

CREATIVITY IN SCIENCE and ART

Jerome I. Friedman

A common aspect of all creativity, in both science and art, is to give us some sense and meaning of the various observations, impressions and emotions that fill our lives. Art is a reflection of the world around us and within us as interpreted by the artist. In physics, for example, there is a similar objective. Physicists want to understand the various phenomena that are observed in the physical world. They try to find the fundamental principles that explain and relate these phenomena. They want to describe the world in a succinct and beautiful way - very much like a poet. Like a Haiku poem, a set of equations describes and relates a complex assortment of phenomena with a great economy of symbols.

Creativity requires a powerful imagination and a strong intuition. Imagination is always an experimental process. It is the ability to manipulate images and symbols in the mind to make combinations that are totally new. Reasoning is constructed with moveable images, just as poetry is. Very often analogies are the threshold to creativity, which often results from combining images or ideas that appear to be quite dissimilar. Since the number of possible combinations of

images in the imagination can be very large, there must be some constraints that help select those which are considered promising.

One of the elements that helps select possibilities for the imagination is intuition, which consists of imprints of experience, knowledge, relationships, and attitudes of taste just below our level of consciousness. It is highly likely that intuition exists in the unconscious because in general we can't justify it. The fact that a good deal of processing goes on below our conscious activity is suggested by a number of cases in the scientific literature of discoveries or crucial insights that appeared to occur spontaneously or occurred in dreams.

The great mathematician, Karl Frederick Gauss described in a letter to a friend how he finally proved a theorem on which he had worked unsuccessfully for four years. He said "... As a sudden flash of light, the enigma was solved. ... For my part I am unable to name the nature of the thread which connected what I previously knew with that which made my success possible". Similarly, Polya, a 20th century mathematician remarked: "When you have satisfied yourself that the theorem is true, you start proving it." There are a number of other such examples in the literature.

While the use of imagination is an exploratory process, a sometimes overriding constraint to flights of the imagination is knowledge or logic in the conscious mind - such as principles that are considered too important to be violated. But these constraints should not be too strong. Very often they arise from the intellectual orthodoxy of the time. But in science there are some constraints that have to be there because they embody extensive, well established experimental evidence, such as the conservation of energy. But in the long run, a theory, no matter how beautiful or self-consistent, must provide predictions that conform to nature, or it will be dropped. Are there any such restrictions in art? One of the most important constraints in art is the artist's sense of aesthetics. However, for a work of art to be ultimately successful, it must have a certain compatibility with the experiences and culture of the observer.

Creativity in science is a combination of rationality and non-rational processes, of recklessness and constraint, of imagination reigned in, but not too tightly. The same description would aptly apply to the arts and humanities.