SYMMETRY: THE NEEDED BRIDGE BETWEEN THE ARTS, THE SCIENCES AND THEIR MATHEMATICS, AND THE HUMANITIES

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The search for a picture, a symbol of how the world works in principle, is a contemporary activity that began in ancient Greece (six centuries B.C.) when Thales asked: What is the world made of? He speculated that water was the fundamental element. Today we think in terms of quarks, although they have never been found. How does Nature work? He wasn't sure. And today we are still not sure. We have some answers but no pictures. Or so it seems.

For the modern period, artists have often referred to how the world works in principle as the "ultimate" or "pure" reality; physicists use the term "physical reality." To the physicist, in terms of partial differential equations or group theory, physical reality is entirely mathematical and does not lend itself to pictures. Is the same true for art?

With all due respect, the representation of the structure of reality is too important an idea to be left to the obscure mathematical symbols of the physicist. As Susanne Langer put it in her book, Problems of Art , "Nothing is so elusive as an unsymbolized conception." Therefore, any effort by artists to create a deeper comprehension of the abstract, ethereal realm of physical reality, no matter what structures are employed, is, at best, tentative and should be a starting point and not a conclusion.

Like poetry, this is a search for an image, not for facts. This is a search for a symbol that could help organize the facts. "It is an effort to

make reality conceivable, memorable." said Langer. My venture into this "invisible, intangible, unknowable" realm of physical reality began in 1986 after I had created a vocabulary of ideal geometric forms, all from the same underlying structure of interacting waves of energy. This theory is based entirely on my struggle to develop a language to communicate the meaning of my patterns and the resulting realization of a loose correspondence between the symmetries I was discovering in my work and the analogous symmetries that one finds at the heart of Nature.

My work's meaning is intended to bridge the gap between the nonvisual mathematical reality of the physicist and the need for a symbolic representation. In bridging the gap, I investigate the boundary between chaos and order, between simple and complex patterns, between reality and appearances.

The modern idea of symmetry, or *invariance* in the laws of Nature, is derived from the ancient Greek idea that underlying all change in the material world, something--an ultimate reality--does not change. A hundred years after Thales, Plato employed simple geometrical symmetries, like translation, rotation and reflection, and the right angle triangle as an analogy for the basic building blocks of the material world. To Plato, the ultimate reality was mathematical. Today the modern mathematical conception of physical reality with its inherent geometric and abstract symmetries is sometimes referred to as being fundamentally "Platonic."

The ancient Greek search for unity has lead in modern times to classical concepts of "atoms and the void" and Relativity Theory, and, in contemporary physics to Quantum Theory and quarks, and a new and deeper respect for the fundamental role of symmetry of the laws of Nature. Astronomer John Barrow sharpens our focus by explaining that Einstein's special insight was to recognize that while our perceptions of Nature may be relative--the same experiment will yield different results for different observers--the laws of Nature are *not* relative. In order for the laws derived from these experiments to be the *same* for "everyone, everywhere, everytime," Einstein required that all physical laws be

invariant under various geometric symmetry operations, like a translation in space, a translation in time, and a rotation in space. In Barrow's words: "The principles of special relativity are statements of *invariances* in Nature. They are laws about laws."

Regarding his work, Heinz Pagles writes, "Today physicists look for new symmetries . . . knowing that these imply new conservation laws. The idea of *invariance*, which was the ancient [Greek] idea of physical law, has in modern physics become the idea of symmetry, and the task of modern theoretical physics is to uncover the symmetries of the world. Most of the history of modern physics is the discovery of new symmetries."

Recognizing these connections, it became important to figure out the patterns through which the laws of Nature show themselves in principle. It seems that I have constructed ideal geometric structures, similar in symmetry content to Plato's ideal forms, not made of triangles, but, of resonating waves of positive/negative energy, a twentieth century analogy of physical reality. Some symmetry concepts explored are: translation in space, translation in time, rotation in space, reflection in space. Indeed, these same geometrical symmetries are common not only in poetry and music but also, said anthropologist Dorothy Washburn and mathematician Donald Crowe, in the carving, tile, pottery, basketry and textile patterns of widely separated and diverse cultures.

My art is not a picture of reality. Rather, in broad principle, in terms of energy, symmetry and structure, my work is a reflection of some of the deepest symmetries that we call the laws of Nature, like our conservation laws. Like the modern conception of physical reality, the process of creating my patterns can first be described in terms of partial differential equations (two waves of energy interact, like light--electromagnetism). Then, several layers of symmetry later, the work can be described in terms of group theory, mathematical forms I was unfamiliar with, forms that describe physical reality and our own ultimate reality.

The common ground for artists, physicists, mathematicians, philosophers, anthropologists, crystallographers and others is that we are

all searching for the same fundamental structure, a structure that somehow explains how Nature works in principle. There is no reason to expect that at the deepest levels of reality there would be any correspondence between views, yet there is no reason why there shouldn't be, at least in broad principle.

For the arts, the sciences and their mathematics, and the humanities, symmetry is the aesthetic bridge that makes visible the invisible architecture of Nature. By calling attention to these concepts of symmetry as an aesthetic bridge between the divided cultures, it is hoped that more of the general public will become aware of the difficult and complex, yet aesthetic, struggle of humanity to understand its origin. This is the struggle to better our lives by creating order from the fundamental chaos of our origin.

Selected Sources:

John D. Barrow, The World Within the World, Oxford University Press, 1990.

Linda Dalrymple Henderson, The Fourth Dimension and Non-Euclidean Geometry in Modern Art, Princeton University Press, 1983.

Karl Gerstner, The Forms of Color, MIT Press, 1986.

Stephen W. Hawkins, A Brief History Of Time, Bantam Books, 1988.

Morris Kline, Mathematics and the Search for Knowledge, Oxford University Press, 1985.

Susanne K. Langer, Problems in Art, Charles Scribner's Sons, New York, 1957.

Lawrence LeShan and Henry Margenau, Einstein's Space and Van Gogh's Sky, Physical Reality and Beyond, MacMillan, New York, 1982.

Heinz R. Pagels, The Cosmic Code, Quantum Physics as the Language of Nature, Bantam Books, 1984.

Charles Van Doren, A History of Knowledge, Bantam Books, 1991.

Dorothy K. Washburn / Donald W. Crowe, Symmetries of Culture, Theory and Practice of Plane Pattern Analysis, University of Washington Press, 1988.

Anthony Zee, Fearful Symmetry, A Search for Beauty in Modern Physics, MacMillan, New York, 1986.