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Is Beauty A Valid Criterion for Truth?

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Both beauty and Truth lie beneath many of mankind's deepest desires and aspirations. The search for beauty drives many people to travel to pristine forests or untouched coastlines to experience awe, while the search for knowledge about the Truth of the universe in which we live compels many to study the tiniest particles or largest spaces we can conceive in order to get a slight hold on our place in a seemingly endless and impartial existence. Our rational proclivities lead us to search for Truth and solid facts; our intrinsic appreciation for natural beauty allows us to deeply appreciate the beauty of a sunrise after a lifetime of daylight. Beauty and Truth both cause people to experience life and their own world in different and unique ways.

Though examining Truth and beauty are great adventures in their own rights, examining the relationship between the two is also very interesting. The behavior of the universe when examined on both infinitely large and infinitely small scales can have many elements of beauty. Likewise, many beautiful occurrences in nature can have intriguing scientific explanations. When considering the idea that a proposed theory uniting every phenomenological law of physics will be recognizable because of its intrinsic beauty, however, it seems strange and almost irrational to add an aesthetic criterion to a scientific theory. This invites the question, "Is beauty a valid criterion for scientific Truth?" This question will be examined through a comparison of philosophic and scientific ideas about beauty and Truth, as well as a comparison of the implications of both positive and negative responses.

Beauty and Truth cannot be compared, however, without some knowledge as to what kinds of "beauties" and "Truths" should be related to each other; a father and mother marveling at the wonder of the life of their newborn child is quite different than a scientist realizing that one theory can be said to unite all others in a relatively succinct manner. These contrasting wonders are rooted in similar feelings of awe, though one phenomenon is deeply personal and the other very large and infinite. For the sake of

comparison, beauty will be divided into three sections, philosophic beauty or aesthetics, beauty in nature and mathematical beauty.

The Merriam-Webster dictionary defines beauty as, “the quality or aggregate of qualities in a person or thing that gives pleasure to the senses or pleasurably exalts the mind or spirit.” The field of aesthetics in philosophy centers on art and beauty as well as the phenomenon of taste. It may seem strange at first that this type of beauty could be used as any sort of criterion for Truth; taste is incredibly subjective and the assertion that one kind of beauty is right and true while another is false and superficial seems entirely unrelated to hard, scientific facts.

Admittedly, it is unlikely for an entirely scientific Truth to ever result from a work of art. Art is interpretive and contextual, and science demands objectivity. However, the feelings evoked in a person experiencing beauty might possibly give rise to a different kind of “Truth”, one that resonates within the person as “this is Good” or “this is Real” on a very deep level. Ineffable sensations of joy, whether produced by musings on the miracle of life or the unity of the universe, lead to knowledge that may never be quantified scientifically, but will be known to the person experiencing the joy as a certain kind of Truth.

Natural beauty or the beauty of nature and the natural world combines elements of both philosophic and mathematical beauty. Many people have strong emotional reactions to vast landscapes and the rising sun over a dark, unlit sky. National and state parks, hiking trails, gardens, scenic drives, aquariums and zoos likely would not exist if most people were indifferent and unimpressed by the diversity of life in the world. The emotional responses of people experiencing natural beauty can be very similar to those of people examining works of art or listening to music. The human drive to create and experience art is absent in natural beauty; it is replaced with mathematical and scientific law.

The impersonal Colorado River carved the stunning Grand Canyon and an incredible explosion millions of years ago painted the night sky with streaks of galaxies and stars. These images may appear to be chaotic or random, like the flow of a given cup of water’s path down a river, but are ruled by strict laws of physics. Patterns and symmetry in nature show repeated growth in an order in a definitively mathematical way; shell spirals and sunflowers repeat in Fibonacci sequences and behave in curiously patterned ways even at high magnification. The phenomenon of fractals, which are uniquely repeating geometric shapes that appear to be copies of the original shape at high magnification, is an easily beautiful mathematical idea.

Self-similarity and repetition in fractals, as well as simple proofs without words are two ways to see breathtaking mathematical beauty without the knowledge needed to do mathematical research. Albert Einstein described mathematical beauty as “the poetry of

logical ideas” also stating “In this effort toward logical beauty spiritual formulas are discovered necessary for the deeper penetration into the laws of nature“(Zee 114). Mathematical beauty is the most closely related form of beauty to the idea of a final theory being recognizably beautiful. Laymen likely will not find a raw symmetrical equation to be beautiful, but experienced physicists or mathematicians will be able to see the inherent beauty. The lack of a layman to experience this beauty does not discredit its power; in *Of the Standard of Taste*, David Hume argues that it is necessary to frequently survey or contemplate a particular species of beauty in order to more fully appreciate the specific beauty (Hume 261). A theoretical physicist is the experienced art critic of unified final theories.

Finding Truth in the previously mentioned types of beauty varies with each beauty imagined. This does not imply that Truth is ultimately subjective or “in the eye of the beholder”, but rather that one must think about Truth in its appropriate context. For example, a novel describing the days of a workweek as identical and boring may be intending to show the true feelings of the narrator, rather than describing a complete account of each day’s activities.

To describe and define Truth in ways that will be conducive to comparisons with beauty, philosophical ideas about knowledge and what can be known will be examined, as well as the scientific method. Theories concerning knowledge are more applicable to the question “Is beauty a valid criterion for scientific Truth?” than direct philosophical ideas concerning Truth; many of the theories describing Truth address the topic in a way that undermines the very validity of scientific truth. The philosophy and truth of science is an interesting and massive topic in itself and is beyond the scope of this paper. Knowledge theories and epistemology are much more relevant to the question at hand.

Two opposite ideas concerning knowledge and for our purposes, philosophic truth, are Rationalism and Empiricism. Rationalism is the belief that knowledge is attained through reason, rather than sense experience. Rene Descartes’ famous assertion that “I am, I exist” is “necessarily true each time I utter it or conceive it in my mind,” is a defining characteristic for Rationalism. Descartes comes to this conclusion only after doubting the existence of everything he can possibly doubt and reasoning that he cannot doubt the existence of his own thoughts. Knowledge of Truth, then, can only come from reason using the facts one already knows for sure. The Stanford encyclopedia of philosophy describes rationalism as having three main theses: The Intuition/Deduction Thesis: “Some propositions in a particular subject area, S, are knowable by us by intuition alone; still others are knowable by being deduced from intuited propositions,” The Innate Knowledge Thesis: “We have knowledge of some truths in a particular subject area, S, as part of our rational nature,” and The Innate Concept Thesis: “We have some of the concepts we employ in a particular subject area, S, as part of our rational nature.” These theses take describe rationalism in different terms than

Descartes, but still focus on the idea that knowledge comes from reason rather than raw sense experience.

Empiricism, on the other hand, is the belief that knowledge is a product of sense experience. The Stanford encyclopedia of philosophy defines the main thesis of empiricism as “We have no source of knowledge in S or for the concepts we use in S other than sense experience.” David Hume is an empiricist who contrasts Rene Descartes’ method of denial of all existence except that which can be reasoned by instead examining the “origin of ideas.” Hume asserts that all creative power can be reduced to “compounding, transposing, augmenting or diminishing the materials afforded us by the senses and experience, ” an idea that seems to be diametrically opposed to the method of developing different ideas based on reasoned Truths.

Upon first glance, the “scientific method” appears to be based more heavily from empiricism than rationalism. An experiment is, by definition, “a test under controlled conditions that is made to demonstrate a known Truth, examine the validity of a hypothesis, or determine the efficacy of something previously untried.” However, reason must be applied to the experiment in the form of a hypothesis so that the data obtained has more meaning than simple numbers or observations upon a page. The scientific method can be simply defined as a series of steps involving observation of a phenomenon, development of a hypothesis, development and performance of an experiment in order to prove or disprove the hypothesis, data analysis and a conclusion. These steps are not meant to be exclusive and can be arranged and re-arranged in order to better fit a specific question. Both reason and experience are necessary in different ways for different types of questions and experience. For example, a biologist observing a dog sniffing the ground will know from previous experiments that the dog is following a scent, possibly in search of food. This knowledge is heavily based on empiricism; the biologist knows from prior experience that dogs have a heightened sense of smell. In contrast, a biologist might reason that the dog’s development of a sense of smell has evolved as a survival mechanism in order to better find food, but cannot ever observe that evolution firsthand. Evidence helps support the ideas of macroevolution, but reason puts those elements into context. Through a long chain of intuitive reasoning, one could ideally develop a line of truth that would explain every phenomenon in the world; in life, evidence is valued much more highly than reason in the somewhat speculative arenas of macroevolution and the search for a unified explanation for the universe.

Could a theory uniting every phenomenological law of physics be recognized as true because of its intrinsic beauty? As previously asked, is beauty a valid criterion for scientific Truth, especially the very deep Truth of a unified theory? A “yes” answer implies an intrinsic need for beauty in scientific Truth, while a “no” denies some of the abstract reasoning found in symmetry and simplicity, as well as potentially defying Occam’s Razor. Given a cursory knowledge of what criteria are necessary for beauty,

such as pleasure, symmetry and simplicity as well as what criteria are necessary for Truth, one could make an argument that elements of beauty could fall into the fields of reason and sense experience needed for a scientific theory. Slight intuitive reasoning is necessary to see symmetry and simplicity, especially in cases of mathematical beauty. A proof of the Pythagorean theorem that does not use words must still be understood rationally for one to see the beauty. Beauty must also be experienced through the senses, though not quite in the same way as a scientific experiment. The sense experience in the case of experiencing something beautiful will not be nearly as replicable as an observation of gravity and will be much more subjective, but could be a valid criterion for one person's conviction of the Truth of the theory. Using this reasoning, a physicist's conviction that a proposed theory that explains the facts in a succinct, clear manner will be True would be a valid conviction. Indeed, the Yang-Mills theory was, in the words of A. Zee ". . . an intellectual construct based on aesthetics," but was able to describe symmetrical physical phenomena after being developed with the thought that the theory ". . . did not appear to have anything whatsoever to do with the natural world" (187). Beauty in the form of a symmetric mathematical equation described phenomenological Truth.

Though it would be excellent for a theory to elegantly describe the overall physical behavior of the universe, it is not inherently necessary for scientific explanations to be succinct. The field of biology in particular has such a vast variety of life and behavior that it would be impossible to develop a theory that described every individual's behavior at a point in time. The differences between the fields of physics and biology are great, but science does not choose to force complexity in one field and simplicity in another. As A. Zee states in *Fearful Symmetry*, "While one would be deeply perturbed if space-time were not ruled by exact symmetries, no pressing imperative demands that material particles must also obey exact symmetries." (186). The subjectivity and need for individual experience in defining beauty also creates problems when using beauty as a criterion for Truth. Defining a level of complexity that overthrows those of simplicity and symmetry is an entirely subjective aesthetic process. When examining art, one may prefer Salvador Dali to Pablo Picasso simply as a matter of taste. Likewise, developing a Truthful final theory based on aesthetic ideas could be argued as nothing more than a matter of taste for mathematical theories.

Because beauty is a hard concept to quantify, it is very hard to make beauty a criterion for Truth the same way other components of the scientific method are criteria for Truth. That being said, beauty can be a valid criterion for scientific Truth when applied to modern physics. Beauty and Truth are quite often deeply related in a way that was best stated by John Keats in Ode on a Grecian Urn: "Beauty is truth, truth beauty, -that is all ye know on earth, and all ye need to know."

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