

# Teaching Physical Science From a Christian Perspective

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**T**he physical-science professor may at times have difficulty thinking of ways to integrate faith into the teaching of the subject, as there seem to be fewer obvious opportunities in these subjects than in say, literature or history teaching. There are, however, many ways to integrate faith in the physical sciences.<sup>1</sup> This article will offer some ideas and suggestions for helping students discover that “all truth is God’s truth.”<sup>2</sup>

The first section briefly describes the historical Judeo-Christian foundation of scientific principles. The next three sections provide specific examples of physical-science topics that intersect with Christianity and outline some of the inherent limitations of science as demonstrated by the “new physics.” The fifth and sixth sections deal with physical-science evidence that points to a Creator. These and the next two sections discuss connections between physical science and Scripture in the area of time. The final section suggests several additional possibilities for integration.

## Historical Relationships Between the Physical Sciences and Religion

Although people of other cultures, such as the Chinese, the Greeks, and Muslim Arabs<sup>3</sup> understood certain scientific concepts, the Judeo-Christian culture in Western Europe

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strongly influenced the development of science as we know it today. Because they viewed God as Creator and Lawgiver, scientists and theologians in Western Europe concluded that His creation would be lawful, amenable to study with rational inquiry, and subject to cause-and-effect relations. Their belief that the personal God of Christianity is separate from nature led them to conclude that there were abstract natural laws, and that the principles and results of such laws could be discovered

and studied objectively. Genesis depicts a freely created world that must be experimented upon to be understood, a good world worthy of human experimentation. The Bible says that human beings were created in God’s image, with the rational ability to understand the world and a mandate to care for it.

Many of the founding fathers of science, such as Kepler, Boyle, Newton, Faraday, Kelvin, and Maxwell, were Christians and saw little tension between their theology and their scientific work. Their biographies provide fascinating sidelights to a discussion of the laws they discovered.<sup>4</sup>

In Scripture, God is often portrayed as the direct cause of everything that hap-

pened—including the apparent manipulation or suspension of the laws of physical science, e.g., causing normally unseen objects to become visible, making an axe head float, walking on water, turning bitter water to sweet, parting the Red Sea, causing Jericho’s walls to fall, and punishing evildoers with lightning, earthquake, or fire. Christian science professors may ascribe many of these phenomena to supernatural abrogation of natural law, but might also suggest divinely directed low-probability events or natural law unknown in Bible times as an explanation.

**T**homas Aquinas’ synthesis of Christian theology with Aristotle’s geocentric worldview became the official philosophy of the 16th-century church. Aquinas appropriately believed that reason and revelation should be consistent, since they have the same Author; however, once theology was united with a particular scientific model, arguments against that model appeared to undermine the Bible as well.<sup>5</sup>

Galileo’s observations conflicted with this geocentric worldview, and his condemnation by the church may be the best-known historical example of the clash between science and faith.<sup>6</sup> However, Galileo was not without fault, either. His sarcasm made enemies, and his book made the pope appear a fool. His science had problems as well, with its use of astrology, rejection of elliptic or-

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bits, incorrect arguments about tides, dogmatic faith in math, and overstatement of his case.

Class discussions about the historical relation between science and religion should include the issues of progressive truth, invalid scientific claims based on Scripture, and the “language of appearance” such as “the corners of the earth” and “the windows of heaven.”

### **A Trend Toward Naturalism**

Although many of the founding fathers of science were Chris-

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tians, their emphasis on mechanistic natural law gradually came to dominate science. Thus, when Laplace used the nebular hypothesis to explain the origins of the solar system, he reportedly told Napoleon that he had no need to include God. Since physical phenomena could be explained without the need for God's direct agency, scientists concluded that perhaps God was not needed anywhere, even for life. Thus, the god-of-the-gaps argument—in fact, any appeal to non-naturalistic forces—eventually fell into disrepute. Scientific reasoning gradually led to a totally mechanistic worldview based on naturalism, objective rationalism, determinism, and reductionism, with seemingly no room for the supernatural.

It is appropriate for science to explain as much as possible naturalistically; however, it goes too far when it excludes other possible explanations. Recent developments in the physical sciences suggest that a completely naturalistic worldview is not totally satisfactory. These recent developments can be introduced to students by beginning with a discussion of the properties of light<sup>7</sup>—a particularly meaningful and important topic for the Christian as well as the physical scientist.<sup>8</sup>

**H**istorically, the properties of light have been explained by the use of particle and wave models, although the wave model became the standard by the end of the 19th century. Several pieces of data, however, remained unexplained. Attempts to deal with these problems led to two major revolutions, relativity and quantum mechanics. In addition, developments in cosmology and astrophysics, complexity/chaos theory, and artificial intelligence (and its relation to conscious mind) combined to create a “new physics.”<sup>9</sup> These physics developments in no way negate the many virtues of science, but they do show that science is not a complete, stand-alone worldview.

The following sections will describe how these new theories partially undermine some of science's basic assumptions about human intuition and objectivity, determinism, reductionism, and naturalism. Just as the foundations of science were based on a lawful, personal, just God, so also these new developments are understandable in terms of the biblical Deity who alone is all powerful, all wise, and eternal. These limitations of naturalism can be incorporated into discussions of 20th-century developments in the physical sciences.

### **Intuition and Objectivity Are Incomplete**

Human beings have difficulty comprehending extreme conditions. Normal intuition proves inadequate when humans attempt to visualize complicated concepts in science, as well as in religion. Special relativity theory describes how mass increases and time slows at high speeds. General relativity theory describes how light bends and time slows in strong gravitational fields. Quantum mechanical theories describe phenomena at the size of the atom: the constant creation and destruction of particles, the indeterminacy of a particle's position and momentum, the blurred difference between wave and particle. Cosmological theories require the boldest extrapolation in science to describe the immense distances and times of the universe, including a singularity (an abrogation of natural law) at the beginning. These theories model the un-

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**Physical-science teachers can discuss with their students ways that divinity has occasionally manipulated or suspended the laws of science.**

known using the known. Just as the Bible cannot completely explain God in human language, science also has difficulty explaining extreme conditions in understandable terms. In both cases, reality exceeds human attempts at description.

Relativity theory can be related to theological issues. Both the special and general theories address the relativity of time<sup>10</sup> and have led to speculations about how God experiences time. The  $E=mc^2$  equation suggests that a God with infinite energy could easily create matter *ex nihilo*. The theory of general relativity suggests additional dimensions for space, making more understandable the supernatural capabilities of angels, such as the ability to appear and disappear at will and to walk through walls.<sup>11</sup>

Science assumes that humans can be unbiased observers of an objective reality. However, the observer apparently does affect what is observed, not only in the “soft sciences” such as psychology, but also in the physical sciences. In relativity theory, the location of the observer is important; absolute simultaneity is not possible. According to quantum mechanics, what is seen depends on the experiment and the observer, e.g., radioactive atoms are

both un-decayed and decayed until observed, as parodied by Schrödinger's cat. Objectivity is impossible in astrophysics, since there is only one universe to observe, and we are part of what we are observing. The human mind introduces a certain degree of subjectivity, as well.<sup>12</sup> It can alter the natural world from outside, making the physical universe an open system.

### **Determinism and Reductionism Are Insufficient**

Nature was once believed to be totally deterministic. Laplace went so far as to suggest that the future behavior of the universe would be completely predictable, if the present conditions were perfectly known.

**N**ow, chaos theory recognizes that in practice, most situations are too complex for every effect to be traced to its cause. Higher levels of order cannot be explained by first principles, because minute imprecisions in initial conditions can dramatically alter the final results. Heisenberg's uncertainty principle states that even in theory, the exact position and speed of a particle cannot both be known. For example, although the general properties of radioactivity can be described, no specific cause can be given for the decay of an individual atom.

In these situations, described by the new physics, cause-and-effect relations break down. Determinism no longer provides a complete description of reality. Although free will does depend to some extent on cause and effect, these new developments can provide an avenue for the Creator to intervene and for the creature to act freely. Free will is the exclusive property of a conscious mind.

Complexity theory also suggests that the whole is greater than the sum of its parts. Although a novel requires combining letters and words, its final product consists of more than mere spelling and grammar. In like manner, nature also appears to have hierarchical levels with emergent properties. For example, the conscious mind requires matter and life, but consists of more than just physical and chemical laws, cellular interactions, or computer logic.

### **Design**

Chance plays a part in nature, but life and humanness are more than mere end-products of natural law. The universe appears designed, with the constants of nature apparently fine-tuned for life. Numerous examples have been given<sup>13</sup> including the ratio between the strong and electromagnetic force, the neutron/proton mass ratio, and the mass of the universe. Some scientists, such as Steven Weinberg, recognize the fine-tuning, but believe that a final theory could prescribe values for the constants without any surprising coincidences. However, even he recognizes that a cosmological constant of exactly zero may require some kind of anthropic principle<sup>14</sup> for explanation.<sup>15</sup>

### **Time and Its Beginnings**

Time, for God, apparently does not directly correspond to human concepts of time (Psalm 90:4; 2 Peter 3:8). When God intervenes in the universe, strange effects in time perception can result, such as appearance of age in created objects, adjustments in time measurement due to Joshua's long day and Hezekiah's sundial, and the rate of change of natural processes during the water-

## **Recent developments in the physical sciences suggest that a completely naturalistic world-view is not totally satisfactory.**

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to-wine miracle.

Time is an essential feature in the physical sciences as well as in Christianity. The scientific concept of linear time parallels the biblical account of time progressing from a Creation and Fall to a judgment and an apocalypse. This contrasts with Hindu and Buddhist cultures, where time is viewed mainly as cyclical with little change or progress.<sup>16</sup>

Lord Kelvin developed the second law of thermodynamics by unifying two of his deepest theological commitments: (1) Natural law is created and governed by divine power; and (2) The world is progressively developing toward an inevitable end. He believed that the universe required a Creator/Designer to "wind it up" at the beginning.<sup>17</sup>

Whether or not one accepts the Big Bang model, this theory does point to a beginning for the universe, space, and time. It suggests an effect without a cause as well as a limit to scientific explanations. For these reasons, the theory was initially resisted by scientists.<sup>18</sup> Arno Penzias, a contributor to the theory, says "astronomy leads us to a unique event, a universe which was created out

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model for their students the role of a searcher who is willing to weigh the options and at times admit, "I don't know."

Modern science has constructed a fairly comprehensive long-age model, with supporting evidence, whereas no comprehensive short-age naturalistic model exists. However, science has its limitations, so it is not irrational to reject some of its claims. Short ages for life on Earth do seem to fit best theologically; however, it is important not to make unsupported claims based on the limited information contained in inspired sources.

Conflict between science and revelation regarding time issues seems very apparent, and may never be fully resolved this side of heaven. When discussing these topics with their students, Christian teachers can point to other examples of inevitable conflict due to our finite comprehension, such as the divine/human nature of Christ and the dual wave/particle nature of light. A range of resolutions to the conflict should be suggested, since considering more than one option can encourage greater objectivity. As I seek to develop my understanding of origins, I include reason based on evidence from both nature and Scripture, but also faith in a loving, omniscient, and eternal God.<sup>20</sup>

## The End

Several years ago, *Discover* magazine suggested varied possible end-of-the-world scenarios caused by physical events: asteroid impact, gamma ray burst, collapse of the vacuum, rogue black holes, giant solar flares, reversal of Earth's magnetic field, global warming, a particle accelerator mishap, a nanotechnology disaster, environmental toxins, a robot takeover, alien invasion, and divine intervention.<sup>21</sup>

Unprecedented devastation is possible. The ethics of weapons development and nuclear power is an important topic for the physical-science student, from nuclear bombs to Chernobyl's radioactive fallout to chemical warfare. Speaking about the atomic bomb, J. Robert Oppenheimer said, "In some sort of crude sense which no vulgarity, no humor, no overstatement can quite extinguish, the physicists have known sin; and this is a knowledge which they cannot lose."<sup>22</sup>

Others suggest that the universe will end with a whimper instead of a bang. The second law of thermodynamics states that the amount of useful energy in the universe is decreasing. The world could end with disorder and pollution and the universe by heat death.<sup>23</sup> Christian teachers can compare these physical science scenarios to scriptural details of a final future catastrophe as foreshadowed by a past devastating judgment (e.g., Genesis 6-9; Matthew 24; 2 Peter 3; Revelation 15-16).

## Modern Scientists and Religion

Teachers can share with their students discussions about religion and science that appear regularly in the scientific literature<sup>24</sup> and the popular press.<sup>25</sup> Numerous prominent physical scientists

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of nothing, one with the very delicate balance needed to provide exactly the conditions required to permit life, and one which has an underlying (one might say 'supernatural') plan."<sup>19</sup>

## Origins

Like the Big Bang theory, issues relating to the origin of the Earth require an understanding of geophysical and geochemical principles, e.g., paleoenvironmental chemistry, viscosity and plate tectonic rates of motion, paleomagnetism and changes in Earth's magnetic field, volcanism and magma fractionation, heat flow and cooling of large magma bodies, modeling meteor impacts, and radiometric dating. Any professor who tackles such topics at the interface between historical science and inspiration should use care.

**T**eachers can lay out for their students the evidence for various models of origins, along with the strengths and weaknesses of those theories. Whether or not they choose to provide specific answers to difficult questions, Christian teachers should adopt a professional approach. Through showing respect for views with which they may not agree (with no cavalier ridicule, pat answers, or refusal to discuss certain topics), they can

today are Christians.<sup>26</sup> Although Steven Weinberg expresses well the standard scientific skepticism about religion,<sup>27</sup> Paul Davies does not share his scorn for “the notion that there might exist a God.”<sup>28</sup>

Both professors and students of physical science share ethical responsibilities relating to science, which include good stewardship of God’s creation and providing scientific expertise to the community. Interacting socially with scientists in the secular world opens numerous opportunities, not otherwise available, of sharing a lifestyle and a worldview.

The physical-science professor should find that integrating faith and learning is quite feasible, since much of the foundation of the physical sciences was developed by scientists with a Christian worldview. Some topics, such as thermodynamics and the fine-tuning of physical constants, may provide support for faith. Other topics, such as light and time, can give direct ties between science and faith. Recent physical-science theories offer opportunities for discussing important philosophical topics, such as objectivity, determinism, reductionism, and naturalism. Both the scientific press and popular news present current issues relating to physical science and faith. With a little thought and planning, physical-science professors can use these and other ideas to integrate faith into the teaching of their subject. ☞

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Russia. He currently works with the Geoscience Research Institute (see <http://www.grisda.org/>) in Loma Linda, California, and is directing his studies toward geochronology.

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## NOTES AND REFERENCES

1. Ben Clausen, “Integrating Faith and Learning in the Teaching of Physics.” In Humberto M. Rasi, compiler, *Christ in the Classroom: Adventist Approaches to the Integration of Faith and Learning*, vol. 26-A (Silver Spring, Md.: General Conference Education Dept.), pp. 421-432.
2. Arthur F. Holmes, *All Truth Is God’s Truth* (Grand Rapids, Mich.: Eerdmans, 1977).
3. See, for example, Pervez Hoodbhoy, *Islam and Science: Religious Orthodoxy and the Battle for Rationality* (London: Zed Books, 1991).
4. See Nancy R. Pearcey and Charles B. Thaxton, *The Soul of Science: Christian Faith and Natural Philosophy* (Wheaton, Ill.: Crossway Books, 1994), pp. 21-37. The first chapter provides numerous references relating modern science to the Judeo-Christian worldview, and the remainder of the book does well at interrelating many religion and physical science topics. See also Fred Heeren, *Show Me God: What the Message From Space Is Telling Us About God* (Wheeling, Ill.: Searchlight Pub, 1995), pp. 334-363.
5. David J. Tyler, “The Impact of the Copernican Revolution on Biblical Interpretation,” *Origins* [Journal of the Biblical Creation Society] 21 (1996), pp. 2-8.
6. Charles E. Hummel, *The Galileo Connection: Resolving Conflicts Between Science and the Bible* (Downers Grove, Ill.: InterVarsity Press, 1986), pp. 81-125.
7. See Benjamin L. Clausen, “Can Science Explain It All?” *College and University Dialogue* 3:2 (1991), pp. 8-10.
8. In Scripture, light and its properties are often an important part of stories and metaphors, e.g., Genesis 1:3-5, 14-19; 9:13-17; Leviticus 24:2-4; Psalm 104:2; 119:105; Proverbs 4:18; Isaiah 60:1-3; Matthew 4:16; 5:14-16; John 1:4-9; 8:12; 9:5f; 1 Corinthians 13:12; 2 Corinthians 3:18; 4:6; 1 Timothy 6:16; James 1:23. See also Ellen G. White, *The Desire of Ages* (Mountain View, Calif.: Pacific Press Publ. Assn., 1940), chapter 51, “The Light of Life.”
9. In addition to light, water and fire are two other topics of significant interest and importance to Christians as well as physical scientists.
9. Paul Davies, *God and the New Physics* (New York: Simon and Schuster, 1983).
10. See, for instance, S. Clark Rowland, “Space Odysseys and Time Dilation,” *Spectrum* 29:1 (Winter 2001), pp. 30, 31.
11. Hugh Ross, *Beyond the Cosmos: The Extra-Dimensionality of God* (Colorado Springs, Colo.: NavPress, 1996).
12. Euan Squires, *Conscious Mind in the Physical World* (New York: IOP Publishing, 1990).
13. See, for example, John D. Barrow and Frank J. Tipler, *The Anthropic Cosmological Principle* (Oxford: Oxford Univ. Press, 1986).
14. “What we can expect to observe must be restricted by the conditions necessary for our presence as observers” is one way of stating the Anthropic Principle—an attempt to explain the observation that the universe appears to be expressly designed for life.
15. Steven Weinberg, *Dreams of a Final Theory* (New York: Pantheon Books, 1992); see review by Benjamin L. Clausen, “How Final Is Final?” *Origins* 22:1 (1995), pp. 43-46. See <http://www.grisda.org/origins/22043.html>.
16. See, for example, the book written by nuclear physicist Lawrence W. Fagg, *Two Faces of Time* (Wheaton, Ill.: Theosophical Publ. House, 1985), especially the chapter, “From Cyclical Rituals to Judeo-Christian Linearity,” pp. 102-116.
17. Crosbie W. Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (Cambridge: Cambridge Univ. Press, 1989), pp. 327-332, 497-523.
18. Robert Jastrow, *God and the Astronomers* (New York: W. W. Norton, 1978), pp. 111-116.
19. Henry Margenau and Roy Abraham Varghese, eds., *Cosmos, Bios, Theos: Scientists Reflect on Science, God, and the Origins of the Universe, Life, and Homo Sapiens* (La Salle, Ill.: Open Court Publ. Co., 1992), p. 78.
20. Benjamin L. Clausen, “Time in Science and the Bible,” *Geoscience Reports* 22 (1997), pp. 1-5. See <http://www.grisda.org/georpts/2201.html>.
21. Corey S. Powell, “Twenty Ways the World Could End Suddenly,” *Discover* 21:10 (October 2000), pp. 50-57.
22. Kip S. Thorne, *Black Holes and Time Warps: Einstein’s Outrageous Legacy* (New York: W. W. Norton, 1994), p. 223.
23. If the second law of thermodynamics can be applied to the universe as a closed system, the universe is progressing toward equilibrium conditions, i.e., maximum disorder or entropy, where all temperature differences will have disappeared. This is called “the heat death of the universe.”
24. See, for example, W. Wayt Gibbs, “Beyond Physics,” *Scientific American* 279:2 (August 1998), pp. 20-22; Mano Singham, “Teaching and Propaganda,” *Physics Today* 53:6 (June 2000), pp. 54, 55; Freeman Dyson, “Science and Religion Can Work Together,” *APS (American Physics Society) News* 9:10 (November 2000).
25. See, for example, Sharon Begley, “Science Finds God,” *Newsweek* (July 20, 1998), pp. 46-51; Chandler Burr, “The Geophysics of God: A Scientist Embraces Plate Tectonics—and Noah’s Flood,” *U.S. News & World Report* 122:23 (June 16, 1997), pp. 55-58.
26. For example, see John Polkinghorne, *One World: The Interaction of Science and Theology* (Princeton, N.J.: Princeton Univ. Press, 1986).
27. Weinberg.
28. Paul Davies, *The Mind of God: The Scientific Basis for a Rational World* (New York: Simon and Schuster, 1992), p. 231.

# Suggested Reading

## Science and Christianity

- Nancy R. Pearcey and Charles B. Thaxton, *The Soul of Science: Christian Faith and Natural Philosophy* (Wheaton, Ill.: Crossway Books, 1994).
- Fred Heeren, *Show Me God: What the Message From Space Is Telling Us About God* (Wheeling, Ill.: Searchlight Publ., 1995).
- Charles E. Hummel, *The Galileo Connection: Resolving Conflicts Between Science and the Bible* (Downers Grove, Ill.: InterVarsity Press, 1986).
- David C. Lindberg and Ronald L. Numbers, eds., *God and Nature: Historical Essays on the Encounter Between Christianity and Science* (Berkeley, Calif.: Univ. of California Press, 1986).
- John Polkinghorne, *One World: The Interaction of Science and Theology* (Princeton, N.J.: Princeton Univ. Press, 1986).

## Scientists as Christians

- Geoffrey N. Cantor, *Michael Faraday: Sandemanian and Scientist: A Study of Science and Religion in the 19th Century* (New York: St. Martin's Press, 1991).
- John Fauvel, Raymond Flood, Michael Shortland, and Robin Wilson, eds., *Let Newton Be!* (Oxford: Oxford Univ. Press, 1988).
- Richard S. Westfall, *The Life of Isaac Newton* (Cambridge: Cambridge Univ. Press, 1993).
- Blaise Pascal, *Pensées*. Translated With an Introduction by A. J. Krailsheimer (New York: Penguin, 1966).
- Paul Theerman, "James Clerk Maxwell and Religion," *American Journal of Physics* 54 (April 1986), pp. 312-317.
- Crosbie W. Smith and M. Norton Wise, *Energy and Empire: A Biographical Study of Lord Kelvin* (Cambridge: Cambridge Univ. Press, 1989).

## 20th Century Physics

- Paul Davies, *The Mind of God: The Scientific Basis for a Rational World* (New York: Simon and Schuster, 1992).
- Paul Davies, *God and the New Physics* (New York: Simon and Schuster, 1983)
- Kitty Ferguson, *The Fire in the Equations: Science, Religion, and the Search for God* (Grand Rapids, Mich.: Eerdmans, 1994).
- Trinh Xuan Thuan, *The Secret Melody* (Oxford: Oxford Univ. Press, 1995).
- Nathan Spielberg and Bryon D. Anderson, *Seven Ideas That Shook the Universe* (New York: Wiley, 1987).
- Richard Morris, *Dismantling the Universe* (New York: Simon and Schuster, 1984).
- Steven Weinberg, *Dreams of a Final Theory* (New York: Pantheon Books, 1992).

## Cosmology and Relativity

- Robert Jastrow, *God and the Astronomers* (New York: W. W. Norton, 1978).
- Hugh Ross, *Beyond the Cosmos: The Extra-Dimensionality of God* (Colorado Springs, Colo.: NavPress, 1996).
- Stephen W. Hawking, *A Brief History of Time* (New York: Bantam, 1988).
- Kip S. Thorne, *Black Holes and Time Warps: Einstein's Outrageous Legacy* (New York: W. W. Norton, 1994).

## Quantum Mechanics

- James T. Cushing, *Quantum Mechanics: Historical Contingency and the Copenhagen Hegemony* (Chicago: Univ. of Chicago Press, 1994).
- P. C. W. Davies and J. R. Brown, eds., *The Ghost in the Atom* (Cambridge: Cambridge Univ. Press, 1989).

## Artificial Intelligence and Consciousness

- Roger Penrose, *Shadows of the Mind: A Search for the Missing Science of Consciousness* (Oxford: Oxford University Press, 1994).
- Francis Crick, *The Astonishing Hypothesis: The Scientific Search for the Soul* (New York: Scribner's, 1994).
- Daniel Crevier, *AI: The Tumultuous History of the Search for Artificial Intelligence* (New York: Basic Books, 1993).
- Euan Squires, *Conscious Mind in the Physical World* (New York: IOP Publishing, 1990).

## Complexity Theory

- James Gleick, *Chaos: Making a New Science* (New York: Penguin, 1987).
- M. Mitchell Waldrop, *Complexity: The Emerging Science at the Edge of Order and Chaos* (New York: Simon and Schuster, 1992).

## Design

- J. P. Moreland, ed., *The Creation Hypothesis: Scientific Evidence for an Intelligent Designer* (Downers Grove, Ill.: InterVarsity Press, 1994).
- John Gribbin and Martin Rees, *Cosmic Coincidences: Dark Matter, Mankind, and Anthropic Cosmology* (New York: Bantam Books, 1989).
- P. C. W. Davies, *The Accidental Universe* (Cambridge: Cambridge Univ. Press, 1984).
- John D. Barrow and Frank J. Tipler, *The Anthropic Cosmological Principle* (Oxford: Oxford Univ. Press, 1986).

## Time

- Paul Davies, *About Time: Einstein's Unfinished Revolution* (New York: Simon and Schuster, 1995).