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Exploring Uncharted Territory

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Exploring Uncharted

Professors engage a host of ethical, philosophical and scientific issues in a yearlong seminar that ultimately raises more questions than it answers — and puts them in their students' shoes.

What is the nature of the universe? How did the universe begin? Why is there something, rather than nothing? Is life inevitable in the universe? Is consciousness? What does it mean to be human? What is the nature of personhood? What is the nature of ultimate reality?

During the 2007-2008 academic year, a group of Furman faculty engaged these and other provocative questions in a seminar titled "Science and Religion: A Dialogue for the 21st Century," sponsored by Furman's Lilly Center for Theological Exploration of Vocation. The 20 of us who participated represented a broad spectrum of academic specialties — natural sciences, social sciences, mathematics, computer science, religion, literature and philosophy. Our commitment to the seminar entailed extensive reading and reflective writing in addition to many hours of discussion.

The questions we confronted are examples of what scholar Ian Barbour calls "limit questions" — questions that arise at the boundaries, or limits, of the understanding of the world that science provides. Like the photograph (opposite) of the Reflection Nebula in Orion that was used as the seminar's logo, which shows bright starlight partially obscured by the blackness of an interstellar dust cloud, limit questions juxtapose the known with the unknown, that which is well understood with that which remains mysterious. Barbour suggests that although these kinds of questions arise within science, they cannot be answered by science alone. Instead, they require interdisciplinary dialogue involving science, religion and philosophy.

Among the many issues we pondered over the course of the year, two of the limit questions were, "Is life inevitable in the universe?" and "What is the nature of human beings?" In the sections that follow, I'll describe the issues that we discussed in connection with these two questions — although it should be noted that no consensus about the answers has been reached by scholars in general, or by our group in particular. I'll also describe our efforts to determine how we might bring these complex, open-ended, often controversial issues into our classrooms at Furman.

NASA/HUBBLE HERITAGE TEAM (STScI)

By Susan Smart D'Amato

Cosmology & the Anthropic Principle

Cosmology is the study of the large-scale structure, history and future of the universe. What is the current thinking in this field about the origin of the universe as we know it today?

Cosmologists tell us, based on a combination of experimental data and theoretical physics, that approximately 13 billion years ago the universe was in an extremely compact state of high temperature and high matter/energy density. Then, for reasons that are not well understood, it began an explosive expansion known as the Big Bang, an expansion that continues today.

As the universe expanded and cooled, fundamental particles such as quarks coalesced into protons and neutrons, which went on to coalesce into the nuclei of the lightest elements, forming hydrogen, helium, lithium and beryllium. These nuclei eventually joined electrons to form atoms in a gaseous state; still later, gravity squeezed localized regions of gas into hot, dense regions where nuclear fusion could begin.

Whenever nuclear fusion began in the core of a gas cloud, a star was "born," initiating a "lifetime" spanning millions to billions of years in which the star churned out enormous amounts of energy as it fused light elements into heavier ones. Over time, as some stars ran out of nuclear fuel, they "died" and either gently or violently ejected much of their stellar material into their galactic neighborhood. The debris provided raw material from which the next generation of stars could form.

The new generation of stars formed in clouds containing heavier elements than the first generation. Over time, some interstellar clouds of dust and gas contained a sufficient number and quantity of heavy elements to allow rocky planets to coalesce within the swirling cloud of material surrounding the young stars at their center. This is how we believe our solar system formed some 4.5 billion years ago.

Thus we believe that all the elements we find on Earth today, from the silicon, oxygen and iron in our planet's continents and oceans to the carbon, oxygen and nitrogen found in our own bodies, were forged in stellar furnaces

billions of years ago. The "stuff" of rocks (and of life) is a product of the laws of nuclear physics as they play out in the births and deaths of stars.

This brings us to one of the limit questions emphasized by Barbour. In recent years cosmologists have puzzled over the Anthropic Principle, the idea that the physical laws of the universe seem to be fine-tuned to allow for the development of life. In *When Science Meets Religion: Enemies, Strangers, or Partners?* Barbour writes:

> "A striking feature of the new cosmological theories is that even a small change in the physical constants [the constants of nature] would have resulted in an uninhabitable universe. Among the many possible universes consistent with Einstein's equations, ours is one of the very few in which the arbitrary parameters are just right for the existence of anything resembling organic life. . . [T]he possibility of life as we know it depends on the value of a few basic constants and is remarkably sensitive to them."

He goes on to cite several examples of this fine-tuning. First, there is the rate at which the universe is expanding. If, just after the Big Bang, the universe had expanded at even a slightly smaller rate, then gravity would long ago have dominated the outward push of expansion, giving rise to a universal "crunch." On the other hand, if the rate of expansion had been even slightly greater, gravity would have been unable to cause local gas clouds to condense into hot, dense regions where stars could form.

"The expansion rate itself depends on many factors, such as the initial explosive energy, the mass of the universe, and the strength of gravitational forces," states Barbour. "The cosmos seems to be balanced on a knife edge."

A second area of cosmic "coincidence" involves the formation of elements, both the primordial elements formed shortly after the Big Bang and the heavier elements formed later in stars. Our model indicates that the conditions of the universe in the smallest fraction of a second after the Big Bang caused hydrogen and helium (the lightest and simplest elements) to be formed in specific amounts.

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NASA/JOHNS HOPKINS U. APL/SWRI/GODDARD SPACE FLIGHT CENTER

Some see the Anthropic Principle as a non-issue, pointing out that if the laws of physics had not led to the development of life, then we wouldn't be here to raise the question of why the laws are the way they are.

If the strong nuclear force that binds protons and neutrons into atomic nuclei had been even slightly stronger than it actually is, then soon after the Big Bang, all the hydrogen in the universe would have fused into helium, leaving no hydrogen in existence. Without hydrogen, water could never have formed on the surface of our planet. And without water, life as we know it would not exist.

By the same token, if the properties of helium, carbon and oxygen nuclei had been even slightly different from the properties they actually possess — if the fine balance were upset just a bit in one direction or the other — then either helium would never have fused into carbon in the cores of stars, or helium would have fused into carbon, but then the carbon would have immediately fused into oxygen. In either case, there would have been no carbon left in stars that could later form the organic molecules on which all known life is based.

These and other "coincidences" — all of which must have occurred, and occurred in just the right sequence, for life to exist today — are the puzzles the Anthropic Principle calls to our attention.

What are we to make of the Anthropic Principle? Some scientists see it as a non-issue, pointing out that if the laws of physics had not led to the development of life, then we wouldn't be here to raise the question of why the laws are the way they are. Other scientists acknowledge the high improbability of the conditions that were "just right" for the development of life, but postulate that our universe is only one of many "island universes" in a greater "multiverse," most of which do not harbor life.

But could the Anthropic Principle be interpreted as evidence of design? Barbour points out that many eminent physicists see evidence of design in the early universe, agreeing with the statement made by Freeman Dyson that "the universe in some sense must have known we were coming." Some see religious implications in this view; others do not.

As for the Lilly faculty, we ended our discussion of this issue in much the same way that we began it — by acknowledging that it is a complex, open-ended question with no unambiguous answers.

Neuroscience and human nature

Neuroscience, the modern science of the brain, is another area that gives rise to limit questions that challenge our accustomed ways of thinking about the world and ourselves. Seminar participants had the opportunity to confront some of these questions in the spring of 2008, thanks in part to a visit to Furman by Christian philosopher Nancey Murphy, who delivered the Charles Townes Lecture in Faith and Reason.

Murphy met with our seminar for an hour during her time at Furman. In preparation, we read selections from her recent book *Bodies and Souls, or Spirited Bodies?*

Murphy argues that advances in neuroscience undermine the commonly held view that human beings are composed of multiple, distinct "parts" — body and mind, or body and soul (two dualistic views), or body, soul and spirit (which she calls a trichotomist view). Citing brain imaging studies, studies of patients with brain damage or disorders, and experimental investigations of perception, memory and cognition, she articulates a physicalist view, stating, "It is becoming increasingly obvious to many that the functions and attributes once attributed to the soul or mind are better understood as functions of the brain."

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However, she says, this does not mean that all our thoughts and behavior can be reduced to the electrical and biochemical processes of our brains. Arguing against reductionism, she states that "our complex neural equipment, along with cultural resources, underlies our capacities for morality . . . free will . . . and the ability to be in relationship with God."

Turning to questions of theology, Murphy argues that, despite a centuries-old tradition of dualism in Christianity,


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As part of their exploration of science and ethical issues, seminar participants studied the play Copenhagen. *Michael Frayn's work, set in September 1941 in the midst of World War II, recounts a meeting between physicist Niels Bohr and his former protégé Werner Heisenberg (a German), who were on opposite sides of the conflict. The two had collaborated on work that led to the development of the atomic bomb. Furman produced the play in the fall with an all-faculty cast of Margaret Oakes (English), Kevin Treu (center, computer science) and Doug Cummins (theatre arts).*

the Bible is not unambiguous in its anthropology, or theory of human nature. She states that, as far as the Old Testament or Hebrew Bible is concerned, "current [biblical] scholars . . . claim that the original Hebraic conception of the person comes closer to current physicalist accounts than to body-soul dualism."

She points out that it is widely agreed that the Hebrew word *nephesh*, translated in the King James Version of the Old Testament as "soul," should be understood as referring to "the whole living person" rather than to one part of a body-and-soul combination. The New Testament scriptures, however, can be interpreted in a variety of ways; thus, she concludes, "There is no such thing as *the* biblical view of human nature *insofar as we are interested in a partitive account*. The biblical authors, especially the New Testament authors, wrote within the context of a wide variety of views, probably as diverse as in our own day, but did not take a clear stand on one theory [of human nature] or another."

Although Murphy presents physicalist anthropology as widely accepted among biblical scholars today (and as almost universally accepted among neuroscientists), this view was new to many of us in the Lilly seminar, and, no doubt, to many who heard her lecture. On the one hand, this view is helpful in reconciling apparent discrepancies between scientific and scriptural understandings of human beings. On the other, it is all too easy to hear in physicalism a reductionist claim that humans are "nothing but" their atoms and biochemical processes — physical beings who end when those processes end.

Murphy says, however, that "this 'physicalist' position need not deny that we are intelligent, moral and spiritual. We are, at our best, complex physical organisms, imbued with the legacy of thousands of years of culture, and most importantly, blown by the Breath of God's Spirit; we are *Spirited bodies*." And although her physicalist philosophy is incompatible with a view of the afterlife, in which a soul separates from the body at death in order to unite with God, it is compatible, she argues on philosophical as well as biblical grounds, with a theology of bodily resurrection.

For many of us, Murphy's book and visit generated — and continue to generate — more questions than answers. But then, perhaps that is to be expected and welcomed in a seminar dedicated to exploring uncharted territory.

Building a Community of Truth

The issues on which we focused during the Lilly seminar were complex, open-ended and often controversial. They offered us an opportunity to expand the boundaries of our understanding, both personally and professionally, by engaging difficult questions within the supportive context of an interdisciplinary community of scholars.

What did the participants think about their year in the seminar? Some praised the benefits of reading outside their area of expertise and the opportunity to exchange points of view with colleagues from other fields. Others embraced the challenge of considering what bridges exist between religion and science — and between other fields as well.

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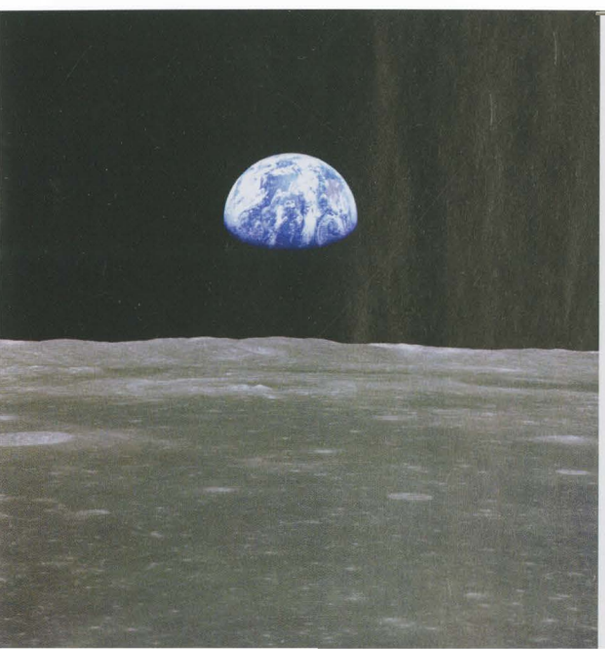
Participants also addressed how they expected the seminar to influence their teaching. One said, "I found myself placed in the role of the student again, which has allowed me greater empathy with the struggles my students face on these significant questions." Others volunteered that "I think we all see the need now for humility, for listening," and "I am more comfortable now with ambiguity, with not having all the answers."

These responses seem to indicate that the Lilly program provided the kind of learning environment that Parker Palmer advocates in *The Courage to Teach*, a book we read and discussed at the close of the seminar. Palmer calls his model of teaching and learning "participation in a community of truth," where he defines truth as "an eternal conversation about things that matter, practiced with passion and discipline."

Palmer calls on us to reject a philosophy of teaching and learning that sees education as a hierarchical system in which knowledge is transmitted "downward," from "expert" to "amateurs." In its place he invites us to envision a "subject-centered circle of knowers" in which all learners — teachers as well as students — are in relationship with the subject and with each other. Unlike the hierarchical model, Palmer emphasizes collegiality and community and invites those among the "circle of knowers" to exhibit diversity, humility and a tolerance for ambiguity while participating in the free exchange of ideas.

Palmer's model may have familiar overtones to those who have been following the development of Furman's new curriculum over the last few years. It seems especially fitting that in the year just prior to implementing a revamped and redesigned academic program, 20 Furman faculty had the opportunity to have just the sort of experience we want for all our students: the chance to be part of an intellectual community composed of thinkers near and far, present and past; the opportunity to read, analyze, reflect on and discuss issues of significance; and the invitation to join with others to create new knowledge, understanding and meaning as we engage questions of ultimate concern. |F|

The writer, a member of the Class of '77, is a professor of physics at Furman. She coordinated the Science and Religion seminar with David Rutledge, Reuben B. Pitts Professor of Religion. They are developing another seminar, titled "Simpler Living, Radical Change: Theology, Ethics and Sustainability," for the 2009-10 academic year.



Science and Religion Seminar Reading List

Ian G. Barbour, *Religion and Science: Historical and Contemporary Issues* (HarperSanFrancisco, 1997).
Barbour, *When Science Meets Religion: Enemies, Strangers, or Partners?* (HarperSanFrancisco, 2000).
Francis S. Collins, *The Language of God: A Scientist Presents Evidence for Belief* (Free Press, 2006).
Owen Gingerich, *God's Universe* (Harvard University Press, 2006).
Ursula Goodenough, *The Sacred Depths of Nature* (Oxford University Press, 1998).
Stephen Jay Gould, *Rocks of Ages: Science and Religion in the Fullness of Life* (Ballentine, 1999).
John F. Haught, *God After Darwin: A Theology of Evolution* (Westview Press, 2000).
Nancey Murphy, *Bodies and Souls, or Spirited Bodies?* (Cambridge, 2006).
Parker Palmer, *The Courage to Teach: Exploring the Landscape of a Teacher's Life*, 10th edition (Jossey-Bass, 2007).
Holmes Rolston, *Science and Religion: A Critical Survey* (Templeton Foundation Press, 2006).
Charles H. Townes, *Making Waves* (AIP Press [Imprint], 1997).