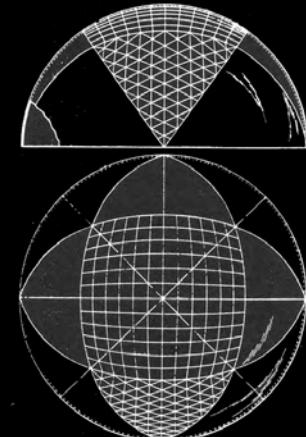


Comprehensive Anticipatory Design Science

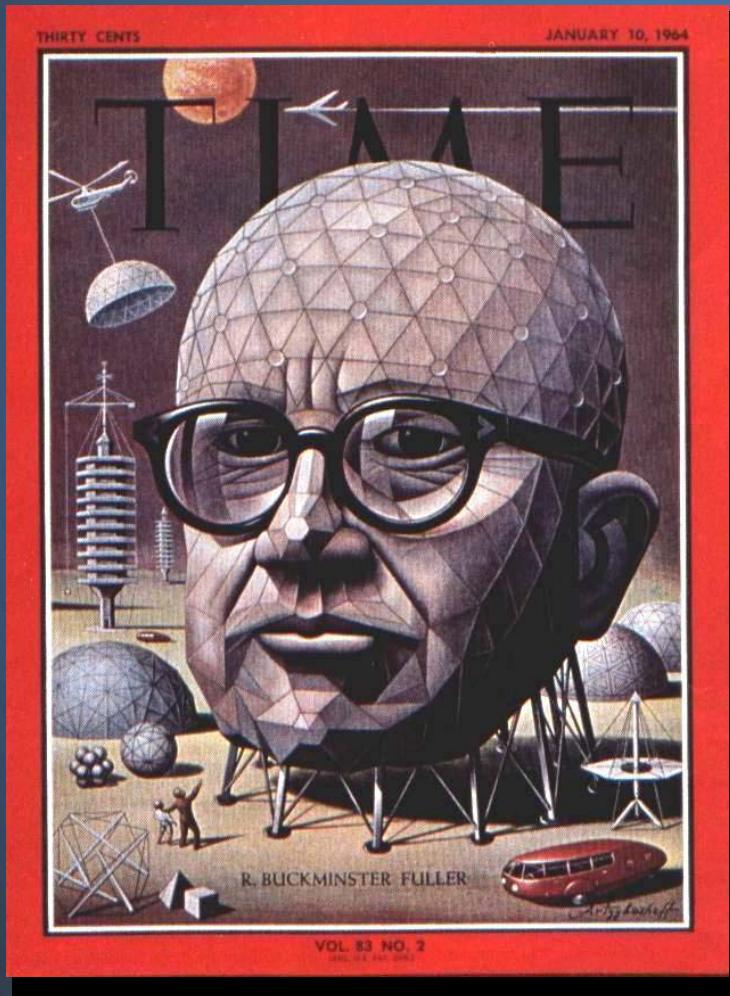
Operating Principles For
A Sustainable World



Greg Watson
Bioneers Global
Amsterdam
May 31 – June 1, 2010



Bucky Fuller



What is Design Science?

“The function of mankind is to think, to discover and use principles. We are here to serve as local Universe information harvesters and local Universe problem solvers employing human mind’s unique access through science to some of the generalized principles governing eternally regenerative Universe. We are going to have to exercise this responsibility within decades or perish.”

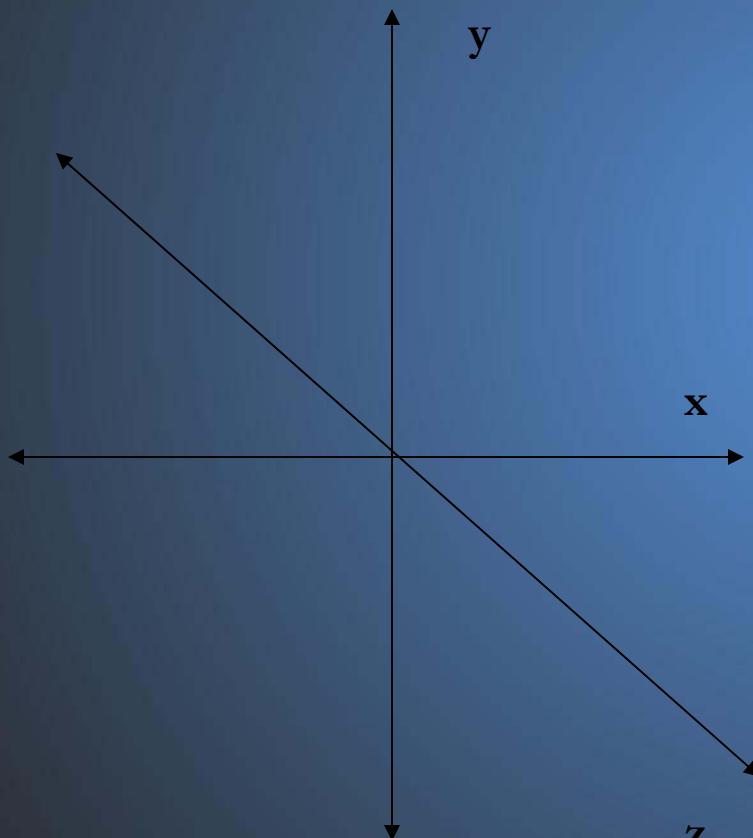
[Design Science is] “...the effective application of the principles of science to the conscious design of our environment in order to help make the Earth’s finite resources meet the needs of all humanity without disrupting the ecological processes of the planet”

Buckminster Fuller

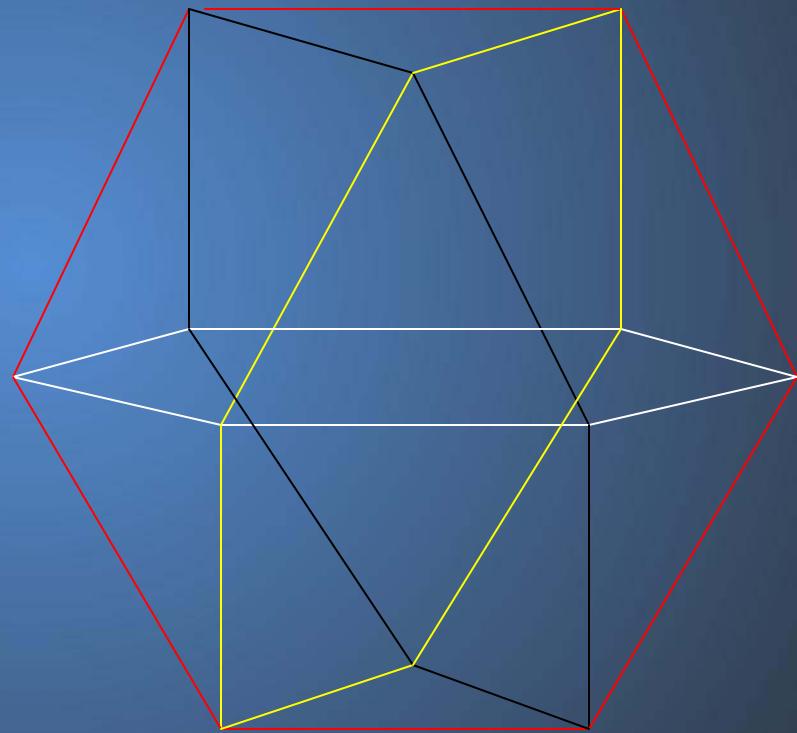
What we know from experience

- Physics has found no straight lines – has found only waves.
- Physics has found no solids – only high frequency event fields
- Universe is not conforming to a three-dimensional perpendicular-parallel frame of reference

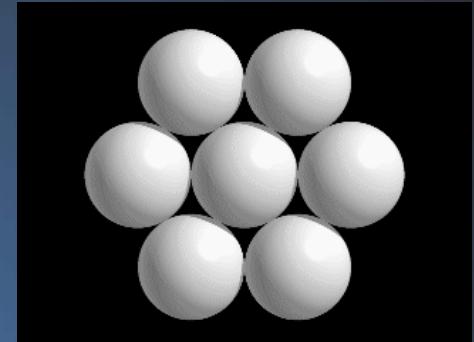
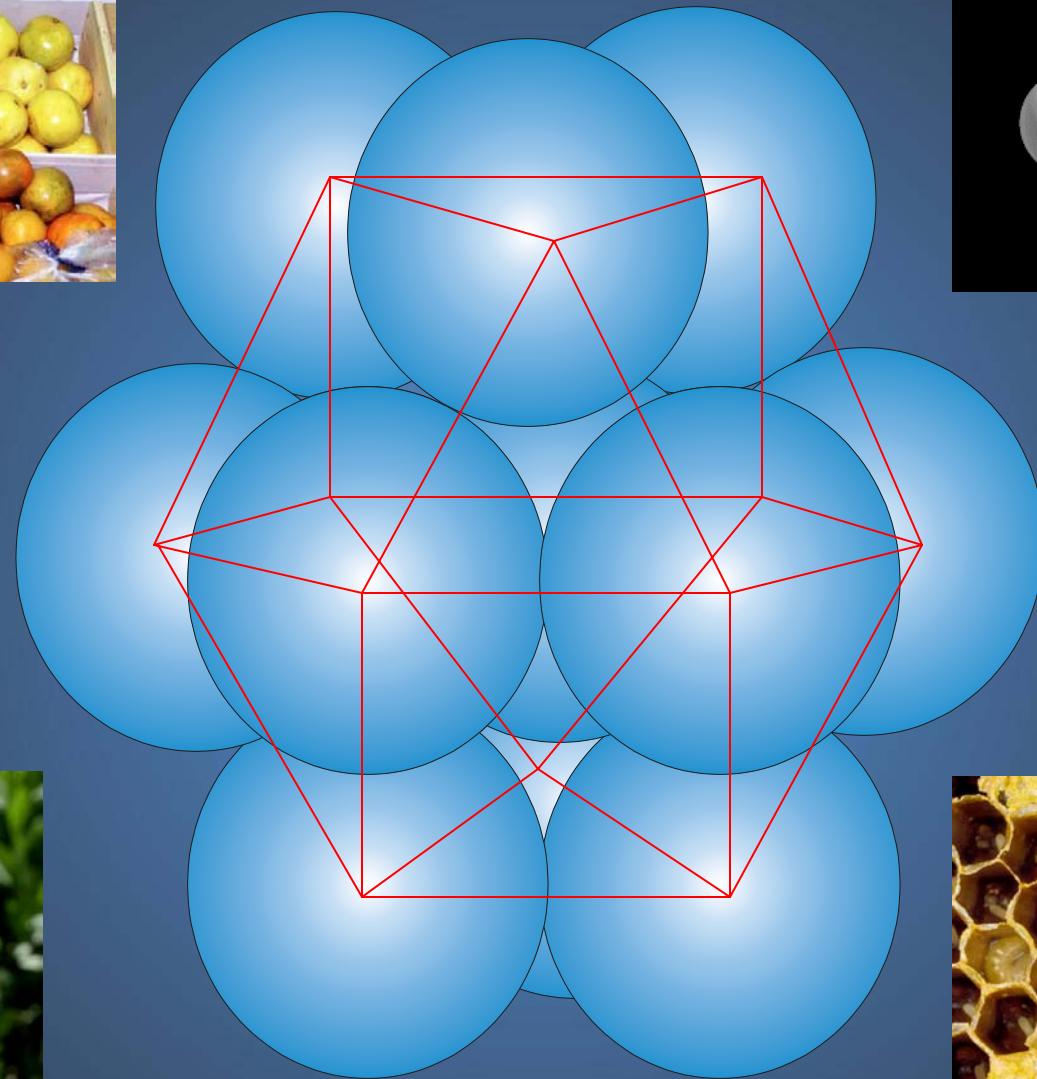
What's Your Worldview Framework?



Cartesian Coordinates



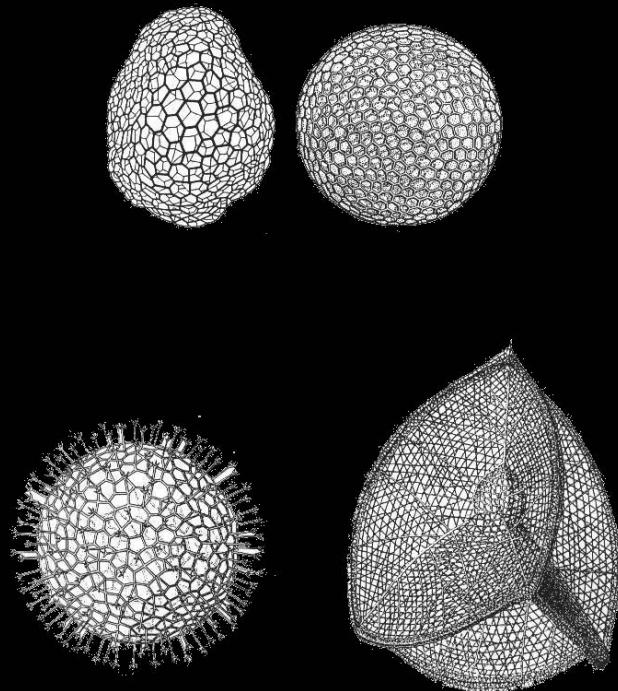
Vector Equilibrium
(Nature's Coordinates)



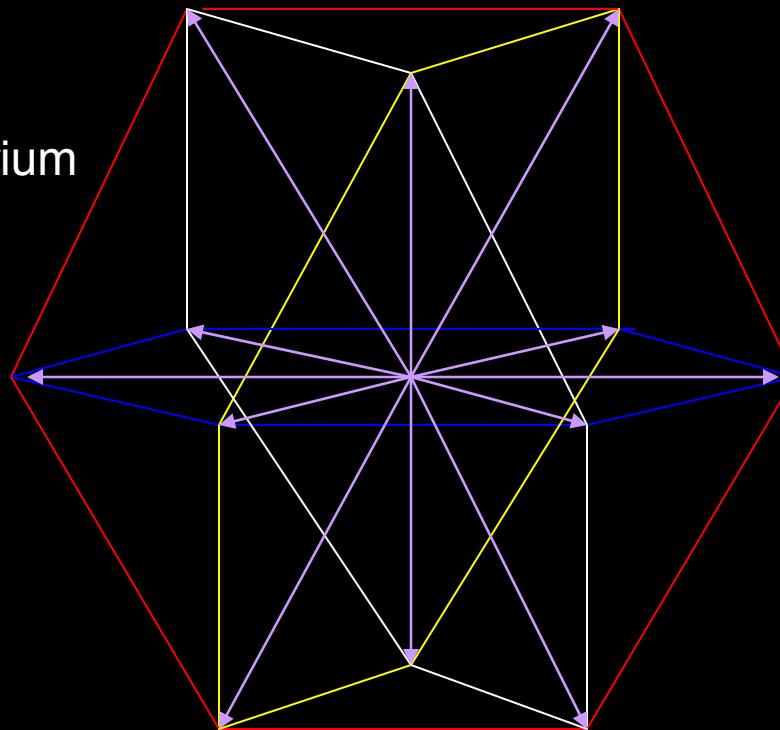
The vectors defining Nature's coordinate system connect the centers of closest packed spheres

Pattern Integrity

Fuller was the first designer in history to understand a structure as pattern comprised entirely of energy and information.



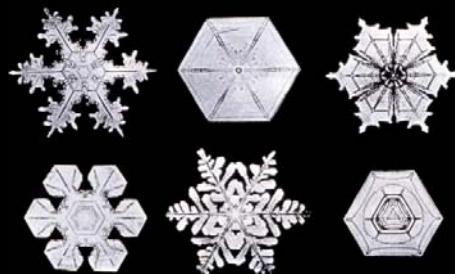
Dynamic Equilibrium



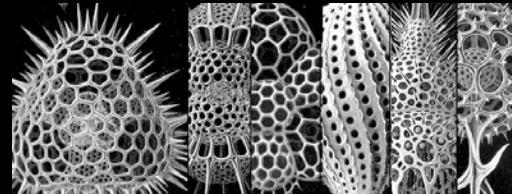
Radiation and gravity always and only coexist. Disintegrative radiation and integrative gravity in symbiosis describe the elusive object of the quest for a “unified field.” In a more poetic sense, these characteristics also identify love as being both shining radiation and all-embracing metaphysical gravity.

Nature's Design Strategy

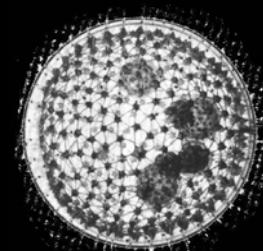
- Minimum Inventory/Maximum Diversity
 - Minimum “toolkit of basic patterned integrities”
 - Maximization of structural forms
- Resilient/Regenerative/Evolving
- Resource conserving
 - Do more with less
 - Gain greatest possible advantage with minimal resource investment



Snowflakes



Radiolaria



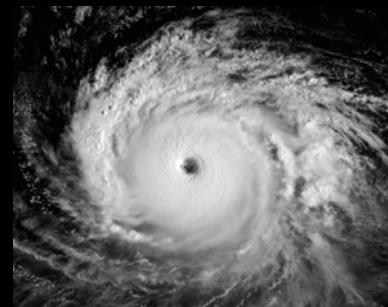
Volvox protozoan

Scalable Design

Nature's Design Principles are Independent of Size



Galaxy



Hurricane



Nautilus



DNA Buckyball



Pollen

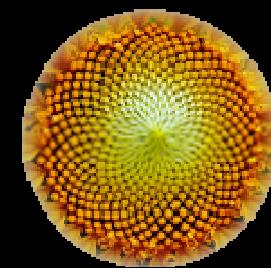
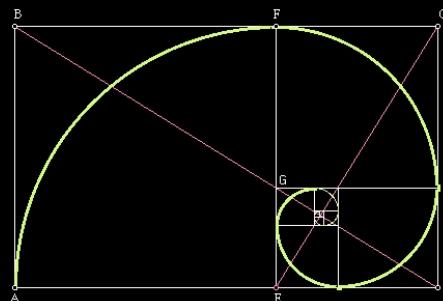


Honeycomb

What Is Technology?

“Humans have thus far evolved the industrial complex designing which is only of kindergarten magnitude compared to the complexity of the biological success of our planet Earth. In its complexities of design integrity, the Universe is technology”

R. Buckminster Fuller, Synergetics: Explorations in the Geometry of Thinking



Rebel Architect

Fuller was the veritable Einstein, the Schönberg of architecture...

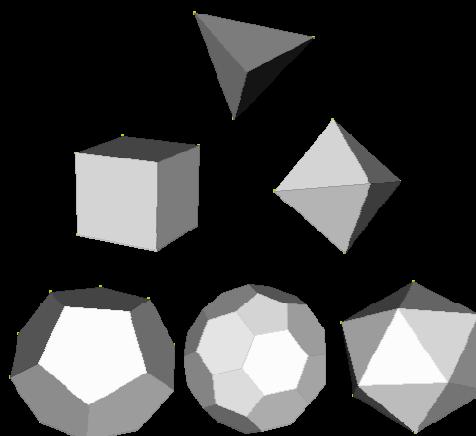
He was the first to truly marry design to science and philosophy...
and *he alone was responsible for more fundamental innovations and transformation of thought than the entire profession could muster or lay claim to in several hundred years.*

“Forget Fuller?” Any 17. 1997
Reprinted in “Far From Equilibrium. Sanford Kwinter (ed)

System

The first subdivision of Universe into a conceivable entity separating all that is nonsimultaneously and geometrically outside the system, ergo irrelevant, from all that is nonsimultaneously and geometrically inside and irrelevant to the system; it is the remainder of Universe than conceptually constitutes the system's set of conceptually tunable and geometrical interrelatability of events

All systems can be modeled as polyhedra



Synergy

Synergy means behavior of whole systems unpredicted by the behavior of their parts taken separately

Water and its life-supporting properties are unpredicted by the properties of hydrogen and oxygen examined separately from one another



The extraordinary tensile strength of alloys is unpredicted by the tensile strengths of its constituent metals



Generalized Principles

- Humanity has inherited an inventory of generalized laws of Universe from the Copernican-Kepler-Galileo-Newton discoveries, which they in turn inherited from their Greek, Mesopotamian, Egyptian, Indian and Chinese predecessors.
- All of the generalized laws can be expressed in mathematical terms.
- They are all eternally operative and interaccommodative.
- Together, the thus-far-discovered generalized laws guarantee the integrity of nonsimultaneous, only partially overlapping, Scenario Universe.
- There is no information to suggest that the inventory has been completed.

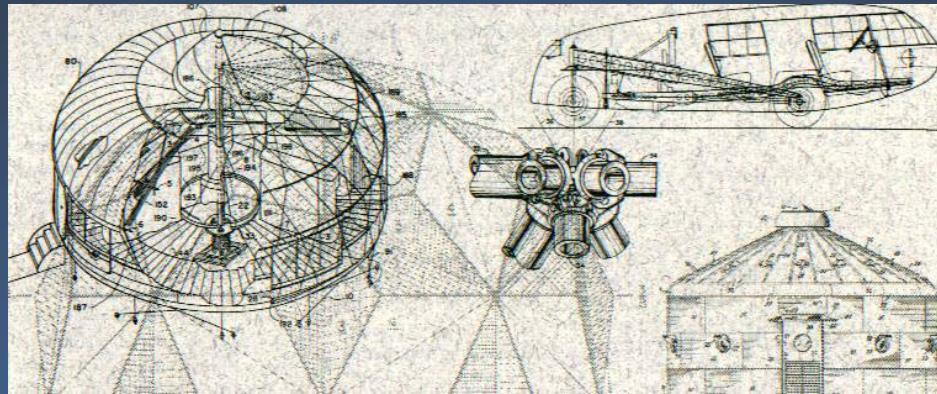
Trim Tab Principle

- Using generalized principles to determine the set of actions which can be taken to change the course of a larger system.
- An artifact or action specifically designed and placed in the environment at such a time and in such a place where its effects would be maximized thereby affecting the most advantageous change with the least resources, time and energy invested.

Design Science Planning Process

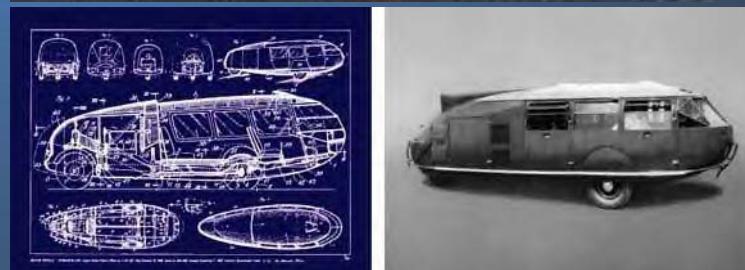
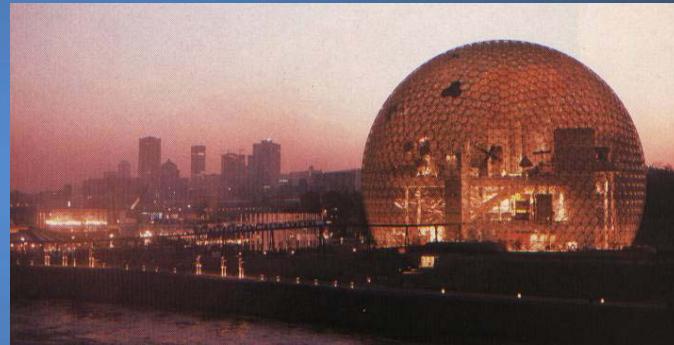
“The greater complex is never predicted by the parts of the lesser complex. Therefore, I surmise that to learn anything you must start with the whole – with Universe.

Buckminster Fuller. *Synergetics*.

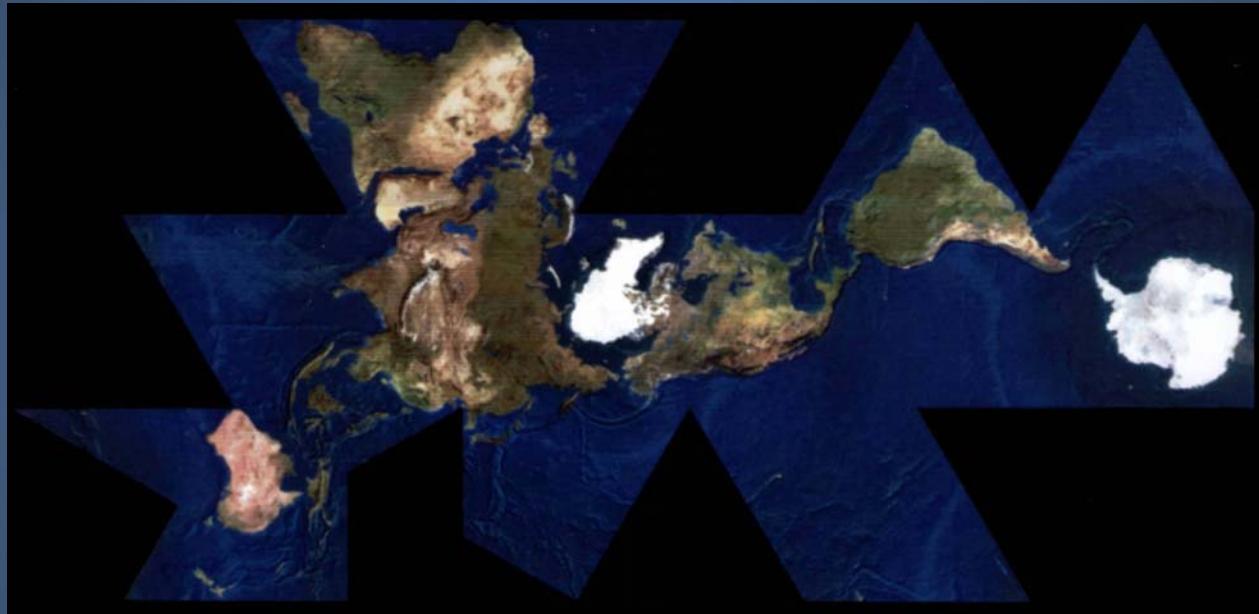


INVENTOR

- Geodesic Dome
- Dymaxion Car
- Dymaxion Rowing Shell
- Dymaxion House
- Dymaxion Map
- Octet Truss
- Synergetic Geometry



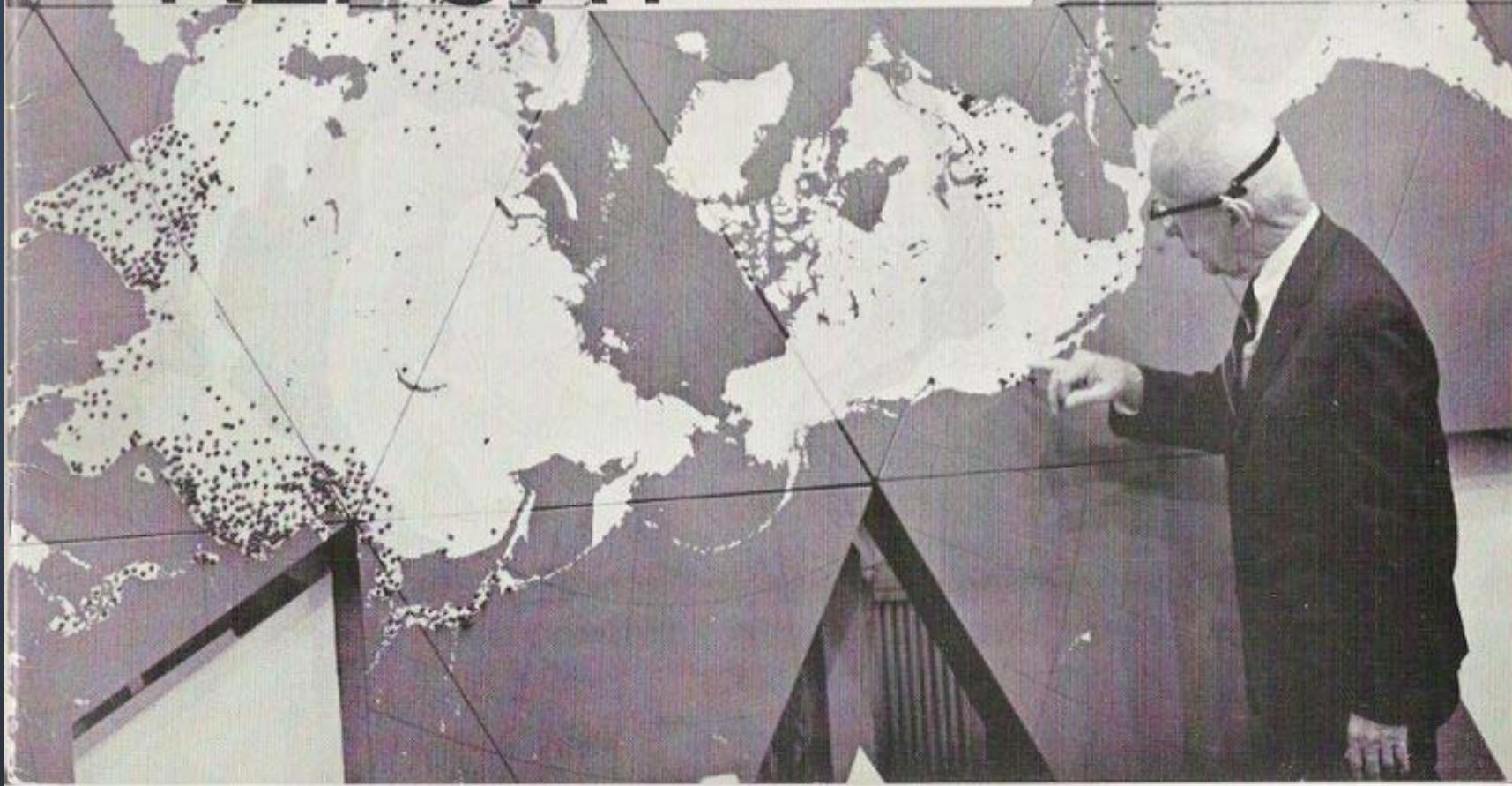
Dymaxion Map



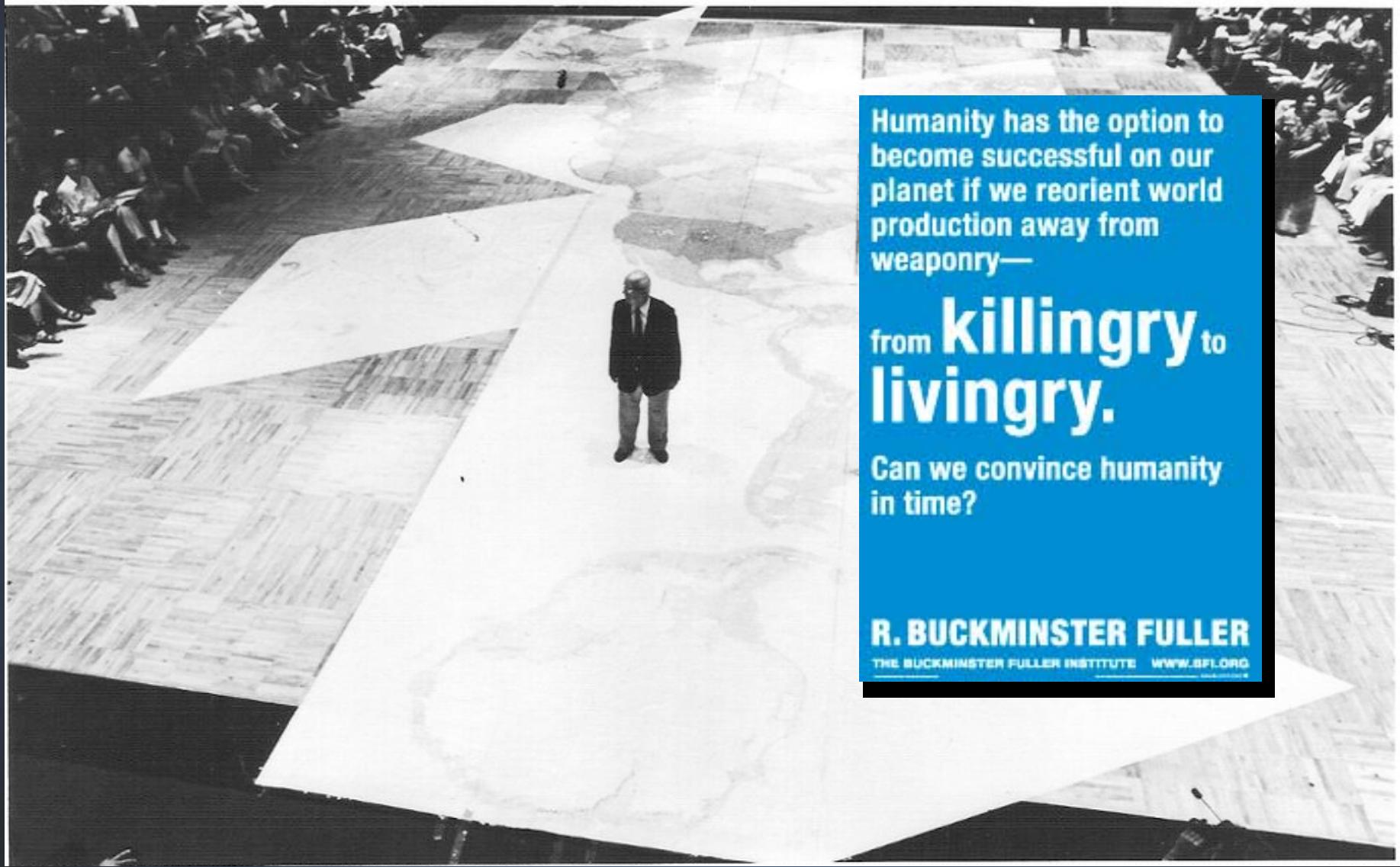
The only flat map of the entire surface of the Earth that reveals our planet as it really is - an island in one ocean without any visible distortion of the relative shapes and sizes of the land areas, and without splitting any continents.

acc 160-12-15

WORLD GAME REPORT



World Game, Not War Games



Humanity has the option to become successful on our planet if we reorient world production away from weaponry—

from **killingry** to **livingry**.

Can we convince humanity in time?

R. BUCKMINSTER FULLER

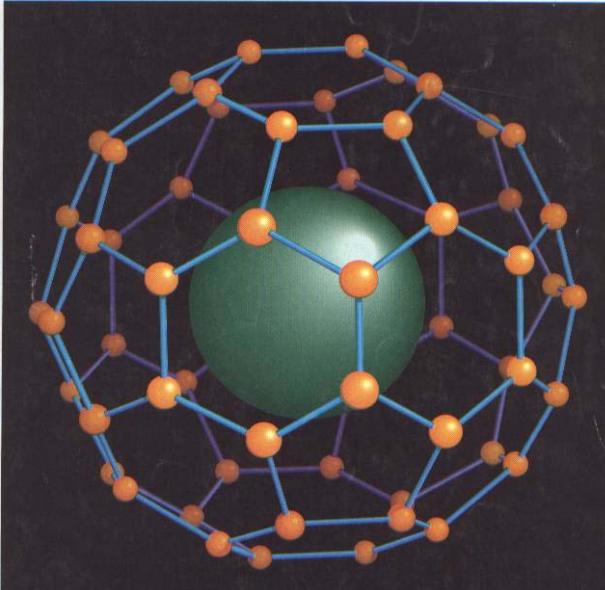
THE BUCKMINSTER FULLER INSTITUTE WWW.BFL.ORG

Buckminsterfullerene

SCIENTIFIC AMERICAN

OCTOBER 1991
\$3.95

*Remnants of a planet that failed to form.
Still no technological fix for oil spills.
What made higher life-forms possible?*



Buckyball, the third form of pure carbon, cages an atom in its lattice.

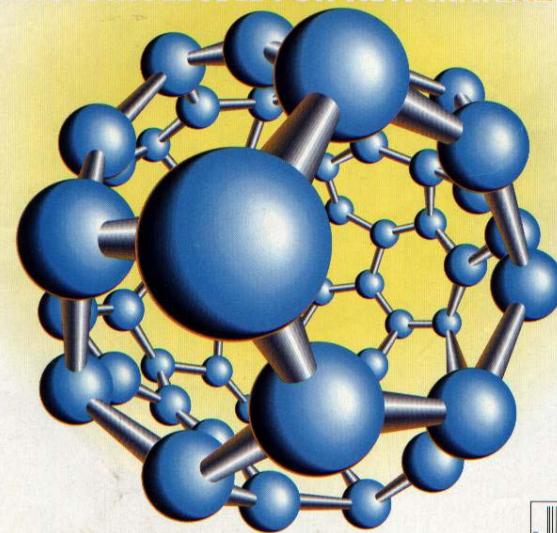
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5-YEAR NEW CAR GUIDE

Popular Science 

NEW TINY 35s

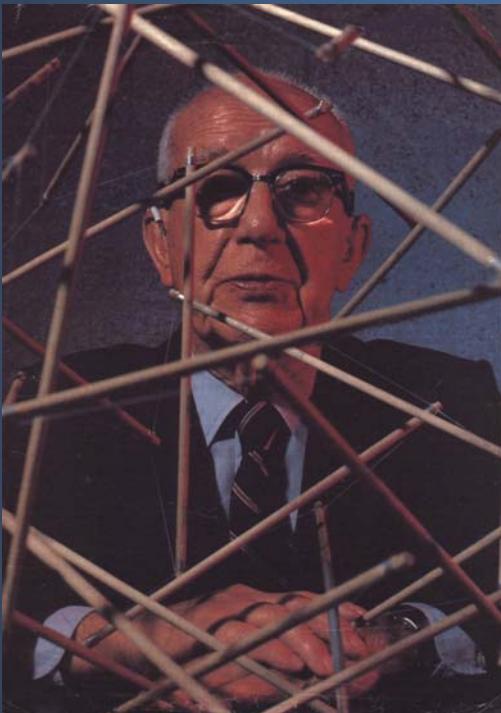
BUCKYBALL
MAGIC MOLECULE FOR NEW MATERIALS



AUGUST 1991
\$2.00
CANADA \$2.50

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Tensegrity



Scientific American January 1998

The Architecture of Life

A universal set of building rules seems to guide the design of organic structures—from simple carbon compounds to complex cells and tissues

by Donald E. Ingber

Life is the ultimate example of complexity at work. An organism, whether it is a bacterium or a baboon, develops through an incredibly complex series of interactions involving a vast number of different components. These components, or subsystems, are themselves made up of smaller molecular components, which independently exhibit their own dynamic behavior, such as the ability to catalyze chemical reactions. Yet when they are combined into some larger functioning unit—such as a cell or tissue—utterly new and unpredictable properties emerge, including the ability to move, to change shape and to grow.

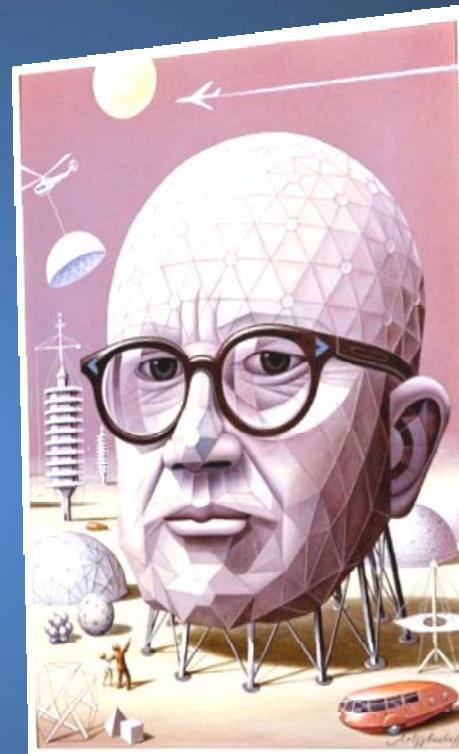
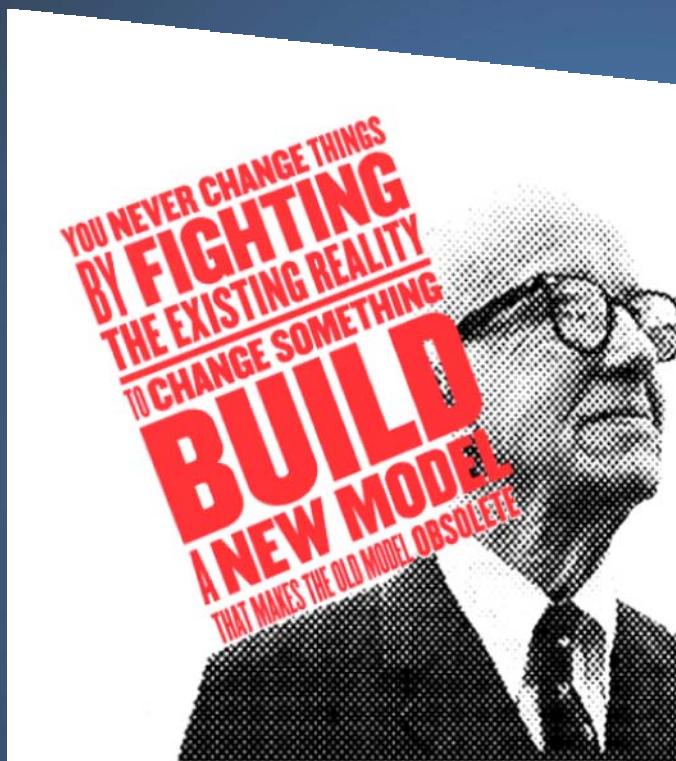
Although researchers have recognized this intriguing fact for some time, most discount it in their quest to explain life's fundamentals. For the past several decades, biologists have attempted to advance our understanding of how the human body works by defining the properties of life's critical materials and molecules, such as DNA, the stuff of genes. Indeed, biologists are now striving to identify every gene in the complete set, known as the genome, that every human being carries. Because genes are the "blueprints" for the key molecules of life, such as proteins, this Holy Grail of molecular biology will lead in the near future to a catalogue of essentially all the molecules from which a human is created. Understanding what the parts of a complex machine are made of, however, does little to explain how the whole system works, regardless of whether the complex system is a combustion engine or a cell. In other words, identifying and describing the molecular puzzle pieces will do little if we do not understand the rules for their assembly.

That nature applies common assembly rules is implied by the recurrence—at scales from the molecular to the macroscopic—of certain patterns, such as spirals, pentagons and triangulated forms. These patterns appear in structures ranging from highly regular crystals to relatively irregular proteins and in organisms as diverse as viruses, plankton and humans. After all, both organic and inorganic matter are made of the same building blocks: atoms of carbon, hydrogen, oxygen, nitrogen and phosphorus. The only difference is how the atoms are arranged in three-dimensional space.

This phenomenon, in which components join together to form larger, stable structures having new properties that could not have been predicted from the characteristics of their individual parts, is known as self-assembly. It is observed at many scales in nature. In the human body, for example, large molecules self-assemble into cellular components known as

organelles, which self-assemble into cells, which self-assemble into tissues, which self-assemble into organs. The result is a body organized hierarchically as tiers of systems within systems. Thus, if we are to understand fully the way living creatures form and function, we need to uncover these basic principles that guide biological organization.

Despite centuries of study, researchers still know relatively little about the forces that guide atoms to self-assemble into molecules. They know even less about how groups of molecules join together to create living cells and tissues. Over the past two decades, however, I have discovered and explored an intriguing and seemingly fundamental aspect of self-assembly. An astoundingly wide variety of natural systems, including carbon atoms, water molecules, proteins, viruses, cells, tissues and even humans and other living creatures, are constructed using a common form of architecture known as tensegrity. The term refers to a system that stabilizes itself mechanically because of the way in which tensional and



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