

Paul Davies and the Philosophy of Science

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Précis:

Beginning with a recognition of significant epistemological authority in science, Paul Davies concludes that the universe is indeed meaningful and purposeful. He points to the laws of nature as evidence for this intrinsic purpose as well as for process theology. While not a follower of historic Christian orthodox theology, Davies's positions on cosmology are much to be preferred over those scientist's views which affirm a purposeless, meaningless universe defined by random accident. While Davies is reluctant to accept a transcendent Creator who made the universe by sovereign, supernatural power, it is encouraging to find a non-Christian scientist acknowledge unambiguous theological realities—that the universe is fraught with evidence for rationality, meaning, and purpose.

Introduction

Paul Davies is a widely recognized scientist, author, and lecturer. He has written and edited over twenty-five books including *The Mind of God*, *The Last Three Minutes*, *The Cosmic Blueprint*, *About Time*, and *Are We Alone?* Davies is director of Beyond: Center for Fundamental Concepts in Science, and co-director of the Cosmology Initiative—both at Arizona State University. He has also held appointments in astronomy, physics and mathematics at the Universities of Cambridge, London and Newcastle upon Tyne, and Adelaide. He is an authority in the fields of cosmology, gravitation, and quantum field theory. Other interests of Davies include the nature of time, high-energy particle physics, the origin of life, and the nature of consciousness. Davies is the recipient of many awards, the most noteworthy being the 1995 Templeton Prize for progress in religion. This is one of the world's most prestigious prizes for intellectual endeavor and is presented adjacent to the tombs of Charles Darwin and Isaac Newton in Westminster Abbey. Davies is one of the most significant scientists of our time, not only

because of his research and accomplishments, but because he writes on a popular level as well as an academic one.¹

Davies' philosophy of science is to a great extent derived from his extensive research in cosmology, physics and astrobiology. Perhaps the single most important religious statement on Davies' view of science was made when he said, "science offers a surer path to God than religion."² Davies meant what he said. He went on to say,

I made the statement to be deliberately provocative, and it is often quoted, so I suppose I got it right! I distinguish between God and religion. I think religion often gets in the way of our understanding of God, because it is based on faith and ancient scripture, and not reasoning and evidence. . . . However, I would not wish to claim that science can provide the whole truth. It is just that what science does provide is 'reliable knowledge' rather than Truth. So it is a 'surer path.'³

Starting with the recognition of significant epistemological authority in science, Davies concludes that the universe is indeed meaningful and purposeful. He points to the laws of nature as evidence for this intrinsic purpose as well as to the God of process theology. Davies sees further evidence for transcendent purpose in the emergence of life in the universe—particularly on earth but also, in his view, probably elsewhere in the universe. The aim of this essay is to examine Davies' view of science and his stance on purpose and meaning in the cosmos based on his broad research. My hope is that this study will lay the groundwork for further work and assessment.

Paul Davies' Notion of Science

Davies contends that "science offers a surer path to God than religion." This statement is an encapsulation of his overall notion of science. Upon this statement, Davies builds an entire worldview of a purposeful and meaningful cosmos with life—especially human life—filling an elemental role in it. Davies writes, "I belong to the group of scientists who do not subscribe to a conventional religion

but nevertheless deny that the universe is a purposeless accident.”⁴ Furthermore, Davies asserts that “human beings are built into the scheme of things in a very basic way.”⁵

While science does have great authority in revealing the truths of the universe, it has limits. Something must pick up once science can go no further. Davies states, “I am not saying that science and logic are likely to provide the wrong answers, but they may be incapable of addressing the sort of ‘why’ (as opposed to ‘how’) questions we want to ask.”⁶ Davies rejects established religion as a guide to ultimate truth, but he has no problem with a mild sort of spirituality in dealing with “ultimate questions.” Michael J. Buckley notes that Davies identifies with some of the thought of Werner Heisenberg, who defined God as “the central order of things or events” and the “inner core of a being whose outer manifestations may be highly diverse and past our understanding.”⁷ Davies’ view of God will be discussed later, but it is appropriate now to consider that Davies does recognize the limits of science and acknowledges that spirituality does play a role in the investigation of the cosmos.

Davies’ belief that science plays the key role in the investigation of the cosmos cannot be overstated, however. Answers to deep philosophical and religious questions can depend on the power of science. Issues such as an ultimate meaning to our existence—whether human beings are the only sentient beings in the universe, or whether life is the product of chance or of law—“hinge on what science can reveal about the formation of life.”⁸ It is also of utmost importance to stress Davies’ statement that “science takes as its starting point the assumption that life wasn’t made by a god or a supernatural being: it happened unaided and spontaneously as a natural process.”⁹ So, it is fair to say that Davies is a methodological naturalist, even though he affirms purpose and meaning in the universe to the exclusion of blind chance.

Davies’ view of the difference between science and religion is seen in the disparity between objectivity and subjectivity. He perceives science as having an advantage because “the alleged order claimed by science is open to direct test, whereas religious experience is a private phenomenon.”¹⁰ Furthermore, a scientist stands ready to abandon a position if that position is disproved in the laboratory. In contrast,

Davies asserts that religion rests on the authority of revelation and a religious person will hardly abandon a position based on what is interpreted as revealed wisdom from God.¹¹ Perhaps for Davies, the most important distinction between science and religion is seen upon consideration of the momentous advances made by scientific discovery and their impact on religious questions. According to Davies, “the very conceptual framework in which the religious questions are posed can be altered by scientific advances.”¹² This statement is bold, but it is not flippant.

Davies’ Templeton Prize address provides some context to the above statement. He discusses the character of the laws of nature, laws that are based upon mathematics, which are not discernible to us through casual observation. He speaks of the great complexity of those laws, which are veiled at first, but are later revealed having been “painstakingly extracted from nature using arcane procedures of lab, experiment and mathematical theory.”¹³ Davies marvels at man’s ability to discern the secrets of nature, to “decode” its messages. The wonder of science is that human beings can “use it to decode nature and discover the secret laws the universe follows.”¹⁴

To summarize, it is clear that Davies places the highest confidence in science to find answers to the deepest questions of the cosmos and mankind’s place in it. The great leaps forward over the centuries as a result of deep labor in the laboratory and faithful reliance on inductive reasoning have proven that science is at least as worthy as religion, if not more so, in the quest for knowledge of the universe. Science has shown us, in the discoveries of Copernicus, Galileo, Darwin, and Einstein that it can even change the parameters wherein the fundamental questions of religion and philosophy are asked. Science has benefited mankind in ways that cannot be enumerated, and promises to continue to do so at an even more rapid pace.

The pace of science is quickening because of an emerging paradigm that is replacing that of Newtonian mathematics and physics. The details of this new paradigm will be explored later, but Davies sees this new paradigm as one that will exercise great influence on scientific thought. It provides an optimistic picture of a dynamic, growing universe over and above the Newtonian pessimism of a dying universe.¹⁵

The important thing to observe about Davies' notion of science is that science provides a way for mankind to understand the universe in which we live. Science is sufficient to "explain the existence of complexity and organization at all levels" and thus show that there is meaning in the universe.¹⁶ This is the subject of the next section of the essay.

Davies' View of Purpose and Meaning in the Universe

The centerpiece of Davies' philosophy of science is that the scientific method can be used to comprehend the universe, and the universe can be understood as being rational, intelligible, meaningful and purposeful. All scientific inquiry depends upon this fact. If the universe were a chaotic mass of unruly systems, there would be no ability to fathom any of those systems. Since the universe does show meaning, rationality, intelligibility, and purpose, it can be studied, and the laws of nature can be induced from its repeatable processes. Indeed, those laws are the best evidence for purpose in the cosmos. Davies notes in many of his writings that if the laws of nature could be adjusted, even at minute levels, the universe as we know it would cease to exist, and life itself would not be possible. The laws of nature even seem to have life written inextricably into them. Davies quotes Freeman Dyson in his Templeton Address to make this point when he states, "the universe knew we were coming."¹⁷

Davies has much to say in his writings about life, specifically about its origin and meaning. His book *The Fifth Miracle*¹⁸ was written for this exact purpose, but the subject is treated in some of his other works as well. While Davies certainly does not view life as merely an accident of chemistry that occurred in the primordial soup of 3.5 billion years ago, he is quite careful not to ascribe a miraculous¹⁹ divine origin to life on earth or elsewhere in the universe. Thus, there is a substantial gap in human explanation for life in the universe. While science maintains the ability to explain many of the particulars about the when and where of the origin of life, it cannot account for how it originated. Davies' position on this gap in understanding is simply

that scientists are missing a major piece in the puzzle. Life was clearly meant to exist in the universe, but the fine points of how it originated in the universe remain a great mystery. Davies contends “that a fully satisfactory theory of the origin of life demands some radically new ideas.”²⁰

What is one to make of this statement? What does Davies mean when he calls for “radically new ideas”? Davies is prepared to challenge the orthodoxy of Darwinism with respect to the origin of life. He accepts the notion of natural selection once life has been established. He is even open to natural selection occurring on other planets. However, when it comes to the issue of life’s origin, Davies is not convinced that biological evolution can give the satisfactory answer that is required.

The orthodoxy of biological evolution teaches that life is not a preordained phenomenon in the cosmos. Life began on earth as a result of random chemical processes about 3.5 billion years ago. In other words, since the origin and development of life is a meaningless set of accidents, there is no ultimate cause for it. If Davies is correct in his assertion that life is built into the laws of nature at the most deep-seated level, then orthodox Darwinian evolution is flawed at its core. For Davies, not only is life preordained; it is moving toward a particular end. According to Davies, the sticking point for scientists who still cling to accepted orthodoxy is that “‘end’ sounds suspiciously like ‘goal’ or ‘purpose’—taboo words in science for the last century, redolent as they are of a bygone religious age.”²¹ But this kind of “radical” idea is what is called for, in Davies’ estimation. He goes on to propose that the laws of physics include the property of self-organization. That is, matter and energy are encouraged to evolve from simple to sophisticated levels of complexity. This property of self-organization will be treated later, but the point is that Davies does not trifle when he proposes “radically new ideas.”

Davies points to the deep and organized complexity in life that simply could not be the result of accidental spontaneity. Given the fact that in order to initiate life certain specific chemical forms and reactions must be present and take place, the explanation that biological evolution offers is implausible. As Davies writes, “a random complex network of reactions is unlikely to yield life.”²² The implausibility of

the accidental formation of life by a spontaneous chemical event has been compared by Fred Hoyle “to a whirlwind passing through an aircraft factory and blowing scattered components into a functioning Boeing 747.”²³ The odds against the random formation of molecules constructing DNA are one to $10^{40,000}$. To put this into perspective, one would have the same chance at flipping a coin and coming up heads 130,000 times in a row.²⁴

The notion of the inevitability of life and consciousness in the cosmos is recognized in part by the theory known as the anthropic principle. This theory states that “the universe is designed in such a way as to make intelligence emerge, so that the inhabitants of the universe . . . possess an ever-increasing consciousness.”²⁵ Davies accepts this principle. Because Davies is not satisfied with the idea of a random universe or the accidental origin of life from haphazard chemical processes, it is important to note that he sees human existence as meaningful. While he is not ready to say that human existence is at the center of meaning in the universe, he does find it encouraging that humans are not trivialized by a view of life’s origin as a freak event. Davies writes,

I don’t mean that Homo sapiens as a species is written into the laws of nature. The world hasn’t been created for our benefit; we’re not at the centre of creation. We are not the most significant thing. But that’s not to say that we are totally insignificant either. One of the depressing things about the last three hundred years of science is the way it has tended to marginalize . . . human beings and thus alienate them from the universe in which they live. I think we do have a place in the universe—not a central place but a significant place nevertheless.²⁶

Earlier in this essay, the property of self-organization was introduced in the context of the origin and meaning of life. This property is fundamental to Davies’ thesis of a meaningful and purposeful universe. To review, the property of self-organization is a tendency found in the laws of physics that encourages matter and energy to evolve from simple to sophisticated levels of complexity. It is neither miraculous nor accidental.

So then, what is the source of the creative power of the universe?²⁷ Over the course of history, most people have attributed this creativity to an omnipotent, omniscient, omnipresent God who stands transcendent over space and time, having created both. The big bang theory seemed to affirm the belief in a supernatural creation event and also seemed to generally track with the Genesis account of creation. Most people have accepted the premise that creation was a singular act, occurring at one spectacular event.

Rather than accept this position, Davies stresses that the creation has not stopped since the big bang. “[T]he universe has never ceased to be creative,” Davies asserts.²⁸ In saying this, not only does Davies deny the necessity of a Creator God; he denies that God creates anything at all. Rather, it is the universe itself that creates, using the laws of nature as the agency of creation. The self-organizing property of the laws of nature allow for the continual creation of new matter and energy. Thus, the universe is not dying a slow death by the gradual dispersal of heat throughout space, but progressing through the creation of new forms. Davies states, “[e]vidently physical processes exist that can turn a void—or something close to it—into stars, planets, crystals, clouds and people.”²⁹ Furthermore, Davies writes,

Only very recently have scientists begun to understand how complexity and organization can emerge from featurelessness and chaos. Research in areas as diverse as fluid turbulence, crystal growth and neural networks is revealing the extraordinary propensity for physical systems to generate new states of order spontaneously. It is clear that there exist *self-organizing* processes in every branch of science.³⁰

How can something be created out of nothing? How can something be caused without a cause? How can true spontaneity exist in the cosmos? Whereas these questions have been addressed by theology and philosophy for generations, they have fallen into the realm of science in the past few decades. The central scientific authority for answers to these questions comes from quantum physics.³¹ Quantum theory, simply put, states that energy and light do not flow in consistent patterns, as previously thought, but instead exist in ultraminute

packets called quanta.³² Quantum physics has turned the worldview of scientists upside down by invalidating Newtonian physics and mechanics. Heisenberg's principle of indeterminacy asserts that the behavior of matter is essentially uncertain rather than predictable.³³ As Davies explains, "Quantum processes are inherently unpredictable and indeterministic; it is generally impossible to predict from one moment to the next how a quantum system will behave. The law of cause and effect, so solidly rooted in the ground of daily experience, fails here. In the world of the quantum, spontaneous change is not only permitted, it is unavoidable."³⁴ Thus, citing quantum physics, scientists such as Davies allege a universe that can indeed create itself from nothing, organize itself into its present state, and continue to renew itself using self-organizing principles.

What are the far-reaching scientific and philosophical consequences of quantum physics? To state them in two words, provocative and staggering. Davies notes that, even though attributing quantum physics to the whole universe (a field known as quantum cosmology) is speculative and provisional, "it is no longer entirely absurd to imagine that the universe came into existence spontaneously from nothing as a result of a quantum process."³⁵ Some other scientists that Davies references are Nobel Prize-winner Ilya Prigogine and Isabelle Stengers, authors of *Order Out of Chaos*. According to these scientists, "Our universe has a pluralistic, complex character. Structures may disappear, but also they may appear."³⁶

Although scientists have been enthralled by the discoveries and ramifications of quantum physics, there is a lack of agreement on the source of nature's creative power. According to Davies, there are three positions on the issue. The first position is that of complete reductionism. According to this view, there are no truly developing phenomena. Instead, every physical process, either explainable by mathematical principles or by observation, is reduced to the behavior of elementary fields in interaction. All levels of complexity can be described using the laws of mechanics directing those fields and particles. Any gulf of knowledge must be attributed to the current ignorance about the details of the given process. To Davies, this is an unacceptable position, because it is based on the outdated concept of determinism.³⁷

The second position is that of uncaused creativity. Adherents to this position recognize the existence of highly organized forms and processes and that they do not necessarily follow from lower level laws. New forms are created in the universe separately from what came before and are not compelled by any predetermined goal. Again, Davies rejects this position because it leaves the nature of organization unexplained. An orderly progression from featurelessness to complexity can be seen in the universe, but to hold to uncaused creativity would be to oversimplify the process. Uncaused creativity is an unscientific attempt at answering a scientific problem.³⁸

The third position, preferable to Davies, is that of organizing principles. Given the existence of a proclivity in nature to organize simple forms into complex ones independently of lower level laws, there is a necessity to find some physical principles in addition to the lower level laws to explain the transition. One of the fundamental properties of nature is its ability to steadily organize simplicity into complexity. This phenomenon can be observed in physics, chemistry, biology, astronomy, and ecology. Spontaneous self-organization is not unusual in nature, but rather, is the norm. Organizing principles must exist that are transcendent over the known laws of physics that have yet to be discovered. In Davies' estimation, science is on the verge of discovering these new general principles, and these discoveries will not only affect science but also the way scientists think about science.³⁹

While it is clear that science alone cannot reveal the meaning of life or the purpose of the existence of the universe, scientific paradigms do profoundly influence thought on these issues.⁴⁰ Two paradigms now seem to be in conflict, the one having dominated scientific thought for three centuries and the other emerging out of new discoveries in physics and taking the place of the first. The first paradigm, the Newtonian paradigm, considered the universe to be a great machine. To understand this great mechanism, one could reduce the universe to the behavior of each individual mechanism and find that it was under the control of deterministic forces.⁴¹ While change and evolution may be observed in the universe, no such thing was possible in reality. There was only a reorganization of particles, and no fundamental change at the atomic level. A central tenet of the Newtonian paradigm is the second law of thermodynamics, which points to the inevitable

deterioration of the cosmos by heat death, the dispersal of all energy to uniform levels throughout the universe. Also, the creation of the universe was seen as an instantaneous event, and once creation was effected, nothing else was created.⁴²

The new paradigm, which is replacing that of Newton, is centered upon the principle of self-organization. This principle does not belong with the Newtonian paradigm because at its core is the notion of dynamism and real change, rather than a mere rearrangement of atoms. The predictability of the deterministic Newtonian paradigm is lost and replaced by the unforeseeable modes of behavior of physical systems in the new paradigm. The characteristics of this new paradigm are spontaneity, complexity, collectivity, global coherence, unpredictability, growth, continual creation, and “unidirectional change in the direction of *progress*.”⁴³

An analogy that Davies uses is that of a flower. He writes, “Instead of sliding into featurelessness, the cosmos rises out of featurelessness, growing rather than dying, developing new structures, processes and potentialities all the time, unfolding like a flower.”⁴⁴ This analogy suggests that there is a plan built into the universe, and the universe is progressing toward realizing that intrinsic plan. While the new paradigm calls for unpredictability in the universe, that is to say that certain states of affairs arise in which many possible lower level potentialities of development present themselves. Thus, an element of innovation and creativity exist along with unpredictability. But the key to this paradigm of growth and progression is that higher laws of nature—self-organizing laws—encourage the development of deeper complexity and orderliness rather than compel it by some arbitrary act either of God or of nature. Davies affirms, “In physics, chemistry, astronomy, geology, biology, computing—indeed, in every branch of science—the same propensity for self-organization is apparent.”⁴⁵

This new paradigm can be called predisposition. It is not to be confused with predeterminism, which holds that everything in the universe in its particular state has been established from the beginning of time. Predisposition also denies the inevitability of any particular life form, so human beings cannot be said to be at the center of meaning in the universe. Predisposition’s claim is that nature has an innate tendency to progress in the way that it has from the big bang forward, given the

rule of its laws. The future cannot be known, but room is left for true creativity and endless potential, as well as human free will. One strong aspect of the predispositional paradigm is the anthropic principle. Here it is apparent that the laws of physics call for the rise of complex life forms, including consciousness, but without the deterministic aspect of the Newtonian paradigm. The anthropic principle also calls for life to exist and develop elsewhere in the universe.⁴⁶

What does this new paradigm have to do with meaning and purpose in the universe? As Davies says, predisposition calls for a “cosmic blueprint.”⁴⁷ Thus, there exists a set of laws that call for a progression from simplicity to complexity to develop in the universe. The universe has the freedom to create itself again and again. There is a “blueprint” for development, but this is not pre-determinism, because at the lower levels of physics, there is profound unpredictability. The principle of stochasticity is central to the predispositional paradigm. In a stochastic system, unpredictability is there, but rationality exists in fixed mathematical laws. At the atomic level, there is instability and fluctuation that ensures the open nature and inscrutability of the future. New forms and systems are available to arise, and the universe has great potential to advance. The difference between stochasticity and anarchy is seen in the fact that the expansion of systems in the universe is achieved by laws and principles that encourage them rather than coerce them. Davies even sees stochasticity as a device conveniently used by a Deity. So, what one finds is order proceeding from disorder.⁴⁸

The paradigm of predisposition, the anthropic and self-organization principles, and the stochastic system all point to a universe that is meaningful, intelligible, purposeful, and rational. Davies takes great pains to build a strong foundation for these claims using science that is governed by sound method. But Davies is a scientist who seems to recognize divine action in the cosmos. While he has said that he shies away from established religion (“science offers a surer path to God than religion”), he admits that science can only take a person so far when addressing ultimate questions.

Conclusion

Paul Davies is without question one of the most renowned scientists of the twenty-first century. His knowledge base is broad, covering the fields of quantum physics, astrobiology, cosmology, chemistry, and mathematics. His positions are much more preferable to those scientists who would hold to a purposeless, meaningless universe that is defined by random accident after accident when the evidence suggests that God is the Designer of this universe. It is regrettable that Davies is reluctant to accept a Creator who made the world by a miraculous demonstration of His sovereign power. He certainly seems to move closer in that direction than many scientists, and perhaps his research will ultimately persuade him. Still, it is encouraging to find even a non-Christian scientist come face to face with unambiguous theological realities—that this universe is fraught with evidence for rationality, meaning, and purpose. It is not so by accident. Humanity does indeed fulfill a most essential and significant role. And finally, as Davies says himself as he concludes *The Mind of God*, “We are truly meant to be here.”⁴⁹

Notes

1. “Paul Davies: A Short Biography,” *The Australian Centre for Astrobiology*, October 23, 2003, <<http://aca.mq.edu.au/PaulDavies/pdbiography.htm>> (November 23, 2004). Further biographical information on Paul Davies can be found at <<http://aca.mq.edu.au/PaulDavies/pdavies.html>>. The publisher of these sites is The Australian Centre for Astrobiology, Sydney, Australia. See also <http://cosmos.asu.edu/index.html>.
2. Paul Davies, *God and the New Physics* (New York: Simon and Schuster, 1983), ix.
3. Paul Davies, “Re: A Question for You, Sir,” November 21, 2004, personal e-mail (November 21, 2004).
4. Davies, *The Mind of God* (New York: Simon and Schuster, 1992), 15.
5. *Ibid.*
6. *Ibid.*, 226.
7. Werner Heisenberg, *Physics and Beyond: Encounters and Conversations*, in “Religion and Science: Paul Davies and John Paul II,” Michael J. Buckley *Theological Studies* 51 (1990): 312.
8. Paul Davies, *The Fifth Miracle* (New York: Simon and Schuster, 1999), 27.

9. Ibid., 28.
10. Paul Davies, "Re: A Question for You, Sir," November 22, 2004, personal e-mail (November 22, 2004).
11. Paul Davies, *God and the New Physics*, 6.
12. Ibid., 218.
13. Paul Davies, "Physics and the Mind of God: The Templeton Prize Address," *First Things* 55 (August/September 1995): 32.
14. Ibid.
15. Paul Davies, *The Cosmic Blueprint* (New York: Simon and Schuster, 1988), 197.
16. Ibid., 203.
17. Davies, "Physics," 34.
18. The subtitle of this work is *The Search for the Origin and Meaning of Life*.
19. In an analysis of Davies' philosophy, it is important to distinguish between "miraculous" divine work and "natural" divine work. As we shall see, Davies does not discount the possibility that God works within the laws of nature to initiate the forms and processes of the universe.
20. Davies, *The Fifth Miracle*, 17.
21. Ibid., 247.
22. Ibid., 27.
23. Ibid., 27-28.
24. Ibid.
25. Jeffrey Marsh, "Explaining the Universe—*The Mind of God: The Scientific Basis for a Rational World* by Paul Davies," *Commentary* 94 (August 1992), 58.
26. Davies, *Are We Alone?*, 128.
27. Davies' work, *The Cosmic Blueprint*, is dedicated to the exploration of this question.
28. Davies, *The Cosmic Blueprint*, 1.
29. Ibid.
30. Ibid.
31. For a detailed study of quantum physics, two works of Paul Davies in particular can be referenced: 1) Davies, Paul ed., (*The New Physics*. Cambridge: Cambridge University Press, 1989) and 2) Davies, Paul. *Other Worlds*. (New York: Simon and Schuster, 1990). *The New Physics* is a collection of highly technical essays, while *Other Worlds* is written for a general audience.
32. Hyman Frankel, review of *The Mind of God* by Paul Davies, *Science and Society* 58 (Summer 1994), 233.
33. Ibid., 234.
34. Davies, *The Cosmic Blueprint*, 5.
35. Ibid.
36. Ilya Prigogine and Isabelle Stengers, *Order Out of Chaos*, in *The Cosmic Blueprint*, Paul Davies (New York: Simon and Schuster, 1988), 5.
37. Davies, *God and the New Physics*, 139-140.

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38. Ibid., 140-141.
 39. Ibid., 142.
 40. Ibid., 197.
 41. These deterministic forces comprised a central role in complete reductionism, according to Davies. This was one reason why he found the position wanting.
 42. Ibid.
 43. Ibid., 198.
 44. Ibid., 200.
 45. Ibid.
 46. Ibid., 201.
 47. Ibid., 202.
 48. Davies, *The Mind of God*, 191-192.
 49. Ibid., *The Mind of God*, 232.