

Reflective Pieces

with Arnold O. Benz, “Astrophysics and Creation: Perceiving the Universe through Science and Participation”; Whitley Kaufman, “Poetic Naturalism: Sean Carroll, Science, and Moral Objectivity”; and Doren Recker, “Faith, Belief, and the Compatibility of Religion and Science.”

ASTROPHYSICS AND CREATION: PERCEIVING THE UNIVERSE THROUGH SCIENCE AND PARTICIPATION

by *Arnold O. Benz*

Abstract. I explore how the notion of divine creation could be made understandable in a worldview dominated by empirical science. The crucial question concerns the empirical basis of belief in creation. Astronomical observations have changed our worldview in an exemplary manner. I show by an example from imaginative literature that human beings can perceive stars by means other than astronomical observation. This alternative mode may be described as “participatory perception,” in which a human experiences the world not by objectifying separation as in science, but by personal involvement. I relate such perceptions to “embodied cognitive science,” a topical interdisciplinary field of research in philosophy, psychology, and neuroscience. Embodied cognitions initiate processes that can convey personal experiences of the stars. Such cognitions may involve religious apprehensions and give rise to sophisticated values. It is argued that the knowledge available through astrophysics and interpretation of the universe as divine creation represent two different ways of perceiving the same reality and should thus be seen as mutually complementary.

Keywords: astronomy; divine action; divine creation; embodied cognition; participatory perceptions; physicalism; universe

Why talk about God at all? Physics has not discovered any divine action, nor is there any scientific necessity to postulate its existence. Quantum mechanics, chaos theory, and Bang cosmology imply the unpredictability of natural processes and limits to scientific knowledge, but there are no “gaps for God” (Drees 1995, 223–37). As a physicist I ask the above question in view of the empirical basis of religion. How does religion relate

Arnold O. Benz is Emeritus Professor at the Institute for Astronomy, ETH Zurich, Switzerland; e-mail: benz@astro.phys.ethz.ch.

to reality? This article is dedicated to persons whose worldview is dominated by science and its objectivity, to my colleagues and to contemporaries on whose horizon religion simply does not appear.

Much of today's science–theology dialogue draws upon the developments in physics of the twentieth century. Dispute between science and religion did not end with the new physics. Paul Davies launched a counterattack, claiming that “recent advances in fundamental science are more likely to reveal the deeper meaning of existence than an appeal to traditional religion” (Davies 1983, 8). Here I propose that the new physics may still raise provocative issues concerning methodological limits and divine action, but do not answer today's most pertinent questions about the divine.

The purpose of this article is to turn the emphasis in the science–religion dialogue away from a focus on new science toward recent developments in human cognition. Science has been building on empirical evidence since the time of Galileo Galilei (1564–1641). What are the underlying perceptions of religion? They may not play the same role as in science, but theology cannot ignore them in answering the question at the beginning of this article. How to experience the divine is the primary challenge of a person shaped by a present-day scientific worldview. Religious experience has been a topic of scholarly inquiry at least since William James's *Varieties of Religious Experience* in 1902. Such inquiry started out as a psychological enterprise and is an issue in modern investigations in the much broader context of “embodied cognition” (e.g., Damasio 2003; Clark 2016). Much of today's misunderstanding between science and religion results from ignoring a fundamental difference between the perception from which each realm of knowledge originates.

THE VIEW OF MODERN ASTRONOMY

First, non-scientists must realize how modern science differs from ancient natural philosophy. Astronomy, for example, changed qualitatively with the introduction of telescopes and a millionfold since then by quantitative advances. This has led to today's view, where we find ourselves in a universe that is a hundred quadrillion (10^{17}) times larger than Galileo supposed. The Sun is not in the center of the universe as he argued. More important, the cosmos is not in steady harmony, as Pythagoras and many other ancient philosophers believed. The universe has a history and a future. It has formed and continues to form in a turmoil of matter and energy. Everything was once created, and everything will eventually decay, including stars, galaxies, and even matter. Mankind is not only small in body size and short-lived in lifespan, but part of the evolution of the whole universe. The awesome cosmic developments amaze, horrify, and cry for understanding and orientation.

Yet is this new cosmic scenario true? It results from ordering the pictures of individual objects in different states of formation. They can be put into a reasonable chronology. But that is not all. The physical and chemical equations known from terrestrial laboratories are applied to model the formation processes. Numerical models are compared to the observations to confirm the ordering and predict observable features for future observations. Such comparison may contradict the initial model. If so, it would be even more interesting because a new theory must then be found that fits better and penetrates deeper into reality. Thus we can never claim a theory to be true, but only to be good—that is, useful for the purpose at hand. A good theory explains all relevant observations while dependent on as few assumptions as possible. Relying on good, but not true theories, we use our cars or fly to Mars.

SCIENCE AND RELIGION

When the modern sciences started to flourish, the physico-theological researchers of the seventeenth century, such as William Derham (1657–1735) or Johann Jakob Scheuchzer (1672–1733), believed that sound evidence for God could be derived from scientific observations of the natural world. Nature's properties were explained, in turn, by the graciousness of the Creator. In this notion of God there is no gap between science and religion. There is a smooth transition as if they were the same and as if theology began where natural sciences ends. However, David Hume (1711–1776), and later Immanuel Kant (1724–1804), demonstrated the physico-theological proof for God to be circular reasoning: "God is assumed to be wise; we observe that nature is finely tuned; therefore it was created by God; therefore God exists." Yet the assumption that "God is wise" implies his existence in advance, and therefore the argument is not substantiated. Even worse, the idea that science and religion are closely related and serve basically the same purpose brought religion into competition and conflict with science. Every new scientific explanation of the world by natural causes, such as Darwin's theory of evolution, was a blow to such a theology. Today, the idea of searching for the divine in nature and for its Creator through reason and scientific inquiry is still alive. Such "natural theology" may be inspiring, but is not conclusive in rigorous scientific terms. Some authors nevertheless claim to have found direct evidence in science for supernatural phenomena using some version of the above argument from design (Behe 2006, 252).

Another movement attempting to level out the differences between science and religion started in the 1970s: the New Age and its "quantum mysticism." Parallels between modern physics and Asian spirituality were explored and allegedly found (Capra 1975). The physics that proponents of this movement emphasized drew heavily on the uncertainty principle of quantum mechanics, which they understood to signify unpredictability

and a rather fuzzy character of reality. Later authors went so far as to propose a convergence of physics and mysticism into a virtual identity (Talbot 1980). However, quantum mechanics is a mechanical description of the temporal evolution of a system's physical parameters. It uses rigid mathematics. Quantum uncertainty rules in every atom and molecule of our brain, but there is no apparent bridge from sturdy mechanics to the colorful manifestations of our consciousness. How should we set up a Schrödinger equation to describe happiness, guilt, or free will? The parallel may easily reduce to the simple fact that we understand in depth neither quantum reality nor human consciousness.

Nevertheless, quantum mechanics did have a big impact on our understanding of the world. It revised the deterministic view of Newtonian physics to propose instead an open future that is not entirely predicted by the uncertain present. According to the usual Copenhagen interpretation, reality does not even exist until it is observed. This new space of indetermined reality led to a significant theological development. All of a sudden, there was a place again for God. Does God act in this world through quantum uncertainty (Russell 1988 and others)? Needless to say, belief in God's active influence has become easier in this light than it had been in an eighteenth-century world described as mechanical clockwork. For example, Ian Barbour (2006, 116) envisioned divine action taking place in the holism of quantum non-locality. The physicist-theologian John Polkinghorne (1989, 28) sees "a much more promising line of inquiry [in] the subtlety of behavior enjoyed by complex dynamical systems," referring to the unpredictability of the future known from chaos and complexity theory.

However, postulating divine action with benefit of the new physics has been criticized from the outset. Hodgson (2000, 505) and others pointed out that in the usual statistical interpretation "quantum mechanics is irrelevant to the question of God's action in the world" because the statistical average is deterministic and leaves no room for divine creativity.

Can quantum mechanics serve as a metaphor for the uncertain and non-local properties of consciousness or for the openness of the future? In a metaphor, a complex concept or experience is described figuratively by another, simpler and well understood phenomenon. Robert Brecha (2002, 917) warns that the intricacies of physical theories make them far removed from usual metaphors by requiring an imprecise nonmathematical language. Quantum mechanics is very well suited to describe reality in mechanical terms although by probabilities, but not more. Quantum chaos is not well understood even by the specialists (Koperski 2000).

More fundamental criticism arises from a philosophical perspective. Is physics the right starting point? Can theology build on modern physics? The development of the science-religion dialogue has been reviewed by Losch (2005), who points out that "our world is more than physics." Christian hope for a new creation cannot be based on science (Benz 2001,

162). The questions express doubts about a widespread philosophical attitude known as scientism or physicalism (Smedes 2004). It assumes, often implicitly, that reality is based on a fundament given by physics. But this is not a provable assumption. Taede Smedes (2004, 273) criticizes the science–religion dialogue based on arguments derived from the new physics as a “category mistake.” More critically, Lydia Jaeger (2012, 295) challenges “the physicalist assumption that physics provides a true and complete description of nature’s causal web.” The criticism may well be justified but does not explain why it might still be worth talking about God. To resolve that question one must consider how the divine is experienced and becomes part of our reality.

PARTICIPATORY PERCEPTION

Here I want to expound the proposition that not physics but experience is the origin and basis of our relation to reality. This proposition boldly extends Polkinghorne’s slogan “epistemology models ontology” (Polkinghorne 1998, 31) to a more general perspective of human perception. I apply it not only to science, but to existential experience, including religion. Scientific and existential perceptions should be taken fully in earnest but as two discrete pathways in the human quest for knowledge (Benz 2017, 100).

Let me start with an example related to art and astronomy. It is an experience Walt Whitman ([1867] 1999, 180) describes in the following poem written some hundred and fifty years ago:

When I heard the learn’d astronomer;
 When the proofs, the figures, were ranged in columns before me;
 When I was shown the charts and the diagrams, to add, divide, and
 measure them;
 When I, sitting, heard the astronomer, where he lectured with much
 applause in the lecture-room,
 How soon, unaccountable, I became tired and sick;
 Till rising and gliding out, I wander’d off by myself,
 In the mystical moist night-air, and from time to time,
 Look’d up in perfect silence at the stars.

The poet experiences the stars in two ways: first in the report on objective, scientific observations and measurements, and second through his own experience of poetic, transcendental, and mystical awareness. The latter kind of experience does not permit a person to remain in an objective, passive role. Instead it requires the person himself or herself to become the instrument of observation. Whitman was directly involved in this second mode of perceiving the stars. He was personally affected by it and, figuratively speaking, came into resonance with the universe. He perceived the stars not as a matter of course, but as an overwhelming presence. No

doubt, Whitman participated subjectively in this experience, which I name “participatory perception.”

The two ways of perception are related to each other. In the poem they do not take place on just any dark night, common in electricity-free America of the nineteenth century, but on the night of the astronomer’s presentation. I understand the poem to mean that the knowledge provided by the astronomer—as boring as it was—opened a new way toward the poet’s personal, subjective experience of the stars. Astronomy confronted the poet with a new worldview and opened for him a new horizon within which he had to find himself again. Whitman’s perception of “silence” refers to the stars as well as to his environment and his inner state. Silence is a feeling and state of being. It is not measurable, not objective or the product of scientific observation. The silence of the stars cannot be explained through astronomy and lies beyond the boundary of science. Yet it seems to have been more real and had more effect on Whitman than the presentations of the astronomer.

What astronomers are after is a causal account of cosmic evolution from the Big Bang to today. The goal is to find the origin of cosmic phenomena, and relate cause and effect to mathematical explanations. What is published in professional journals and that for which scientists are crowned is objective and rational. Yet astronomers today try not to bore a public audience with diagrams and equations, but show pretty pictures taken by the latest telescopes. Thus they attempt to combine what was in sequence for Whitman: objective knowledge and subjective impression. They give their best and may sometimes succeed better in our own day than in Whitman’s—not only because they have better pictures, but because they realize that fascination is a key selling argument for astronomy. And fascination results from a subjective and non-rational perception of the universe.

What is this “human-based” way to perceive the universe? We recognize first that stellar photons travel through space to our retina as they do to a charge coupled device (CCD) detector of an astronomical telescope. But this objective process is not the only component of perception. There is also an embodied cognition system, which records more than photons (Varela, Thompson, and Rosch 1991; reviewed by Wilson and Foglia 2016). The endpoint of this perception is the feeling of awe by which Whitman participates for a moment in the grandeur of the universe. Through it he restores himself and orients himself in the world.

Embodied cognition is the result of interplay between sensory stimuli of the body and the emotions and feelings of an individual. Whitman describes the bodily perceptions he encounters externally as “moisture” and “silence.” They include implicitly the personal antecedent in the lecture hall and features of the environment, such as the solitude and darkness. Emotions are involved from the outset and are basic. Thus inside and outside are intermingled. Embodied cognition envisages the whole situation

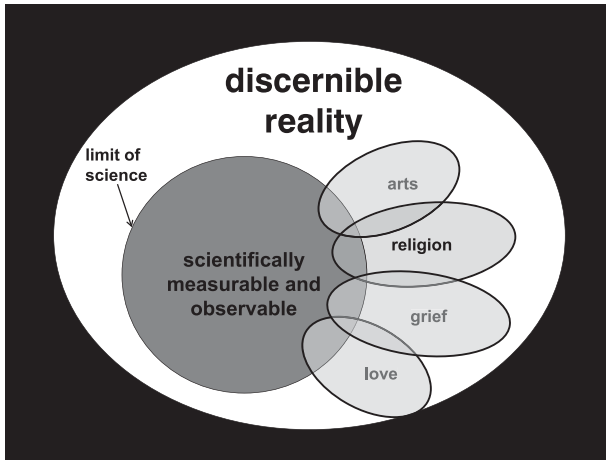


Figure 1. Schematic representation of reality. *White*: discernible reality; *dark gray*: reality selected by natural sciences; *light gray*: some parts of reality accessible only by participation (from Benz 2017).

of the individual and all senses, so it cannot be reduced to the detection of stellar photons. At the very beginning of participatory perception, primitive reactions of attraction and avoidance may occur as observed already in single-celled organisms (e.g., Thomas forthcoming). They eventually become more processed primary emotions such as surprise, happiness, fear, anger, disgust, or sadness. Sophisticated feelings and values, such as art and religion, form at a higher level, but are present in primitive form from the beginning of the cognitive process.

Participatory perceptions are excluded, as subjective, from the methodology of modern science. They may emerge in artistic expressions like those of Whitman when the perceiving person participates in an individual way. To some degree, he or she can control the perception. It is related to the person and not necessarily repeatable. Nevertheless, it may be an unforgettable moment in which time seems to stand still. Such participatory perceptions can engender overwhelming feelings. Life becomes tranquil and everything changes. Embodied cognition can be an active means of assessing immediate or future action. Thus, it may have a concrete, significant effect and must be considered an important element of the individual's relation to the outside world.

Let me explain with the schematic Figure 1, applying set theory. Reality discernible to humans is represented by the white oval. A part of it, shown as a dark gray circle is accessible to quantitative measurements and objective observations, and is the basis of all sciences. But there is more. Participatory perceptions reveal a realm of reality where science cannot operate. The beauty of art cannot be measured. It has obviously scientifically measurable

components such as brain activity, heartbeat, hormone level, and so on, but this is not what full and direct perception is about, which includes the impression of beauty. It is the same with religious experiences, the essence of which is not part of science. Love and grief can also be very real and are more than what science can explore. There is a limit to natural science, given the fraction of reality it selects initially. Ellipses in light gray in the figure indicate perceptions of reality which lead to cognitions beyond science. They are partially amenable to scientific observations, indicated by the overlap between the circle and the ellipses. The brain activity during meditation, for instance, is being well studied by various imaging techniques (for an overview, see Treadway and Lazar 2009). Yet, these objectively measurable effects of emotions, feelings, and life-changing experiences may be an insignificant part of the experience. Figure 1 suggests that both kinds of perception have a legitimate capacity to explore reality.

WHAT COULD CREATION MEAN TODAY?

Now let us apply these distinctions about perception to the highly disputed notion of divine creation. Having proposed that physics is not the only relation to fundamental reality, I now suggest that traditional dogma should not be put in its place either. Experience by human beings was originally the basis of religious belief. It included visions and revelations as its deepest and most important parts. My proposition is that recognizing the role of participatory perception is essential also today to rendering plausible the notion of a divinely created universe and to make divine action understandable in a modern worldview.

Why and when to speak of creation? In science there is nothing really new, as everything has a cause and follows from the laws of nature. Even chance processes conserve energy and momentum. The perception of newness includes subjective elements which are not part of science. They are accompanied by feelings of surprise and happiness. The Swiss theologian Hans Weder notes that we encounter divine creation when we newly discover *with a sense of wonder* that something has been given to us, something we could not bring about ourselves but that is essential for our existence (Weder 1999, 68). Defining creation by such experience moves the notion from ontology to epistemology. It shifts our perspective from rational explanations of the remote past (e.g. the formation of the universe or the human species), to fascination with the present universe where every second some 30,000 stars form (Benz 2017, 137). In an astronomical worldview divine creation can only mean to involve the whole universe in the past, the present, and the future. Creation occurs every second.

I propose that the primary experience of creation begins with emotions of amazement and delight about an important fact in life. These primary emotions may lead to a relation, such as the relational emotion of gratitude.

Examples of such experience of creation are available in several of the biblical psalms, in particular Psalms 19 and 104. A person may recognize for instance that despite a presently awkward situation life is basically good (Genesis 1: 31). Or that, considering the many imaginable possibilities, we may not ever have existed at all. Or that the universe is not a matter of course, but an extraordinary gift. For me personally, most relevant is the cognition that time for development is generously granted—not only in the cosmos, but also in my life, even at this very moment.

This article argues that the understanding of religion in a science-dominated worldview requires a new focus on the basis of religion. The empirical reasons to talk about creation and God's acting in the world are embodied cognitions, those perceptions of reality in which humans participate and which are, in general form, accessible to all human beings. Walt Whitman illustrates in his poem their importance in our experience of reality and their difference from scientific perceptions. They are essential in art as well as in religion and come into play all the time in psychology and throughout the course of human existence. Science-and-Religion should take up the new opportunities offered by psychology for their future dialogue. In the new round of discourse, scientists will have to admit that science is less comprehensive than widely believed—not only because of quantum mechanics or chaos theory, but because the fullness of reality is greater than science can perceive. Above all, I believe we must recognize that the two ways of perception are not in competition, but complement each other in a fundamental way.

ACKNOWLEDGMENTS

A version of this essay was presented at the symposium on "Precision, Ambiguity and Intuition in Science and Arts" during the annual meeting of the American Association for the Advancement of Science, Pacific Division, in San Diego, CA, June 17, 2016. I am thankful to John Gatta, Andreas Losch, and Jesse J. Thomas for commenting on an early draft of this article.

REFERENCES

- Barbour, Ian G. 2006. "Indeterminacy, Holism, and God's Action." *In God's Action in Nature's World*, edited by Ted Peters and Nathan Hallanger, 113–28. Farnham, UK: Ashgate Publishing.
- Behe, Michael J. 2006. *Darwin's Black Box: The Biochemical Challenge to Evolution*. New York, NY: Free Press.
- Benz, Arnold O. 2001. *The Future of the Universe: Chance, Chaos, God?* New York, NY: Continuum.
- . 2017. *Astrophysics and Creation: Perceiving the Universe through Science and Participation*. New York, NY: Crossroads.
- Brecha, Robert J. 2002. "Schrödinger's Cat and Divine Action: Some Comments on the Use of Quantum Uncertainty to Allow for God's Action in the World." *Zygon: Journal of Religion and Science* 37: 909–24.

- Capra, Fritjof. 1975. *The Tao of Physics: An Exploration of the Parallels between Modern Physics and Eastern Mysticism*. Boulder, CO: Shambhala Publications.
- Clark, Andy. 2016. *Surfing Uncertainty: Prediction, Action, and the Embodied Mind*. Oxford, UK: Oxford University Press.
- Damasio, Antonio. 2003. *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*. Orlando, FL: Harcourt.
- Davies, Paul. 1983. *God and the New Physics*. London, UK: J. M. Dent.
- Drees, Willem B. 1995. "Gaps for God?" In *Chaos and Complexity: Scientific Perspectives on Divine Action*, edited by Robert John Russell, Nancy Murphy, and Arthur R. Peacocke, 223–37. Vatican City State: Vatican Observatory Publications.
- Hodgson, Peter E. 2000. "God's Action in the World: The Relevance of Quantum Mechanics." *Zygon: Journal of Religion and Science* 35: 505–16.
- Jaeger, Lydia. 2012. "Against Physicalism-plus-God: How Creation Accounts for Divine Action in Nature's World." *Faith and Philosophy* 29: 295–312.
- Koperski, Jeffrey. 2000. "God, Chaos, and the Quantum Dice." *Zygon: Journal of Religion and Science* 35: 545–59.
- Losch, Andreas. 2005. "Our World Is More than Physics – A Constructive-Critical Comment on the Current Science and Theology Debate." *Theology and Science* 3: 275–90.
- Polkinghorne, John. 1989. *Science and Providence: God's Interaction with the World*. London, UK: SPCK.
- . 1998. *Science and Theology: An Introduction*. London, UK: SPCK.
- Russell, Robert John 1988. "Quantum Physics in Philosophical and Theological Perspective." In *Physics, Philosophy, and Theology: A Common Quest for Understanding*, edited by Robert John Russell, William R. Stoeger, and George V. Coyne, 343–74. Notre Dame, IN: University of Notre Dame Press.
- Smedes, Taede A. 2004. *Chaos, Complexity, and God: Divine Action and Scientism*. Leuven, Belgium: Peeters.
- Talbot, Michael. 1980. *Mysticism and the New Physics*. New York, NY: Bantam Books.
- Thomas, Jesse J. Forthcoming. *The Embodied Wisdom of Animals and Humans, Including the Body Politic and Embodied Religion*.
- Treadway, Michael T., and Sara W. Lazar. 2009. "The Neurobiology of Mindfulness." In *Clinical Handbook of Mindfulness*, edited by Fabrizio Didonna, 45–57. New York, NY: Springer.
- Varela, Francisco J., Evan Thompson, and Eleanor Rosch. 1991. *The Embodied Mind: Cognitive Science and Human Experience*. Cambridge, MA: MIT Press.
- Weder, Hans. 1999. *Kosmologie und Kreativität*. Leipzig, Germany: Evangelische Verlagsanstalt.
- Whitman, Walt. [1867] 1999. *Leaves of Grass*. Retrieved from <http://www.bartleby.com>
- Wilson, Robert A., and Lucia Foglia. 2016. "Embodied Cognition." In *The Stanford Encyclopedia of Philosophy*, edited by Edward N. Zalta. Retrieved from <http://plato.stanford.edu/archives/sum2016/entries/embodied-cognition/>