Pedagogy in Religion and Science

with Timothy Gibson, "Between Knowing and Being: Reflections on Being Taught Science and Religion by Professor Christopher Southgate"; Louise Hickman, "Modeling the Cosmos: Transformative Pedagogy in Science and Religion"; Willem B. Drees, "God, Humanity, and the Cosmos: *Challenging a Challenging Textbook"; and Christopher Corbally and Margaret Boone Rappaport, "Teaching Science and Religion in the Twenty-First Century: The Many Pedagogical Roles of Christopher Southgate."*

TEACHING SCIENCE AND RELIGION IN THE TWENTY-FIRST CENTURY: THE MANY PEDAGOGICAL ROLES OF CHRISTOPHER SOUTHGATE

by Christopher Corbally and Margaret Boone Rappaport

Abstract. With the goal of understanding how Christopher Southgate communicates his in-depth knowledge of both science and theology, we investigated the many roles he assumes as a teacher. We settled upon wide-ranging topics that all intertwine: (1) his roles as author and coordinating editor of a premier textbook on science and theology, now in its third edition; (2) his oral presentations worldwide, including plenaries, workshops, and short courses; and (3) the team teaching approach itself, which is often needed by others because the knowledge of science and theology do not always reside in the same person. Southgate provides, whenever possible, teaching contexts that involve students in experiential learning, where they actively participate with other students. We conclude that Southgate's ultimate goal is to teach students how to reconcile science and theology in their values and beliefs, so that they can take advantage of both forms of rational thinking in their own personal and professional lives. The co-authors consider several examples of models that have been successfully used by people in various fields to integrate science and religion.

Keywords: experiential learning; models; science and education; science and religion; team teaching; the New Physics; theology

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Christopher J. Corbally, SJ, is a Jesuit priest with the Vatican Observatory Research Group, for which he has served as Vice Director. He is an Adjunct Associate Astronomer with Steward Observatory, University of Arizona, in Tucson, AZ, USA; e-mail corbally@as.arizona.edu. Margaret Boone Rappaport is a cultural anthropologist who works on issues of science, religion, and art, with the Human Sentience Project, in Tucson, Arizona and previously was Lecturer at Georgetown University, Washington, DC, USA; e-mail msbrappaport@aol.com.

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Different Ways of Teaching

An overarching lesson from many teachers' experience seems to be a consensus that somehow, for multiple reasons, science and religion have a difficult time joining together in the lives of many people. At the opposite end are people like Christopher Southgate, for whom science and religion both have a comfortable home. There are not many people who are trained in both science at the doctoral level, and in ministerial practice and theology in the academy. A few have doctorates in both, but again, not many. Therefore, what can these few individuals tell us about the integration of the two "juggernauts" of the twenty-first century, science and religion? And, why do so many students (and teachers, too) have such difficulty in bridging the gap between these two ways of thinking? It is a puzzle.

Teaching science and religion as dual topics is one of the best ways to understand why they sit uncomfortably in so many people. Furthermore, it is important for educators to ask why this discomfort is so prominent and important today (Barnes et al. 2017; Forsyth 2017). Have science and religion changed so much? Well, maybe they have. Science now takes us to the Moon, and soon, to Mars. It was only a generation or two ago when parents and grandparents wondered if humans *should* go off-world. Now, it is almost taken for granted that humans did go and will do so again, and that the remainder of the world populations will take part in these accomplishments. That is indeed different. Science has changed, and its role in people's lives has changed.

Religion has changed, as well. Populations migrate all over the globe, taking up residence in nations whose languages and cultures are entirely different. We are only one or two generations away from a time when few people went far from their natal village, hamlet, or neighborhood. Today, one religion runs up against others, and conflicts result—due to people, holidays, prayer schedules, and clothing, not to mention marriage customs. In the past, many people got along well because they never met anyone very different from themselves!

Therefore, science has changed, to the great benefit of so many people who have stable diets, better medicine, and more energy. Religion has changed because its many forms now know they occupy a world where many other religious forms exist. The question looms large for every twenty-first century citizen: How do I get along with all these different people? How do I get along with my children, who study topics in biology that my grandparents would never have imagined? How do I encourage my teenagers to pursue careers in science that will take them so far away from us?

We need new guidance and a good framework for understanding and teaching how to comprehend what has happened to us.

The Role of Editor and Author of a Textbook

A good textbook is a requisite beginning for organizing our thinking about the conflict and accommodation of science and religion. Christopher Southgate's comprehensive textbook, *God, Humanity, and the Cosmos*, now in its third edition (2011), provides that good organization with which to develop our own personal understanding, or to teach a course or a unit on the topic of "Science and Religion." The textbook is also useful in teaching the large variety of other courses mentioned below. It is fully documented, and includes treatments of the main issues that characterize the field of science and religion. A teaching module (which is easily used as a lesson plan) can be crafted from any of the full chapters in the book. At the same time, the book's table of contents provides a kind of issues-overview for teachers, especially first-time teachers in the field. A graduate seminar could begin with the table of contents, allowing each student to focus on an area that interests him or her the most. Then, presentations to a class or group can give experience in public speaking on these issues. Equally important is gaining a facility for leading question-and-answer periods on topics that many people find difficult to discuss.

We shall take examples from *God, Humanity, and the Cosmos*, and illustrate how Southgate's well organized textbook can provide different types of resources for different types of teaching.

Our first example is Chapter 5, "Theology and the New Physics," by contributor Lawrence Osborn (Southgate 2011, 127–61). Physics has naturally been a field that brings to a head many science–religion conflicts. The field of physics is set up to clash with very high-level concepts in many cultures around the world, because physics provides the modern, industrialized world's scientific cosmology. It attempts to describe when and how the universe originated, and both when and how its eventual demise will occur. Indigenous peoples have many diverse models for the same, some quite elaborate (Grim 2001). Their underworlds, first beings, and spirit worlds look different, and interact with humans in ways different, from Christian cosmology or the way that physics models the universe.

The conflicts between scientific cosmologies and traditional faith-based cosmologies might well find a home in secondary school classes on World Civilization or World Cultures. Many schools teach classes in the Great World Religions and some have classes in Anthropology and Sociology. Chapter 5 could illustrate for all these courses the variety of ways in which humans have conceived the cosmos and how it interacts with the human and the supernatural.

For the physics graduate students in university, there might be a different use for Chapter 5. Some postsecondary institutions offer seminars for students who are, themselves, training to teach in a university. One of the authors of this paper once asked university students to prepare a year-end

panel on theological approaches to physical anthropology, and to discuss central conflicts and major thinkers. After a term of learning physical anthropology and evolution, it was refreshing to see what students thought about people who had successfully integrated the science they had been learning with their faith. The students made especially good use of works by evolutionary anthropologist Teilhard de Chardin, who was also a Jesuit priest.

Similarly, a creative physics professor could ask three physics graduate or undergraduate students to prepare a panel discussion to explore ways of conceiving the cosmos, or the ways in which physics concepts of the cosmos are similar to and different from historical and traditional approaches to the same concepts. Those who are teaching assistants should be prepared for questions from students of various faiths, and challenges to the science they teach. We believe that any instructor of college-level physics could well read Chapter 5, in order to prepare for student questions, especially if the students are encouraged to voice their ideas and reactions about the science–religion conflict. Those who teach introductory physics may find that students somehow sensed this conflict but had never really voiced their questions.

Chapter 5 can help the enterprising Sunday school teacher, who leads adult discussions on modern roles for science and religion, in light of newspaper articles and/or the latest findings in physics. People can bring to the discussion articles on physics from magazines or newspapers, and then discuss how they might differ from a traditional Christian approach. What questions are raised? What conflicts have occurred in people's daily lives? Have they ever reached an impasse with anyone else over their beliefs about the cosmos and the ultimate fate of human beings?

The Role of Teacher in Oral Interaction with Students and Others

Christopher Southgate uses innovative and experiential methods to teach. One such example is how he teaches the physics concept of "quantum entanglement."[1] He chooses two students and gives each a playing die and asks them what number is on their dice; they answer at random. They begin standing next to each other, and then are "entangled." They interact briefly as two particles might. (Students might shake hands or touch each other on the shoulder). The instructor whispers to each of them a number, but the class does not know this. Both dice are now held closely in the students' hands so that they can no longer be observed. The students move across the room from each other and face away from each other. They are too distant for one to directly contact or see the other. Southgate explains that entangled particles are linked in certain properties, and they lose their own individual properties and instead take on part of a whole new identity

together. As soon as we observe one property in one of the two particles, the other (which did not have a defined state) immediately takes on the counterpart properties. It is like having two dice that, together, always equal 7, but we do not know in what proportion the component numbers are. It could be $1 + 6$, or $2 + 5$, or $3 + 4$. Experiments have shown that prior to observing the particles, neither one has a value for these properties. The particles are like the dice being held by the two students, rolling around in their hands. However, if you observe one (and the instructor walks to one student and asks their die number), the other immediately takes on the appropriate counter number, even if it is all the way across the universe. One year he used up-and-down spin instead of the dice, so the activity is flexible.

The critical extension of this last exercise is to then ask students what religious concepts appear to behave like the entangled particles. What is the new identity they have together? Some students might suggest, "Oh, this is the way I talk with God, and that God talks with me." Prayer is communication, but there is also alignment between the person who is praying and God. There is a mysterious complementarity in prayer, which can be likened to quantum entanglement.

One of the authors jointly led a "Cosmic Retreat" (Corbally and O'Donoghue 2011) in which it was explained how understanding the physics of stars makes us appreciate the long chain of nuclear synthesis that produces the matter we are surrounded by—all of the elements and the structures of the cosmos. The Creator's involvement is not just at the beginning, but is sustaining the whole process through supernova, star synthesis, and the "birth" of new star systems, even now. We were created in this type of synthesis, and new people are still being created. Our difference from other matter is that we are conscious of God. The synthesis has ultimately produced beings that can look on God's creation with "new eyes" and a new appreciation.

Another example of Southgate's teaching methods illustrates a dual, or "two views," approach to understanding phenomena.[1] First, he holds up two tennis balls. One, he says, is a regular "Newtonian" tennis ball, moving by the force of gravity in motions that are describable in precise mathematical terms. He invites the students to watch as he gently throws it across the room to an associate, usually bouncing it across the floor. The second tennis ball is, he announces, "procured at great expense with great difficulty, and wonderfully rare." It is an "Aristotelian" tennis ball. The latter knows nothing of gravity or forces, but rather it moves by desire, constantly willing to return to the center of the earth where it originated. It desires to descend to that which is most like it. He invites the students to observe carefully the tennis ball's motion, while it, too, is thrown across the room. The motion is, of course, identical. The question he emphasizes is this: What framework should we use to describe the motion of the tennis balls?

This illustration, which Southgate demonstrated at an American Academy of Religion meeting as well as in the classroom, reminds us of the widely observed human ability to describe essentially identical phenomena with two completely different frameworks. Our best examples come from cultural anthropology, but there are excellent examples from the history of science, as well. Human beings are able to devise various theories, thanks to a neurological capacity called the left hemisphere interpreter, which allows humans to develop explanations virtually non-stop. It is a concept well tested by Michael Gazzaniga et al. (2013) and others. A rather astounding aspect of this capacity is that none of the explanations have to be based on science. Whether some are, and some are not, depends ultimately on scientific testing and practical experience in living. Without scientific testing, human beings can and do believe in all types of explanations for physical, social, and supernatural events. They have brains that develop explanations whether an individual "wants to" or not. One individual on one side of the Earth develops one explanation for illness, while another on the opposite side of the globe develops a different explanation for the same illness, using different belief systems. The explanations can diverge widely if people are from different societies and cultural backgrounds.

Such creative divergence emerges in one of Southgate's favorite teaching techniques, which is to run small "contests."[1] Students are invited to submit extra work voluntarily for a prize—anything from a chocolate bar to a bottle of wine. Tasks ranged from drawing a picture of Schrödinger's cat to writing a short essay on why humans find waterfalls so beautiful. These are enjoyable and formative ways for students to engage with the course material, and they regularly participate with great enthusiasm.

Chapter 9 of *God, Humanity, and the Cosmos* is titled "Some Resources for Theological Thinking on God and the World from Outside the Christian Tradition" and it is by Michael Negus and Southgate (Southgate 2011, 255–73). This chapter rounds out an essentially Christian religious overview with comparable perspectives from Jewish philosophy, Hindu metaphysics, Taoism, and Buddhist spirituality. It ends with New Age faiths centering upon "deep ecology" and the "Gaia hypothesis." The authors heard an oral presentation about a related, experiential approach conducted by our colleague, Christopher Impey, who is an astronomer, and who published his experiences in a book co-authored by the Dalai Lama and others (2015). He has spent a number of summers working with exiled Tibetan monks in Nepal, teaching them some Western astronomy. Because he found that these priests thought in very literal, structural ways, they needed to construct a physical model of our solar system—a big one, big enough to wander through it, talk about it, and discuss what they saw. Impey's student-monks constructed their solar system outside on a flat surface, using pebbles and gravel. They were better able to understand the

placements of the planets, their relative sizes, and the sizes of various orbits after they had constructed their own large-size model. Their understanding came in a process that was very different from an approach that had been used in the West (Impey 2014).

Roles in Team Teaching

In a sense, Christopher Southgate has the advantage of being his own team teacher. He has expertise in both science and theology and can take the perspective of both scientist and theologian. Chapter 12 of *God, Humanity, and the Cosmos,* "Science and Education," by Michael Poole (Southgate 2011, 330–49), provides a useful overview on science education within the science and religion dialogue. Science teachers will necessarily be confronted with religious questions because their students "live in two worlds"— a world of science and a world of faith. As Harry Shipman and colleagues (2002) confirm from their experience, "A person sitting in a science classroom is not just a science student; she or he is a thinking human being who sees the world in terms of a variety of other contexts."

Many teachers take the option of ignoring the dialogue, but that is not helpful to the students because they interact constantly with parents, friends, and teachers who believe different things, and want the students to believe as they do. This has no meager consequences. Students can be lost and forced into expected school and career tracks that may not suit them. We have all heard of doctors who become doctors only to drop out because they "did it for their parents." The same is true of priests. Some of them discover that they have their "mother's vocation" or "father's vocation," and not their own.

Some science students can experience strong pressures to conform to parental expectations that may not be realistic in the context of the modern workforce. For example, studying evolution in biology, or "going to the Moon" as in astronomy or aeronautical engineering, may give some parents pause. Pressures on female students are especially severe. They can be strongly influenced by peer or family pressures to "choose a field more suited to a woman" instead the science field they may prefer. This has given rise to a strong, new, international "STEM Women" movement for female students in science, technology, engineering, and mathematics fields, where young women can find support for their ambitions. Interestingly, religion can also be a support for women of color in science (Ceglie 2013).

Given that teachers are often "funneled" into the specialties that they choose, they can have a difficult time learning about the two sides of the science–religion debate (Billingsley et al. 2014; Govender 2017; Hermann 2013). After all, they may think, science classes are for science, and humanities courses are for humanities students. Even Southgate's textbook is primarily designed for theology students, though Michael Poole, in

Chapter 12, makes suggestions for extending teaching modules to new uses. Here, we have taken Southgate's lessons to heart, by suggesting alternative uses for his textbook.

Team teaching is one way that the science/religion dialogue can be effectively covered without requiring science and humanities teachers to re-tool. We have three examples.

The first example is from astronomer Harry Shipman (2003), who taught with philosopher, Jeffrey Jordan, at the University of Delaware. The course enrolled a mixed group of undergraduate students from all departments at the university. Shipman and Jordan focused on four major issues rather than tackle the whole gamut laid out in Southgate's textbook. They chose (1) the Big Bang and the idea of a Creator, (2) the "reality" of miracle reports, (3) the conception of a human being from the viewpoint of scientific advances, and (4) Darwinian evolution and a belief in God. They used several pedagogical approaches that were then somewhat unusual: the group work, weekly papers, and an exam structure that encouraged answers more thoughtful and lengthy than is often the case (Shipman 2003, 6). In their evaluation of one group of students, they classified the students' responses to a writing project according to the insightful categories of "being confrontational, distinct, transitional, or convergent in their approach to science and religion" (Shipman 2003, 10). They were happy to report a clear movement toward transitional and convergent approaches to science–religion as the semester progressed. Their team teaching worked!

The second example comes from Thomas Lindell who, in the fall of 1998, launched an undergraduate course in the Department of Molecular and Cellular Biology (MCB) at the University of Arizona: MCB 414, Science and Theology. Lindell invited two additional faculty, Martinez Hewlett (MCB) and William Stoeger, SJ, (cosmologist with the Department of Astronomy and Vatican Observatory) to co-teach the course. Lindell describes the course and its effectiveness:

> Stoeger taught Cultural Cosmology (i.e., the Book of Genesis) and Physical Cosmology that related our current understanding of the origin and expansion of the universe. Lindell and Hewlett then presented our understanding of the origin and evolution of life on Planet Earth. In addition, early in the course, Lindell presented lectures on "Myth, Metaphor, and Imagination" to gain some perspectives on the nature of religion. With this background, we then began to discuss how we can make sense of theology in light of the starkness of science. Seminal to this segue was to begin to understand how one's God imagery shapes how we DO theology. Interestingly, we invited students to do their own theology with an outline provided. This was done twice, once early in the semester and at the end of the semester. . . .
>
> Over the years since this course was last offered [spring 2007], numerous students have related comments on how this course shaped how they viewed religion. And, we as instructors also went away with a sense of having contributed in ways that invited growth and evolution in students' thinking

without in any way overtly influencing them in ways that reflected our own worldviews (Lindell 2017).

The third example is the co-authors' experience of team teaching in the writing of the "Science/Religion Conflict Dialogue." Our students were teachers in a northeastern U.S. Catholic diocese. Teachers were given three scenarios on which to base their dialogues, and invited to elaborate on the details of their imagined conversations. The teachers met in groups, wrote their dialogues ("scripts"), and then acted them out.

Science/Religion Conflict Scenario #1
U.S. born teen Sonya comes home and tells her devout, evangelical parents from Mexico that she has a chance to win a scholarship in biology to the local university. No one in the family has ever attended college. The parents believe that the Earth was created in a week, according to the Bible.

Science/Religion Conflict Scenario #2
Dipak comes home for a weekend stay with his Hindu parents who live in a large Midwestern city. He tells them he is going to move in with his girlfriend, Pilar, who is from the same city, but she and her family are all devoted Catholics. They are both studying physics and plan to teach abroad in India.

Science/Religion Conflict Scenario #3
Grandma Jones is paying her granddaughter Lindsey's way through school, after Lindsey lost both her parents in a car crash. Grandma Jones doesn't believe that human beings are supposed to leave the Earth, so she receives her granddaughter's news of a college major in aerospace engineering with surprise.

Most remarkable was the real quality of the conversations, so much so that our upcoming book on this technique will be titled *Talking Real*. The teachers knew, after all, how their students spoke colloquially, and they successfully incorporated their language. The teachers did a fine job imagining action and dialogue surrounding our three scenarios. The reader can join in imagining the many different directions that encounters based on these scenarios could go. And they did!

Models for Integration

Because teaching science and religion requires the integration of very different perspectives, it is useful to mention several types of models that can be offered when teachers prepare themselves to answer questions from students. Having successful models will give confidence to instructors preparing to teach science and religion for the first time.

Historical figures have long preceded Southgate in successfully incorporating science and religion viewpoints in their teaching, research, and writing. We mentioned Teilhard de Chardin, a Jesuit priest who was also a physical anthropologist. Gregor Mendel, an Augustinian priest, became

Abbot of a monastery in Brno, Bohemia. At the same time, he conducted botanical experiments that, for the first time, illustrated the independent assortment of factors (now called "genes") that determined the inheritance of physical traits. Hildegard of Bingen was a political and administrative whiz as a Benedictine Abbess. She was also a musician, composer, polymath, writer, and mystic. Her severe headaches and visions have long been a focus of speculation; some suggest she suffered from temporal lobe epilepsy. All these historical figures provide useful examples of individuals who successfully integrated science and religion.

A recent book entitled *The Territories of Science and Religion* (2015) by Peter Harrison describes the misconception of a perpetual, timeless battle between science and religion. The author's compelling challenge to this conception underscores the fact that the categories themselves—science and religion—are relatively modern concepts that became externalized versions of internal virtues: "an intellectual habit" for science and "a moral habit" for religion. These "habits" go back to definitions by Thomas Aquinas, which in turn were based on Ancient Greek philosophy. In the externalization of these categories, science began to take over the whole "territory" of knowledge from religion, aided by the benefits resulting from technology. Harrison suggests that perpetuating the conflict of science and religion is false, and we need to move beyond the old "maps." He likens Karl Deutsch's unflattering definition of a nation as "a group of people united by a mistaken view about the past and a hatred of their neighbors" to a fitting description for those who in recent times have sought to foment hostility between science and religion (2015, 20). Harrison writes that our personal challenge is to draw out and apply a new, critical map showing science and religion in our lives, a map that is true to the territories of contemporary science and contemporary religion, not the territories of the past when political power or polemics drew the boundaries. These new territories will include the activities of both science and religion that benefit individual humans and society at large.

Southgate's textbook, by promoting deep reflection on the nature of religion and science, will help us avoid the pitfall of false boundaries between the two disciplines and realize their beneficial activities.

Finally, a model for the integration of science and religion can often best be found within a person's own expertise. When one of the authors was completing his theology course at Heythrop College in London and was looking towards doctoral studies in astronomy, he wrote a masters level dissertation titled *Towards a Rationale of the Vatican Observatory* (Corbally 1977). In this, he proposed that the mutual relevance of natural science and theology had three components: (1) indirect, expressing that both disciplines employed symbols, models, and paradigms in their methodology, yet maintained a difference of emphasis and degree in using these; (2) quasi-direct, recognizing that reality is multileveled, with each level

distinct in epistemology yet raising questions for the adjacent levels; and (3) direct, where data and theory from one level become "focused" on the concepts in another.

Corbally visualized each of these three types of relationships in a graphic model, using parts of a reflecting telescope, like Newton's. The indirect relationship in (1) is symbolized by the parallel sides of the telescope tube. The quasi-direct relationship in (2) is symbolized by the different levels becoming concentric circles supporting a telescope's mirror. The direct relationship in (3) is symbolized by the parabolic reflecting mirror that focuses the beams of light coming into the telescope. He suggested that, when combined, "the three models are integrated into the form of a prime-focus astronomical telescope—curiously appropriate for those who ask why it is astronomy that is the field of [Catholic] Church involvement with research science" (1977, 39). He concluded, "Fanciful or not, this paradigm system begins to open up further investigation into the interrelation of the two disciplines [science and religion]. It points to a lifetime's work, and so also indicates a moment for the present discussion to come to an end" (Corbally 1977, 40).

Such models for the integration of science and religion—(1) in the lives of noted historical characters; (2) in the metaphor of "territories" after Harrison; and (3) in the metaphor of a reflecting telescope after Corbally—can help the teacher preparing to answer students' inevitable questions. Exploring these different models may suggest still other images, relationships, and concoctions where differences co-mingle and antithetical themes find common ground. Integration is possible, and that truth, in the end, is the most important lesson for the new teacher to learn.

Note

1. Each of these three examples was kindly contributed by Bethany Sollereder, a former PhD student of Christopher Southgate, in personal communications (November and December 2017).

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