kruft 1994: 439). This criticism was exemplified in the German philosopher Ernst Bloch's (1885-1977) work *Das Prinzip Hoffnung (1938-1947),* written during his exile in the United States (Ibid: 440). Design critics and theorists took up the apparent flaws of this rationalist view of functional and geometric architecture in the late 1960s (Klassen 1990: 6).

The unadorned shapes of modern architecture did not communicate any meaning to people. According to Klassen, "The new architecture was silent: the new buildings engaged in no dialogue with each other; and neither did they communicate with man" *(Ibid:* 6). Semiotics, as it was proposed by the Swiss linguist Ferdinand de Saussure and the pragmatic philosopher Charles Peirce, seemed to offer the architecture theorists and critics a method of making their environment meaningful again.

5 Pragmatics refers to the study of signs and their relationship to their users; semantics is the study of signs in relationship to what they refer to; and syntactics is the study of signs in relationship to each other. See Leech and Thomas, 1990:174-175.

The first of these architecture critics and theorists was Christian Norberg-Schulz, whose *Intentions of Architecture* (1965) approached the interpretation of architectural forms through a scientific and logical framework. Norberg-Schulz used the Peircean behaviorist, Charles Morris, in Iris analysis of architecture. A few years later, Charles Jencks, co-editor with George Baird of *Meaning in Architecture* (1970), wrote an article that analyzed architecture from a Saussurean perspective. Lionel March, editor of the book *The Architecture of Form* (1976), was one of the first architecture theorists and methodologists to incorporate Peirce's concepts of deductive, abductive and inductive reasoning for the purpose of defining a logical design process. In 1979, the architect theorist Juan Bonta wrote *Architecture and its Interpretation:* although Klassen claims Bonta's method is basically Saussurean,[6] Bonta's analysis of architecture owes a great deal to Peirce's concept of semiosis. The following year, *Signs, Symbols and Architecture* (1980), edited by Geoffrey Broadbent, Richard Bunt and Charles Jencks, combined architecture theorists who were influenced by Peirce's semiotic with the theorists who based their research on Saussure's semiology. Umberto Eco was one of the authors in this compilation who represented the Peircean tradition.

More recently, the architecture theorist Marco Frascari has used Peirce's semiotic system in the analysis of diagrams in architecture. Frascari uses Peirce's ideas of deductive and abductive reasoning in this analysis. The design critic and theorist, Clive Ashwin, also discusses drawings and diagrams and their relationship to Peirce's semiotic theory. He uses Peirce's semiotic to develop a theory of drawing. Ashwin believes that drawing is a sign system with important cultural implications that can be expressed in the etymology of various terms (1989: 199, 201).

Codes and Interpretation

Umberto Eco follows Peirce's definition of semiosis, according to which there are infinite possibilities for interpretation processes (Eco 1984: 2). Interpretations, says Eco, serve as codes that connect the form with the form's function, including how the designer of the designed object will align the function with the form that he or she chooses (Eco 1980: 21).

6 Klassen discusses the theoretical argument of the architecture theorist Scruton, who attacks the semiological methods Bonta uses to analyze architecture. Scruton thinks information theory is irrelevant in analyzing aesthetics as does Richard Wollheim. Scruton believes that information theory is a pseudo-science. See Klassen, 1990: 8.

According to Eco, aesthetic texts and ideological statements constitute “impossible worlds.” Codes, he says, are structures of these impossible or “cultural worlds” (Eco 1976: 62). He defines a code as “…a system of signification, insofar as it couples present entities with absent units” *(Ibid:* 8). When there is an underlying rule in which something presented to the addressee's perception stands for something else, signification is present *(Ibid:* 8). A code is a part of a system of signification and is an *” elementary structure of communication” (Ibid:* 32).

The anthropologist John Deely defines a code in the following terms:

> Code, in short belongs to the object experienced and idea to the organism experiencing. Both alike serve to ground, channel, and define or specify the relationships of dependency that comprise the objective world in its integral being subsumptive of the physical. (1990: 66)

A code helps to channel and direct relationships between various objects. This encoding creates within the decoder a certain 'partial duplication' or a partial replication of the ideas that created the original encoding. The encoding imposes a common conception that is within and beyond the perceptually shared objectivity or similar perceptual viewpoint *(Ibid:* 66).

Code Invention

Code invention, says Eco, is the expression that is produced by the recognition of a previous experience, linking an expression with a content unit (1976: 245). Invention takes place in two ways, either moderate or radical. A “moderate invention” is a direct projection from a perceptual representation into an expression-continuum. This facilitates realization of an expression-form that will dictate the rules used to produce an equivalent content-unit *(Ibid:* 252).

Eco defines invention as:

> …a mode of production whereby the producer of the sign-function chooses a new material continuum not yet segmented for that purpose and proposes a new way of organizing (of giving form to) it in order to map within the formal pertinent element of a content-type. (Ibid: 245)

In a “radical invention,” or “a proposal of new conventions,” the sender strays away from the perceptual model, then goes directly to the “unshaped perceptual continuum” where the person organizes his or her perception. Here, the realized expression occurs when the sender has a fixed result of the perceptual labor. After this expressive labor is defined or enacted upon, the person then arrives at a perceptual mode, or a “sememic representation” *(Ibid:* 254). This is exemplified during innovative periods in the history of painting or artifacts. Eco cites, for example, the Impressionistic movement in painting. The addressees or receivers of Impressionist works tended to reject the Impressionist's stylistic form because they could not construe their subject matter, form or styles as being meaningful in any real way. Eco claims:

> Take the case of the Impressionists, whose addressees absolutely refused to 'recognize' the subjects represented and said that they 'did not understand', that the painting 'did not mean anything', that real life was not like that, etc. This refusal was due to the addressees' lack not only of a semantic model to which the mapped items might be referred, but also of a percept to guess at, since they had never perceived in this way. (Ibid: 254)

What occurs in this case is radical code-making, whereby a new set of conventions is proposed. Eco argues that the sender of the message, the Impressionist painters in this instance, aimed for semiosis and failed for that particular time period. However, Eco fails to realize that it was not the subject matter itself but the manner in which this content was represented that confused the addressees of the Impressionist period. The Impressionistic style was later culturally accepted. The movement needed a chairperson, an interpreter. According to Eco, semiosis succeeded only years after the new convention was introduced *(Ibid:* 254).

Eco contradicts his own notion of “radical invention” by claiming the following:

> In fact, no one ever really witnesses cases of total radical invention, nor indeed of total moderate invention, since texts are mazelike structures combining inventions, replicas, stylizations, ostentions and so on. (Ibid: 254--56).

Semiosis relies upon previously established codes. In this sense, codes may be invented only by relying on old ones *(Ibid:* 256).

"Radical invention," therefore, can never exist insofar as it relies upon previous codes or conventions already established within the community. It is consequently by virtue of convention that Eco believes that society must recognize "prophets" in their culture in order for them to exist. Otherwise, the prophets become outcasts of society *(Ibid:* 255).

In inventing new codes, the creator, or the prophet as Eco claims, will propose new and imprecise sign-functions. Eco gives the example of a painting by Raphael, which he argues is beyond duplication "...because he *invented* his rules as he painted, proposing new and imprecise signfunctions and thereby performing an act of code-making" *(Ibid:* 181). Eco, however, does not mention that functional objects may also represent a sign function of code-making. In verbal language, Eco believes, one is capable of distinguishing the various signal-units, so that even a text that at first seems complex is capable of being duplicated by using them. In a painting, for instance, the signal units are not very distinguishable and are considered to be "dense" or "continuous," and thus hard to duplicate *(Ibid:* 181). In such cases, it can be difficult to isolate certain "productive rules," or the rules and conventions that have governed the creation *(Ibid:* 181).

The Grammar of Architecture

The reading of codes in architecture and products forms a certain grammar, respective of the building or the product being analyzed semiotical- ly. In his article "Function and Sign: The Semiotics of Architecture," Eco analyzes architectural forms into semantic, pragmatic, and syntactic units in order to create a theory of architectural meaning. The building can function as a text composed of the elements of language.

In the same article, Eco lists the varieties of the architectural code that constitute a building's grammar. First, there are technical codes, known as pragmatic codes, which deal with architectural engineering. The architectural form is reduced to the elements of columns, wiring, insulation, beams, and other elements where there is not communicative 'content' (Eco 1980: 38). There are, however, cases where the structural or technical function or the technique itself becomes endowed with meaning through the values of a certain community. This becomes known as the structural logic or the reasoning and justification behind the techniques employed *(Ibid:* 38–9).

Second, there are syntactic codes. These codes are typological codes that are essentially spatial. The circular plan, Greek cross plan, open plan, labyrinth, and high-rise are all examples of syntactic codes. Syntactic codes also explain how the placement of architectural elements are conveyed through cultural conventions *(Ibid:* 38).

Third, there are semantic codes. These codes consist of units of architecture, and entail the relations that occur between architectural syn- tagms and their connotative as well as denotative meanings. These meanings may denote the main functions of architecture, such as the roof, stairway and window, or may have connotative secondary functions, such as the tympanum, triumphal arch, or the neo-gothic arch. They may also connote certain ideologies afferent to such spaces as "the parlour," or "living room," or they may have typological meaning according to their functional and sociological categories such as "villa," "school," or "palace" *(Ibid:* 39). Eco claims that these codes are based upon the model of verbal language in which a variety of messages may be generated *(Ibid:* 39).

> The architectural theorist Marco Frascari also suggests that architecture can function as a text. He claims:
>
> Buildings are cultural texts that are generated by assembling fragments, excerpts, citations, passages, and quotations. Every building is then both assimilation and a transformation of other buildings. Every architectural piece echoes other pieces into infinity, weaving the fabric of the text of culture itself. The buildings elements are the joints of the construction of human culture; they are compelling demonstrations of how we inhabit the world. We assemble the tropes or building elements in trophies. The Greek word trope means a turn, or a twist, hence the twisting of words; it is also connected with trophy because trophies were built on the battlefield on the site where the tide of the battle turned in favor of the winner. Trophies were built using the spoils of the slain enemy; they were set up to appease their souls and prevent the gods' punishment of the victors. The enemy casualties 'were thus 'turned,' troped, from murders in sacrifices. (1991: 22--3)
>
> To Frascari, architecture is made up of tropes of sacrifice. The mental associations that these carry were first represented in the architecture of the classical Orders where the knowledge had a base in images and figures. A trope, according to Frascari, ``...is a playful interpretation that relates forms that

otherwise would never be associated. A trope is always based on rhetorical figures of signification'' (Ibid: 14--15). Meaning is achieved by translating the formal characteristics using a cross reference of images that help to create architecture that is an ``eloquent and intelligible'' [7] environment for humans (Ibid: 15).

Architecture should be viewed as "...an intellectual representation resulting from the traces of semiotic practices, i.e., the manipulation of signs in accordance with 'cultural reasons'" . Architecture, therefore, can convey cultural meanings that are created by both physical and mental substances that are displayed in our constructed environment *(Ibid:* 3).

Product Semantics

In the last quarter of the twentieth-century, industrial design theorists and critics have called for a new and more appropriate system of coding in design, one that discards the Modernists' uniformity of expression of objects in favor of a variety of expressions of objects (McCoy 1990: e3).

7

Frascari is unclear about the meaning of the term ``intelligible.'' This term seems to resemble Jan van Pelt's and Westfall's term. According to these authors, the term ``intelligible'' makes reference to building and structural types. They claim the following in reference to ``intelligible'' design: ``The architectonic versions stand in a different relationship to the structural types than the political versions do to the building types. This is because building types belong in a class with political forms, not with material forms. To put it in terms of Kant's distinctions, the political versions belong to the intelligible world of moral law rather than to the sensible world of natural law where the architectonic versions reside. As a result, knowledge of the building types alone cannot teach a person how to contrive the architectonic structure of an example. Knowing the type does not lead directly to the design. Knowing this is to be a temple does not produce the Parthenon every time. Because the connection between building types and structural types is one of contingency rather than necessity, each building must be designed anew. The art of building requires knowledge of the sensible world which contains the natural laws that the examples of the structural types and their components imitate and thereby make intelligible. Acquiring

The Modernists claimed the “universality” of unadorned, reduced forms that conveyed moral and political values of “truth” , “virtue” and the promise of technology. Technology was molded into a system of minimalist forms that depicted function (Krohn and McCoy 1989: 114).

In the early 1980s, industrial design theorists and critics began to emphasize the role of culture in design. Industrial designers who use product semantics tend toward establishing visual linkages between the technological object and other aspects of human life by metaphor, analogy, simile, myth and allegory (McCoy 1990: e4).

Along with these ideas, some industrial designers have incorporated ideas from cognitive theory and communication theory. Such theories were used to analyze the socio-economic environment in which the object was created (Krippendorff 1990: al3).

The industrial design theorists of product semantics, by incorporating the use of semiotic theory, realized that people use language to name objects and speak about their qualities (Vakeva 1990: g5). Language does not only describe or make reference to objects, nor does it just instruct or persuade; it also functions as an aspect of a person's social reality (Krippendorff 1990: al5). According to product semantic theorists, language becomes relevant for analyzing products from various cultures (Vakeva 1990: g6).

Industrial design theorists have mostly referred to the semantics of the product, although they have also undertaken the syntactic and pragmatic analysis of a product. The syntactic and pragmatic analysis of a prod-

this knowledge begins with the examination of actual buildings and of the properties of materials supplied by nature for building them. It ends (in so far as it ever ends-because circumstances change revision must be constant) in providing a coherent manner of organizing the material within which the enduring content of the building is embodied.” See Jan van Pelt and Westfall, 1991: 254.

> uct examines the product's visual appearance as well as other qualities (Vihma 1990: f7).
>
> The theorists began to focus upon the meaning of the object's environment (Vakeva 1990: g5). The analysis of the object's meaning, therefore, took into account its social-cultural and historical context (Oehlke 1990: e8).

Peirce's semiotic theory seems to offer a method for exploring the content and the context of meaning of the industrial object (1990: Vihma f5). The following paragraphs will discuss Peirce's science of semiotic.

4 Peirce's Semiotic

Peirce's doctrine of signs and semiosis[1] was the beginning of a theory that other semioticians expounded upon and helped advance. In 1867, Peirce expressed the following sentiment:

> I am, as far as I know, a pioneer, or rather a backwoodsman, in the work of clearing and opening up what I call semiotic, that is, the doctrine of the essential nature and fundamental varieties of possible semiosis; and I find the field too vast, the labour too great, for a first-comer (sic). (1992: 284)

His theory of signs posits that the universe is comprised of signs and sign systems; it also specifies what is required of these signs for semiosis to occur. Peirce stated: "Semiotics is knowledge about semiosis; it is the theoretical accounting for signs and what they do" (Deely 1990: 105).

Any investigation into Peirce's semiotic must begin with the question: What is the nature of a sign such that it makes semiosis possible? This question may be applied to the various roles the sign plays in architecture, the fine arts, literature, anthropology, and science. The role of the sign and its objectivity,[2] and what is distinctive about such objectivity in the sign being analyzed, are questioned. The sign's objectivity in these disciplines is based upon the sign's signification, (Ibid: 106) production, and interpretation (Innis 1985: viii). Semiosis has to depend upon the interpreter's experience and knowledge concerning the action or processes in which the sign is involved in (Deely 1990: 51).

1 Peirce defined semiosis as: "...an action, or influence, which is, or involves, a cooperation of *three* subjects, such as a sign, its object, and its interpretant, this tri-relative influence not being in any way resolvable into actions between pairs." See Peirce, "A Survey of Pragmaticism: Logical Interpretants." *(Collected Papers.* Vol. V.: 323–343).

2 The term *objectivity,* according to Deely, in dependent upon the "objective world." He defines the "objective world" as "...the action of signs within our experience." See Deely, 1990:19-20.

According to Umberto Eco, semiosis is a communication process; it " ...is the process by which empirical subjects communicate, communication processes being made possible by the organization of signification systems" (1976: 316). Eco's semiosis describes how a culture produces and assigns meanings to signs; he therefore views semiosis as a product of culture and society.

John Deely extends this idea of semiosis as a cultural product into the realm of plant and animal environments. He claims that:

> So far we have noted that semiosis, in the fullest sense of the action of signs, extends well beyond the boundaries of culture,
>
> as even well beyond the boundaries of animal societies, to include the dynamics of plant life and even the dynamics of chemistry and physics down to the quantum level insofar as there is a question of future outcomes and law governed interaction. Our concentration has been on the explicit absorption and redistribution of elements of [the] physical environment within the relational network of [the] objective world through cognitively mediated experience, [brackets mine] (1990: 67)

Deely recognizes that the action of the sign processes involves human experience, as well as that of all organisms in their relationship with their environment. The environment is seen as a sign system in and of itself *(Ibid:* 73), and this system includes all the organisms contained within it.

The American anthropologist, David Clarke, argues that Peirce's semiotic is a logical discipline and not an empirical science. Clarke believes that Peirce's semiotic describes certain aspects of the sign as it is used by any organism capable of learning from experience; it is not based upon aspects that are found within the empirical sciences (1990: 58). In this manner, Peirce's semiotic is considered a normative science taking into account that ideas are based upon logic *(Ibid:* 62). To Clarke, Peirce relies upon the *logical* interpretation of how the sign stands for an object *(Ibid:* 83).

Meanings, according to the American semiotician Charles Morris, cannot exist without the interpretation of signs and 'semiotic', the general study of signs. They are disclosed as a relationship between meaning and action (or behavior). Morris suggests that semiotic itself is to be developed as a behavioral theory (1970:16).

In summary, Peirce uses various qualities of human experience, habit and law; he also uses deductive logic, and the general theory of signs or semiotic. He asserts that human experience and thought are communicated or signified through signs. Clarke notes that Peirce's theory of signs may be approached as a theory of experience or phenomenology (1990: 62). It is Peirce's belief that ideas may be signs that involve the mind's interpretation of various sign processes or semiosis, in other words, the action among signs (Innis 1985: 3).

Peirce's Concept of Sign

For Peirce, the sign is an important aspect of the process of semiosis (Zeman 1977: 26). Peirce defines the sign as "...something which stands to somebody for something in some respect or capacity" (Peirce 1985: 5). A sign also may stand "...for something to the idea which it produces or

modifies" (Fitzgerald 1966: 40). The sign is comprised of the object for which the sign stands and is a process that occurs in the interpreter's mind, known as the interpretant *(Ibid:* 40). Peirce's sign is the relationship that exists between the sign and its object. He believes that it is this relationship that will determine the cognitive sign that stands for the object (Peirce 1985: 5).

Anthropologist David Clarke reiterates Peirce's notion of the sign by noting, "a sign is any object of interpretation, a thing or event that has significance for some interpreter. It can stand for some object for this interpreter, signify an action to be performed, arouse in the interpreter a feeling or emotion, or combine two or more of these functions" (1990: 1). Examples of what constitute signs for Clarke are ideas, natural events such as actions that take place within the environment, diagrams and drawings resembling the object they are representing, and sentences that follow certain grammatical structures or rules *(Ibid:* 24).

"I propose to define as a sign," writes Umberto Eco, "everything that, in the grounds of a previously established social convention, can be taken as something standing for something else" (1976: 16). Like Peirce, Eco believes that everything in the environment is a sign, and that the natural environment is a conglomeration of signs *(Ibid:* 15). He gives the example of smoke as a sign of fire. The fire need not be perceived along with the smoke; the smoke acts as a sign through the "social rule" that smoke

is associated with fire *(Ibid:* 17). Eco adds the role of society as an important aspect in determining what is defined as a sign. A sign develops through the conventions of a particular community. The community agrees to and establishes the various meanings that a certain action, object or word can have.

The action of a sign relates to Peirce's semiosis. Eco echoes Peirce in defining semiosis as " ...an action, or influence, which is, or involves, an operation of three subjects, such as a sign, its object, and its interpretant, this tri-relative influence not being in any way resolvable into an action between pairs" (1984: 1). The sign, in the process of semiosis, becomes a sign in a philosophical manner *(Ibid:* 10).

According to Eco, in the process of semiosis, the object may function as the central object of semiotics if one decides that a category can describe a series of human as well as animal behaviors, (vocal, visual, ter- mic, gestural, etc.) *(Ibid: 7).* Eco points out that the most important questions pertaining to semiosis are: What does it mean for animals and humans to convey or communicate ideas or aspects of the universe? Do they express these by verbal means only, and what are the similarities that are to be found between verbal and nonverbal communication *(Ibid: 7)?*

Peirce's Semiosis: Sign, Object, and Interpretant

In Peirce's semiosis, there are three relata involved: the Sign, the Object and the Interpretant (Zeman 1977: 24–5). The triadic relationship of these three occurs among the Sign itself (which can be a physical object, image, quality, idea) and, what the sign stands for —its Object—, and the Interpretant (Goudge 1969: 139). The Sign is an object that exists in the world. The Object is a sign that functions alone; it may be understood by one person and not another. In this respect, the Object functions as an aspect of a person's consciousness (Zeman 1977: 25).

The Object is active in semiosis in two ways. This duality of the Object may be determined by the notion that the Object is either a Dynamical Object, "...the efficient but not immediately present Object," or the Immediate Object, "...the Object as the sign represents it" (Peirce 1958/8: 232). Peirce exemplifies this duality in the sentence, "The sun is blue." The Objects of the sentence are "the sun" and "blueness." Peirce noted that the word "blueness" functions as the Immediate Object, or "the quality of the sensation," which is made known through a person's feelings. He claimed that the

Immediate Object is the “sundry sensations” the sun produces (Peirce 1958/8: 138). The Dynamical Object is the existential relationship; the emitted light is the Dynamical Object, and involves the perception of the sensation that relates its location, mass and volume (Peirce 1958/8:138).

Peirce argued:

> It is true of both Immediate and Dynamical Object that Acquaintance cannot be given by a Picture of a Description, nor by any other sign which has the Sun for its Object. If a person points to it and says See there! That is what we call the ``Sun'' the Sun is not the Object of that sign. It is the Sign of the sun, the word ``sun'' that his declaration is about; and that word we must become acquainted with by collateral experience. (1958/8:138)

Another example Peirce gives is a portrait with the subject's name printed below it. The portrait can convey information only if the person looking at it knows whom the name represents; if not, then it represents what the name of the person looked like. In this manner, the text also functions as graphics. Peirce claimed that a sign can only be understood if the interpreter has “collateral acquaintance” with the object (1958/8: 139). Peirce does not discuss in depth what is meant by “collateral acquaintance” or “collateral experience.” These terms seem to convey social convention or, as Eco believes, they refer to the fact that a sign conveys its meaning to a given community by convention. These terms also make reference to Peirce's term 'habit'.[3]

The Interpretant, like the Object, has a dual nature (Zeman 1977: 25). Peirce's concept of the Interpretant is expressed in the following statement:

> The Sign creates something in the Mind of the Interpreter, which something, in that it has been so created by the sign, has been, in a mediate and relative way, also created by the Object of the Sign, although the Object is essentially other than the Sign. And this creature of the sign is called the Interpretant. (1958/8:136)

3 To Peirce, a habit is responsible for any succession of ideas. A habit is “...the great 'Law of Association of Ideas,' the one law of all psychical action.” See Peirce, “Association: General Characteristics of Mental Action.” *(Collected Papers:* Vol. VII.: 249–250). Peirce also argued that a person's habits are responsible for the growth of ideas. He noted: “...there are three ways by which Human Thought grows, by the formation of habits, by the violent breaking up of habits, and by the action of innumerable fortuitous variations of ideas combined with the differences in the fecundity of different variations.” See Peirce, “Notes On Science: The History of Science.” (*Collected Papers.* Vol. VII.: 175–181).

According to Peirce, the Interpretant is created by the Sign which is determined by the Object and given meaning by the "Interpreting Mind" (1958/8 Ibid: 136). The meaning is taken from observation and the interpreter must have previous knowledge of what the sign denotes. The sign or sentence "Hamlet was mad." provides another example. A person will understand the meaning of the sentence only if the person interpreting it is acquainted with the mental condition known as "madness." This knowledge is obtained through experience and previous knowledge by observing or reading the culturally correct definition of a madman. To Peirce, this is known as "collateral observation" *(Ibid:* 136). He claimed that "collateral observation" is not a part of the Interpretant.

The main function of the Interpretant is the manner in which different subjects combine as represented by the sign and their relationship to one another. Peirce does not give any detailed explanation of how this is to be achieved, but he gives the example of a genre painting —a humble, domestic scene—as such a Sign. He claimed that most of what is understood in a painting arises from the person's familiarity with the customs represented in the painting. The clothing, he claimed, is not part of the significance or "the deliverance" of the painting; it only conveys the subject. The subject and the object are identical. Peirce never states exactly in what sense the significance of the painting is the "sympathetic element" familiar to the Interpreter. He claimed this was another Interpre- tant of the Sign (1958/8:136-7).

Peirce's Index, Symbol and Icon

The three relata of Peirce's semiosis —the sign, object and interpretant—define his three trichotomic divisions of the sign. In the first division are the categories of qualisigns, sinsigns, and legisigns.[4] The second division is comprised of the categories of Icons, Symbols, and Indices. The third division contains the categories of rhemes, dicisigns, and arguments.[5] These three trichotomies represent the ten classes of signs that he later developed into sixty-six classes (Peirce 1958/8: 228–30).

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4 *Aqnalisign* is a quality that functions as a sign. *Asinsign* is an actual existent thing or event that functions as a sign. A *legisign* is a law that functions as a sign. This law is usually established by conventions of humans, therefore every conventional sign functions as a legisign. The legisign becomes significant because a group or community establishes it as such. See Peirce, "Division of Signs; One Trichotomy of Signs." *(Collected Papers.* Vol. IL: 142–143).

5 Peirce defined each of these signs as follows: A *Rheme* "...is a Sign which, for its Interpretant, is a Sign of qualitative Possibility, that is, is understood as representing such and such a kind of possible Object. Any Rheme will perhaps afford some information; but it is not interpreted as doing so." A *Dicisign* "...is a Sign, which, for its Interpretant, is a Sign of actual existence. It cannot

The second division, which consists of Icons, Symbols, and Indices, falls into Peirce's science of logic category known as Speculative Grammar,[6] which includes the meaning of signs (Fitzgerald 1966: 37). Peirce's concept of Speculative Grammar can be summed up as:

> ...an analysis of the nature of assertion, which rests upon observations, indeed, but upon observations of the rudest kind, open to the eye of every attentive person who is familiar with the use of language and which, we may be sure no rational being able to converse at all with his fellows, and so to express a doubt of anything, will ever have any doubt. (Almeder 1980: 23)

In summary, Peirce is stating that icons, symbols, and indices include the connection a person may make: Through the conventions and expressions of language, a person forms a link with the object or idea being observed. Therefore, Peirce argued, signs are made known through observation, experience and convention.

Peirce's Icon

Peirce defines an icon as a sign that refers to a particular object by a similarity of characteristics. In Peirce's icon, the main emphasis is a comparison of two qualities. These qualities become similar when they are situated in the context of a comparison in the interpreter's mind (Fitzgerald 1966: 47). Peirce states:

> An icon is a representamen of what it represents and for the mind that interprets it as such, by virtue of its being an immediate image, that is to say by virtue of characters which belong to it in itself as a sensible object, and which it would possess just the same were there no object in nature that it resembled, and though it never were interpreted as a sign. (1960/4: 359)

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be an Icon, which affords no ground for an interpretation of it as referring to actual existence. An Argument "...is a Sign which, for its Interpretant, is a Sign of a Law. A judgment is a mental act by which the judger seeks to impress upon himself the truth of a proposition." See Peirce, "Division of Signs: A Third Trichotomy of Signs." *(Collected Papers.* Vol. II.: 144–146).

6 Peirce's "speculative grammar" was taken from the ideas founded by the Scottish Franciscan philosopher, Duns Scotus (1260-1308) who was the first philosopher to call this category of signs, "grammatica speculative" or, according to Peirce, "pure grammar." See Peirce, "Division of Signs: Ground, Object, and Interpretant." *(Collected Papers.* Vol. II.: 134–136).

Peirce posits a similarity here between the icon and its object, a similarity that is found in the "sign vehicle" itself (Fitzgerald 1966: 49). This definition of an icon is also a definition of an iconic sign vehicle. The division of the sign vehicle into an icon, an index and a symbol is based upon the relationship that exists between the sign vehicle and its object; this relationship may exist before the sign is used *(Ibid-.* 51).

Peirce's offers the following definition of an icon as it relates to its object:

> An Icon is a sign which refers to the Object that it denotes merely by virtue of characters of its own, and which it possesses, just the same, whether any such Object actually exists or not. It is true that unless there is such an Object, the Icon does not act as a sign; but this has nothing to do with its character as a sign. Anything whatever, be it a quality, existent individual, or law, is an Icon of anything, in so far as it is like that thing and used as a sign of it. (1960/2:143)

Peirce gives another definition of the icon:

> A pure icon can convey no positive or factual information; for it affords no assurance that there is any such thing in nature. But it is of the utmost value for enabling its interpreter to study what would be the character of such an object in case any such did exist. (1960/4: 359)

The icon does not represent how things are in fact, but discloses certain characteristics of an object whether it is present or not (Fitzger- aldl966:52). Peirce argued that icons are not necessarily realistic images. They may be based upon resemblance and the sharing of certain properties between a sign and its object. He includes as icons such things as graphs, diagrams, maps, metaphors, algebraic expressions, hieroglyphics, and syntax (Innis 1985: 2).

An icon may relate to an actual physical object such as a sculpture, a painting, or an artifact, which can bring iconic relations to an interpreter's mind (Fitzgerald 1966: 54). An icon may also be a drawing of a "statue, pictorial composition, architectural elevation, or piece of decoration, by the contemplation of which he can ascertain whether what he proposes will be beautiful and satisfactory" (Peirce 1960/2: 159). The idea is not, however, a pure icon because the image created in the mind of the interpreter is caused by an external object (Fitzgerald 1966: 55). This is expressed in Peirce's statement:

> It (the icon) is of the nature of an appearance, and as such, strictly speaking, exists only in consciousness, although for convenience in ordinary parlance and when extreme precision is not called for, we extend the term icon to the outward objects which excite in consciousness the image itself, [brackets and term mine] (1960/4: 359)

The icon, in this instance, is the idea or the cognitive image that is formed in the interpreter's mind. The icon makes reference to an external object that exists in the environment (Fitzgerald 1966: 55).

Eco condemns Peirce for using the term 'iconism' in a loose manner, as an "umbrella term" in which he includes references to objects such as mental images, graphs or paintings[7] (1976: 199). Eco believes that what Peirce is trying to define is the relationship between an expression and its content-type, which Eco calls "ratio difficilis." Eco does not believe in Peirce's notion that the idea of iconism only designates the visual relationship between similar spatial properties the diagrams display. He argues that spatial properties do not stand for other spatial relationships *(Ibid:* 198).

Eco argues:

> How, in the graphic representation, does the appartenance to a class become appartenance to a given space? By a mere convention (even if based on certain mental mechanisms, used to thinking or to imagining either by temporal succession or by spatial proximity) that establishes that certain abstract relations can be expressed by spatial situations. (Ibid: 199)

To Eco, these represent metaphors, not icons *(Ibid:* 199).

"An absolute replica" or icon, according to Eco, is a utopian idea. He claims that it is difficult if not impossible to reconstruct all the properties of a given object; however, people possess a certain "common sense" that allows them to recognize similar features among objects that belong to the same class of objects. Eco gives the example of two Fiat 124 cars that are the same color but which function as two doubles and not as each other's icon. Another example he gives is the duplicate of a functional object, a knife. The knife, according to Eco, must have the same degree of sharpness and the same surface texture exactly in order to be considered an icon *(Ibid:* 180).

7 Peirce, however, did not believe this to be so; he noted that there was no such thing as a "pure icon" but just various degrees of icons. See Fitzgerald, 1966: 52. Eco takes prerogative to claim this viewpoint.

Most people, according to Eco, believe that icons are based upon similarities between objects, because they contain some similar features. He states, "The most prudent attitude in this case is to propose that the iconic device may possess certain elementary "iconic markers" and that sometimes a minimal resemblance is due to the fact that the iconic sign, even though different in shape from its object…performs the *same function" (Ibid:* 208). They believe that any similarity conveys an iconic sign even if it is based solely upon function *(Ibid:* 208).

Eco believes that in order to duplicate an object it is necessary to reproduce all the properties contained within the "model-object" *(Ibid:* 180). The duplicate must retain the exact orders and interrelationships that the original possessed *(Ibid:* 180). He does not explain the exact tolerances that would define a double. It seems that Eco will settle for no less than zero tolerance. Eco notes that if the object is a complex one —for example, using the Chevrolet vehicle to make a double—the principle of duplication will not change. What changes is the number of rules and technical difficulties involved in making the double of the vehicle *(Ibid:* 181).

He states, "Any duplication which does not follow all the rules of production, and which therefore produces only a given percent of the mechanical and the functional properties of the model-object, is not a double, but at best a partial replica" *(Ibid:* 181). The duplication of an object, however, is not a "pure" icon.

In summary, an icon, according to Peirce, is a sign that displays some similarity to the object it portrays. The icon exemplifies the structure of the relationships of their objects and their similar qualities. Peirce believed that there are no such things as pure icons (Fitzgerald 1966: 55).

As Peirce claimed, icons may include maps, diagrams, algebraic expressions, graphs, syntax and grammatical expressions. Icons also include all likenesses that may be displayed in sculptures, graphics, scientific illustrations, documentary photographs and films (Wallis 1975: 12).

Peirce and Diagrams as Icons

Peirce believed that diagrams are produced in order to lead to a “better understanding of states of things, whether experienced, or read of, or imagined” (Peirce 1960/3: 260). The thought or idea that was conveyed through the diagrams exemplified the “possible expressions” that a “possible interpreter” could interpret with respect to the diagram's essential character (Peirce 1960/4:10). The diagrams did not function as the thought or idea per se, but were representative of the various visual relations that were analogous to the iconic relations (Peirce 1960/4 : 348).

In his discussion of diagrams as icons, Peirce stated:

> Namely, if I may try to state the matter after you, one can make exact experiments upon uniform diagrams; and when one does so, one must keep a bright outlook for unintended and unexpected changes thereby brought about in the relations of different significant parts of the diagram to one another. Such operations upon diagrams, whether external or imaginary, take the place of the experiments upon real things that one performs in chemical and physical research. Chemists have ere now, I need not say, described experimentation as the putting of questions to Nature. Just so, experiments upon diagrams are questions put to the Nature of the relations concerned. (1991: 250)

Peirce's claim here is that icons are not merely visual but can also express conceptual relationships.[8] The diagram's relation of parts and the interrelationship of these parts combine to give form or substance to the idea.

8 This notion of conceptual relationship refers to icons as types. Types exist in thought and not in matter or image. The authors Jan van Pelt and Westfall state: “...a type and its example are connected, as is a thought and its material embodiment, and thus the thought and the image. The image is not material embodiment, and thus the thought the image. The image is not the type but merely an aspect of it. The type's image is pregnant, however. It suggests what can come from the yet-to-be-born thing it can be taken to be. That embryo is found in the reflection flowing from experience with the examples, and thus contains within it something about the activities it serves and accommodates as well as the materials appropriate according to varying circumstances. In this sense it is a natural symbol of the political purpose it accomodates. In both the most simple and most complex way, then, the type's character is embodied in its plan diagram, and that plan diagram is about a purpose which is virtually a diagram of how actions achieve the purpose the building serves. See Jan van Pelt and Westfall, 1991:164.

Peirce also believed that diagrams functioned as icons through the conventions a community shares.[9] He affirms this in the following: “A diagram is a representamen which is predominantly an icon of relations and is aided to be so by conventions” (Fitzgerald 1966: 52). Diagrams are icons, but they have value only by virtue of cultural conventions and symbols. The American semiotician John Fitzgerald notes that while Peirce's ideas concerning conventions may be expressed in reading blueprints and diagrams, the reader must first be familiar with the conventions the creator used *(Ibid:* 52).

According to architecture theorist Marco Frascari, drawings may be seen as semiotic tools as well as models of architectural representation. Frascari argues that these architectural representations may “range from survey or measured drawings, which interpret the reality of the constructed world, to construction and design drawings, which are to be interpreted for the construction of the world” (1991: 90). Drawings, together with the constructed world, constitute what may be termed the “architectural project” *(Ibid:* 90).

Frascari uses Peirce's theory of semiotic to discuss architecture. He states that the “architecture project” is iconic because it is based upon inferences taken from constructive architectural drawings. These architectural drawings, he affirms, are diagrams based upon architectural theory and change accordingly to provide relationships with the form to be built. To Frascari, these are the constructive drawings and they demonstrate construction *(Ibid:* 91).

9 Peirce argued that deductive reasoning is based on diagrammatic reasoning. This reasoning is iconic in nature. He noted: “All necessary reasoning without exception is diagrammatic. That is, we construct an icon of our hypothetical state of things and proceed to observe it. This observation leads us to suspect that something is true, which we may or may not be able to formulate with precision, and we proceed to inquire whether it is true or not. For this purpose it is necessary to form a plan of investigation and this is the most difficult part of the whole operation. We not only have to select the feature of the diagram which it will be pertinent to pay attention to, but it is also of great importance to return again and again to certain features. Otherwise, although our conclusions may be correct, they will not be the particular conclusions at which we are aiming.” See Peirce, “Three Types of Reasoning: The Plan and Steps of Reasoning.” *(Collected Papers.* Vol. V.: 98–102).

In architectural drawings, architects act as observers of their physical environment and their constructed work; they also act as observers of their own internal vision. The physical construction is the combination of what the architect visualizes on the drawing board and the site where the construction is to take place. The internal world is what happens on the drawing board where the architect or designer expresses his or her own diagrams and graphic constructions. Peirce termed these diagrams and graphics "mental imagines" *(Ibid:* 91).

Peirce noted that the icon can reveal certain truths of observation that are evidence of construction. These truths are discovered through the process of deduction. He noted:

> For a great distinguishing property of the icon is that by the direct observation of its other truths concerning its object can be discovered than those which suffice to determine its construction. Thus, by means of two photographs a map can be drawn, etc. Given a conventional or other general sign of an object, to deduce any other truth than that which it explicitly signifies, it is necessary, in all cases, to replace that sign by an icon. (1960/2:158).

The icon, therefore, is capable of revealing certain truths through deduction and convention. Through the observation of diagrams, the employment of deductive reasoning helps to bring about various consequences from the hypothesis (Peirce 1960/3: 350).

The drawings are, according to Peirce, "theoretic (or theoremic) and corollary (or corollarial) reasoning." In theoretic reasoning, a new idea is brought into the argument (Frascari 1991: 92). Peirce notes that theoretic (or theorematic) reasoning draws conclusions of the conditions represented in the diagram. It is by observing these diagrams that modifications or experiments may be performed on them (Peirce 1958/2: 152).

Frascari states that this notion is not new in architectural thinking or in the formulation of architectural hypotheses. Corollary reasonings, to Frascari, are the ideas that are used in the building program; for example, the shape of a certain type of plan determines the boundary lines in both the two dimensional drawing and the building (1991: 92). Frascari claims that in theoretic or theorematic reasoning a new idea is brought into the argument. Peirce, however, argues that theorematic as well as

corollary reasoning are deductive[10] in nature. These both represent what he termed "Necessary Deductions" [11] (1960/2: 152). According to Peirce, it is only possible to bring a *new* idea into the argument through abductive rea- sorting (1960/5: 106). The ideas to which Frascari alludes, which are shown in the diagram, are not new ideas but ideas that have already been established by convention. Corollary or deductive reasoning conveys certain truths about the diagram's construction (Peirce 1958/2: 152).

The diagrams display various relationships and disclose a variety of possible translations. These diagrams are "constructive drawings" that demonstrate the nature of construction. Frascari notes, "As Peirce points out in the fifth article of his definition of a theorem, a demonstration is 'what traces out the reasons why a certain relationship should always subsist between the parts of a diagram'" (Frascari 1991: 91). The demonstrations are the signs of "architectural abduction." Architectural abduction,

10 lTheorematic and corollary reasoning are deductive in character. They both represent a "...mode of reasoning which examines the state of things asserted in the premisses, forms a diagram of that state of things, perceives in the parts of that diagram relations not explicitly mentioned in the premisses, satisfies itself by mental experiments upon the diagram that these relations would always subsist, or at least would do so in a certain proportion of cases and concludes their necessary, or probable, truth." See Peirce, "Lessons From the History of Science: Kinds of Reasoning." *(Collected Papers.* Vol. I.: 28–33).

11 Deductions, according to Peirce, are necessary or probable. A necessary deduction is either corollarial or theorematic. "A Corollarial Deduction," to Peirce, "is one which represents the conditions of the conclusion in a diagram and finds from the observation of

according to Frascari, is the notion that architecture is based upon inferences that are taken from architectural drawings (Ibid: 91). Abduction,[12] according to Peirce, is iconic (cf. Frascari 1991: 91).[13] Peirce specifies that these abductions[14] were the ideas embodied in the diagrams (1960/5: 106).

In an architect's drawing, the emphasis " ...is to make visible what is invisible" (Frascari 1991: 92). In a drawing, the architect is conveying various functional denotations so that the viewer may determine certain qualities and connotations that stem from past, present and future buildings. Drawings, as mentioned earlier, are semiotic tools that make the intangible more tangible *(Ibid:* 92).

Frascari's notion of the invisible relates to Peirce's notion that diagrams do not resemble their objects in appearance; instead it is "only in response to the relations of their parts that their likeness consists" (Peirce 1960/2: 159). These relations can be analyzed using Peirce's three types of signs, namely known as icons, indices, and symbols.

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12 this diagram, as it is, the truth of the conclusion. A Theorematic Deduction is one which, having represented the conditions of the conclusion in a diagram, performs an ingenious experiment upon the diagram, and by the observation of the diagram, so modified, ascertains the truth of the conclusion." See Peirce," Division of Signs: The Trichotomy of Arguments." *(Collected Papers.* Vol. II.: 152–155).

lAn abduction, according to Peirce, is a method that forms a general prediction and is justifiable only in the hope of it being able to predict future conduct in a rational manner. See Peirce, "The Trichotomy of Arguments." *(Collected Papers.* Vol. II.: 152–153).

13 lPeirce stressed that abductions are iconic. He noted: "The mode of suggestion by which, in abduction, the facts suggest the hypothesis is by resemblance, —the resemblance of the facts to the consequences of the hypothesis." Since icons are based upon similarities, it is possible to assume that abductions are also iconic. See Peirce, "The Logic of Drawing History From Ancient Documents: Abduction." *(Collected Papers.* Vol. VII.: 36–144).

14 Abductions are responsible for any new idea introduced into science. See Peirce, "Three Kinds of Goodness." *(Collected Papers.* Vol. V., 77–93). Through the process of abduction a person studies facts and uses a theory in order to explain them. It is through abductions that a person acquires an understanding of things. See Peirce, "Three Types of Reasoning: Instinct and Abduction." *(Collected Papers.* Vol. V.: 105–107).

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Frascari argues that any edifice may be viewed as a combination of its content and expression. He suggests that the edifice may be seen in Peircean terms as a "dynamic object" that motivates the sign. Thus, "designs" are motivated signs expressed in drawings. Frascari quotes Eco on this point: "a sign just does not stand for something else, it may also be something that can be interpreted." The edifice or the "nontrivial building" is the physical manifestation of the process of interpretation (Frascari 1991: 92).

Semiosis, as seen by Frascari, operates in architecture through infinite possibilities of interpretation, incorporating graphic signs so that the architect may "remember the past, experience the present, and anticipate the future experience of the constructed reality" *(Ibid:* 93). The infinite process of semiosis is evident in the graphic texts, the design and presentation, the construction, shop, and survey drawings. Semiosis also occurs in imagined buildings that have become the stimulus for other designs that produce new constructions and drawings *(Ibid:* 93). Frascari sees semiosis as a cyclical and infinite process.

Drawings are demonstrations of architecture known as "prosperous tools" for the constructor. Frascari points out that drawings are:

> ...monsters within the labyrinth of the building trade, showing the nature of construction. They are the documents out of which the builders, the building management, and all the other trades related to the making of buildings derive their interpretation in the making of the templates and jigs necessary for construction. (Ibid: 94)

These demonstrations or tropes of the term "monster" can be, as the architecture historian George Hersey claims, representative of the terms *demonstrant, demonstrantur,* or "they are to be shown, they show, and they are shown" (Hersey 1988: 134–135). For Frascari, architectural drawings are technology icons that convey three of Peirce's semiotic relationships. First, the relationship between any real artifact and the 'projected icon' of that artifact signifies socially what is the 'right understanding of the sign.' This is known as the 'immediate interpretant.' Second, the relationship between the artifact and the 'instrumental icon' that occurs in the mind of the interpreter is responsible for the construction. This is known as the 'dynamic interpretant.' Finally, the relationship between the 'instrumental icon' and the 'formal icon' that occurs within a certain culture, is the 'final logical interpretant' (1991: 94).

To the semiotician Clive Ash win, a designer's drawing is iconic insofar as it records and transmits resemblances through the process of representation. Representation is the presentation of making an immaterial form or idea that exists only as a concept in the designer's mind, material on the drafting paper. This presentation or iconic image —the drawing—can be noted in the etymological link between the terms 'image' and 'imagine' (1989: 201).

Peirce—Metaphors and Analogies as Icons

Art and science differ in their approach to creativity. In artistic creativity, the main idea is to present a new feeling or quality of feeling that can be described metaphorically. The American semiotician Douglas Anderson states that it is a metaphor itself that brings together two or more new ideas (1987: 68). Peirce thought that both the scientist and the artist include hypoicons in their thought processes. In science this is known as an analogy, and in art it is known as metaphor *(Ibid: 77).*

In science, three types of hypoicons may be used. An image may be used in a "pictorial designation of a hypothesis." An analogy is often used in diagrams and in mathematical formulae. Metaphors may be used when arguing new hypotheses; they aid in describing new concepts *(Ibid:* 15).

The notion of a hypoicon can be understood in terms of Peirce's 'Firstness.'[15] Peirce states:

> Those which partake of simple qualities, or First Firstnesses, are images; those which represent the relations, mainly dyadic, or so regarded, of the parts of one thing by analogous relations in their own parts, are diagrams; those which represent the representative character of a representamen by representing a parallelism in something else, are metaphors. (Peirce 1960/2:157)

Anderson argues that the artist may use these three types in the process of creating a work of art.

15 Peirce defined his metaphysical category of Firstness as: "...the mode of being which consists in its subject's being positively such as it is regardless of aught else. That can only be a possibility." An example Peirce gives of Firstness is the color of an object; for example the color red. The color red will remain the color red once the definition of red has been established in the cultural framework of the perceiver.

Eco states that a metaphor " ...substitutes one expression for another in order to produce an expansion (or a "condensation") of knowledge at the semantic level" (1990:139). Eco does not believe, like Peirce, that a metaphor is an icon; it is a separate entity *(Ibid:* 140). However, Eco's definition of a metaphor does however suppose that metaphors have iconic qualities since in order to substitute one term with another there must exist a similarity in meaning.

Anderson's definition of the metaphor is similar to Eco's insofar as it claims that a metaphor "...is like an image or an analogy." The metaphor is similar to what it represents, "...not because of an antecedent identity or a similarity or a reminiscence but it is a similarity which it creates" (Anderson 1987: 73). Therefore, Anderson's concept of a metaphor is not an icon but may contain some iconic qualities *(Ibid:* 73).

Peirce thought of metaphors as iconic signs. Their function is different from that of diagrams or analogies. An analogy is a type of metaphor that is comprised of three elements: the two relata and the form they share (Ibid: 69). An example of this would be a road map; the map shares certain forms with the territory it depicts.

According to Peirce, words are metaphorical in character when a person combines certain qualities together with his or her aptitudes to discover resemblances or associations based upon these similarities (Peirce 1960/3:260). A metaphor carries meaning that is symbolic. "A metaphor," Anderson argues, "is a symbol whose iconicity dominates" (1987: 69). He confirms this argument by quoting Peirce, "One sign frequently involves all three modes of representation, and if the iconic element is altogether predominant in a sign, it will answer most purposes to call it an icon" *(Ibid:* 3). Metaphors may function in some respect as a symbol and an index; however, the metaphor's iconic qualities override these *(Ibid:* 69).

Peirce's Symbol

In "Logic as Semiotic: The Theory of Signs," Peirce examined the origins of the term 'symbol.' The Greeks were the first to use the term 'symbol- os', which in twentieth-century terminology is the 'symbol'. The Greeks used the term to signify 'throw together', and it was applied whenever there was a contract or a convention developed. Aristotle used the word as a conventional sign or a noun. He also used the word to mean a signal that was agreed upon by a certain community (Peirce 1985: 18).

Peirce took it upon himself to reinterpret the term through the meaning given to it by Aristotle. Peirce defined the symbol as "...a Represent- amen whose Representative character consists precisely in its being a rule that will determine its Interpretant" (Peirce 1985: 16). He claimed that words, sentences, books and conventional signs are symbols. An example of a symbol is the word 'man'; it is a sign that is a replica of the word in its written and verbal form. He argued that the word in itself does not exist but that it has a "real being" because "existents will conform to it" (1985: 16). The word becomes a sign because it is a "habit" or "law" that creates a replica that can be interpreted as meaning 'man ' (1985: 16). He stressed that by a set of general rules or "habits" , the word acquires meaning. Words and their meanings are general rules but the word is responsible for expressing the "qualities" that the replica possesses (1985: 17).

Peirce noted that "A symbol is a sign naturally fit to declare that the set of objects which is denoted by whatever set of indices may be in a certain way attached to it is represented by an icon associated with it" (1985: 17). In this statement, Peirce suggests that a person associates an idea or meaning with a word that can be stated as the "mental icon." The "mental icon" is the image a person creates in the mind (1985: *Ibid:* 17); this image is what Peirce also termed the "psychical product" (1958/8:112).

In the article "On the Algebra of Logic," which first appeared in the *American Journal of Mathematics,* Peirce refers to the symbol by the term "token." He suggested:

> A sign is in a conjoint relation to the thing denoted and to the mind. If this triple relation is not of a degenerate species, the sign is related to its object only in consequence of a mental association, and depends upon a habit. Such signs are always abstract and general, because habits are general rules to which the organism has become subjected. They are, for the most part, conventional or arbitrary. They include all general words, the main body of speech, and any mode of conveying a judgment. For the sake of brevity I will call them tokens. (Corrington 1993:145)

The sign or, as Peirce suggests above, the "token" is responsible for creating something in the mind that has meaning for the interpreter. The sign is connected to its object in this manner by an arbitrary and conventional act, an act of habit that stems from the person's social and communal life *(Ibid:* 145).

Peirce also believed,

> Any ordinary word as 'give', 'bird', 'marriage', is an example of a symbol. It is applicable to whatever may be found to realize the idea connected with the zvord: it does not, in itself, identify those things. It does not show us a bird, nor enact before our eyes a giving in marriage, but supposes that we are able to imagine those things, and have associated the word with them. (Fitzgerald 1966: 63--64)

To support his argument, Peirce gives the example of class designations as instances of symbols. For example, Peirce gives the word “cuckoo” as a symbol for bird. The word does not resemble a bird but suggests the meaning of the particular genus of bird, “cuckoo.” This sign or symbol has a meaning comprised of an interpretant sign. Symbols have a third type of meaning consisting of the interpretant signs that they determine (Peirce 1958/8: 92).

Peirce's view is therefore that a symbol functions as an idea connected to a particular word (Peirce 1985: 18). It is through symbols that we associate certain ideas and objects with a particular word. He states, “Through symbols we can imagine certain things or ideas and connect or associate a particular word with them” (Peirce 1985:18). When we speak or write a word, it functions as a replica, or embodiment of the word that is being pronounced or written. The symbol does not carry any meaning by itself; its meaning relies upon the person(s) interpreting it. If there are no interpreters, the symbol does not function as a sign.

Symbolic Form

Form, like language, is symbolic. Form is the shape given to an artifact by human intention. In English, the word 'form' has the aesthetic connotation that is not found in the word 'shape.' 'Shape,' which corresponds with the Old English 'sceapan' and the German word 'schaffen', conveys the creative implication of this activity. Form may be given to natural objects by the process of growth and by crystallization. The science of form in nature is known as morphology, which is derived from the Greek term for form—*morphe* (Guralik and Neufeldt 1994: 529). However, there is no science that analyzes form in human artifacts, although there are certain laws or habits that we have assigned to them (Read 1966: 30).

The Greeks thought of form as the shape, outline, or configuration of anything, combined with the inner relatedness and harmony of an object (Guralik and Neufeldt 1994: 529). To the Greeks, the word 'art' did not exist; instead they applied the word 'techne,' which was not viewed as being separate from reality, physics or metaphysics. 'Techne,' according to the German existentialist philosopher and social critic Martin Heidegger (1889-1976), was neither art nor technology but was the ability to plan and organize, and invent efficient tools (Read 1966: 45).

According to the design historian Donald Bush, man exemplifies his cultural link through artifacts by incorporating human and animal forms. He believes that the use of nature as an impetus for creating designs enables a community to display its common values and beliefs. He explains,

Historic examples show that mankind delighted in the incorporation of human and animal forms in the objects of daily use, and that a shared system of such animated forms reaffirmed an understanding of the users' place in Nature's scheme and the role of these objects in the rituals and routines of a natural life. The useful object communicated shared beliefs, values, and interests. (Bush 1990: 3)

It follows from this that the historical analysis of a form can convey the form's socio-cultural context.

The English art critic Herbert Read believes that historic examples of a form's continuity should not be the major focus of investigating an artifact; the focus instead should be on what makes the form continue to survive in a given community compared to other forms. He states,

But ...it is not the historical continuity of the form that is of immediate interest, but the nature of the form that guarantees such continuity" (1966: 36). Read considers that ritualistic form is refined either for its own sake or for the purpose of a certain function that may no longer be viewed as being utilitarian *{Ibid:* 40).

Read notes that in the past symbolic value was given to a form because it was similar to a natural form. Read states that "a symbol is only a symbol insofar as it signifies an unknown, or not otherwise expressible, perception or feeling" *{Ibid:* 47). He claims that there are two values symbolized in an artifact: one of perception and sensation, and the other of intuition and feeling *{Ibid:* 47). In an artifact created by a Neolithic human, for example, the main impetus to the form came from his or her experience.

The Neolithic human gradually developed from experiencing his or her environment, from a "conditioned response" to the physical properties such as symmetry and harmony of proportion to his or her own body. The forms of animals, fish and plants were components of the external environment *{Ibid:* 48).

Read claims:

Since form is prior to human experience, we can legitimately assume that the consciousness of form was received from the natural environment of man, and then spontaneously matched in his artifacts. But it was the form that was matched, not the appearance, and it was the form that was symbolic. *(Ibid:* 48)

Read's idea of a utilitarian form that is transformed into a ritualistic form is also viewed in the same light by industrial designer Hans-Jurgen Lannoch and the architecture theorist Hilkka Lehtonen. Lannoch also believes the objects are refined to fulfill certain human desires. He argues that humans are not interested in "...designing specific forms for specific meanings," but claims that humans are "...relating the process of creation of form to human needs, wishes, and hopes" (1990: 11).

Lehtonen argues that the form of an object reflects the way humans wish to control their environment. A community assigns various conventions and cultural meanings to artifacts. Form is always contained and produced within a sphere of meaning. However, the modernist or functionalist design movement did not view forms in the environment in this manner. Lehtonen asserts: "modernism and functionalism rather embody a positivistic ideal of objective control over the environment" (1990: 7). The modernists also did not see that the "rational" form was also a symbol.

Architect and theorist Donald Preziosi also regards the symbol as an aspect of cultural conventions. The symbol's conventions consist of the relationship between a "signans" and "signatum" brought about through convention. When an object is viewed symbolically, the main emphasis is on the meaning that is conveyed through the form or the content, known as the meaning of the object (Preziosi 1979: 70).

The anthropologist Harry Silver believes that when analyzing the symbolic dimension of an object, it is best to analyze the logic that motivated the creation of a particular object. This logic is responsible for other cultural patterns or conventions within that same society (Silver 1979: 279). The semiotician Mieczystaw Wallis points out that "...the object symbolized is usually something more important than the object that is the symbol" (1975:42). On this interpretation, the symbol is fixed by convention and is a conventional sign.

Peirce's Index

Peirce defined an index as a sign that refers to its object by a "dynamical" relationship. This relationship exists between the three-dimensional object and the person or subject perceiving the object as a sign. Peirce believed that an index is not related to its object by either similarity or analogy. He explained that,

> [An index is] a sign, or representation, which refers to its object not so much because of any similarity or analogy with it, nor because it is associated with general characters which that object happens to possess, as because it is in dynamical (including spatial) connection both with the individual object, on the one hand, and with the senses of memory of the person for whom it serves as a sign, on the other hand ...(1985:12-13)

An index, then, is a sign vehicle functioning as a sign of its object by an existential relationship with that object in the interpreter's mind (Fitzgerald 1966: 61).

Peirce proposed two types of index: the "genuine" index and the "degenerative" index. Genuine indices are comprised of demonstrative and personal pronouns, while degenerative indices are relative pronouns. Relative pronouns may indirectly or "accidentally" refer to something that exists in reality, but they directly refer to images that are created in the mind for which previous words are responsible for (Peirce 1985: 13).

Peirce claimed that demonstrative and relative pronouns are examples of causal relations because they "denote" things without describing them. They act as index fingers pointing, bringing attention to the existence of an object, a structure, or a certain relationship (Corrington 1993: 146). He stated this action of denotation in the following:

> We now find that, besides general terms, two other kinds of signs are perfectly indispensible in all reasoning. One of these kinds is the index, which like a pointing finger, exercises a real physiological force over the attention, like the power of a mes- merizer, and directs it to a particular object of sense. One such index at least must enter into every proposition, its function being to designate the subject of discourse (sic). (Peirce 1992: 232)

Here again, the index does not bear any resemblance to its object, but rather is existentially linked to it (Zeman 1977: 37). It forces the interpreter's attention and directs it to a given moment of time. An example of an index is smoke signaling to an interpreter the presence of fire. The visual smoke is the pointer that draws the interpreter's attention to the fire. The connection between the smoke and fire is a causal connection that exists independently before the interpreter. Another example of an index is a neon arrow that signals to the interpreter the direction he or she is to follow. In both of these examples, the interpreter uses a connection that is already present as the basis for the sign relation (Fitzgerald 1966: 45).

Peirce later added the terms of *subindex* or *hyposeme*[16] to refer to any "actual" relationship an index might have with its object; examples of these are proper names, personal demonstratives, relative pronouns, or letters attached to a diagram. Peirce contradicts himself, however, by claiming that none of these are indices because they are not individuals (Peirce 1985: 18). He does not explain what he means by "individuals" . His example of indices of this sort include a clock that indicates the time of day, a knock on a door indicating a visitor, or a weathervane indicating the direction of the wind (Peirce 1985: 13).

Peirce included in his list of indices the pronouns "this" and "that" because the interpreter has to use his or her observational skills when hearing these words in order to establish a link between the mind and the object being referred to (Peirce 1985:14). Umberto Eco calls the pronouns "this" , "that" , "here" and "there" *deictic* or *anaphoric* verbal signs. These are similar to nonverbal pointers, such as a pointing finger or a directional arrow that have expressive semantic verbal pointers that can be extended to semantics of non-verbal indices (Eco 1976: 115). Eco claims that the pointing finger is an analysis of space that has semantic properties and spatial coordinates. He suggests that " ...a non-verbal index has the same sign-function structure as has a verbal one, the same capacity to be analyzed into syntactic and semantic markers, but some of its syntactic markers seem to be *motivated* by its content" *(Ibid:* 185).

16 16p$_e$irce claimed that *" Subindices* or *Hyposeines* are signs which are rendered such principally by an actual connection with their objects." See Peirce, " The Trichotomy of Arguments." *(Collected Papers.* Vol. IL: 152–153).

Peirce considered that directions, a set of instructions for instance, are also indices. Peirce argued that “some indices are more or less detailed directions for what the hearer is to do in order to place himself in direct experiential or the connection with the thing meant' (Fitzgerald 1966: 60). Fitzgerald's use of the term 'thing' in this context is synonymous with the object. Directions connect the object with the interpreter. Indices put the interpreter in contact with the object or person either physically or mentally.

In summary, an index is first a sign vehicle that functions as a sign of its object through an existential relationship to that object. Second, this relationship calls the attention to the actual existence of such an object. This raises the question: “What kind of existing things usually act as indices?” *(Ibid:* 57). Third, indices in language can be pronouns, grammatical subjects, and or directions for drawing attention to a particular object. An index's main function is to guide the interpreter to the object intended. Indices become degenerate because they must rely upon convention *(Ibid:* 61).

Methodology

Peirce's semiotic system will be applied in this study to determine how Fuller structures his language. This study examines the question of whether these structural rules or codes, based upon the index, icon and symbol, are congruent with the codes exemplified in his Dymaxion Vehicles, patent text, *4D Time Lock* text, and patent diagrams. This study also searches for the interconnections between Peirce's theory of signs and Fuller's designs and writings.

Peirce's semiotic is based upon principles of formal logic from which he derived his pragmatic principles. His semiotic, as a method, is therefore founded upon logic. Logic, according to his theory of signs, is dependent upon the icon, index, and symbol as well as the interpretant, sign, and object. Peirce classified three kinds of signs —the Icon, Index, and Symbol—which “...form the necessary conditions for the meaningfulness of propositions in a general purpose of language” (Fitzgerald 1966: 65). Peirce's semiotic is a logical interpretation. The sign, according to Peirce, is the object or idea that is being analyzed. In order for something to be a sign, it must produce an effect in some interpreter and this effect is called the interpretant. It is a process that occurs in the mind of the interpreter, or the interpretant of the sign (Peirce 1985: 5).

The Dymaxion Vehicles, patent text, patent diagrams, and *4D Time Lock* are cultural signs that can be interpreted. The investigation into Fuller's sign system, the Dymaxion object and texts, uses Peirce's semio- sis. The sign process of semiosis questions what is distinct about Fuller's sign system that makes this process possible. Semiosis is based upon the sign's signification (Deely 1990: 106), production and interpretation (Innis 1985: viii). It is dependent upon experience and knowledge in the action or processes in which the sign is involved.

The sign does not function in semiosis alone, but is in relationship with the object and interpretant. This study will use Fuller's written texts and other critical writings about Fuller in order to describe the meanings of his texts and Dymaxion Vehicles.

It is also important to compare the Dymaxion Vehicle with other similar and dissimilar vehicles of the time. This comparison is accomplished through the analysis of other critical writings on the so-called 'Streamlined' era.

The differences and similarities between the patent diagrams, patent text, *4D Time Lock* text, and the three-dimensional object can be analyzed by using Peirce's definitions of the index, symbol and icon.

Peirce's indices are signs that have an existential link with the object. They are signs that are not related to the object by similarity, but are related by a dynamical connection that includes spatial connections with the physical object and the language in question. Diagram letters and numbers, and the three-dimensional object, act as indices. Indices guide the interpreter to the object (Peirce 1985:13).

Peirce's symbols are representamen[17] in which the interpreter can link certain ideas and words with them (Peirce 1985: 16–17). The Dymaxion Vehicle, patent, and *4D Time Lock* text function as symbols. This analysis is made known through Fuller's own writings and through the critical interpretations of other critic's writings from later time periods.

Peirce's icons are signs that make reference to an object or idea through a comparison of qualities based upon their similarities. These include photographs, diagrams, three-dimensional models, and prototypes (Peirce 1985:10-11).

17 1[7]A sign always functions as a representamen. “A sign, or representamen,” according to Peirce, “is something which stands to somebody for something in some respect or capacity. It creates an interpretant in the mind.” See Peirce, “Ground, Object, and Interpretant.” *{Collected Papers.* Vol. IL: 134–136).

The Dymaxion patent writing, Dymaxion Vehicle, and *4D Time Lock* text function as codes that can be interpreted by using communication theory. Communication theory is a process that grounds and channels information from an encoder to a decoder (Eco 1976: 33). Communication succeeds even in misinterpretation; it is a reinterpretation process that is cyclical in character. The Dymaxion object can be viewed as a text that discloses meanings that can be interpreted or "read."

These Peircean conventions of language can be applied to the reasoning of a mythic, functionalist philosophy as it relates to Fuller's designs and writings. This investigation questions the similarities and differences between these two forms, language and design. In this manner, Peirce's semiotic offers a useful tool for applying the meanings and logical reasons that are necessary in the signification, production and interpretation of meaning found in the industrial object. The following chapter will help to clarify these similarities using Peirce's semiotic. This will be done through content and text analysis.

5 Peirce's Sign and the Dymaxion Vehicle

Using Peirce's concept of the sign, the Dymaxion Vehicles can be read as signs interacting within the environment. As signs, they stand for something to a specific person, social group or culture. The Dymaxion Vehicles function as signs because they stand for something in some respect or capacity. They represent the idea and the product that Fuller created. The idea of Fuller's concept of the Dymaxion Vehicle creates an idea or interpretant in the interpreter's mind. What this idea is can be discussed through past and present written statements and visual aids.

The diagrams and drawings from Fuller's 1937 patent of the Dymaxion Vehicles and the text from this patent are also viewed as signs. The Dymaxion Vehicle is an object that can be interpreted. It signifies an action that was to be carried out, and created an expression through its form and ideology.

Peirce's sign does not function in isolation. The sign forms a relationship with the object and interpretant. Thus, when analyzing the Dymaxion, the sign, object and interpretant will all play a role. Using Peirce's triad of sign, object and interpretant, it is possible to analyze how a form can dictate the behavior of a person. Whether the Dymaxion Vehicle dictates behavior is a fundamental question relating to Peirce's triadic relation. To discover this, we must search for similarities between Fuller's written language and the object, namely, the Dymaxion Vehicle.

Fuller and Peirce's Sign, Object and Interpretant

Underlying Peirce's triad of sign, object and interpretant is the concept of collateral experience and observation. Peirce's collateral experience plays an important role in the analysis of Fuller's Dymaxion Vehicles and writings. Fuller believed that experience is a necessary prerequisite of design. He reports that his naval and engineering experiences were the impetus for the creation of the Dymaxion Vehicle. He also notes

that “functional sense” and logic were important in his designs: “Having encountered the many problems set forth in my 4D book, there came to my assistance the logic and fundamental functional sense, inherent from my long association and natural love of the sea and its boats” (Fuller 1970: 88). In this instance, his Navy experiences, logic, and function served him in the development of the Dymaxion Vehicle.

According to Fuller, experience is also an important aspect of logic and is noted in his patent writing. In his book *4D Time Lock,* he links collateral experience to his design methodology in the following:

Through protracted isolation for mental research, analysis, and design, truly aided by material self negation, guided by a vast catalogue of experience, have we leaped ahead (in faith) to the critical “Bottle neck” of progress. Materially acquiring its stewardship through patents, etc. may we at last banish feudalism and the cultivated prosaicness of self-consciousness in everyday life (sic). (1970: 20)

Fuller claimed that through patents society can progress to achieve utopia. He saw American culture in the 1930s as unpoetic, unromantic and dull. Society and the products of that society lacked an aesthetic sense of beauty. The American economic system, to Fuller, was synonymous with the medieval, European politico-economic feudal system that kept society in the service of the elite. Fuller's ideas perpetuate his “romantic functionalist” beliefs.[1]

He also explained the role that collateral experience takes in his book, *4D Time Lock,* published in 1928. Fuller pointed out that his book was intended for a specific audience or using Eco's term, a “model reader.” [2] He stated that the book was to be read in a specific manner:

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1 The architecture theorist Winand Klassen notes that the German architecture theorist Hanno-Walter Kruft argues, in his book *Geschichte tier Architekturtheorie* of 1986, that Le Corbusier was not a technical functionalist but a functionalist whose ideas were motivated by a romantic type of functionalism. I recognize Fuller as a “romantic functionalist” in Kruft's sense.

2 Eco's theory of the “Model Reader” (Eco, 1979), investigates the various strategies that act as a system of instructions in which the main purpose is to produce a reader “...whose profile is designed by and within the text.” See Eco, 1990:, *Limits, 52.* A text, in this manner, thus can be viewed as being created in order to produce a Model Reader. A text directs a Model Reader who tries various interpretations that the text is trying to direct. Thus, the main purpose of the text is to create a Model Reader who is capable of producing conjectures about it. The Model Reader tries to define the meaning that the model author is trying to communicate. For further discussion of the Model Reader, see Eco, 1990: *Limits,* 52–59.

To be readable to the general group for whom it was intended, detail of this order had perforce to be left out of 4D book and of this letter. As you may realize from 4D, there is but one proper method for handling *any* one of these questions. With the proper application of experience to thought, the solutions have been clearly revealed. (1970:121)

Peirce's collateral observation is also needed for a semiotic investigation of the Dymaxion Vehicle. It is important to be acquainted with the Object, in this instance the Dymaxion Vehicle, patent drawings, photographs, *4D Time Lock* text, the patent text, as well as the ideas that were
their motivation, in order to understand the relationship that exists among them.

Collateral observation is determined by the Object, (the Dymaxion Vehicle, patent drawings, photographs, patent text, and *4D Time Lock* text), which determines the idea or interpretant in the interpreter's mind. The idea the Dymaxion produces in the mind of the interpreter is just as important as the actual object. The object does not exist before the idea. The notion of collateral observation is expressed in the diagram below.

Designer's ideas behind = the motivation of the Dymaxion Vehicle

Object - Dymaxion Vehicle Photographs Patent Drawings Patent Text

4-D Time Lock Text

Interpretant ideas formed in interpreter's mind

Experience is not the only important point of similarity between Fuller and Peirce, so too are observation and convention. The following chapter will help to disclose the meanings that Fuller wished to convey through observations and conventions. Using Peirce's concepts of icon, index and symbol, these ideas will be further analyzed.

Fuller's Dymaxion Vehicles and Peirce's Icons

Peirce's icon is represented in Fuller's Dymaxion Vehicle as the comparison of qualities found among the three Dymaxion Vehicles. The visual aspects of the Dymaxion Vehicles, along with the technical rules, or engineering principles, are similar enough to be termed icons. Fuller differentiates between all three vehicles by the various changes he introduced during the development of each vehicle. These qualities consist of the differences and similarities displayed in the three Dymaxion Vehicles, which will be outlined in the following paragraphs.

The first Dymaxion Vehicle (fig. 2) had two forward wheels that were propelled by a Ford V-8 engine mounted in the rear of the vehicle, behind the passenger compartment. The single rear wheel made possible a tight turning radius, enabling the vehicle to park in-line between other cars. To prevent side collisions, Fuller planned for a warning device activated by the extreme turning of the steering wheel (Bush 1975:105).

Dymaxion Vehicle Number One was similar to the wingless, tail-less fuselage of the 1928 drawing. It was hand built using a combination of aeronautical and automobile techniques (Marks 1960: 29). The tear drop form was interrupted only by a "hood-mounted" air-intake cooling device for the engine located in the tapered rear of the vehicle. The body consisted of aluminum placed on an ash frame, was 5.7 metres in length, capable of seating eleven, and had a cockpit cover with doors on the left side. After the 1933 Chicago World's Fair accident, parts of the roof were removed to provide ventilation. The vehicle was fitted with aircraft seats and seat belts with controls similar to an aircraft's, such as airspeed indicators and radios. The entire body was "multi-hinged" on a chromemolybdenum aircraft steel ladder chassis divided into two scissor-like sections that were hinged at the front axle (Ibid: 30). The weight of the passengers, as well as the Ford V-8 engine driving two front wheels, was supported by this forward ladder frame. The Dymaxion's body was situated on a steel A-frame, and the rear steering wheels pivoted 160 degrees. Fuller duplicated Ford's rear, now front-beam axle, transverse leaf-spring suspension, and friction dampers. The axle on the Dymaxion vehicle had smaller tension-dampened transverse leaf springs that were located on the long A-frame (Pawley 1990: 68–69).

The second Dymaxion Vehicle (fig. 3) was developed after the completion of Dymaxion One. This vehicle had a canvas roof similar to the first Dymaxion Vehicle. This vehicle contained more windshield glass units than the first vehicle; it also had headlights that opened and doors on both sides instead of only one. This car disappeared for a number of years and was found abandoned in California during the 1960s. It now resides in the Harrah Automobile collection in Reno, Nevada, and only its exterior has been refurbished *(Ibid:* 66).

The third Dymaxion Vehicle (fig. 4) was finished in 1934 just before financial problems forced the factory to close. The third vehicle had a ventilation system in the engine compartment and in the sides of its body. It was the only Dymaxion Vehicle to feature flush door handles and an all-metal roof. Fuller omitted the roof-mounting

air-intake system found on the first two Dymaxion vehicles. It was very similar to Dymaxion Vehicle Number Two. This third Dymaxion was photographed at the 1934 Chicago World Exposition where it executed 180-degree turns. Leopold Stokowski, a noted conductor of this era, bought this Dymaxion but kept it for only a short time. It was later restored at the Beech aircraft plant in Wichita, Kansas, in 1945. This was the Dymaxion that was later photographed alongside Fuller's private plane. It was last reported seen during the 1950s with over 300,000 miles documented *(Ibid:* 66).

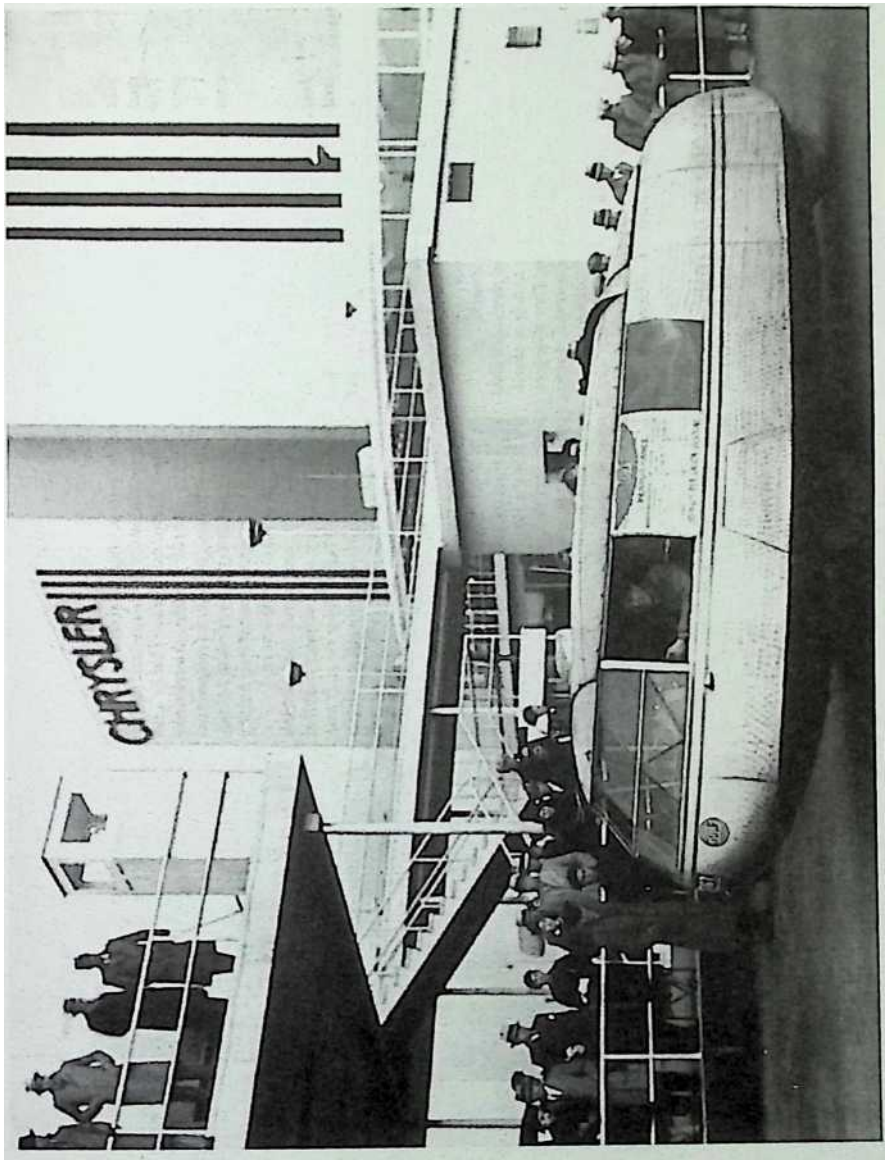

Fig.2. Dymaxion Vehicle#!. Copyright 1960Allegro Fuller-Snyder.

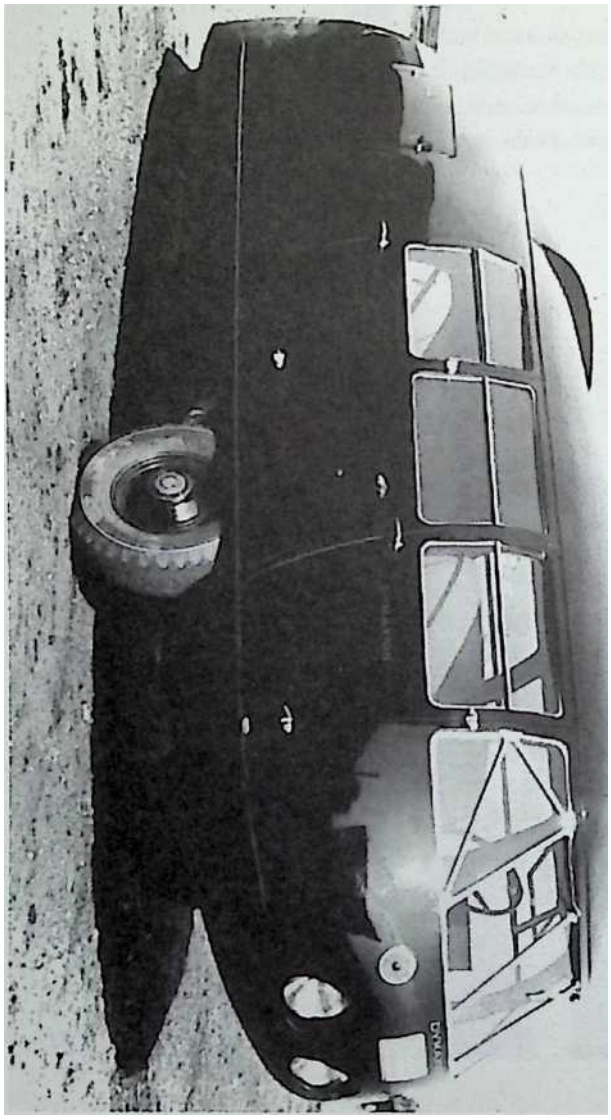

Fig. 3. Dyinaxion Vehicle #2. Copyright 1960 Allegro Fuller-Snyder.

Fig. 4. Dymaxion Vehicle #3; Copyright 1960 Allegro Fuller-Snyder.

The Dymaxion Vehicles, if we accept Eco's definition of a double,[3] are representative of doubles and not partial replicas. There is a high degree of similarity in the ideas, laws, and rules incorporated into all three vehicles. The Dymaxion Vehicles can also be icons by virtue of their similar function. According to Peirce, icons are produced upon resemblance and the sharing of certain properties (Peirce 1985:10).

Eco does not believe that spatial relationships can be iconic (Eco 1976: 198). However, the Dymaxion Vehicles, when analyzed as icons, can be representative of spatial properties. They can stand for similar or different spatial relationships. In this case, there are three similar vehicles, yet each one differs to a certain degree in its various automobile units. They are all based upon the same streamform principles and laws. Eco does not discuss the existence of spatial properties with respect to differences and degrees in the distribution of car units, such as the placement of windows, engine, steering wheel, and exterior wheels. A comparison of configurations can be made, and hence spatial relationships can exist. The spatial relationships stand for the logic Fuller uses,[4] which can become an icon of the idea. The similar ideas are the logic behind the similar form, which equals the icon.

The spatial relationships that exist between the various automobile elements differ only slightly from one Dymaxion Vehicle to the next. It is impossible to assess the similarities and differences among the interiors of each Dymaxion Vehicle since the only interior photograph in existence is that of the first Dymaxion Vehicle (fig. 5).

Dymaxion Vehicles “Two” and “Three” form an iconic relationship with Dymaxion Vehicle “One” in three ways: first, by visual similarities; second, by spatial similarities; and third, by the ideas on which their construction and function are based. Eco defines an icon in terms of its visual qualities only. If ideas are icons, as Peirce claims, then the Dymaxion Vehicles “One” , “Two” and “Three” are icons in more than their visual appearance. Fuller based all three on similar laws and principles of aerodynamic streamlining, which were derived in part from the rules of nature.

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3 Eco states that a double, or “duplicative replica,” is a token that has all the characteristics and properties of another token. For a further description of the constitution of a double, see Eco, *Theory,* 1976:180-181.

4 It is my view that Fuller's logic incorporates abductive, inductive, and deductive reasoning in a Peircean framework.

Peirce also believed that there was no such thing as a “pure icon” , although “icons” existed because they were based upon similarities and resemblances (Fitzgerald 1966: 52). If we take Peirce's definition into account and not Eco's,Fuller'sDymaxions also function as icons in visu-

Fig. 5. The interior ofDyniaxion #1. Copyright 1960 Allegro Fuller-Snyder.

al appearance. The number of similarities between the vehicle's elements, or iconic markers as Eco calls them (1976: 208), outweighs the number of differences between all three Dymaxions.These measurements are accomplished through content analysis.

The feeling that the Dymaxion Vehicle evoked in the receiver can be created even in the absence of the physical object in itself; all that is needed is the idea or the interpretant of the object. The Dymaxion Vehicle evoked a certain feeling in the user as well as the onlooker through the interpretant or the idea created in the mind of the interpreter.

The two-dimensional images of the Dymaxion Vehicles can also form icons. The interpreter can experience the Dymaxion Vehicles through photographs and films. Films represent a kinetic aspect of the vehicle from the vehicle's exterior. The interpreter does not need to be inside the Dymaxion Vehicle for the sensation of movement or action to be created in his or her mind,[5] thereby giving the form meaning. The sensation of movement or action is also formed in the mind when viewing each Dymaxion Vehicle separately in photographs. The interpreter can relate similar experiences and sensations based upon the form of each and by reading Fuller's own words, who actually rode in the car.

Since ideas are also iconic in quality,[6] Fuller's ideas of evolution function as icons. His ideas concerning the biological, evolutionary process are exemplified in his design methodology as it relates to automobile design. He suggested,

As mechanical truths are revealed so do we progress towards perfection; though there can be no absolute perfection in the material world. So has the automobile or airplane continually approached perfection. As it has approached perfection, by the process of the application of truth, so has it approached one final design. (Fuller 1970:11)

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5 The sensation created in the mind of the interpreter is produced by deductive-inductive reasoning. Peirce claimed that "Deduction proceeds from Rule and Case to Result; it is the formula of Volition. Induction proceeds from Case and Result to a Rule; it is the formula of the formation of a habit or general conception-a process which, psychologically as well as logically, depends on the repetition of instances of sensations." For an in-depth study of the sensations created by deduction and induction, see Peirce, " A Theory of Probable Inference: General Characters of Deduction, Induction, and Hypothesis." *(Collected Papers.* Vol. II.: 446–449).

6 Peirce believed that the only way of communicating an idea is through the use of an icon. Every assertion, in Peirce's view, must be comprised of an icon or set of icons, or the sign's meaning is made known only by incorporating an icon. See Peirce, "The Icon, Index and Symbol." (*Collected Papers.* Vol. IL: 156–173).

Automobile design is seen as an evolutionary process[7] or, in Fuller's phrase, as "one final design" *(Ibid:* 11). It is the best and most "perfect" design. Truth, according to Fuller, can be applied technically; however, truth cannot be applied mechanically in reality. Fuller does not state exactly what these mechanical truths are. These mechanical truths may represent mass production. Machinery and technology can be applied to create better designs in airplanes and in automobiles. This is tantamount to a functionalist, "technocratic" belief" or ideology: Technology is the answer to solving design problems. The design process or methodology is the application of "truth." We do not know exactly what Fuller means by "truth" being applied. Fuller uses the metaphor of mechanical truths as representing progress. He compares humans progressing towards perfection in terms similar to design progressing towards perfection. He was basically Darwinian[8] in these views, even though he often claimed to be anti-evolutionary in his design philosophy and methodology.

Historian Robert Marks claims that Fuller is not Darwinian in his design methodology. He notes the following with respect to Fuller's anti- evolutionary design process:

> Fuller makes cumulative experience a pivotal factor in change. Experience is finite; it can be stored, studied, directed; it can be turned, with conscious effort, to human advantage. Darwinian evolution is assumed to be operative in ways independent of individual will and design. Darwinian posits chance adaptation to survival; Fuller's approach pivots on the conscious, selective use of cumulative human experience. (1960:10)

Marks, however, contradicts himself when he states: "In its simplest form, Fuller's Dymaxion concept is that rational action in a rational world, in every social and industrial operation, demands the most efficient over-all performance per units of input. A Dymaxion structure, thus, would be one whose performance yielded the greatest

7 The design historian Meikle notes that automobile designers during the late 1920s until the middle of the 1930s tried to create the ideal Platonic form. Industrial designers of this era thought they could discover the one correct form that was latent within a certain type of product. For a discussion of how the designers of this era relied on Platonism in their design philosophy, see Meikle, 1979: 93–94.

8 Darwinian theory states that animals and plants will tend to adapt their forms to their environment, eventually becoming the most ideal form for their species. For an in depth discussion of this biological theory from the pragmatist's viewpoint, see Peirce, "A Guess At The Riddle: The Triad in Biological Development." *(Collected Papers.* Vol. I.: 214–218). It is my opinion that Fuller is Darwinian in many of his beliefs.

possible efficiency in terms of the available technology" *(Ibid:* 9). This statement is Darwinian in its motivation and meaning. According to Marks, any Dymaxion project embodied or symbolized the most evolutionary *ideal* notion of technology. Although these statements are generally correct, Fuller is Darwinian in his design process as stated earlier. He believed in a form that fits its purpose and function, and this ideal form was the aerodynamic, streamlined vehicle.[9]

As stated earlier, the image of the Dymaxion Vehicle created iconic relationships in the interpreter's mind. The interpreter need not view the vehicle itself for an image similar to the Dymaxion Vehicle to be created in his or her mind. Other "streamline" vehicles are iconic of the Dymaxion Vehicle and vice versa; examples of this are Paul Jaray's vehicle design of 1922 and other streamlined vehicle designs of the era. These contain a sufficiently high percentage of similar "iconic markers" [10] to make them

9 The design historian Meikle notes that the streamline designers of the late 1920s and 1930s "...meditated on society's evolution, they tended to think in terms of permanence, just as they conceived of the automobile evolving toward the ultimate form of the teardrop." See Meikle, 1979:187. Also, Meikle gives the designer Raymond Loewry's chart on the evolution of the automobile. See Meikle, *(Ibid:* 187).

10 To Eco an iconic marker is an aspect of an icon. It is one unit of the total iconic sign. He claims, " ...the iconic device may possess certain elementary iconic markers and that sometimes a minimal resemblance is due to the fact that the iconic sign, even though different in shape from its object..., performs the same function." See Eco, *Theory,* 1976: 208–209. Thus the iconic markers will create an icon of an object even if the object does not look like the object it resembles visually.

icons of each other and of the term —or archetypal category—"streamline." [11] The term "teardrop form" represents all vehicles under this type[12] by virtue of their similarity in appearance, function, and laws governing their creation as well as their cultural interpretations.

Just as Fuller's Darwinian beliefs are iconic, so too are his pragmatic ideas. The reason that Fuller created his Dymaxion Vehicle prototypes as experiments "#1," "#2" and "#3" is to be found in his pragmatic philosophy. He built these prototypes to test the ideas and his functionalist principles. Fuller used all of the above-mentioned beliefs to create the "best design" of a transportation device.

Fuller expressed his belief:

My three experimental units of 1933,1934 and 1935 were called the Dymaxion 4D transports. As a result of building and testing these three successive types of the 4D transport I learned of the primary cross-wind, cross-furrow, in-rut, on ice, in-traffic, inparking, ground looping, cornering, high-speed accelerating and decelerating problems and answers and, to the best of my knowledge, am at present better prepared than others for initiating the successful prototyping phases of this new era transport. (Fuller 1969: 20)

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11 The use of the term '" archetype" ' makes reference to the industrial design theorist, Krippendorff's notion that the ideal type is equal to the prototype that is created in the mind of the interpreter. These ideal types are based upon the archetype in the interpreter's culture. See Krippendorff, 1990: al3.

12 The term 'type' refers to a historicist epistemology, in which buildings reflect and contribute to culture just the same as art, literature, politics and religion. The building becomes a cultural artifact. This notion breaks with the traditional belief that buildings imitated the order of nature. The type in the historicist vein relates to the notion of structure and beauty. These are connected because they both stem from the nature of the three- dimensional building. See Jan van Pelt and Westfall, 1991:144. As the authors Jan van Pelt and Westfall claim: "...actual buildings accommodate particular functions in the service of the enduring purposes symbolized in the plan diagram for the type of building it is. Analogous to the relationship between purpose and function in the art of building is the relationship of form and material. In the art of building as in the art of politics, there are certain true, enduring, atemporal types of forms that can be known incompletely at best and only in the intellect, in words, symbols and images independent of material. Actual buildings include matter, but matter alone is as unbuildable as form alone is. Matter, in other words, is formless-it is something like mud, smoke, a combination of mud and smoke, or something else which can only be known through analogy. While sensible (that

There is a particular logic and reasoning behind Fuller's choice of a three-dimensional form for the Dymaxion Vehicles. He claimed that material evidence or experiment is needed to convince the public of scientific discoveries such as his Dymaxion system. For example, he compares Lindbergh's flight in 1933 to that of his automobile and housing units. He stated the following:

"Theoretically the two world air routes most recently coursed the Lindberghs, i.e., to the Orient and Russia via Alaska, and to Europe and Africa via Greenland and Iceland, were evident to the world-considerate architect years ago and academic to the scientifically minded for some time past, yet until Lindbergh had actually landed at the New York airport on December 19, 1933, having jauntily traced and retraced his routes, was a notion of popular transportation by air over the pioneered track conceivable? It takes material demonstration to win popular credence of scientifically-arrived-at-theory. (Fuller 1934: 10)

Fuller claims that material evidence is needed in order to give his own ideas credibility. He offers this material evidence as the reasoning is, the sense makes its presence known), it is unknowable because, lacking form, there is nothing within our perceptions of it for the mind to grasp. Bridging the gap between form and matter is the architectonic substance of building." I am following this definition of type in this study. For a discussion of the various historical types, see Jan van Pelt and Westfall, 1991: 144–254.

behind his choice to convey his design ideas in the three-dimensional prototype[13] as well as in the diagrams. By developing these prototypes, he wished to convince the public of his ideas. This became important to him, and he promoted[14] his ideas because he often felt that he was a failure[15] and needed to reassure himself that his ideas were feasible and not mere speculation. The Dymaxion Vehicle's streamlined form was based upon scientific theory.

13 lThe prototype as mentioned here functions as an icon of a type. This also makes reference to Krippendorff's archetype or the ideal of a type. See Krippendorff (1990:13a) for further discussion of the archetype and prototype.

14 For a discussion of the artist promoting ideas as propaganda, see March 1976: 36–37.

15 The author Hatch believes that Fuller often thought of himself as a failure due to the notion that he did not accrue money as other men had during his era. Thus he claims, "...exacerbated his sense of person inadequacy, of failure." See Hatch, 1974: 77.

Aerodynamics gave Fuller the empirical data with which to give credibility to his design ideas. Fuller's main purpose in making the prototypes, although he never wanted them to be mass-produced, was to claim that the idea was an important aspect of the three-dimensional design process or construction of the "ideal prototype." Fuller's own view on this point seems to contradict his ideas of the Dymaxion designs as equivalent to "social design" (Marks 1960: 8). He produced these designs only in order to prove that they were feasible and could be built; he did not care if they were ever mass-produced for society. These Dymaxion designs were therefore built for his own gratification.

Fuller received a grant from Philadelphia stockbroker Philip Pearson to produce the prototypes. Pearson was a supporter of Fuller's ideas and wanted to see them brought to fruition. Hoping to help end the economical struggle of the Great Depression, Pearson supported Fuller's ideas by giving him a few thousand dollars.

The prototyping cost of the Dymaxion Vehicle would be about one hundred million dollars.[16] However, the technologies of the automotive and airframe industries were more advanced. By using the parts from these two industries, he could produce and test his vehicle's ground taxiing qualities. He also believed that production of the three prototypes was worthwhile just for the experience. Fuller also learned the economics of creating a prototype by having to purchase all of the production tools that were needed for such an endeavor (Ben-Eli 1972: 755).

Fuller—Diagrams as Icons

16 According to Fuller, the cost of prototyping the Dymaxion Vehicle would equal the cost of prototyping the Dymaxion House, which was estimated to cost at least one million dollars. See Ben-Eli, "Interview.." (1972: *Architectural Design.* 755).

The ideas behind the creation of the Dymaxion Vehicles are displayed in the patent diagrams (figs. 6 & 7) and 4D drawing (fig. 8). Fuller experimented with the diagrams before the creation of the three-dimensional Dymaxion Vehicle. The diagrams are experiments in and of themselves.[17] Fuller's Dymaxion Vehicles were produced through the variations of the "4D Auto-Airplane." The original conception of the "4D Auto-Airplane" had to be changed because it proposed the incorporation of technologies that were unavailable at the time.[18]

The drawings and diagrams of the Dymaxion Vehicle are based upon theories of transportation design developed during the 1930s. These drawings and diagrams dealt with the streamlining of a form, and were intended to create a new relationship with the product and the environment. These changed in form for a specific reason. The drawings and diagrams of the Dymaxion Vehicle are based upon the theories and histories of streamlining that provided a foundation for the Dymaxion Vehicle form to be built. Fuller elevated this theory into a philosophy, thereby making it mythic in nature. An investigation into the history and theory of streamlining is needed in order to determine if Fuller's design philosophy can function as a theory.

The history of streamlining in design has its beginnings in the history of hydrodynamics and aerodynamics. The term hydrodynamics, first introduced by Daniel Bernoulli in 1738, incorporated the sciences of hydrostatics and hydraulics. Before the use of empirical data, hull designs were largely developed based upon intuition and trial and error. Experiments, often crude, were carried out in England in 1765. It was not until 1869 that one of Her Majesty's was to be tested by measuring speed and resistance in sheltered waters. This experiment was rejected, and Frederick Reech of England was given the funds to test various hull types through a water-filled trench (Bush 1975: 4).

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17 Peirce noted that the transformations occur to diagrams in order that the characteristics of one diagram can be seen in another. He gave the example such as "...in analysis we treat operations as themselves the subject of operations." See Peirce, "Three Types of Reasoning." *(Collected Papers.* Vol V.: 94–111). Therefore the diagrams can be viewed as experiments in and of themselves. This notion relates to Peirce's type of deductive reasoning known as theorematic reasoning. See Peirce, "Division of Signs: The Trichotomy of Arguments." *(Collected Papers.* Vol. II.: 152–155). Fuller developed the drawings of the 4D "Auto-Airplane" which eventually lead to the Dymaxion patent drawings. In my view, these drawings helped Fuller to develop what he felt was the ideal vehicle design.

18 Fuller discusses the technical difficulties he had in trying to create the 4-D Autoplane in his autobiography, *Ideas* (1969:19-20).

During the nineteenth century, it was discovered that the motion of fluids occurs under laminar and turbulent flow. Laminar flow is

Dec. 7, 1937.

2,101,057

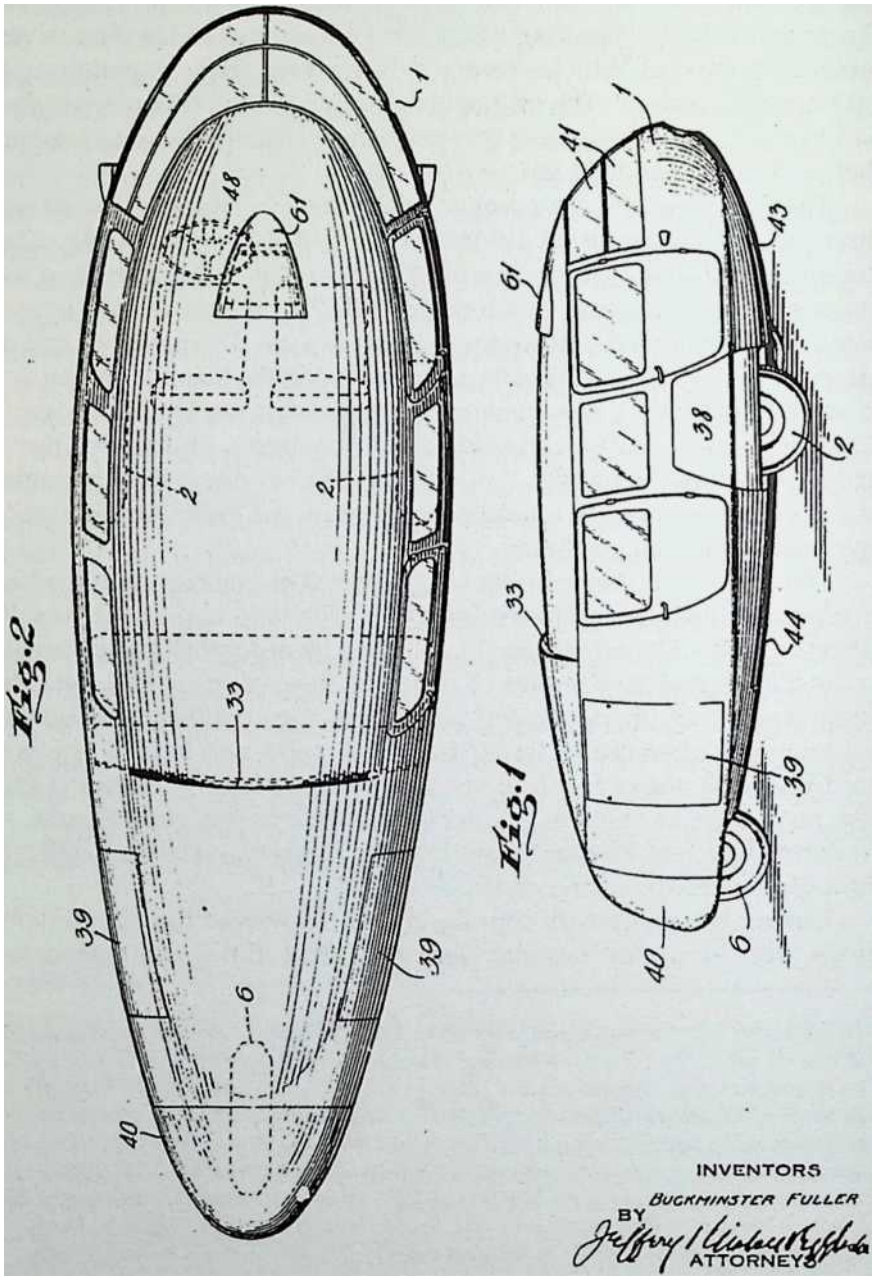
B. FULLER

MOTOR VEHICLE

Filed Oct. 18. 1933

4 Sheets-Sheet 1

Fig. 6. The Dymaxion Vehicle Patent Diagram. Courtesy, United States Patent Office.



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MOTOR VEHICLE Filed Oct. IB, 1933–4 Sheets-Sheet 4

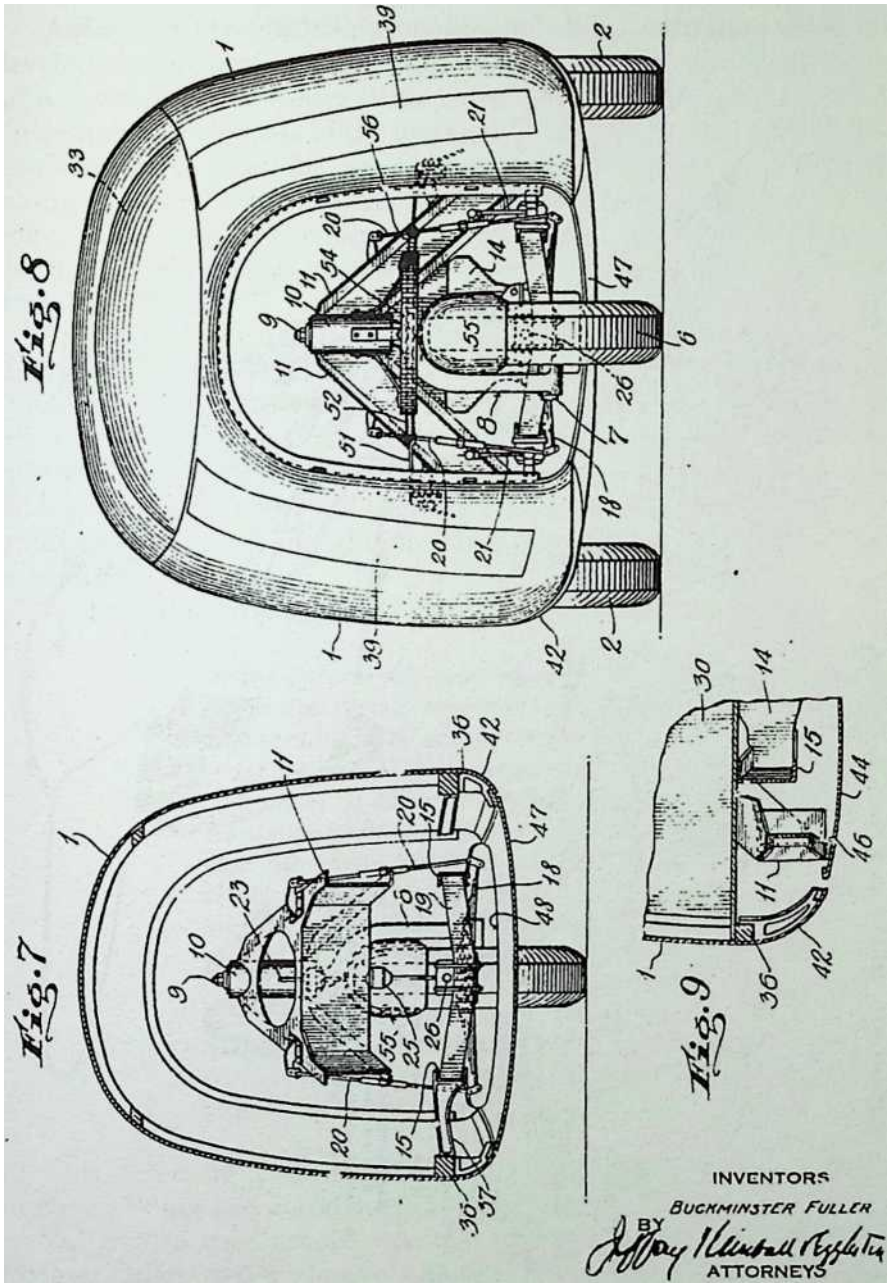

Fig 7. The Dymaxion Vehicle Patent Diagram. Courtesy, United States Patent Office.

described as a series of parallel layers in a moving fluid that have their own velocity and direction without disturbances in the forward motion. Turbulent flow is the rough eddy of a fluid that is created by an alien form. As a product of this turbulence, a partial vacuum is caused at the rear of the form retarding its forward movement (fig. 9) *(Ibid:* 4–5).

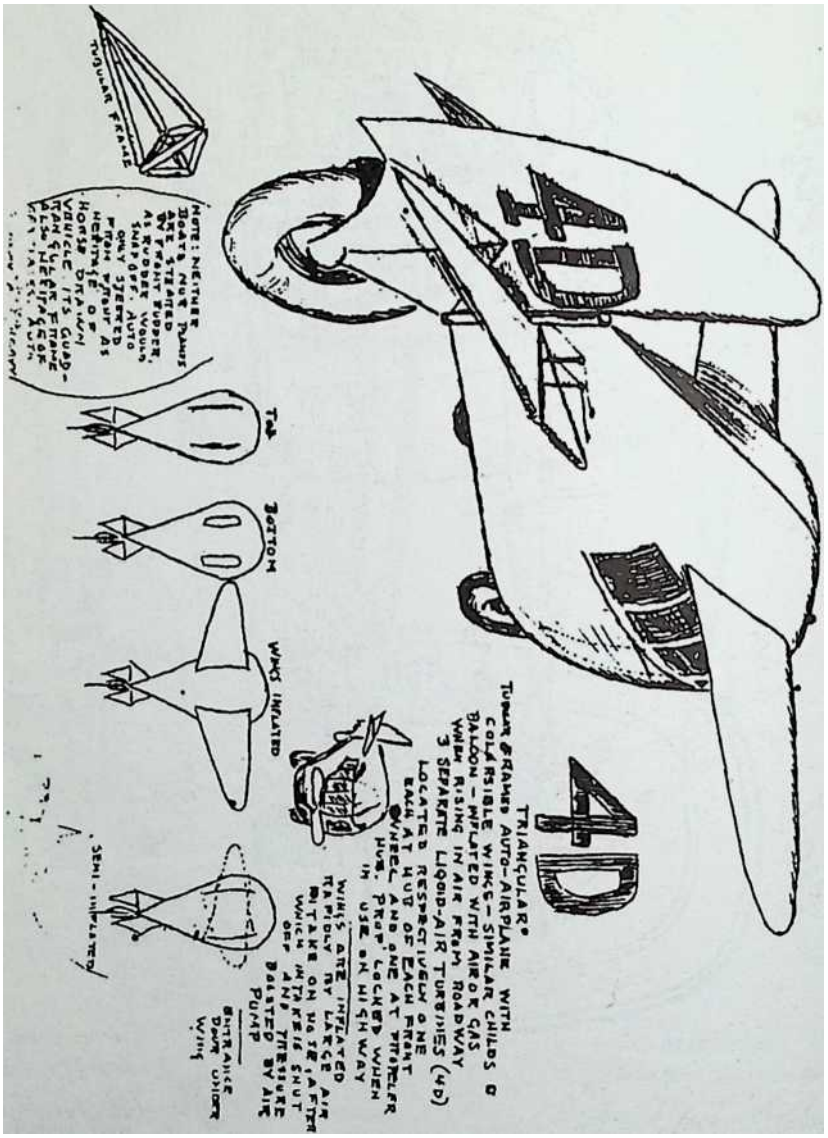

Fig. 8. *Drawing of the 4D Auto-Airplane. Copyright 1960 Allegra Fuller-Snyder.*

A body is termed *streamlined* when the flow creates a relatively small amount of turbulence. The first theoretical drawings of streamlines were realized by W.J. Macquorn Rankin. These are visualized in wind tunnels in which streams of smoke are blown over the model form *(Ibid:* 5).

Auto-body designers later began to discuss wind resistance and developed more sophisticated ideas of aerodynamic theory. The teardrop form supplanted the wedge shape as the ideal form that best exemplified streamlining. Scientists in the nineteenth century were interested in the forces that acted upon the rear of an object heading into a force, such as a wind or current. Meikle quotes the designer Norman Bel Geddes on this point: "This effect was described as a boundary layer of rolling tubes of air, 'that acted much as roller bearings over which the outer air moves'" (Meikle 1979: 141).

This boundary layer, if it did not converge smoothly at the rear of the object, would disintegrate "into a chaos of retarding eddies" (iWd:141). The ideal form had a broad round front, which would guide the boundary layer gently along a tapering body that developed into a point. It was impossible to round the vehicle's underside because of the location of the wheels. This led to the ideal teardrop form for a land vehicle. This shape emulated drops of water gliding down a smooth surface with the least resistance *(Ibid:* 141).

As Donald Bush suggests:

> In the natural sciences, the view is often taken that animal forms are altered directly by the forces acting upon them or more gradually by adaptation. In his classic treatise, On Growth and Form, Sir D'Arcy Wentworth Thompson used the term streamlined to describe organic structures that offer the least resistance while in motion. One example he used was the hen's egg. Its particular shape results from the deformation of an elastic spheroid in passing through a peristaltic tube (one in which motion is induced by progressive waves of contraction and relaxation.) While in the oviduct, the egg may be viewed as 'a stationary body round which waves are flowing, with the same result as when a body moves through a fluid at rest.' Thompson treated the development of the egg as a hydrodynamic problem, simplified by the absence of turbulence. It is a streamline structure of a simple kind. (Bush 1975: 8--9)

This statement uses nature, particularly the egg form, as a metaphor for streamlining and aerodynamic principles.

Fuller also uses nature as a metaphoric description in the design process. Fuller used the laws of nature as a source for conveying his ideas of aerodynamics. These ideas were illustrated in the diagrams in his arti-

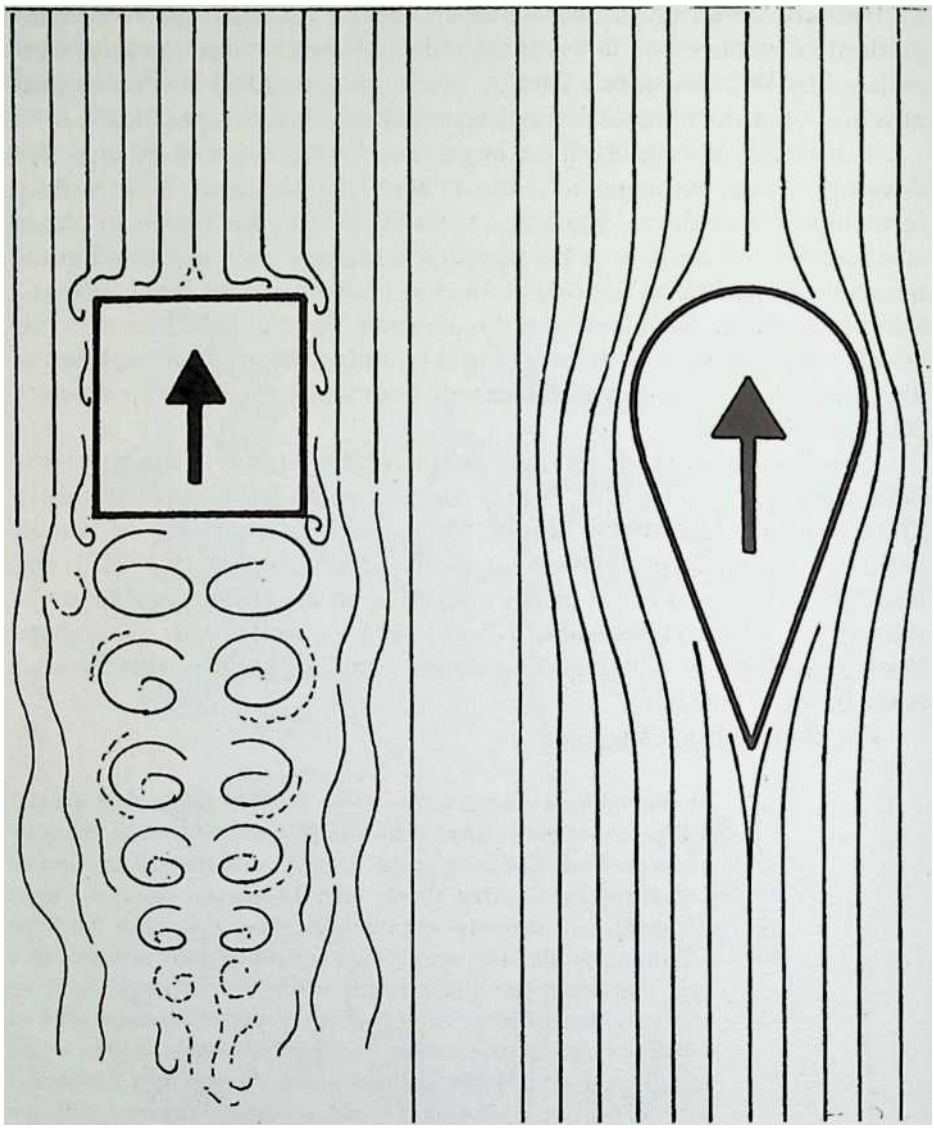

Fig. 9. Diagram of the effects caused in a flow by a streamline form (RIGHT) and a non-streamline form (LEFT). Courtesy, collection of Dr. Donald J. Bush.

cle, “Streamlining,” published in *Shelter* magazine. He claimed that nature could be a source for the creation of a transportation vehicle. His diagrams illustrate the laws that he chose to translate in terms of the technical qualities and characteristics of the Dymaxion vehicle.

Unexpected changes occurred with each of the prototypes that were taken from only one patent containing five diagrammatic drawings. The variations that occurred are not shown in these patent drawings. The changes that take place with each element, or sign vehicle, such as the windows, doors and periscope, are therefore not shown in these diagrams. The patent diagrams were produced in order to protect a specific design principle (Lamas 1930: 236). These patent diagrams can be read as scientific diagrams. The design methodologist and theorist Lionel March summarizes this idea in claiming that the main function of “...any scientific endeavour is to establish general laws or theory, the prime objective of designing is to realise a particular case or design. Both require deduction, the quintessential mode of mathematical reasoning, for analytical purposes. Yet science must employ inductive reasoning in order to generalise, and design must use productive inference so as to particularise (sic)” (March 1976: 18). The patent diagrams of the Dymaxion Vehicle reflect certain theories of aerodynamics displayed in the two- dimensional drawings. However, they may also be viewed as a particular case of design: the outline drawing of the form discloses the streamline shape or the streamlined vehicle design.

Fuller explained his ideas concerning people's unfamiliarity with diagrams that discuss issues concerning stress problems on certain forms. He draws an analogy with nature in order to explain the streamlined form in the 1932 *Shelter* article. He noted the following:

They are not, however, familiar with the stress arguments of the problem. While it would theoretically seem that a perfectly round front would prove the best streamline form, as indicated in the volume, or forward end of an egg, this is true only in cases of relatively slow motion of the penetrating body through the penetrated medium. The stress function at the point of primary impact of the penetrating body into the penetrated medium is that of rendering the penetrated medium asunder. (1932: 76)

Fuller uses the common analogy of the 1930s —the egg shape—as a form in nature that is representative of the streamlined form. The medium and penetrating body refer to the stress relationships to which the object is submitted.

Fuller also used diagrams in the modeling of the streamline form and its reaction to the medium. He stated the following:

Air-craft handbooks, either elementary or advanced, are replete with diagrams indicating the flow of a penetrated medium about a penetrating body showing the swirling areas of regurgitation, in which latter swirls the lack of density approaches vacuum proportions holding back the penetrating body by suction. The diagrams indicate the compounded pressures banked up in advance of relatively non-streamlined bodies.Most people are familiar with these diagrams. *(Ibid:* 76)

These diagrams can also function as indices pointing to the qualities of the streamlined form in its reaction with the medium. The icons, discussed in this statement, confirm that there must be a familiarity with the design mentioned. They function as icons because the reader must have some familiarity with the design. Diagrams partake of and illustrate certain cultural conventions. Diagrams function as sign systems that can be read similarly to the language of the culture in which they were produced. The reader must be familiar with the iconic meaning that dictates what an automobile is in order to read the diagram as a vehicle of locomotion.

Fuller used diagrams in order to model[19] and illustrate this concept of the streamline form and its reaction to the environment. The diagrams are shown in the *Shelter* article but not in the patent diagrams.

Fuller also uses the term "indicating" in the previous quote to display how the diagrams may show the medium being penetrated by a given body, in this case the teardrop form. The diagram's function, according to Fuller, depends on the various theories of nature that exist in a two- dimensional format that the reader can understand and interpret.

The diagrams, in this instance, also function as indices, though Peirce never discusses this. The diagrams function as an index by pointing to various aspects or qualities of the streamform in reaction to the viscosity of various media. The use of numbers and letters indicates certain elements of a form and elements such as drawings of wheels and windows. We relate these elements to what is culturally known as an automobile "semantic unit." [20]

The 4D patent diagrams and drawings, along with the constructed prototypes of the Dymaxion Vehicles, represent the industrial object or the "industrial project." [21] The "industrial project" includes the Dymaxion house drawing (fig. 10) insofar as it demonstrates an aspect of Fuller's

am following Jan van Pelt's and Westfall's definition of a model. These authors state: "...the type's character is embodied in its plan diagram, and that plan diagram is about a purpose which is virtually a diagram of how actions achieve the purpose the building serves. This is a *model,* or an example produced in relatively close proximity to the designer who draws on it and which, because it illustrates intelligent and useful solutions to concrete problems that are still prominent in the art of building, he can follow relatively literally." See Jan van Pelt and Westfall (1991:160-165), for a discussion on models.

[2]This makes reference to Eco's definition of a semantic unit, which functions as a cultural unit and is recognized as the meaning of a term. See Eco, 1976: *Theory* 66.

2[1]! am using Frascari's notion of the "architectural project." I believe that this idea also applies to industrial design.

Dymaxion philosophical system. Fuller thought of the car and house as a system that functioned symbiotically. The Dymaxion Vehicle was developed to deliver the Dymaxion Houses by air to any remote site so that a high standard of living could be made possible no matter where a person was located (Marks 1960: 27). The Dymaxion house, Dymaxion Vehicle, the house, and the vehicle diagrams are the designer's interpretation.

In the diagrams, Fuller conveys certain functional denotations of the Dymaxion Vehicle that the reader may understand through the various qualities and connotations that stem from these past, present, and future automobiles. Fuller incorporates not only automobile technology and history into his vehicle designs, but also aeronautical and nautical technology as well.

Fuller shared the views of the Swiss architect Le Corbusier on the use of appropriate technology as a solution to design problems. Le Corbusier's *Vers Urie Architecture (Towards a Nero Architecture,* 1923) described the logic and functionalism of such designs as ocean liners, airplanes and automobiles (Bush 1975: 39). Fuller read Le Corbusier at the time of writing his book, *4D Time Lock,*[19] and cites it as a contributing factor to his own ideas. Le Corbusier's work compared the evolution of the automobile form with

19 Fuller noted that: "...Le Corbusier, 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 notation with the notation 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." See Fuller, *4D Time Lock* (1970: 79)

the development of Greek architecture. He discussed the problems of wind resistance and incorporated into his book a chart that described the resistance coefficients of various forms, including the teardrop.The architect Le Corbusier learned from the industrial designer, Norman Bel Geddes, that the teardrop was to become the ultimate form for the automobile (Meikle 1979:144).

Through his drawings, Fuller becomes the observer of the physical environment, as well as the observer of his constructed world of objects. The Dymaxion Vehicle is included in this realm of objects. He is also an observer of his own internal world vision or worldview. It is possible to view these diagrams as “mental imagines” (Frascari 1991: 91) or “mental icons” (Peirce 1985:17) known as the “psychical product” , a “generalized percept” (Peirce 1958/8:112). The diagrams and drawings become mental representations of ideas that are exhibited in an external object. The illusion of Fuller's utopia thus functions as an aspect of reality. These drawings and diagrams represented his utopian vision of a certain lifestyle; the internal vision was his internal, mental environment.

We can apply Peirce's deductive, theoretic[23] and abductive reasoning in analyzing the Dymaxion Vehicle. Theoretic reasoning was used in the creation of the Dymaxion Vehicle through the conventions of diagram-

Fig. 10. Drawing of the Dymaxion House and Vehicle. Copyright 1960 Allegro Fuller-Snyder.

matic drawings. Abductive reasoning occurred when Fuller brought a new idea into the argument. The new idea was expressed in the development of a vehicle that could travel over land, through the air, and on water. It was mainly the idea that was new, *not* the streamlined form per se.

Corollary reasoning, one of Peirce's theories,[20] [21] is a form of reasoning used to determine what Frascari terms the “boundary lines” in the patent diagrams and in the physical object, the Dymaxion Vehicle. The shape of the product was the “streamform” that comprised the “product plan.” Fuller wanted this form to convey functionalist beliefs and values. The shape alone in the drawings cannot convey this; we need to analyze the text in order to determine if Fuller's designs and ideas are truly functionalist in nature and origin. The shape of the product —the functionalist, streamline,

20 What is meant by theoretic reasoning is the same as Peirce's theorematic reasoning, which is a form of deductive reasoning

21 What is meant by corollary reasoning is the same as Peirce's corollarial reasoning, which is a form of deductive reasoning.

product plan—helps to determine “boundary lines” in the drawings and in the physical object. The Dymaxion Vehicle prototypes are motivated signs that are expressed in Fuller's patent drawings. He interprets the past, present, and anticipated future of the constructed reality of the Dymaxion Vehicle through the patent writings and diagrams.

The Dymaxion idea or philosophy, as stated before through the process of semiosis, determines the design and construction of the drawings, as well as the three-dimensional form of the Dymaxion Vehicles. The Dymaxion “industrial project” can be manifested in Fuller's graphic texts, presentation designs, construction, and drawings.

Fuller wanted to convey a specific interpretation or translation of the written language into the two-dimensional diagrams, which were limited to a degree. The diagrams were also the physical demonstrations of the designer's —or Fuller's—mental icons, or interpretants that represented the Dymaxion Vehicle.

In his book *4D Time Lock,* Fuller said that his patent had a limited interpretation.

Fuller noted the following:

The ensuing patent specifications and drawing in no way are designed as artistic compositions, but merely demonstrate both verbally and graphically a functional composition on which claims of invention must be patent by law be based. They are exhibited here for those who wish to follow through details that may throw light on previous broad statements. They are further exhibited as material translation of our philosophy, lest there be accusations of inability to fathom them. This has been done to far greater extent than is purposely exhibited here, lest other than functional representation confuse or prejudice interpretations, and constructive comment that might not seem acceptable or applicable (sic). (1970: 25–26)

By making reference to a *functional composition,* Fuller is stating that the patent text is functionalist in design, both in terms of its diagrams and its language. A functional composition is therefore also composed of a functional language. Fuller is translating his functionalist philosophy from the idea to the physical form. He is manipulating these sign vehicles in order to transform the unreal into a reality. This action involves the translation of a philosophy from the idea to the physical form.

Fuller wrote *4D Time Lock* as an aesthetic text, and intended it to be read in conjunction with his patent text and diagrams. The patent has a certain verbal and graphic functional composition. It was a system that was to function symbiotically to express his myth of functionalism. However, Fuller had a certain amount of freedom in the patent text to choose various terms to describe and promote his ideas of a "functional streamline vehicle."

The patent diagrams may be seen as iconic representations of Fuller's functionalist philosophy. Restated: "By adherence to truth fear becomes eliminated. BUT YOU CAN'T BETTER THE WORLD BY SIMPLY TALKING OF OR TO IT. PHILOSOPHY TO BE EFFECTIVE MUST BE MECHANICALLY APPLIED (sic)" (1970: 6). Fuller is again reiterating his belief that functionalism is a philosophy and not a theory that can be applied. This notion of experimenting with philosophy, —and applying it mechanically—, reiterates Fuller's own pragmatic values, which must be tested in order to be accepted as truth.

Fuller also stressed in *4D Time Lock:* "Remember we must translate philosophy to temporal demonstrations. This involves fourth dimension thinking and industrial projection (sic)" (Ibid: 26). The industrial projection is equal to the diagrams. The diagrams are not artistic statements or representations. Fuller is trying to add to his diagrams a scientific terminology, thus giving them greater credibility. He believed that his ideas could be displayed in physical form through his drawings and diagrams. He also noted that "4D thinking" was responsible for such industrial projections.

The Dymaxion diagrams can be described as "monsters in the labyrinth" of product design;[22] they demonstrate the nature of the vehicle's construction. The builders of the Dymaxion Vehicles interpreted these diagrams or blueprints, which helped them create the various templates and jigs that were necessary components of construction.

22 I am referring to Frascari's notion of the diagrams or drawings of architecture as being "...monsters within the labyrinth of the building trade." See Frascari, 1991: 94. I believe this notion also applies to Fuller's Dymaxion diagrams.

The diagrams became technological icons through social convention. These diagrams or technological icons are responsible for conveying what Frascari describes as three of Peirce's semiotic relationships: (a) the projected icon signifies the socially correct understanding of the sign. This pertains to the social conventions needed in order to understand the Dymaxion diagrams and the patent conventions that Fuller used; (b) the minds of the interpreters responsible for the building or construction of the Dymaxion; (c) the cultural relationship that exists between these two.

In its three-dimensional form, Fuller's Dymaxion Vehicle and the diagrams make reference to each other: both object and diagram are therefore icons. They become what Peirce terms the “psychical product.” This “psychical product” can be viewed as Fuller's philosophy brought into the constructed world. Along with the three-dimensional form and diagrams, Fuller also incorporates metaphors and analogies that help to construct his worldview.

Fuller-Metaphors and Analogies as Icons

Fuller often used nautical metaphors when referring to the exterior form of the Dymaxion Vehicle and its elemental units. He did not include any metaphors when discussing the interior aspects of the Dymaxion Vehicle.

The analogy of a ship's form with a streamlined form of an automobile is noted in the following:

The hull of the racing sailing boat is not only streamlined in relation to its normal position of balance when riding at anchor without sail, but is also streamlined in relation to its average speed; furthermore, it is streamlined in consideration of 'heel', or the multitude of water line cross-sections, resultant from the effect of the wind's laying the boat over at various angles. (Fuller 1932: 73)

In the above statement, Fuller is describing the relationships or metaphors shared by ship and car. For example, the hull of a racing boat is equal to the automobile's capabilities with respect to balance, speed, heel, and wind-force. These metaphors are based upon their similarities. Fuller believed that the incorporation of a hull shape, consisting of an inverted-vee form in the rear of the Vehicle, would help the aerodynamic stability of the Vehicle (Pawley 1990: 58).

The architect and theorist Diana Agrest gives a chart in her book *Architecture From Without* (1993: 40) in which she compares the metaphor of a house with a ship. Her analysis creates a relationship between two signifying systems, dwelling and ocean liner. Such a relationship exists because of the element common to both, namely the

window. Agrest claims, “Through a metaphoric operation, a figurative substitution of the signifying element common to both systems is produced (dwelling/window-liner/window), carrying and transferring codes from one system (liner) to the other (house) *(Ibid:* 39). I have adapted Agrest's chart in order to summarize Fuller's use of nautical metaphors in comparison with an automobile's form:

Ship/Liner Code:	*Boot:* Sail + Inhabit+ Movement+ Technology	*Windo~w:* Passage of Light + View + Seat + Sun	*Decks:* Promenade	*etc.*
Terrestrial/Transportation Code: *Auto:* Inhabit+ Movement+ Technology		*Window:* Passage of light Light + View + Seat + Sun	*Encasing:* Protection	*etc.*
Housing/ Code:	*House* Inhabit + Technology	*Window:* Passage of Light + View	*Wall:* Boundary, Protection, etc.	*etc.*
Metaphor	Liner *Window x* Auto Window	*Liner Window* Light + View Movement + Technology + ..	*= Auto Window* Light + View Movement + .Technology +	

This chart is based upon the similarities between an automobile and a ship in the areas of semantic and cultural units as well as their function through the use of propositions. These similarities are responsible for the creation of the metaphor.

In the following quote, Fuller uses a metaphor for functionalism and for the new era:

The first artists to apply their art to the new industrial canvas were our word artists or authors, who have conceived their manuscripts as not for themselves alone, but for mass production. It is however actually true that the inspirational harmony of art comes to the artist by his individualistic conception and enjoyment (sic). (Fuller 1970:13)

According to Fuller, authors were the first functional designers to produce for the masses. He wanted to emulate these word artists. The metaphor, "new industrial canvas," was meant for a new age of progress.

Fuller was interested in the aesthetic aspect of technology, which he stressed by noting that the artist's material was a metaphor that conveyed emotions and sensations. According to Fuller, the artist's aesthetic is now translated for the age of technology. When he claimed that the era is equal to an era of the "new industrial canvas," he is comparing the Zeitgeist to one that is artistic —a physical canvas to which the engineer, or the technocrat, could apply his skills. The newly available materials and forms

were made possible through new methods of production. He was calling for the superiority of mass-production over fine art productions.

As stated earlier in the section in regards to diagrams, Fuller believed that patents are not to be considered an artistic form. Fuller contradicts this notion in the previous statement. By claiming that mass production is the only true "artistic form" and "aesthetic principle," he is claiming that industrial objects are expressive in their form. For Fuller, these become metaphors for the functionalist philosophy and aesthetic principles, or laws that govern this philosophy. The designer, according to Fuller, is an artist. The metaphor of the designer as artist, therefore, is established and leads to the myth of the designer as artist.[23]

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23 This study uses Hauser's statement on the legend of the artist, as found in March. Hauser states in *The Social History of Art* the following: "The change in the position of the artist, so noticeable under Alexander the Great, it directly connected with the propaganda made on that conqueror's behalf. The cult of personality which developed out of the new hero- worship rebounded to the advantage of the artist both as a bestower and recipient of fame and to back this up there is the "discovery of artistic genius" through the philosophy of Plotinus. Now Plotinus regards the beautiful as an essential attribute of the divine nature. According to metaphysics, only the artist could restore to the fragmentary world of sense that completeness which is lost by becoming separated from God. It is evident how greatly the artist must have gained in prestige through the spread of such a doctrine; he regains the aura of the divinely inspired seer which had surrounded his person in primitive times...The act of artistic creation becomes a sort of unio mystica and is separated more and more from the world of ratio. As early as the first century Dio Chrysostom compares the artist to the Demiourgos (world creator). Neoplatonism elaborates this parallelism with increasing

Fuller stated:

The very strength of metal in tension, which makes possible a scale of fabrication hitherto undreamed of, requires a proper conception of the scale of the picture to be created, by the artist, through industrial channels, before he can properly design in that element. What is more important is that there is required a new modulus of expression, comprehended by and satisfactory to both industrialist and artist. *(Ibid:* 13)

Fuller compared technology to the qualities that were found in the products produced by artists *(Ibid:* 13). According to Fuller, in order for an object to be properly designed it must be produced using industrial processes. By using this comparison, Fuller is arguing that *good design* must be industrially produced. He again compares the industrial designer's creative process to that of the artistic process. This is what he refers to as the new "expression," the functionalist expression. This expression is to be found in his later notion of "transcendentalist design" philosophy.[24]

Along with nautical metaphors, Fuller incorporates aeronautical metaphors when discussing his transport vehicles. In 1929, he also noted that his Dymaxion was to have "...a hangar in which the transport unit, an amphibian airplane-automobile, is found as part of the equipment of the house ..." (Fuller 1929:104).

The equipment of the house is representative of the transport device that served as an accessory to the housing unit. The transport was not a solitary object but functioned within the other mechanisms of the Dymaxion house. The car and house were therefore intended to function as a system. The Dymaxion Vehicle tended to represent aeronautical rather than nautical technology. Fuller leaned towards the aeronautical technology of the day. For instance, the Granville Brothers 'Gee Bee' racing monoplanes can be shown in the drawing of the 4D-Auto Plane's short and stubby fuselages and its wire braced wings (Pawley 1990: 59). This aeronautical body form was later transferred to the Dymaxion Vehicles.

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emphasis on the creative element in the artist's achievement." Thus, " ...the legend of the artist is complete. The power of the personality, the intellectual energy and spontaneity becomes the ideal, in which it finds the supreme expression of the nature of the human mind and its power over reality." See March, 1976: 36–37.

24 For a comparison of Fuller's philosophy with the American transcendentalist philosopher, Ralph Waldo Emerson, see Kenner, 1973:147-151.

Fuller uses the metaphor of the efficiency of streamlining in aeronautical and nautical transportation devices as the opposite of what is found in architecture and automobiles of the era. He also claimed the efficiency of streamlining in the following: “In air transport and water transport, the efficacy of streamlining is as relatively efficient as it is proportionately inefficient in the design of land transport or housing” (Fuller 1932: 73). The streamlining metaphor is used to compare efficient and functional designs with designs that are not efficient and functional. Designs would be more efficient, according to Fuller, if they incorporated streamlining techniques and theories. Here, Fuller is positing himself as a champion of streamlining.

Fuller was not the only designer who promoted designs that would perform actions efficiently. Historian Donald Bush pointed out that it is a twentieth-century phenomenon evident mostly in technologically advanced societies. This is conveyed in methods of production and in objects such as industrial time-motion studies, the superhighway system, and the “modem compact kitchen.” The term “streamlining” is synonymous with saving time and energy, and these forms have symbolic connotations of speed and efficiency (Bush 1975:1).

Mathematical metaphors are also incorporated into Fuller's design philosophy. The historian Robert Marks claimed that Fuller's design credo “...is an assertion, in the tradition of Pythagoras and Newton, that the universe as a whole displays certain signs of orderliness-recognizable patterns of energy relationships. These patterns can be transformed into usable forms” (Marks 1960: 7). Fuller, however, goes beyond Newton to embrace an Einsteinian “conceptual framework.” [25]

This framework is exemplified by Fuller's use of the terms “time” and “4D,” which function as metaphors and analogies taken from Einstein's theory of relativity, which he read before 1929. He affirmed an Einsteinian conceptual framework in the following analogy:

25 [2]®A “conceptual framework” is defined by Merrell, as “...how one views the world, it organizes a person's experiences into a set of categories. The “conceptual framework” is necessary for organizing a person's life experiences, however the experiences selected are culturally determined.” In this way, Merrell suggests that, “A cognitive mechanism governs the development of one's conceptual framework, and hence of one's construc- tion/perception of all culture-bound, Weltanschauung-bound, and language-bound 'symbol systems' in texts.” These “symbol systems” function as fictional constructs. He includes in these constructs, such things as “...literary fabrications, scientific and philosophical modes, religious and mythical creations, mathematical inventions, and so on.” See Merrell, 1985:12.

Just as two and two make four, by our system of mathematics, which is an arbitrary formula, and that is a mathematical truth, so are there mechanical truths, mechanics being but the application, in one of its forms, of time or the fourth dimension to the other three dimension which mathematically describe matter. (1970:11)

Fuller is here using an analogy that incorporates symbols of the Western mathematical system. Symbols such as “time dimension” are taken from Einstein's theory of relativity. He makes use of the mathematical symbolic system or the conceptual framework of Albert Einstein. He uses the mathematical laws and rules (habits) to give credence to his ideas.

These “mechanical truths” use the time metaphor that is equal to the fourth dimension, supporting his “4D Transport” ideas and terminology. Time and matter, to Fuller, are equivalent to the “4D Transport.” He does not explain this notion of time and matter or how it is a mechanical truth; he simply uses the analogy as a comparison. Since Einstein's theory of relativity was accepted by Western culture, he believed that his 4D Vehicle design would be accepted as well. Einstein's conception of a “four-dimensional continuum” effectively quashed the hypothesis of an absolute character for the concept of “time.” His concept of a fourdimensional ” time-space” claimed that the only physical reality was the event itself and not any particular point in space (Einstein 1945: 30). His theory of relativity was therefore based upon the *action* of time.

“TIME and RELATIVITY are” , according to Fuller, “essential components of *construction design and harmonious composition ...“* (1970: 54). Fuller is again making use of metaphors to convey his Einsteinian conceptual framework. This comparison displayed his belief that the Dymaxion Vehicle is a product of the philosophy of Dynamism. This relationship will be discussed later on in this chapter.

Fuller uses nature as a metaphor to describe the mechanics of the streamline theory. However, while most other designers tried to promote streamlining by using fish and bird metaphors, Fuller extended this metaphor and incorporated botanical metaphors. These metaphors are illustrated in the statement: “So does each blade of grass whip its taper in the wind; streamline everywhere, except in man's clumsy contraptions, his block-shaped buildings blocking the wind, blocking progress” (1932: 78).

In the above statement, Fuller gives the example of an object, grass, reacting to a force, the wind, to explain streamlining. He also uses the plant metaphor to suggest that the streamline shape is superior to a building's form. Buildings that have corners angled at 90 degrees can represent metaphors of anti-futuristic forms that inhibit progress. Here, the role of progress in technology has to be streamlined in shape in order to be futuristic. A building's shape does not block progress; he used this statement to support the myth of streamlined-shaped buildings. Society does not need streamlined buildings that do not move or react to a force. Although grass bends, his streamlined buildings do not. This is in opposition to Fuller's functionalist assertions that designed objects should fit their purpose (1970:136,141).

This analogy and simile describing the principles of streamlining are stated in the following:

Streamlining is rampantly demonstrated in animate structures, sharks, birds, human heads, etc., but is popularly over-looked as a design factor of botanical structure. It is, however, found profusely in that field. Great trees, subject to enormous wind stresses, are ably streamlined by the action of their leaf structures which are usually streamlined elements themselves dependent upon their flexible stems.They reveal a rounding address-edge and a tapering of their planes towards their release edges. Boughs of trees in heavy winds will be found, through their flexible adjustment, to form pear shapes described by leaf groups, and the whole tree as a multiple of the streamlined bough forms usually tends toward an overall pear shape. (Fuller 1932: 78)

The pear shape metaphor that Fuller uses in the above statement, as the ideal streamlined form, is not found in the Dymaxion Vehicle.

Fuller incorporates the nature metaphor to produce and expand knowledge at the semantic level of meaning. Does Fuller create the Dymaxions by understanding the principle laws of nature first before he begins his designs? Or does he first write down a specific language before undertaking his Dymaxion designs? This will be examined in the following paragraphs.

Fuller stated the following:

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 thus developed or discovered are inherently *natural.lt* is very important to remember that. (Fuller 1969: 75–76)

Fuller wrote the book *4D Time Lock* and executed the sketches before he applied these ideas to the patent diagrams. First, he needed to write down and use language as a basic structure for his designs. The semantic level of meaning was first applied to his *4D Time Lock,* and then carried over to the principles of the patent diagrams, writings, and finally to the three-dimensional model forms. In this manner, Fuller is claiming he did not discover anything radical: he just took what was available, applying various technologies to establish the form and meaning of the Dymaxion.

Fuller also uses the model of a communication system as an analogy for the American transport system. He stressed:

The great automobile, railway and, potential airways industries are like a giant broadcasting system, prematurely organized.It would be analogous to the radio industry having organized its broadcasting system before manufacturing and distributing its radio receiving sets, not even having a standard hookup to recommend to the trade. Obviously this is an inconceivable condition in our modem economical organizations (sic). (1970: 8)

He claimed that little thought is put into these industries before their production. This is a major flaw in the American economical system. However, Fuller does not state exactly how these relate. Do streamlined designs save money or time? Does the streamlined form act as a formula to ensure timesaving, money-saving designs, and therefore manifesting an efficient society, and by extension a definitive design theory?

The metaphors and analogies that Fuller incorporates in all of the above statements function first as icons; they are used in order to create in the mind of the interpreter the same representation that Fuller wanted to convey. They become symbolic in their meaning.

A symbolic system is formed because a convention within a particular community or sub-culture was created. The culture of 1930s America used the streamlined shape symbolized in the botanical, fish, and egg metaphors to describe such aerodynamic principles as speed and efficiency. The metaphor or myth of streamlining was also realized later in American culture through the writings of the historians Bush (1975) and Meikle (1979).

Fuller uses the following analogy to compare and state the advantages of the streamlined vehicle over the conventional car. Fuller pointed out this analogy in his patent writing statement of 1937:

By thus enclosing the whole running gear including as much of the wheels as consistent with road clearance in a properly streamline external contour, the advantage is gained that the rate of fuel consumption, as compared with conventional cars of equivalent size and weight, falls off rapidly as the speed is increased above about 10 M.P.H. being some 30% less at 30 miles and 50% less at about 50 miles, while within the overall dimensions of such conventional cars the volume of useful cabin space inside the streamline body is much increased, being practically doubled. All of the interior of the body forward of the drop-angle or bulkhead wall 30 constitutes the useful space for passenger or cargo, and due to the drop-angle the rear seat can extend the full width of the body over the subframe 11, as well as over the main frame 15 and with cars of standard tread gauge this provides a seat some 6 feet wide, long enough to serve as a bunk for sleeping purposes (sic). (U.S. Patent 1933: 2)

Fuller is comparing the streamline automobile with that of the automobiles that preceded it. He used the shape as the main functional point of advantage. Fuller only referred to the interior space as a benefit over other automobiles of the 1930s; he never fully documented the interior of the three Dymaxion Vehicles. The seats, according to Fuller, were an improvement over traditional automobiles of the time.

Fuller does not state the safety improvements, if there were any, concerning the interior of the Dymaxion Vehicles, nor does he develop any ergonomical plans involving the interior space and gauges used. Moreover, he never mentions if they were easier or more difficult to use than those of conventional automobiles. It was only the external form that became the metaphor for the functional form and its performance.

All of the above metaphors and analogies act as codes or aids to help the visual perception of the receiver of the final prototypes of the Dymaxion Vehicles. These function with the iconic diagrams, *4D Time Lock,* and patent text to form a complex of codes for the interpreter. All of these representations function to aid visualization and mental perceptions that produce their specific meanings.

The Dymaxion Vehicle, Fuller's Language and Peirce's Symbol

The symbolism of the name or term Dymaxion can be conveyed through its etymological roots. The term Dymaxion is comprised of the words dynamism, n/fl.r-imum and *-ion* (Marks 1960: 24). The term 'dynamism' (noun) is representative of the philosophical theory that claims that phenomena of matter or mind are created through the action of forces (Allen and Hawkins: 447). The term 'maximum' represents the highest amount that is attainable through such forces of matter or mind (Allen and Hawkins 1991: 897). And finally, the suffix '-ion' signifies an instance of these forces (Allen and Hawkins 1991: 747).

Although Fuller did not create the word 'Dymaxion,', he applied it to his various inventions of this era.[26] The logic behind the term's meaning correlates with the construction of the Dymaxion Vehicle. The Dymaxion Vehicle is therefore symbolic of Fuller's use of the philosophy of dynamism, brought into the constructed world.

These laws became the conventions and experiences or the qualities that he incorporated into the Dymaxion's creation and production of meaning.The word 'automobile' expresses these qualities of the Dymaxion Vehicles to the interpreter.

We can view the term Dymaxion as a series of equivalencies, namely as a sign that signifies a norm[27] that is equal to the community of streamline designers that itself is equal to the same or different symbolic system of the interpreter or user. This action can be illustrated by means of the following equation:

Sign+noun+signal+community=same/different symbolic system

We obtain from this equation the following correlation: /designer/or/community of designers/ versus / users/ or/non-desigers/

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26 The word “Dymaxion” was created by an advertising publicist, who was hired by Marshall Field's to create a name that was appropriate for Fuller's exhibit of a model housing structure. Fuller thought the word fitting to his designs and adopted the name for the Dymaxion house, bathroom, and vehicle. For more information, see Kenner, 1973: 163.

27 In this sentence, the noun is equal to the type. For a discussion of nouns and gerunds concerning different building types see, Jan van Pelt and Westfall, 1991:157.

The word 'Dymaxion' becomes a replica for the object as well as for the ideas that Fuller claimed were materialized in the Dymaxion system, which many interpreters later described as radical, utopian, and experi- mental.Through the community of users/interpreters, the Dymaxion creates a habit or law of ideas associated with the term. It is through these ideas —this common linkage that various interpreters believe in—that the word acquires its meaning for a particular community. These words associated with the Dymaxion, such as 'radical' and 'utopian', become general rules for future interpreters. The term 'automobile/vehicle' is the key term in expressing the qualities of the replica, the Dymaxion. It is what the community of interpreters used in order to establish the meaning of the larger category of automobile, which is largely responsible for how we attach meaning and interpret the Dymaxion. It is first of all a means of transportation.

As Donald Bush notes:

The Dymaxion Cars represented the first reexamination of the automobile since its emergence as a motorized horse carriage. Fuller's use of streamlining for scientific reasons and his teardrop designs justified the similar forms promoted during the 1930's by American industrial designers. In light of the development of aerodynamics as they understood it, they had professed faith in an optimum form; streamlining was for them no passing fancy of the stylist. It represented changes they thought could and should come. (1975:108)

In this statement, the word 'Dymaxion' refers to the word used to denote the phrase “streamlining automobile” as a symbol for the class of automobiles in this category. In order to create the interpretant or the idea of the sign, the interpreter must have a representation of the Dymaxion in order for it to function as a sign or symbol. The sign must also have an interpreter to establish its meaning. Ideas, however, can also be symbols. Thus, the term Dymaxion is representative (symbolic) of the whole class of objects known as streamlined vehicles of the 1930s. It also is a form that promoted a certain ideology during that era.

This symbolization of the Dymaxion Vehicles involves the interpretant, or the idea that the sign or Dymaxion produces in the interpreter's mind. It is a stimulus (the stimulus Dymaxion) for sign production and semiosis for the interpreter. The interpretant thus acts as a symbol. It represents an idea or group of ideas for the interpreter by word association and image association.

The Dymaxion functions as a symbol or token; it acquires its meaning through social conventions and becomes a symbolic form for that community. Fuller realized the symbolization of American automobiles in the year 1928 by pointing out the following:

In the automobile industry accessories were at first left off and tendered to the consumer as fitting Xmas presents or other tokens of esteem, selfish or otherwise. Today the automobile industry 'builds in' its accessories in their logical functionary place, properly proportioned to the scale of the particular car. No Fords are now being marketed to which Locomobile sized bumpers are ridiculously applied. The fitting bumper is 'built in'. So will the new industrial home, taking a page from the graph of progress, build in its accessories. (1970: 20)

Fuller relates to the 'symbol' as a 'token' in the above sentence. He is affirming that most automobile makers use an extra "semantic unit," [28] where symbols of esteem and selfishness were applied to the vehicle because consumers felt the need to express or display their own social position and significance. While Fuller argued that the automobiles of the 1930s misused symbolization, he failed to realize that the Dymaxion is also a token representing the functionalist aesthetic and the meaning or meanings that are associated with this aesthetic.

Fuller stated the following with reference to symbolism: "What was termed functionalism really was not functionalism or the use of streamlining applied to things that did not need to be aerodynamic in form became a stylistic mechanism or ornament ritual form of design" (1932: 73). Fuller made reference to this idea again in a 1932 article in *Shelter* magazine:

The infiltration of 'Symbols of Speed,' evolved from aircraft forms, into auto-coach aesthetics has provided such counterdynamic absurdities as the streamline radiator cap, and 'Airfoil' hardware wherein the 'Streamlined' door handles of automobiles often 'back up' counter-dynamically, as in the case of the Auburn cars, etc. No consideration is taken of the fact that the whole automobile is going backward from a streamline viewpoint; that is, that the small end of the automobile, the motor end, is forward and the rounding bulk of the passenger compartment aft, which induces wedging pile-up of the atmospheric medium ahead of the front point, and a high vacuum drag aft (sic). *(Ibid:* 73)

28 This refers to Eco's definition of a semantic unit, which is a cultural unit that conveys the meaning of the term. See Eco, 1976: *Theory,* 66.

Fuller concentrates entirely on the vehicle's exterior appearance, neglecting its interior qualities. He is arguing that it is the form itself that can convey either symbolism or the misuse of symbolism.

The following statement also reveals Fuller's ideas on the proper use of symbols:

The same name labeling, referred to in the political discussion, is well revealed in relative *blatancy to worth,* in the motor car field. 'Here worth is synonymous with simplicity, best exhibited in the Rolls Royce. This may be seen in the perfection of motor housing with its plain, logical, watershed lines, plane square radiator, lack of *fake* wood gas tank bracing (seen on Cadillacs and LaSalles, in imitation of antiquated European functionalism) lack of motor hood selfconscious Hutting louvres, and lack of tin apron over springs and frame. The motor hood is not, as in many American cars, aesthetically designed like a wind-blown bob, or the buttocks of a horse. There is a great philosophy exhibited in the Rolls-Royce design, even though it may be contemporarily supplanted, as the Tribune Tower by 4D housing designs, it was the best at 'its time'. The character of the Rolls-Royce is so functionally portrayed as to need no label, though the most delicate and flatly inobtrusive- unobtrusive one has been habitually used. Removal of which would only enhance its value (sic). (1970: 136)

According to Fuller, the form or the three-dimensional design can symbolize a philosophy. In the above statement, Fuller delineates the requirements of a functionalist philosophy by discussing what he believes should be included or omitted in the design of automobiles. To Fuller, value equals the logic and simplicity of form. He devalues what he terms “self-conscious” design elements, such as “louvres.” He uses cultural, collateral experience and observation as an example of condemning these design elements. He uses the phrase “wind blown bob” as a metaphor for the American automobile's hood design. In this manner, the stylized American hood designs were inspired by hair fashions. One must know what a “wind blown bob” refers to in order to understand the meaning of this statement. In the statement, “There is a great philosophy ..., it was the best at its time,” Fuller is expressing his belief that logos should not be used in order to convince the reader that his Dymaxion Vehicle is not superficial or superfluous in its design and content.

The Dymaxion Vehicle, although similar to the design of the Rolls Royce as stated earlier, was dissimilar in design to the Chevrolet. Fuller states:

Compare this to the 'men's toilet' type of large enameled sign on the cheap Chevrolet, which changes 'styles' so often as to need such a label, with the inevitable reflection that the cost is *stylistically* rather than *mechanically* represented. All the General Motors products are this way. They are one after the other stylistically changed to copy the design of their nearest competitor up the scale. This goes hand in hand with their sales talk of 'getting a little more' for the money with them than elsewhere, an intrinsic inference, which reduce itself to the fallacious 'something for nothing.' As the culmination of a year in which they stressed motor superiority, Packard has earned more than quantity production in much touted Chrysler (sic). *(.Ibid:* 136)

He believed the Dymaxion and the Rolls Royce were not stylistically designed.

Fuller failed to acknowledge that they are in themselves representative of "functionalist styling." [29] Fuller referred to this functionalist styling as social design.[30] The styling of the Dymaxion functions as a "mental icon" (Peirce 1985: 17) by collateral acquaintance or familiarity, social convention, and general rules to which the community and the designer respond. In this manner, Fuller's Dymaxion Vehicles function as "mental icons" by collateral acquaintance with the meaning of the term; this denotes the idea that produces images and an ideology in the mind of the interpreter. This mental icon or "psychical product" (Peirce 1958/8:112) is representative of the three-dimensional object.

Fuller does not disagree with the use of symbols on the condition that they be used according to his functionalist credo. He disagreed with applying symbols to objects that did not have to correspond to aerodynamic theories. This was a misuse of form, and therefore, a misuse of symbols. Fuller considered the unnecessary application of ornament to a vehicle or artifact as proof of a ritualistic design (Fuller 1932: 73). Ritual elements can be defined as the "semantic units" that create the form of the vehicle. This made them symbolic in content. If we take into account that functionalist

29 De Zurko notes in his book, *The Origins of Functionalist Theory.* "The concept of functionalism has had a great influence on modern architectural thought, and it is a fundamental concept in modem architecture. One may appropriately call it the characterizing tendency of modem architecture. It is popularly associated with the modem style and some scholarly architectural historians have called the modem style the "functional style." See De Zurko, 1957: 7.

30 For more information pertaining to Fuller and his views on design functioning as social design see, Marks,1960: 8–9.

design *is* functionalist styling, then Fuller's beliefs and values were not completely functionalist in nature. His views against the symbolism of traditional automobiles are well known. He promoted his designs *and* the myth of what constituted the best design of a vehicle.

Fuller makes use of symbols to convey his views on politics during this era.

He stated:

In this whole letter our perspective point is entirely abstract, wherefrom, all which embodies time, is revealed in the absurdity of nudity, flapping breasted, hairy chested, or selfish bellied, fine clothes, cosmetics, sedan chairs, or automobiles, being but the badges of eras. I seek to point out the *eternal and single truth,* available in abstraction,...These truth debating business laws are known as 'policies', the product of the overworked, secret 'conferences'. They are coincidentally, of the same word derivation as 'politics'. (1970:121)

Here, the phrase “badges of eras” makes reference to symbols (tokens) of social status in use during the 1930s. He is arguing that there is only one viewpoint or judgment of what is the only “eternal” and “single truth” ; there are no other truths except his own “truth” or functionalist philosophy. During this era, he also describes business laws —or what he terms 'policies'—as synonymous with the meaning of the term politics; he claims businessmen are like capitalistic politicians in their meaning and truths. They are flamboyant and not to be trusted.

In the following statement, Fuller conveys his functionalist anti-ornament credo:

Never a thought of the public in the whole cycle except to the hope that they will be awestricken with the 'beauty'. The architects 'renderings' always show tiny groups of these speechless admirers. The submission to this 'art first' coterie has occasioned the stylistic 'fake coverings' of industrial products (sic). *(Ibid:* 141)

The symbolism of the product is revealed through its shape. Fuller objects to the use of a form when there is no need for it, an objection that applies to any product that is not functional or does not convey any selfreference. The aerodynamic stream form should only be applied to industrial products such as vehicles of transport that affected their aerodynamic speed. This functional symbolism is equal to the object's efficiency and purpose of creation.

The stream form covering became a symbol for future products, representing progress and utopia. This style was applied to products and used horizontal lines, rounded comers, and encasements that formed an image of effortless and frictionless motion, representing by extension a society exempt of effort and friction (Meikle 1979: 4).

Fuller also expresses the view that *4D Time Lock* was symbolic in content and form.

Am mailing you copy no. 143 of 4D under separate cover. It must be read in the exact order set down. Like the combination

of a safe it is made up of readily recognizable symbols. It is the order of arrangement that counts. None may 'out smart' the combination of the safe. (1970: 81)

It is arranged according to Fuller's arrangement, in his ordering of thoughts conveyed by manipulating words that function as symbols. The reader must agree with Fuller's symbolic language and meaning; if not, then Fuller justifies this by stating that no person can “out smart” the rules and laws he used to structure meaning. These meanings are only accessible to those who understand and can decode the order and syntax that he uses to translate his thoughts and ideas about design.

Fuller and Peirce's Index

The Dymaxion Vehicles, in their three-dimensional form, display various spatial connections with the patent diagrams. These relationships are taken from previous codes and conventions used in United States patent diagrams and writing techniques. These spatial relationships are formed in the mind of the interpreter by the letters of the diagram, which function as indices of the three-dimensional object and the various units of the vehicle that correspond to the various letters on the diagram. This is made known through the cultural conventions of patents. Fuller incorporates letters and numbers corresponding to these spatial concepts.

The letters and numbers on the diagrams act as pointing fingers that bring the viewer to a relationship with the concept of the Dymaxion Vehicle and the object. The letters of the diagram or words of the patent bear no resemblance to the three-dimensional object: they are linked existentially, bringing about the idea or concept of Fuller's Dymaxion Vehicles. The letters on the diagram and patent writings preexist the interpreter. The interpreter must be acquainted with the English language and

alphabet (as well as the use of patents) before an interpretation can take place. The letters of the diagram, therefore, act as subindices or hyposemes. The interpreter is able to connect the written language with the diagram constructions to convey and receive their meaning.

Fuller also incorporates demonstrative and relative pronouns in his patent writings to help the interpreter create a linkage to the interpretant or idea of the Dymaxion Vehicle. He tries to express images created in his mind to others, in the hopes that they would also interpret the diagrams and writings in the same way as these images were created in his mind. In this process, a transfer of knowledge and experience occurs.

Fuller uses the deictics *this, that,* and *here,* as nonverbal pointers that create spatial coordinates linking the Dymaxion diagrammatic image with the letters and numbers he chose. These also point to the patent writing. The interpreter must understand these indices in order to understand the meaning of the patent. The patent writing functions as a set of instructions; they tell the interpreter how and why a certain form is used. The patent also functions as a set of instructions that tells a user how something is or was done. It functions as the sign of its object—the Dymaxion Vehicle. The letters and numbers of the diagram and writings are viewed as sign vehicles that function as the sign of their object.

Fuller stated in his patent writings:

The forward wheels can be organized as the steering wheels within the broader aspect of this invention, but it is preferred that the steering is done by a rear wheel or wheels such as indicated at 6 which is central of the two forward wheels, being journalled on a stub shaft 7 rigidly fixed in the end of a sin- gle-tined steering fork 8, the head of 9 of which is swivelled to turn on an upright axis. This wheel is preferably of the same size as the forward wheels and interchangeable therewith as in standard automobiles, being readily removed from its stub shaft on the single-tined fork. It may however be dual-tired if desired, or may consist of twin wheels turning together as a unit or like a single wheel and such variants are to be understood as included within the term single steering wheels as used herein (sic). (U.S. Patent 1933:1)

This statement, taken from Fuller's patent, contains the pronouns “this” , “that” and the word “indicated.” By claiming “this invention,” Fuller is referring to the forward wheels of the Dymaxion as its steering mechanisms; he notes they are “within the broader aspect of 'this' invention” *[Ibid:* 1). The phrase “by broader aspect” is obscure.

The reader does not know precisely what Fuller means by this phrase. However, Fuller does suggest that by using the index (" that"), steering is to be accomplished by a rear wheel as indicated by the index #6, which is connected to the object "shaft" correlating to index #7 in the diagram and in the patent text. By writing "this wheel," Fuller is pointing out that the idea of the object "wheel" (a conventional cultural object) is the same size as the forward wheels. However, do these indices correspond to the actual three-dimensional vehicle or just to the diagram and patent writing? In order to answer this question, we first need the physical object to test Fuller's hypothesis.

Fuller also claimed in his patent:

The steering head 9 is journalled on vertically spaced bearings in a deep barrel socket 10 formed in the rear apical end of a generally triangular or A-shaped frame 11 herein termed the subframe, and is slightly castored therein as shown in Fig. 3, to facilitate steering (sic). (Ibid: 1)

In conjunction with the word 'figure,' the word "shown'" helps to suggest a spatial coordinate point linking the describing sentence with the diagram. This is an existential link; one must have the figure or diagram in order to understand the concept of the sentence that appears before the words "Fig. 3" . Does this really help facilitate steering? In order to answer this question, we again must use the three-dimensional vehicle in order to ascertain if this mechanism actually facilitates steering.

In the patent, Fuller also points out; "The usual engine controls, though not shown in the drawings, will be understood to be arranged in any suitable way" *{Ibid:* 2). In this statement, Fuller uses the phrase "usual engine controls" on the assumption that the reader will share the same experience as he does. Fuller does not explain to the reader what the phrase "'usual engine controls'" means. He is implying that these controls are conventional and are made known through cultural convention and collateral experience. Also, when Fuller writes "not shown in the drawing" , the elements to be expressed are conceptual; they are not displayed in the invention patent diagrams. By stating this, Fuller is claiming that the idea is just as important as the physical representation of an idea or concept. How are these elements arranged in a "suitable way" ? Fuller offers no explanation but leaves the reader guessing. He takes for granted that the reader has the same collateral experience that he has and that

the meaning of “suitable way” will be readily understood. Although the non-physical reality is conveyed through the patent vocabulary that Fuller employed, the reader cannot understand the idea. An existential link again is exemplified; the viewer has no spatial or visual reference for the meaning or interpretation of these words.

Fuller states that “The forward windows 41 are either curved to the streamline contour or composed of smaller flat sections collectively approximating such contour” (Ibfd: 2). The object indicated by the number “41” is the front window of the Dymaxion Vehicle, which functions as an index referring to the shape of the form to be executed, namely; the streamlined form. Collectively, the smaller sections correspond to the shape of the three-dimensional object that represents the idea conceptualized in the mind of the interpreter and designer. What ideas are transferred, and do they have the same meaning for the designer as for the interpreter? Here the streamline shape of the line drawing is equal to the term “streamline.” It is the contour and not the word that defines the difference. Both Fuller's diagrams and indices work together to convey their meaning.

Fuller also noted in the patent: “While the body 1 can be variously constructed and wholly of metal, if desired, it is shown as built of wood framing with a light metal covering” *{Ibid:* 2).

In the above statement, Fuller is referring to the body or outer casing of the automobile. Index #1 refers to “the body” of the vehicle. Although Fuller notes that the framing may be of wood and light metal covering, we are never really shown this in the diagram. How is this conveyed by Fuller, who is acting as interpreter of his sign creation—the “body” of the vehicle? This is not conveyed directly in the patent but through collateral acquaintance with the materials and the “type” of form to which Fuller is referring in his patent statement.

He incorporates pronouns as indices in the following statement:

Also specially contributing to the maneuverability and ease of handling generally is the fact that the traction center as well as the gravity center are both located in the same general position, forward of the center point of the wheel base and that this position also substantially coincides with what may be called the streamline center of the body which may be taken as its center of volume or the center of area of its axial section.This center is indicated roughly in Fig. 3 by the small circle 58; the gravity center is lower down and the traction center of course coincides with the axis of the front wheels.The consequences of the grouping of these important centers in the same

general forward location are reflected in the structural economy of the vehicle and become obvious on comparison with the action of conventional cars and especially those which have their traction center rearward of the mid-point of the wheel base. (Ibid:3)

In this statement, Fuller uses the phrase “Fig. 3 by the small circle 58” as an index. He also uses the pronoun “this” to draw the attention of the reader. These words or indices describe what the interpreter is to estimate in his or /her mind. Fuller claims this is the center of volume area. Is this really shown in the patent diagram, the icon? Indices act as pointers to ideas in the mind of the designer and interpreter. Do we see what Fuller wants us to see in our mind by using these diagrams and indices? He often points to the interpretant and the existential linkage. The interpreter must be acquainted with the mental and physical elements mentioned in the patent to gain an understanding of the patent. However, the interpreter does not need complete collateral experience in order to understand either the patent or Fuller's ideas; however, he does need to understand a few concepts of what is contained within a patent.

The Dymaxion Vehicle and Patent Writing as Codes

Patent writings as well as aesthetic texts can be viewed as containing various codes. Fuller's patent text and his ideological statements make up an “impossible world” (Eco 1976: 62); (Merrell 1985:101). Codes become the structures of these impossible or “cultural worlds” (Merrell 1985: 101). These codes convey the meaning of Fuller's Dymaxion Vehicles and writings. When the underlying rules of these codes are disclosed to the reader's perception, meaning occurs. Therefore, codes help to clarify a culture's meaning.

In this case, the Dymaxion Vehicle and the ideas that the interpreter experiences create the signification between the text and the object. This occurs through a communication process that helps to ground, channel, and define the relationships that make up Fuller's objective world. In this manner, the Dymaxion Vehicle —the object—can be seen as a text. The Dymaxion Vehicle contains a message that communicates meaning. This process is shown in the following diagram below based upon Eco's communication diagram in his book *Theory of Semiotics* (1976: 33).

(Dymaxion Vehicle) —> (Fuller) —> signal—channel—signal —> receiver/interpreter source transmitter message define/interpret

Fuller's invention of the Dymaxion Vehicle, both in his patent language, *4-D Time Lock,* and diagrams, chose a "new material continuum" [31] that had not been segmented for that purpose. Fuller proposed a new way of organizing both form and language. He mapped within the formal element of a content-type, his concept of streamline.

The expression produced by this invention recognizes previous experiences that link an expression with a content unit for both the designer and the interpreter. Umberto Eco does not state whether the linkage of an expression with a content unit is for the designer or the interpreter. However, in Fuller's case, it is both.

The Dymaxion is a "moderate invention" [32] that projects from a perceptual representation into an "expression continuum" [33] already established by the social and cultural conventions among a certain class of society during the late 1920s and early 1930s. These conventions are dictated by the rules used to produce an equivalent content-unit. For example, as stated in the patent text, the interior of the Dymaxion Vehicle contained an already established convention of engine design, namely a Ford V-8 engine. It is not known, however, if the controls (such as steering wheel, window handles, gas and break pedals, data display and dashboard instruments) constitute a moderate invention since no record exists of these mechanisms.

The culturally shared ideas form a code. This is established as the "communication" or "shared objectivity" (Deely 1990: 67) that Fuller shares with Jaray and other streamline designers of the era. These "moderate invention" codes were in accord with the designers of the era; however, they were not in accord with the would-be user.

Designers Bel Geddes and Jaray were two such streamlined designers that with whom Fuller shared such objectivity. Paul Jaray, a Hungarian engineer, was one of the earliest designers to apply aerodynamic principles to auto-body designs. He was the chief of design and development at the Zeppelin airship works at Freidrichshafen, Germany, between 1914 and 1923, during which time plans were made to design and build aerodynamic automobiles.The first German patent for such an automobile was granted in 1921. Jaray and his assistant W. Klemperer placed a prototype of a Jaray

31 The " new material continuum" is the physical environment in which rules have not been culturally established in order for them to be recognized. See Eco, 1976: *Theory,* 249.

32 For Eco, a *moderate invention,* occurs when a person projects from the perception a representation into an expression plane. In so doing, the person realizes an expressive form that will dictate the rules the creator, of the object or the text, uses. See Eco, 1976: *Theory,* 252.

33 The *expression continuum,* to Eco, is the plane of consciousness, where the addressee or sender of the object or idea, is produced. This continuum is responsible for generating the habits and mannerisms of the community of the addressee and the sender. See Eco, 1976: *Theory,* 253–254.

on a Ley chassis, and tested it at Zeppelin's newly opened wind-tunnel facilities. The drag coefficient proved to be half that of the stock Ley. Automobiles with closed forms were rare in the early 1920s. According to historian Donald Bush, Jaray-Ley's car was "sufficiently radical" in its appearance to prevent it from being adopted by the public (Bush 1975:101).

Jaray developed the Streamline Corporation in the United States. A patent was awarded on his streamlined designs in 1927 (fig. 11). In the patent, Jaray confirmed twelve variations of the streamline type body and claimed that it was the first automobile of this type. Dixi, Ley, Opel, Mercedes-Benz and Mayback all eventually applied Jaray's body form to their chassis *(Ibid:* 101).

Another designer interested in the streamlined automobile was the American Norman Bel Geddes. In 1928, he completed designs for an automobile that he hoped would be produced within five years, his Motor Car #5. Geddes then designed four intermediate body shapes evolving into Car #1, a conventional car with a few innovations and moderate streamlining. This car was close to the public's "perceptual continuum" [34] of the traditional motor vehicle *(Ibid:* 102).

The Dymaxion was a "moderate invention," but is the Dymaxion a "radical" [35] and revolutionary invention? It was radical to the public although not to the other designers who promoted this form. The sender, in this case, is the designer or creator of the product. Fuller strays slightly from the perceptual model and goes to an "unshaped perceptual continuum" [36] where he organizes his own world, design vision and perception. The expression "The Dymaxion Vehicle" is the end product or manifestation of his idea of perceptual labor. Eco does not state that an idea is an aspect of this continuum. However, the idea is just as important an aspect of the continuum as the product. This expressive labor is defined by the patent writings, along with

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34 The *perceptual continuum,* to Eco, is the plane of consciousness, where the interpreter's or

35 creators conventions are similar to those of the majority within the communit}' of senders and addressees of any message. See Eco, 1976: *Theory,* 254.

According to Eco, *radical invention* takes place when the creator bypasses any known perceptual model and develops his or her own perceptual continuum. See Eco, 1976: *Theory,* 254.

36 The *unshaped perceptual continuum,* to Eco, is a new perception developed by the creator or the sender of a message. This process usually brings about new conventions into a community. See Eco, 1976: *Theory,* 254.

the diagram, and enacted in the construction processes to produce the product, the Dymaxion Vehicle in its three-dimensional form. The receiver consequently has a perceptual mode or "sememic representation" [37] that the interpreter believes Fuller wished to convey.

In the case of the Dymaxion Vehicles, the addressees did not accept the subject of the Dymaxion Vehicle (the streamlined shape), because they could not relate to the form as being real to them —real to life—or consistent with their reality perception of what constituted the "real-to- life." Addressees of the 1930s lacked a "semantic model" [38] that would allow them to compare the elements of the Dymaxion system with those of similar vehicles of the same era. The addressees had never perceived in this way or manner before. The semantic elements of the Dymaxion Vehicles were too different from the traditional vehicles of the era.

Fuller was involved in radical code-making whereby he proposed a new set of conventions for motor vehicles for the American public. These conventions existed mostly in the exterior of the vehicle. The semantic units that made up the Dymaxion's bulbous form, tapering toward the rear, as well as the proposal of a new way of viewing through a periscope, are among some of these new semantic conventions. He also incorporated new building techniques through the use of aircraft dials, three wheels instead of four, and a rear engine instead of the conventional front engine found in the automobiles of this era. To use the metaphor of communication theory, the sender of this message is Fuller. For the American public, Fuller tried for semiosis but felt that he had failed. His forms and his vision —his worldview—were not readily accepted by the public and critics of the era. Sales are a measure of society's acceptance of a product. Society was never given the chance to invest in the Dymaxion Vehicle, since they were never mass-produced.

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37 «°A *sememic representation* is produced through the expressive content and perceptual model. See Eco, 1976: *Theory,* 254.

38 To Eco, a semantic model, can be explained as the *projections* produced at certain points in the space of the expressive continuum that correspond to the certain points on the space of the *" toposensitive perceptive or semantic models."* The similarity in the rules in both these areas helps the addressee to recognize a certain image or meaning of an image. See Eco, 1976: *Theory, 257.*

In 1934, the Chrysler Corporation introduced the American public to the Airflow as an expensive luxury vehicle. It was the most streamlined production vehicle and 11,292 of them were sold in the first year. The Airflow remained in the market for four years. Conventional wisdom holds that the Airflow was progressive in design for its era (Bush 1975: 121).

Fuller did not, however, fail completely in semiosis. He created and invented new codes, some of which were based upon already established codes. The Dymaxion Vehicles used the elements of traditional vehicles —wheels, windows, engine, and doors—all of which served the same function as in traditional automobiles. The difference was the form Fuller gave to the vehicle. The "aerodynamic" codes surrounding streamlined vehicles were already established by the first quarter of the twentieth century.

Radical invention does occur in Fuller's ideas and in his external form. Fuller's Dymaxion Vehicles were closer to an ideal aerodynamic form than any other American production automobile. The Tatra V-8 automobile was the closest to the teardrop form in Europe *(Ibid:* 123). The Dymaxion Vehicles were more radical than the Chrysler Airflow and Tatra V-8, and they proved to Fuller that his ideas and designs were indeed valid.

Fuller makes use of tropes[39] in the design of the Dymaxion Vehicle and in his written language. He twisted various words in *4D Time Lock,* and applied them more frequently in his later writings.[40] Fuller assembled the elements of the Dymaxion into trophies. To prevent punishment from his God, he dedicated his life to creating designs for humanity. This

39 A trope is "...a playful interpretation that relates forms that otherwise would never be associated." See Frascari, 1991:14-15.

40 This is exemplified in Fuller's books such as: *And It Came to Pass—Not to Stay,* 1976; *Ideas and Integrities,* 1963; *Untitled Epic Poem on The History of Industrialization,* 1962; *Intuition: Metaphysical Mosaic,*1973; and *No More Secondhand God and Other Writings,* 1963.

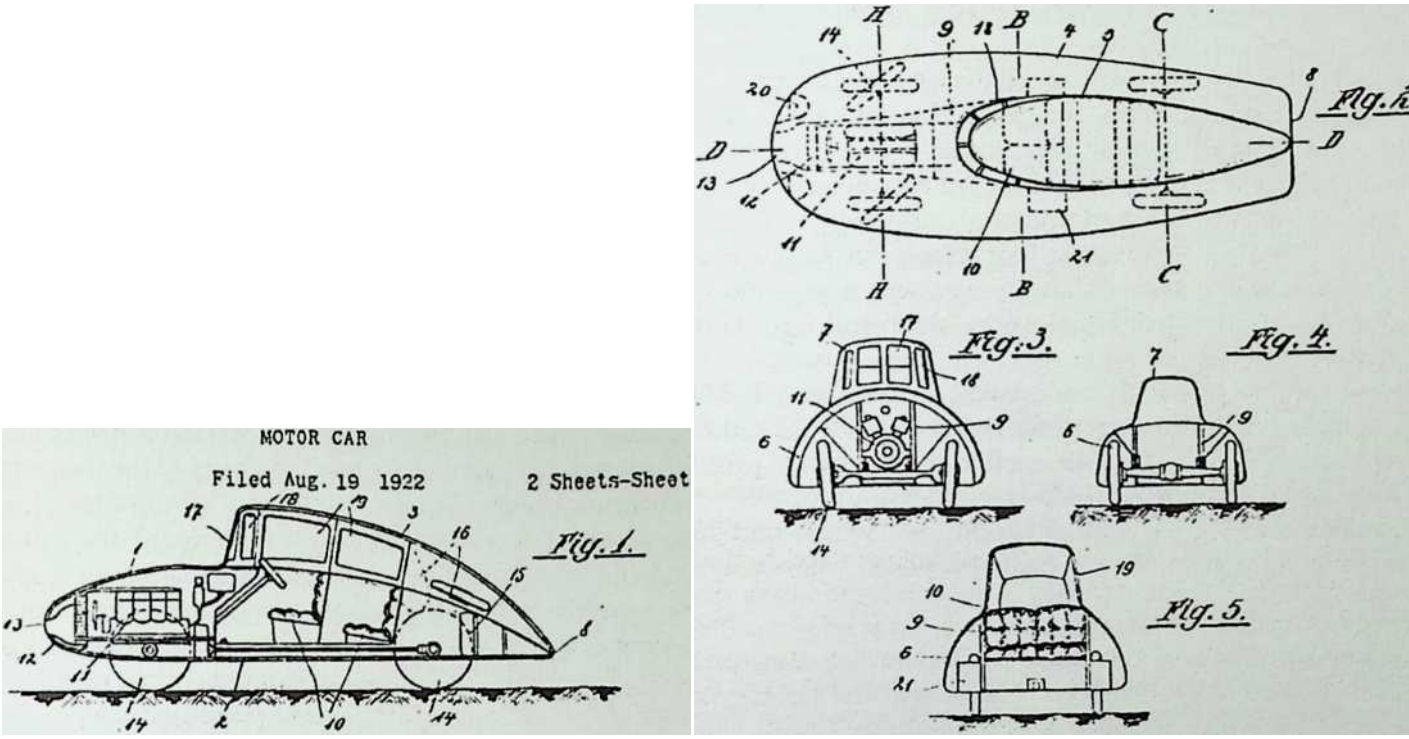

Fig. 11. Paul Jaray's Patent Diagrams of his 1927 Vehicle Design. Courtesy, United States Patent Office. became his raison d'etre, and the myth that he adopted to justify his actions and designs.[41] The sacrifice of creating ``egocide'' [42] adds to this aspect. These sacrificial elements as well as the sacrificed elements of other automobile parts (in addition to the new parts) are reflected in the Dymaxion Vehicle. The tropes in the Dymaxion consist of the elements in other automobiles that were twisted or changed for the pur-

41 The author Hatch believes that Fuller's daughter's death "...left a deep scar upon Fuller's 'soul.'" His daughter died of influenza and Fuller believed that it was the era's inadequate housing that contributed to her deterioration. He set out to develop better living conditions for mankind by creating better housing designs. See Hatch, 1974: 77.

42 Fuller, decided in the late 1920s that he would not commit suicide, but rather "egocide." This was meant to be an "ego" suicide, that would not focus upon the wants of himself, but the wants and needs of other humans. For a discussion on Fuller's notion of "egocide" see Fuller, *Inventions,* 1983: xxvi-xxviii.

> pose of fitting into Fuller's concept of a new ` `auto type.'' Examples of these elements are the rounded doors and windows. Although Fuller often condemned traditional automobiles, he incorporates some of their elements in the Dymaxion Vehicle. All automobiles imitate previous automobiles in various degrees. Fuller incorporated familiar automobile motifs (or semantic units), such as wheels, windows, and doors, into a new form of automobile body type. This new body shape presented some advantages over other automobiles of the same era, notably in regards to aerodynamic function.

One school of thought holds that Fuller felt that he must be punished for his daughter's death.[43] His design philosophy was built upon guilt. To appease his God, Fuller built his designs —or his trophies. Thus, the Dymaxion Vehicle is composed of tropes of sacrifice and mental associations that are manifested in traditional automobiles. The Dymaxion Vehicle is a playful interpretation that relates forms, such as rounded doors, and faceted windows, that had never been associated in this manner before. These tropes are based upon "rhetorical figures of signification" (Frascari 1991:15).

It can be argued that Fuller, along with the designers Bel Geddes and Jaray, created a new code category for automobiles during the 1930s. He created functionalist, aerodynamic, mobile structures. He provided a new expression for automobiles in 1930s society and culture by introducing new materials into the perceptual continuum, which had hitherto not been segmented for that purpose. Fuller proposed a new way of organizing codes, both verbally and three-dimensionally, within a segment of society. These codes are the semantic units expressed as:

vehicles/automobile/transportation/mobile-structure/Dymaxion/car/streamline

As Eco previously claimed, a society must recognize the "radical code inventors" in order for them to be recognized as such (1976: 256). Fuller proclaimed that he was an outcast of society during the 1930s. He was only an outcast to the general public and not to the other streamline designers of the era. Fuller himself states that "If I had not in 1927 committed "egocide," I would probably have yielded long

43 Fuller blamed himself for his daughter's death. He felt a tremendous amount of guilt for not bringing his daughter the walking-cane that he had promised her when he returned from the Yale-Harvard football game. His daughter died soon after his return from the game and the only thing that she asked for was for the walking cane she wanted him to bring back from his trip. See Hatch, 1974: 77.

ago to convention and there with suicide of my 'only-for-all-others' initiative" (1983: xxviii). Fuller believed that he was "unconventional" through his egocide, signifying the suicide of the ego. According to Fuller, this event allowed him to focus his design intentions towards helping humanity. He martyrized himself; it was a baptism of the spirit and of the ego. He became the creator of forms that would help humankind.

The Dymaxion's failure can be attributed to Fuller not being accepted as a prophet of his era. As the design historian Jeffrey Meikle points out:

> Experimental cars like the Dymaxion and radical production cars like the Airflow stimulated publicity, but automakers capitalized on the fad with minor body changes. Automobiles of the early thirties, introduced before streamlining became a sales concern, had some rounding of corners, but generally they had rectangular lines. From 1935 to 1937 the impact of streamlining on auto body design became apparent. (1979:165)

The streamlined vehicle's failure, according to design historian Donald Bush, is suggested in the form it represented. The form, according to Bush, had an iconic relationship with the Zeppelins, which in 1917 were used in aerial bombings on London. Another similar form was the sub-marine: "...a vehicle for terror in the Great War." These designed artifacts had a tapered, cylindrical body that provided easy "penetration and minimal turbulence in their wake." Both moved slowly but efficiently through their fluid environment and were equipped for climbing and diving, as well as being stabilized to prevent rolling. Zeppelins and submarines were designed to move silently in their environment so as to avoid detection. They became known as forms of destruction, making a deep impression on twentieth-century society (Bush 1975: 8). This early negativity accounts in part for the Dymaxion's failure to generate enthusiasm among the American public.

American public's failure to accept the Dymaxion Vehicle is also due to the accident of 1933. While traveling to the 1933 "Century of Progress Exposition," the first Dymaxion Vehicle, was involved in an accident that killed the driver and injured Fuller. As Bush notes, the newspaper headlines depicted the Dymaxion Vehicle as a "freak car," and declared that the "radical three-wheel design" was the cause. Fuller was exonerated after an investigation, but not before media coverage damaged the reputation of the vehicle *(Ibid:* 108).

The Depression also contributed to the Dymaxion Vehicle's failure. As design historian Martin Pawley notes, "...there were no more customers for Dymaxion cars (sic)" (1990: 78). The factory was closed and the assets were sold, a common occurrence for industries in the Great Depression *(Ibid:* 78). Fuller's contemporary, automobile designer William Bushnell Stout, considered Fuller's vehicle conceptions "far ahead of their time" *(Ibid:* 59).

Fuller had different cultural values than those of the majority of the public had during the 1930s. The Dymaxion was a *cultural releaser* or culturally significant only if an *interpretant* existed, in the mind of an *addressee* or *decoder.* This is why the Dymaxion was neglected.

Fuller did not work on any other vehicle designs until 1943, the "D- 45." This vehicle design adopted many of the design principles used in the earlier Dymaxion Vehicles, although it did change somewhat in appearance (Pawley 1990: 79). What changed drastically was society's ideology and belief system, which together constitute the perceiver's "cultural matrices." [44] Both the environment and the Dymaxion contained elements of human culture that were demonstrations of how the world was inhabited in the 1930s. By placing the Dymaxion in a museum, the culture of today is supporting the idea that the car is revolutionary and worthy of exhibition in a sacred space.

The "reading" of the codes that Fuller produced in the Dymaxion form a grammar of the product. These consist of the syntactic, the semantic, and the pragmatic codes that Fuller used. The technical codes and engineering principles of the Dymaxion Vehicle, such as the steering mechanism, engine, fuel, and wiring, all have communicative content. Eco does not believe that these elements have any communicative "content" , although they do have "content." They function as the pragmatic codes of the product. It is important to understand why Fuller chose certain geometric equations and kinetic theories to perform certain functions. These mechanisms were derived from an Einsteinian conceptual framework and included the pragmatic codes.

Fuller uses the following to support his claim of the value of automobiles in regards to the technical codes of the rear engine:

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44 Prown defines *cultural matrices* as the belief system of the perceiver of an artifact. The patterns that comprise these cultural matrices are similar to a film. Prown notes: "The sequence of synchronic patterns that could be triggered by an artifact resembles the sequence of frames in a motion picture; in theory, if we could retrieve all the patterns, we would have a film history. In practice, only a few patterns are accessible, primarily those of the original fabricator and the modern perceiver." For more on "cultural matrices" see, Prown, 1982: 6.

> The forward overhang of the main frame 15 pitches upwards from the forward wheels and terminates at about the bumper level of conventional cars or slightly higher, the purpose of which among other things, is to take any collision impact in the event of accident at a point well in advance of the front seat and to receive it on the main frame, so that the inertia of the engine fixed on the rear of that frame will be available to absorb the impact, as is the case in conventional cars having the engine in front (sic). (U.S. Patent 1933: 3)

According to Fuller, the vehicle's principal gain was low-speed maneuverability with a parking distance only 75 mm longer than the length of the car, and a turning radius only 300 mm greater. Fuller often boasted that at 15 mph the car could make a 180-degree turn (Pawley 1990: 69). However, as we can see from the above statement, Fuller fails to recognize that, in the event of a collision, the rear engine would thrust forward and aggravate the damage.

The syntactic code of the Dymaxion Vehicle may be stated as the plan Fuller used. The Dymaxion's syntactic code consists of the typological or spatial plan. In this instance, the syntactic code is the streamlined and functionalist plan.

The style of the Dymaxion Vehicle is a code, establishing an archetypal model of the “streamline” vehicle. The connotation of streamline style is equal to the futuristic style. The iconic code of the Dymaxion Vehicle is equal to the code of connotation. The vehicles are similar in that they are models of transportation featuring wheels, an engine, doors, windows, and a steering wheel. The streamline style is a stylistic connotation. The style categorization, or iconic code, is equivalent to the Dymaxion Vehicle's connotation.

We can discover these ideas, such as the connotations and denotations, through Fuller's patent writings, models, videos, diagrams, and prototypes. Each one of these units denotes a type of automobile. For instance, Fuller stated in the patent writing that the form is bulbous in front and tapered in back, has curved windows, door panels, etc.

The forms were equivalent in all vehicles known as the streamline type. The placement of such codes or elements of the Dymaxion Vehicles were the result of cultural conventions.

The semantic codes consist of the units of the Dymaxion Vehicle (product), and the relations that occur between the product syntagms, as well as the connotative and denotative meanings. The Dymaxion Vehicle is comprised of sign units or sign vehicles such as roof, belly, window, door, and body, which denote the ideologies that are connoted. The Dymaxion Vehicle connotes a system that was in keeping with the functional and sociological categories of the era. The type of car that the Dymaxion denoted was the category known as streamlined. The Dymaxion Vehicle connotes the attributes of a streamlined vehicle such as fast, efficient, clean; in short, it is an emotionally sterile vehicle.[45] In addition to this connotation, the Dymaxion Vehicle connotes the philosophy of Dynamism.

Fuller attempted to convey the natural and artificial environment in his patent writings and other writings of the time. For instance, the notion of nature connoting efficiency and the artificial environment was equivalent to technology, which also equals efficiency. Therefore, Fuller believed that efficiency of form is synonymous with efficiency of function.

The meaning that the Dymaxion Vehicle form evoked was translated by formal characteristics using cross references of images that helped to create a product that was threatening, unwelcoming, functionally efficient, and clean. The Dymaxion Vehicle should be viewed as a representation, although not necessarily an "intelligible representation." [46]

All of these codes are based on the model of verbal language that generates a variety of messages. These codes applied to the Dymaxion Vehicle, writings and diagrams describe the function it performed and fulfilled. The Dymaxion Vehicle communicated its function. It also promoted a certain lifestyle and mode of transportation, signifying the existence of its possible function and lifestyle, even when idle.

The "4D Auto-Airplane" is a mnemonic device that enables a person —the interpreter—to establish an idea or the notion of a "4D Auto-Airplane" and its progeny. The Dymaxion, even if never seen or used, is comprised of codes that can be interpreted. The "4-D" Dymaxion prototypes became a "model" or "type" (Eco 1980: 13) for the development of later streamlined vehicles.

45 The architecture historian Kruft discusses the German philosopher Ernst Bloch's (1885- 1977), statement pertaining to the functionalist designers who created designs that were the same as '" ice cold robots.'" The connotations of their designs can thus be summed up as cold and unemotional. See Kruft, 1994: 440.

46 This refers to Frascari's term of architecture being eloquent and "intelligible."

Fuller and Code Invention: Language

Interpretation is a major aspect whenever approaching a text theoretically, in this case Fuller's patent writings, 4D *Time Lock,* and his other writings of the era. Fuller's patent text, patent diagrams, *4D Time Lock* text, and the Dymaxion Vehicles, are products of American culture during the 1930s. The writings and the objects encourage a certain meaning that a community values. Fuller's meanings and the community's meanings can thus be compared.

Incorrect interpretations of the Dymaxion Vehicle are also a reflection of the belief system that a particular society holds at various times. It is important, therefore, to analyze the writings that Fuller produced in the 1930s as well as the writings of those historians who discuss the Dymaxion Vehicle.

Fuller was against most of the Modernist ideas (Fuller 1969: 32). Yet he created his own style of "functionalist" language, which was exemplified in the patent writing and then applied to his later writings.

The patent writing produces a certain response that is evoked by Fuller's choice of terminology. This interpretation is made possible by using reader-text interpretation. Fuller produces functionalist thought that is exemplified in the written form of the patent and later transferred to an object, the Dymaxion Vehicle, which is a representation of the patent language. These ideas can be expressed in the following equation:

Fuller + (reader + interpreter) + context/content of patent

Semiosis= (Sender = Addressee + context/content of text, and object Dymaxion both equal semiosis)

Therefore, visualized as the following equation:

> (semiosis, interpretation of) context/content of Dymaxion context/content of writings

Similar to the meanings produced in the Dymaxion Vehicle, the interpreter must take into consideration the fact that Fuller's text also had a very limited number of users. There were no users of the Dymaxion in the majority of society since it was never mass-produced. Since there were no consumers of the Dymaxion Vehicles and patent writing, they both can be analyzed as utopian products.

The analysis of both the patent text and the text of *4D Time Lock* help to establish Fuller's utopian dream, the Dymaxion system. Fuller wrote the patent in a particular manner in order to perpetuate his theories and philosophies. His verbal strategy is used to get the attention of the critical and semantic reader. Fuller used this verbal strategy to perpetuate the myth of functionalist philosophy.

4D Time Lock can be analyzed as an artistic text. The patent writings have a certain structure, as pointed out by Fuller. The reader must make a critical and semantic interpretation of these texts. It is the reader's interpretation of the patent writing and the critical and semantic interpretation of *4D Time Lock* that create a certain meaning that is found within the text. This is equivalent to Peirce's semiosis. The interpreter plays a major role in semiosis. To interpret the Dymaxion, patent writing and *4D Time Lock,* the interpreter must see it as an open work, although the text of the patent and *4D* carry a certain meaning.

The verbal strategy that Fuller employs can be discerned by the "semantic reader" [47] and and the "critical reader," ,[48] which appears in the text as a second-level reading. The patent is written for the semantic reader whereas *4D Time Lock* is written for the critical as well as the semantic reader. Fuller deviates from patent rules, laws, or codes in his *4D Time Lock.* In *4D,* Fuller violates various stylistic and grammatical norms. This produces a work with which the reader is unfamiliar. The text, in this case, gets the attention of the critical reader.

Fuller stated the following about interpreting his aesthetic text, *4D Time Lock:*

47

> semantic reader is also known as a naive reader. The naive reader is a type of Model Reader who eagerly awaits, as in the case of mystery novels, ` ` to fall into the traps of the narrator (to feel fear or to suspect the innocent one)...'' The naive reader tends to ponder over which is the best meaning to choose. This type of reader will look at the textual environment or the circumstance in which the utterance occurs within, in order to select what he or she feels is the best choice of meaning. See Eco, 1990: Limits, 55.

48 The critical reader is able to explain the syntactic reasonings behind a text. This type of reader will go beyond the meaning of the text to the formal characteristics that make up the text. See Eco, 1990: *Limits, 55.*

What I mean is, that those who have read deeply into 4D have found their appreciation of life and its progression vastly improved, and in the void a new, fuller, and happier sense of mental poise and purposefulness than they have ever had before. Almost to their bewilderment, they may take the new concepts with them into the thick of life and not be forced to leave them behind, as with the fictitionary based romance of the novel, or the happy *theories* of the university garden which quickly fade and become useless in the big game (sic). (1970: 91)

The text, Fuller claims, affects people's behavior. Fuller's *4D Time Lock* is a fictitious text, although Fuller does not claim it to be so.

Fuller's written language in *4D Time Lock* questions the rules, codes, and conventions of language. By writing in this particular manner, he is questioning the cultural conventions of language. He deviates from phonological, syntactic, semantic and narrative rules.

For instance, Fuller did not use rules of coherence, although he believed that he did so. He was convinced that his written language was different from Einstein's in conveying meaning and reasoning for his writing style. Yet he did not succeed in such an endeavor. Fuller notes this difference of writing styles in the following:

> After I had worked out my own time laws of relativity (but lightly touched on in the paper) I decided to study the books of and by Albert Einstein in the library here. I find that I check with him quite closely materially and abstractly, both as to cause and effect, and even to the relative importance of formula. The unfortunate thing about Einstein has been that he seems to have obscured his meanings behind most cryptic language, quite unconsciously, being of so scholarly a nature; and only those who talk the same language have been his audience. They, as is typical of all aesthetic people, have retained to themselves the appreciation of his truths, if indeed they have appreciated them, thinking thereby to set themselves apart as ones to be admired for their obscure learning. (Ibid: 54)

However, Fuller fails to realize that his language use in *4D Time Lock* was cryptic to the majority of society during the 1930s and remains so even today.

He also claimed that he communicated in a functionalist manner:

> In 1927 I realized that I had to get into semantics in order to define what it is I was undertaking to do. You may recall that I was committed to communicate to my fellow humans only when they asked me to do so. Whereat I must be able to explain in a clear way. (Ben-Eli 1972: 753)

The symbolic mode of his writings can be discovered within the text that describes behaviors, objects, and events that make sense literally; however, the reader of Fuller's Dymaxion Vehicle and his other writings believes them to be pragmatically inexplicable. The context in which Fuller uses them is not justified. The reader feels an uneasiness because Fuller's writings produce semantic waste. There is a surplus of imprecise significations that he employs in conversational and narrative ways that appear superfluous. The writings contradict the message that Fuller is trying to convey, namely a precise functionalist language: the language of an engineer.

Although Fuller believed that he was giving the reader precise significations, he was not in fact respecting the narrative conventions of the late 1920s and 1930s. He did not convey more ideas in fewer words; he did the opposite. Fuller claimed, "You can talk *simply and to the point* without 'talking down'" [italics mine] (1970: 28).

Fuller created his own language-type and meaning. He wanted his language to reflect a specific, engineer-type, language: a patent-language that signified a functionalist language. This patent-type language, however, can be found in his later writings: *No More Secondhand God* and *And it Came to Pass.*

In the following statement, Fuller conveys his ideas on language and the manner in which language should be applied in this functionalist vein:

It requires excrutiatingly severe mental effort to record thoughts in a manner that will assure their usefulness. This is here set down in juxtaposition to the product of the aesthetically minded phraseologists who judge by quantity and formula not by philosophy (sic). (1970: 40)

It is the content (the philosophical meaning) that is important and not the quantity. He wanted to apply his engineer's philosophy to language, to do the most with the least; to convey the most "meaning" with the fewest words. However, he did not always achieve this.

The historian Robert Marks describes Fuller's semantic waste in the following terms:

Bucky has never been easy to understand-even by those best equipped to grasp his meanings, and those who know him best and love him most. The reason is both psychological and semantic. He overloads the channels of communication. He is ever ready to give too much of himself too spontaneously, too richly, and too quickly. The simplest question evokes a torrent of insights. (1960: 3)

Historian Martin Pawley also notes that the text of *4D Time Lock* is a seminal text that is sparsely illustrated. Pawley states:

'4D Timelock' is a rambling yet condensed document, with hasty sketches, bold chapter headings and short chapters, and frequent references to hundreds of pages 'left out for clarity' while space apparently remains for endless inconsequential correspondence from relatives and celebrities ...(1990: 41)

Fuller, in inventing these new language codes in *4D Time Lock,* was proposing new and imprecise sign functions. His writing style was beyond duplication because he invented his rules as he wrote and designed.

In Fuller's language, it is difficult to distinguish the various “signal units.” [49] His signals in the *4D* language are dense and difficult to duplicate. It is consequently difficult to isolate the “productive rules” [50] that he incorporated into his work.

Every interpretation uncovers aspects of the codes that may not have been pointed out or seen previously. If we concur with Eco, it was the public's fault for not putting the effort into interpreting Fuller's writings and designs through a critical process of interpretation, because Fuller's language as well as his designs were to evolve both in form and meaning.

To interpret Fuller's patent writings, the interpreter has to challenge existing codes and interpret hypotheses that will help him or her comprehend the forms of codification that Fuller used. If the interpreter finds the uncoded elements difficult and complex in their context, it is up to the interpreter to realize that Fuller's message was not based entirely on previous codes. He often referred to non-explicit conventions

49 Eco defines signal units as the following: “For instance, the proper objects of a theory of information are not signs but rather units of transmission which can be computed quantitatively irrespective of their possible meaning, and which therefore must be properly called signals and not signs.” See Eco, 1976: *Theory,* 32–33.

50 Productive rules, according to Eco, are the rules and conventions that govern the creation of an object or a text. See Eco, 1976: *Theory,* 181.

and codes that had been posited before his code-creating, such as the conventions of patent texts and the conventions established in Paul Jaray's and Henry Ford's designs. The interpreter, therefore, must have rules of competence in order to interpret the message contained within the text.

Most interpreters tend to create their own meanings, that do not necessarily match what the designer wanted or intended it them to mean. The interpretation of Fuller's text of *4D Time Lock* and the patent, therefore, is marked by our own cultural biases.

Conclusion

Peirce's semiotic offers a methodology for a semiotic analysis of a related set of form/text/graphics such as Fuller's Dymaxion Vehicles, patent text and diagrams, and book *4D Time Lock.* Fuller created a new sign system for product designs and texts in the America of the 1930s. He can therefore be counted among the first generation of American designers, a group that promised the public a better future. Their faith in science, technology, the American system of mass production and the idea of good industrial design struck an optimistic cord in the bleak days of the Depression (Bush 1975: 1–3,; 181–186).

Peirce's semiotic also offers a method that is based upon generality rather than specificity: It is not a comprehensive framework in which the failure of one area collapses the whole structure (Colapietro 1995: 47). Peirce's phenomenology and epistemology can be used for an investigation of the processes, methodologies, and theories that are used to develop a building or industrial design product. They also can be employed in the investigation of the meaning of language, in this case the language of a particular designer, Fuller. Semiotics, as a theory, offers instruments for analysis, although not necessarily a design procedure.

Peirce's semiotic offers the possibility of better understanding how Fuller's beliefs, habits, and values came into being and how he justified them. Fuller was essentially a *pragmatic* designer who concentrated on the future, stressing movement and action through his language and Dymaxion designs. In promoting his Dymaxion Vehicles, Fuller turned toward language and discourse in order to persuade the readers of the values and beliefs that were reflected in his own designs and writings.

Fuller unwittingly made use of Peirce's concept of *semiosis,* including his definitions of *sign, object,* and *interpretant.* These three relata contain the notions of *collateral experience* and *observation,* which were fundamental to Fuller because of his naval and engineering experiences. His experiences were the basis for the Dymaxion Vehicle design.

Peirce's speculative grammar categories of *index, symbol,* and *icon* also figure into this *resemantization* of Fuller's texts, diagrams, and vehicle designs. The *index* helps to disclose the various spatial connections that exist between the three-dimensional form and the diagrammatic patent drawings. The numbers used in the patent diagram and contained within the patent text function as indices; they direct the interpreter to the two-dimensional form of the diagram, thus creating a relationship between the text and drawing. Fuller also used indices in his patent language. For instance, the words *this, that* and *here* are all pointers that create a spatial connection with the patent diagram drawings. These indices help guide the interpreter to the object in question, namely the Dymaxion Vehicle diagram and patent text.

Peirce's *symbol* is characterized in Fuller's belief and value system as exemplified in the title of the vehicles, houses, shelters, bathrooms, and other components in his system, the Dymaxion. This composite name, as we have seen in its etymological roots, symbolizes and connotes Fuller's philosophy as it is brought into the physical world through the Dymaxion Vehicle. Ideas can exist as symbols, and therefore the term Dymaxion denotes the class of automobile known as the 'streamline' vehicle. However, the terms 'streamform' or 'teardrop' had wider currency than the term 'streamline.' Fuller, however, used the term Dym- axion; it was —and remains—proprietary, being Fuller's own. He used it to validate his theories and designs as an emblem of rational design and as a self-congratulatory seal of approval. By using the term 'Dymaxion', Fuller institutionalized his ego.

The Dymaxion functions as a symbol or token; its meaning comes from the social conventions of a particular social group —those who understand basic aerodynamics—and thus its form becomes symbolic for them. Fuller realized this symbolization of vehicle design. However, he failed to realize that the streamline design he promoted was also a symbolic form.

The term *Dymaxion* carries a meaning that reflects the ideology of the era. Designers of the Depression era advocated the style called streamlining in all products in the hope of streamlining society and creating a more efficient society. Americans during the 1930s refused to accept these designs, which were based upon an ideal Platonic form. They related the forms to their own personal lifestyle, which was not analogous to the smooth, impersonal surface of these designs (Meikle 1979:186).

Fuller's language, as well as his Dymaxion Vehicle design, is symbolic in content. He claimed that there was a certain syntactical arrangement to his language: a symbolic arrangement that could easily be interpreted. However, the interpreter must agree with Fuller's symbolic language and meaning. The meanings contained within his language, especially in *4D Time Lock,* are only readable to the few who can decode the syntax that he used to translate his thoughts on design.

Peirce's icon can also be applied to the Dymaxion Vehicle. Since Peirce's icon is based on similar relationships between two or more ideas or objects, a comparison of the ideas and qualities that were the impetus behind Fuller's creation of the Dymaxion can be made.

The patent diagrams and the diagrams of the “4D Auto-Airplane” function as icons. Fuller's original diagrams of the “4D Auto-Airplane,” which was the motivation behind the Dymaxion Vehicle, are based upon the functionalist product design theories of the 1930s, which promoted the teardrop form. They also incorporate the history of streamlining that helped Fuller create a relationship between the environment and the form to be built. The product design theories were philosophies applied to a product form. Fuller transformed a theory into a philosophy, thereby making it mythic in nature. A theory can never be a philosophy.

It is through the diagrams that Fuller became the observer of both his physical environment and his inner mental environment. The diagrams, in addition to being physical icons, became what Peirce termed the *mental icon* or the *psychic product* of Fuller's utopian vision. Fuller's contribution to 1930s American culture was a new type of idea, more so than the streamlined form of his designs. The industrial designer Paul Jaray had developed a streamlined vehicle at an earlier date.

Although Fuller denied that his Dymaxion Vehicle design was biological in its orientation, his Dymaxion Vehicles are Darwinian in their motivation. Fuller wanted a design that was the best of its kind, and the form was to be the most perfect form. This Darwinian motivation is suggested in *4D Time Lock,* in which he discusses the rules of the interpretation of patents (1970: 26, 80).

It is important to note that Fuller first wrote *4D Time Lock* and executed sketches before he applied these ideas to his Dymaxion patent text, diagrams, and prototypes. The semantic level is thus applied to his language and then carried over to the patent and Dymaxion Vehicles.

Codes are also a part of Fuller's writings and vehicles. It is these codes that convey the signification of his writings and vehicles. Through a communicational process, a relationship between interpreter and object-text occurs. This relationship conveys the meaning of the vehicle and text. Thus the Dymaxion Vehicle can be viewed as a text through the same processes used to interpret the Dymaxion Vehicle's meaning.

Semantic, pragmatic, and syntactic codes are also illustrated in the Dymaxion Vehicles. These codes are the technical elements used, the plan used (i.e., —the streamline), and the denotative and connotative meanings of the Dymaxion Vehicles. These codes are all based on the model of verbal language, the primary function of which is to convey a message.

Fuller's Dymaxion Vehicles created a new relationship with the environment. The Dymaxion Vehicles still contained elements of kinetic motion and the laws of physics that were applied to all land vehicles of the era. Fuller, however, changed the terminology used to represent this relationship. He created new analogies and metaphors to promote his functionalist philosophy, which he hoped would become a theory of proof for the laws of nature in streamlining and aerodynamics. The Dymaxion was created to function with and within the environment, not against it.

Codes are also found in Fuller's language. He claimed he was not a Modernist designer, yet the language and philosophy of the patent contradicts this stance. The patent writing produces a certain response through its terminology. Fuller produced functionalist language in the patent text and then he transferred that language to the Dymaxion Vehicle. This strategy helps to perpetuate the myth of his functionalist philosophy.

4D Time Lock is a fictitious, artistic text that requires a critical interpretation. Fuller violated stylistic and grammatical norms to produce a work that the reader of the 1930s, as well as today, would find difficult to understand. He did not use rules of coherence, although he often claimed otherwise. In *4D Time Lock,* there is an abundance of semantic waste, a surplus of imprecise significations. This book is the opposite of what Fuller wanted to convey, which was a concise, precise, functionalist language.

Fuller's Dymaxion Vehicles and texts are cultural signs that function as an expressive system, conveying meaning. Both Fuller's texts and his objects form a particular grammar that can be read by the interpreter. This interpretation is made possible through the pragmatic philosopher Charles S. Peirce's semiotic theory. This study represents a resemantiza- tion of Fuller's Dymaxion Vehicles, patent diagrams, patent and *4D Time Lock* texts.

Peirce's Semiotic Theory as a Potential Tool for Industrial Designers

Peirce's semiotic theory offers a powerful method of analysis of the industrial design object. His theory may help industrial designers to anticipate the consequences of their designs and help them to understand how their designs impact their sociocultural environment. As a profession, industrial design needs to have a theoretical base from which designers can appreciate the cultural importance of their designs. Peirce's semiotic has attracted architectural critics and theorists, but has hardly begun to be applied to its full capacity in industrial design. It is an investigation of the designed object using the powers of interpretation and inquiry. This is accomplished by means of the method described below.

First, a definition of Peirce's semiotic terms by an inquirer is necessary. It is important to define Peirce's terms of sign, object, and interpre- tant as well as his terms icon, index, and symbol. It is on the basis of these six relata, and the relationship that exists among them, that his premise of *unlimited semiosis* is defined. In this step, the first task of the inquirer is to articulate a definition of the term, and then determine the conceivable consequences, if any, of identifying an object as a sign through the process of unlimited semiosis.

It is the designer's responsibility to reconceptualize Peirce's terms and define them as a “rhetoric of logic” instead of the classical law of logic. This study is based on the assumption that it is not so much a “logic of rhetoric” as in the modernist approach, but a “rhetoric of logic.” It is a matter of how things appear to be written so as to produce a form of logical meaning that is important to this study (cf. Colapietro 1995).

The second part of this process consists of describing the object under inquiry. The question needs to be asked: How is this particular design relevant to Peirce's terms of interpretant, sign, and object, in the process of unlimited semiosis? The cognitive implications of the design, which includes its symbolic, indexical and iconic relationship to its socio-cultural context, is questioned.

Through Peirce's process of unlimited semiosis, Fuller's Dymaxion Vehicles, Dymaxion Vehicle patent text, and similar writings of the period, can all be interpreted as signs interacting with one another. His semiotic theory functions as a theory of communication. It pertains to how communication helps "in the formation and reformation of cultural institutions" (Langsdorf and Smith 1995: 2). It refocuses on culture. Peirce's semiotic is not only a return to the object or the physical thing itself, as Husserl claims, but it includes our perceptions of the world in which the object functions. It is a process of how we understand our world and our designs in context. The investigation of a designer's *Weltanschauung* is therefore important. Peirce's semiotic theory may become a process in which a designer acting as an inquirer might clarify the meaning of his or her designs. The designer must, however, believe that Peirce's semiotic theory is relevant to the investigation of meaning in design.

In this unlimited semiosis framework, Peirce's theory is built upon generalizations that can help to establish certain standards by which the values of communicative designs may be assessed. Peirce claimed that "...the most important operation of the mind is that of generalization (1960/1: 33).

Peirce's semiotic is based on generalities that allow the imagination of the interpreter to use his or her mental facilities to determine the definitions to be used in a particular study. This study follows Eco's belief that Peirce's general theory of signs does have certain boundaries. The interpretation does have certain limitations based upon specific grammatical codes that the author or designer employs. The interpretation, being of an unlimited nature, does not specify that the interpretation is without an object. Any interpretation of a text or a design object, by virtue of the process of unlimited semiosis, occurs through a process that is constantly evolving through the interpretations of a particular culture, or subculture, through critical inquiry. Peirce's theory functions as a mode of inquiry of the industrial design object under investigation; it is heuristic in nature. The theory of semiotic becomes a theory that is fixed within a post-analytic, post-empirical, and postmodern era.

If we accept that everything is a sign, or part of a sign system, as Peirce did, then all objects make reference to each other. In this study, Fuller's Dymaxion Vehicle —the object under inquiry—is in relationship to everything else brought forth in this investigation. The Dymaxion Vehicle, patent text, and Fuller's other texts help to support Peirce's theory that all signs make reference to each other. The texts support the idea that the design object is not to be read as a text, but is to be interpreted by means of similar processes. A text is linear —it has a beginning, a middle and an end, and a set sequence that is read in a time frame—whereas a design is not. It also implies that the text of any designer and any text about that designer will add to a new understanding of that designer and the particular design under investigation. The Dymaxion Vehicle is not the center of attention with everything else as signs relating to that object. On the contrary, the Dymaxion Vehicle is a sign that refers and is referred to by its fellow signs that are chosen to support Peirce's semiotic theory.

The design object and the text function symbiotically. The physical aspects of an object under inquiry are important to investigate but so are the processes, which are cognitive, philosophical, and theoretical. These processes should be considered in relation to the object's socio-cultural context. This study assumes that the emphasis on process enables a person not to know the world but to appropriate it using his or her own words and concepts (cf. Diggins: 1994).

Thirdly, it is also important to understand the language used by the designer in order to explain a particular design. This step inquires into how the designer justifies what he or she does through the use of metaphors, similes, analogies, and tropes. It investigates the phenomenological aspects of the design. The syntactic, pragmatic, and semantic aspects of the three-dimensional object are also considered.

Peirce's pragmatic theory leaves behind the Cartesian self and its claim to universal knowledge. It becomes a reconstruction, not just a critique of an object or idea. His theory may help designers to conceptualize designs through historical examples and aid them in formulating conjectures, testing those conjectures against experience, and then finally using those results.

Peirce's critical inquiry applied to Fuller's designs and texts can disclose the manner in which Fuller, through the rhetoric of his texts, justified his designs. How Fuller's designs were symbolic, indexical and iconic helps to place his Dymaxion Vehicle in a socio-cultural context through the use of text analysis. Fuller used his texts to support the ideas that motivated his designs as well as to validate them. Fuller did not use

the pop cultural language of the 1930s, but rather the words of his own community or sub-culture of streamline designers. He was a pragmatist who looked to future possibilities and used critical inquiry to find a problem to solve, which was a challenge to his intellect. The solution, according to Fuller, was his Dymaxion house, Vehicle, and related writings that helped him to validate his design philosophy and functionalist theory.

Peirce's semiotic theory emphasizes possibilities and not certainties. It should not be thought of as a procrustean bed on the basis of which the designer postulates certain goals and then delineates the means to achieve them. Instead, the emphasis should be placed on possible results of conceptions as they are an aspect of a certain community of inquirers. Some communities have conventional ways of acting, thinking, feeling, believing, and knowing. Designers then are to act as observers, not only as observers of their own communities but of other communities as well. They become the observers of human behavior as well as history. This investigation stresses, as does the semiotician Vincent Colapietro, that Peirce's semiotic is a theory of communication and thus a theory of meaning and that the interpretation of signs will help to disclose meaning to the observer.

It is vital to examine, in a socio-cultural context, how a designer's thoughts are constructed through the designer's exclusion of certain ideas. These sometimes elicit arguments contrary to what the designer originally stated. For example, Fuller was not the socialist designer that he often claimed to be. Nor was he anti-Darwinian, but evolutionary in his design approach. He also often stated that his design philosophy was defined by his concept of ego-cide. However, he did not really commit ego-cide, the complete abandonment of his ego. His designs and his writings disclose a philosophy built upon both self-gratification and guilt.

Design can be conceived of as a language activity in which ideas are examined for their edifying importance and history is studied in order to find out how a designer's beliefs and designs have come to be justified through rhetoric, that is, how he or she legitimized his or her own discourse and actions. In this vein of thought, Peirce's semiotic suggests that knowledge is no longer based upon ideas that are faithful to reality. Design should not pursue any theories of “truth” but look to language to develop a vocabulary that is based on conventions. This strategy, akin to the ideas brought forth by the historian Diggins, tends to disclose certain rhetorical devices in order to reconstruct —rather than represent.

Finally, the object's historical context is interpreted. Language and its meanings change constantly from one moment to the next. Although the meanings of some words change, others will stay the same. This step questions which words have the same meaning in the cultural context of the period being analyzed, compared to the period during which the designer originally used them. The conventions of a community will usually determine the meaning of words at a certain moment in history.

Historically, Fuller may be seen as a romantic. Glorifying as it did optimism and the upward movement of life, his vision of a utopian society appealed to the American romantic psyche, which left the past behind when the Depression undermined faith in American values. This study supports the idea put forth by the historian Diggins, according to which pragmatism represented more a form of romanticism than a simple radicalism; the world was therefore viewed as representing future possibilities. As Diggins claims: "...any philosophy that looks for truth in action has a rendezvous with romanticism" (1994: 49). Fuller, in this Romantic manner, hoped to develop designs that would persuade Americans of their social and political value.

Designers can make history serve them by analyzing previous designs in their own area of expertise. Designers may be able to use ideas that have been once thought of as radical, utopian, and revolutionary. What has been previously termed radical may not be so radical by the standards of current modern technologies. The designer may be able to analyze earlier patents and designs and apply today's technology to make these designs serve present social and cultural conditions. For instance, Fuller's designs were often termed radical, utopian, and revolutionary for their time. Today's designer, by analyzing such designs, may be able to produce vehicle designs that are more creative. By a historical analysis of Fuller's Dymaxion Vehicle using the patent diagrams, patent text, three-dimensional form, and relevant texts, the designer may be able to identify how Fuller's Dymaxion Vehicle designs helped to shape future designs in transportation. Designers should consequently use history to make it serve the present.

Most designers today are unaware of the meanings they incorporate into their designs. Like Fuller, other Modernist designers believed that their work was “pure” and rational, free of symbols and icons. They failed to realize that their work was also symbolic, iconic, as well as indexical. Designers should take charge of qualities in their designs if their designs are to be more interesting and meaningful for consumers as well as for themselves.

This study supports the idea advanced by semioticians such as Lenore Langsdorf and Andrew Smith, namely that Peirce's pragmatic theory of semiotic is evolutionary, not revolutionary. Designers should anticipate an evolution in thinking, acting, and doing as a function of how they use communicative strategies to link and justify their designs.

This study also follows Diggins' research by stressing that through Peirce's semiotic rhetoric, conversation, narration, and discourse are disclosed and should be used to offer a means of coping with what has been labeled “the crisis of modernity.” To analyze design in a Peircean framework, one must focus upon representation, rhetoric, and historical context. This framework may help designers to be more sensitive to and conscious of the meanings they put into their designs. It may also help them to be more creative in a whole new range of forms that may be suggested when one has in mind the symbolic or metaphorical content or intent of the design.

Designs and texts display our perceptions of the significance of our lives. The nature and function of the product's communication is questioned through rhetoric.

Product designers tend to eschew theory in favor of practice. It is important that designers use theory in the design process. Using the approach given above, Peirce's semiotic has the potential to illuminate the communicative process in design in its full complexity.

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During the 1930s the American designer Richard

Buckminster Fuller (1895-1983) created three prototypes of a streamline vehicle design known as the Dymaxion. These vehicle designs function as readable texts comprised of signs that can be interpreted. In order to gain an understanding of how these vehicle designs act as cultural signs that convey meaning, we must also examine Fuller's writings from the same period. His writings have always seemed idiosyncratic, somewhat hermetic, and unnecessarily complex. The semiotic theory created by the American pragmatist philosopher Charles Sanders Peirce holds the potential of arriving at a new understanding of this ``Fuller-speak.''

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List of Figures

List of Tables

Index

Todo list