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Magnificent Obsessions

Higher Speculations: Grand Theories and Failed Revolutions in Physics and Cosmology. *By Helge Kragh, Oxford University Press, Oxford, UK, and New York, 2011, 408 pages, $63.00.*

"Where wast thou when I laid the foundations of the earth? Declare, if thou hast understanding."—Job 38:4

BOOK REVIEW

By Philip J. Davis

Helge Kragh, a professor of the history of science and technology at Aarhus University, in Denmark, is a prolific writer of books and articles in this field. His earlier *Cosmology and Controversy: The Historical Development of Two Theories of the Universe* in 1977 received an honorable mention for Best Professional/Scholarly Book in Physics and Astronomy from the Association of American Publishers. His "Entropic Creation: Religious Contexts of Thermodynamics and Cosmology" discusses cultural responses to the Clausius statement of the second law of thermodynamics. In the present work Kragh focuses his historical and analytical skills on the question of how and why physical theorists constantly try to sum up the universe in one neat package.

Though I am not a physicist, let alone a cosmologist, I found this book easy to read, provided that I did not try to understand at a deep level the real world of the physical phenomena underlying the speculations.

The attempt to understand the cosmos, to ask "why there is something and not nothing," to situate where is "here" and when is "now," and what on earth happened before the Big Bang; to arrive at a TOE (Theory of Everything) through a physical, philosophical, metaphysical, theological, or kabbalistic lens, seems to be an inevitable but magnificent and obsessive piece of chutzpah.

In the course of working out their thoughts, the finest researchers, be they personally committed to an established religion or to a skepticism à la Bertrand Russell, come around finally to some sort of statement or credo that sounds like a kind of optimistic, humanistic deism serving to ward off an indifference typified by Steven Weinberg's "The more the universe seems comprehensible, the more it also seems pointless."

Let's get now to a few of the many Grand Theories described by Kragh. Thales of Miletus (6th century BC) produced what Kragh calls "the deceptively simple world equation H_2O = TOE," which asserts that all is water. Somewhat later, Pythagoras said that "All is number." After two and a half millennia, Pythagoras's speculation can be said to have morphed into another Grand Theory: the Newtonian view of the world as a very large system of differential equations. This, in turn, led to the concept of Laplace's Demon: When given all the initial conditions, the marvelous Demon was quite prepared to carry out the solution of the system by numerical methods then popular. Having now mentioned mathematics explicitly, Kragh refers to a mystic and arguable sweeping statement of MIT physicist Max Tegmark: Everything that exists mathematically is also endowed with physical existence.

Vortices were big with Descartes. Vortices were his guides, according to Kragh, in creating an "extremely ambitious theory [that] covered not only astronomical, physical, chemical, and geological phenomena, but also the realms of life."

Kragh tells us that when the church father Augustine was asked what God was doing before he created the universe, Augustine answered that he was preparing hell for those who pry too deeply. (This is an unexpected laugh in what is essentially a very somber book.) Kragh goes on to explain that the traditional religious explanation of the world is that God made it for mankind to inhabit. This is akin to the strong anthropic principle of Brandon Carter that "the universe (and hence the fundamental parameters on which it depends) must be such as to admit the creation of observers within it at some stage." This strikes me as a relative by marriage of the statement that a sleeping pill works because of its dormative powers.

There is an electrodynamic view of the world espoused by Wilhelm Wien, Max Abraham, and others. In their speculations they rejected the laws of mechanics as a basis for a TOE, replacing them with electromagnetic principles.

There are also the cyclic models of the universe. Newton thought them possible. The second law of thermodynamics sent these models into the wastebasket. Rudolf Clausius thought cyclic models were contradicted by the fundamental law of the increase of entropy. But apparently the idea resurfaces in the writings of Nobelist Frederick Soddy, Alexander Friedmann, Richard Tolman, and others.

There is the New Phoenix Universe. Recall: The phoenix is the mythical bird that periodically burns itself up and then rises from its ashes. Kragh quotes Paul Steinhardt and Neil Turk, picturing the universe as "eternally pulsating, with no original big bang, and no singular points of infinite density and temperature."

We come now to string theory. "Of all the grand attempts to establish an ultimate theory of particles and forces of nature," Kragh writes, "none has been as popular, ambitious, and controversial as the modern theory of super strings 'living' in a space–time of many dimensions." How many dimensions? Kaluza–Klein's five? Stephen Hawking may have been thinking of the eleven-dimensional supergravity theory, a candidate for a TOE, when he expressed the hope "that we might have a complete, consistent and unified theory which would describe all possible interactions."

Kragh turns also to physical eschatology (the discipline that studies the final events of the cosmos). Sir Arthur Eddington thought that "nothing could prevent the entropic heat death." Henry Adams, American patrician and historian of considerable stature, argued as much in his theory of history.

Eschatological speculations come close to theology: "cosmotheology," as some have dubbed the area. There is the Big Crunch, in which the universe shrinks back into a black hole singularity. A pretty dull fate compared to the trumpets, the seven seals, and the Four Horsemen of the Apocalypse detailed in the Book of Revelation. John Barrow and Frank Tipler opine that eternity is unstable. And according to Fred Adams and Gregory Laughlin, all that is left after 10^{118} years is "an exceedingly thin electron–positron plasma immersed in a cold radiation of neutrons and photons." The mathematician and philosopher Alfred North Whitehead raised eschatology to abstract heights with his concept of the panentheistic God: "God and the world stand in a mutual and perpetual relationship: God creates the world and the world creates God."

That TOEs would be discussed from what might be called political or ideological standpoints seems almost inevitable. Thus, John D. Bernal, a Marxist sociologist of science, observed a tendency among British intellectuals to abandon rational thought in considering the big problems. Foremost

on Bernal's list of sinners was Eddington, who, hung up on numerology, wrote that the number of protons in the universe was exactly 136×2^{256}. Moving on to the zeitgeist of the 1970s, Kragh brings Eastern mysticism and spiritual meditation to the stage with Fritjof Capra's *The Tao of Physics*: "The theories of natural phenomena are creations of the human mind, properties of our conceptual map of reality, rather than of reality itself."

It seems that everyone has wanted to get into the TOE act. Voltaire (1694–1778) hoped for the discovery of universal laws covering the physical, moral, and religious worlds. Kragh cites Vladimir I. Lenin (1870–1924), who

> "in his *Materialism and Emperio-Criticism* of 1908 was sympathetic to the new physical view based on fields, ether and electrons. . . . To Lenin, this modern view of physics was congruent with dialectical materialism [i.e., the basis of Marxism] and opposed to relativist agnosticism and idealism."

With TOEs coming from the pens (if not from the laboratories) of writers ranging from cosmologists to kibitzers; with a never-ending sequence of models of all sorts stumbling down the catwalk to critical scrutiny; with such models and theories expounded, studied, discussed, tweaked, rejected, or replaced, the historical events detailed in Kragh's splendid book can be read as a history of science combined with a comedy of errors.

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