

SCIENCE AND RELIGION: SOME DEMARCATION CRITERIA

by *Varadaraja V. Raman*

Abstract. Discussions on the congruence, compatibility, and contradictions between science and religion have been going on since the rise of modern science. In our own times, there are many efforts to build bridges of harmony between the two. Most of these are anchored to particular religious traditions or denominations and also (often) to specific disciplines, notably cosmology, physics, and biology. Though these discussions serve commendable purposes for members of specific faiths and/or disciplines, they are also, for precisely this reason, of restricted appeal. There are not too many discussions of the topic that consider science and religion from a global perspective. It will therefore be useful to define *science* and *religion* in terms of their unique characteristics, draw the line of demarcation between them, and show where they overlap. This is what this paper attempts to do.

Keywords: complementarity; definition; endopotent; exopotent; facts and truths; impact potential; incompatibility; orthogonality; perceived reality.

Ever since the rise of modern science, scientists, theologians, and general commentators have reflected on various facets of the interactions between science and religion and the impacts of one on the other.¹ Scholars interested in the history of ideas, of science, or of culture have also analyzed these interactions and impacts from various perspectives.² These studies have ranged from regarding science and religion as complementary or congruent to orthogonal or incompatible.³ The overall appraisals and views on the subject have often depended on the background and affiliation of the writers and also on the period of history when they were expressed.⁴

Varadaraja V. Raman is Emeritus Professor, Rochester Institute of Technology, 20 Sutton Point, Pittsford, NY 14534. His e-mail address is vvrsps@rit.edu.

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The topic has gained such importance that, aside from journals and conferences devoted to it,⁵ many colleges and universities are now initiating courses with this and related titles.⁶ In this context it should be of some interest to define and categorize the characteristics of science and religion separately. By this means one can better recognize in what ways science and religion are quite independent exercises and in what ways they complement or contradict each other.

APPROACH

A good deal of confusion and misunderstanding on any subject may be eliminated by adopting careful definitions. There will, of course, be disagreements on the definitions themselves, but at least one may say whether or not within the parameters of the definitions adopted a given proposition is acceptable. In other words, if one chooses to modify the definitions, one may also analyze statements on science and religion on their basis. By this approach we can see what leads to disagreements among intelligent people of good will and good faith when it comes to discussions on science and religion. This is the reason for the approach I take in this paper. First I define the terms *science* and *religion* separately. Then I list a set of demarcation criteria for each, which follow not only from the definitions adopted but also from observing the practitioners of science and religion. These are considered under three separate categories: orthogonal/noncontradictory, complementary/compatible, and incompatible. Finally, I state a differentiating principle by which a statement may be classified as scientific or religious.

DEFINITION OF SCIENCE

Science is a collective intellectual effort by the human mind to grasp all aspects of the world of perceived reality in terms of conceptual categories and with the aid of mathematical analysis and ingenious instruments.⁷ An elaboration of terms used in this definition follows.

Collective. There is no branch of science that is the work of a single individual. Science invariably involves the participation of a community of workers in any given field.

Intellectual. The term is used here to refer to the mental capacities of reasoning, analysis, criticism, and formulating reference systems.⁸

Human mind. Science is related to the articulation by the human mind of the experiences that are part of conscious existence.

Grasp. This word is used in the sense of taking hold of.

All aspects. The goal of science (whether realizable or not) is to take into account and explain in its terms and framework every item of human experience.⁹

World of perceived reality. Theoretically, one may consider levels of reality that are beyond human perception. If such exist, they are beyond the scope of science. Science can and does deal only with the dimension of reality that is (or can potentially be) perceived, either directly or indirectly, through the normal human channels of perception. Perception refers to awareness resulting from the normal functioning of the sensory faculties.

Conceptual categories. The scientific enterprise rests on carefully erected concepts and clearly defined terms. Some of these may not correspond to directly observed or observable entities or aspects of perceived reality. But they can always be related one way or another to some aspect(s) of perceived reality.

Mathematical analysis. A good deal of successful science involves describing observed facts in quantitative terms; it also calls for (often abstract) mathematical analysis and reasoning. Much of our understanding of the microcosm would be impossible without sophisticated mathematics.¹⁰

Ingenious instruments. The faculties of human perception are limited in two ways: threshold levels (if sound or light is too faint, the ear or eye will not respond) and range (sound waves beyond the audible frequencies cannot be heard; likewise, electromagnetic waves beyond certain frequencies cannot be seen). Human beings have devised innumerable instruments to (indirectly) perceive a whole world of reality that would otherwise have remained hidden from our awareness forever.¹¹

DEFINITION OF RELIGION

Religion is a communal expression of the yearning of the human spirit to seek communion with the cosmos; it arises from the answer by the human spirit to questions pertaining to meaning, value, and purpose of human consciousness, and it is a sharing of these with fellow members of a faith community.¹² An elaboration of terms used in this definition follows.

Communal. Like science, religion is a collective enterprise. It invariably belongs to a community of people who share similar beliefs.

Expression. The religions of the human family are necessary (inevitable) manifestations of yearning.

Yearning. The word *yearn* means something more than simply wanting. It refers to a very deeply felt longing. The heart more than the mind is involved in yearning. At some moment or other, all healthy human beings of practically all human cultures experience a profound need, which is at the root of religious expressions through the ages.¹³

Human spirit. The term *spirit* may be understood generally as the totality of human consciousness that experiences, reflects, and creates. It becomes relevant in discussions beyond the biological, physiological, and material dimensions of human beings.

Communion is used here in the sense of a profound, meaningful, and intangible bond between entities.

Cosmos refers to the universe endowed with order and possibly with meaning and purpose.

Answers. It is important to recognize that, whereas science is a collective quest, religions are particular answers that have been given over the ages by different personages in different cultures. This is the reason there are many religions but only one body of science at any given time.¹⁴ This is also why religion-oriented discussions look into past writings, while science-oriented discussions look for future solutions.

Human mind. While the religious experience may not require the mind (in the sense of analyzing, proving, and categorizing), the doctrinal formulations and explanations of religion invariably involve the activity of the mind.¹⁵

Questions. Like science, religions are also concerned with some fundamental questions.

Meaning refers to the relevance, significance, and importance, contextual or absolute, of something. Meaningfulness implies the presence of an entity to which something is (or becomes) meaningful. There can be mere existence without any meaning to anybody.¹⁶

Value is a measure of the worth, necessity, or desirability of something.

Purpose implies a goal (explicit or implicit) discovered or suspected in a phenomenon or behavior. It is often associated with a plan of action, intention, or decision, implying a mind behind the execution of the phenomenon or goal to be reached.¹⁷

Human consciousness signifies something more than mere presence or existence. It implies self-awareness and all that comes with it. Whether consciousness is a mere property of the brain¹⁸ or an insubstantial attribute external to human beings need not concern us here.

Sharing. Just as science is a collective enterprise in the search for answers, every religion requires a sharing of beliefs and celebrations in the context of the answers that have been found and accepted by the group.

ORTHOGONAL/NONCONTRADICTORY DEMARCATION CRITERIA

There are a number of aspects of science and of religion that make them totally independent entities, concerned with very different matters. Their goals and methodologies have nothing in common. In these matters, science and religion are equally valid (and interesting) enterprises, and the question of which is right or preferable does not arise. We may call these their *orthogonal demarcation criteria*. Their respective perspectives have nothing to do with one another and are certainly not mutually contradictory. The following are among these:

Science is physiocentric: In the scientific enterprise the presence of human beings in the universe is accidental and as ordinary as any other phenomenon. The goal is to find out how the world functions (has been

functioning and will continue to function) irrespective of the presence of human beings on planet Earth.¹⁹ *Religion is anthropocentric:* In religion, the human presence in the universe is assumed to be central. There can be no religion without taking the human being into account. Indeed, much of religion is the elaboration of the relationship between human beings and aspects (both directly discernible and otherwise) of the world.²⁰ The physiocentric description of the world is intellectually consistent and satisfying. The anthropocentric view is spiritually satisfying. Just as science encourages and enables us to transcend our geocentric perceptions and considers the universe from a cosmic perspective, religion encourages and enables us to go beyond our self-centered preoccupations into a more all-embracing human thought mode and beyond.²¹ The two visions are not contradictory to each other.

Science is descriptive: Science tries to describe how the various aspects of the world function. It gives as detailed and thorough an account as possible of every single phenomenon, from the most minute to the galactic, of which human beings have become aware through their scientific quest.²²

Religion is prescriptive: An important feature of religion is the formulation of specific rules and principles to guide and govern human actions as members of a religious community. Religion does not say simply how people behave but how they ought to behave. Thus, all religions have an ethical component the goal of which is the betterment (and salvation, or liberation) of the individual.²³ The goal of the ethical principles governing the practice of science is to make science, not the practitioner, successful and flawless. Description and prescription are quite different and have nothing to do with each other. They are thus not mutually contradictory.

Science is logic based: The scientific enterprise is wedded to reasons, reference systems, and rational connections. It is not concerned with how people feel in particular situations of their lives.²⁴ *Religion is feelings based:* Religion is very much related to the feelings and emotions of people. Indeed, one of the purposes of religion is to provide appropriate hope, encouragement, and solace to people when they badly need these.²⁵ Here again we see the orthogonality of science and religion. It is perfectly possible for one to sharpen one's logical, analytical faculties as well as the positive capacities for feeling and sharing, such as compassion, kindness, and service. There is nothing contradictory in the insights provided by science and religion.

Science utilizes external, invented instruments: Scientific discoveries call for the direct or indirect use of probing and material instruments contrived by human ingenuity. *Religion utilizes internal, transrational potentials:* Religious recognitions result from the potentials of the human spirit that are intrinsic to it. These potentials cannot be subjected to strict logical analyses. Thus, every religious mode, from revelation and mystical experience to meditation and prayer, involves capabilities that are inherent

to the human condition and is no way dependent upon any external physical instrument. Aside from material instruments, science too utilizes the innate rational capacities of the human mind. Religion states that there are modes of perception and awareness that transcend reason and logic. These are not to be confused with irrational thinking, which merely contradicts reason. Transrational modes refer to attitudes and processes (such as returning good for evil, and meditation) that elevate the human spirit to higher levels of experience.²⁶ The domains of concerns of science and religion are thus orthogonal in this respect also.

Science is quantitative: All sciences involve at least some quantitative analysis. Indeed, all sciences develop in stages, and the mathematization of a science may be taken as an index of its successes in explaining phenomena. This is why physics and its offshoots are sometimes regarded as the most sophisticated sciences.²⁷ *Religion is qualitative:* Religion is essentially qualitative in its explanatory contexts. In religious rituals, however, numbers and geometrical patterns may sometimes be involved.²⁸ The quantitative grasp of the world is tremendously useful and powerful. The qualitative attitudes to the world engendered by religions give an altogether different sort of richness to our experience.

Science satisfies material needs: One of the impacts of science has been the technological and medical dimensions of human civilization, which have contributed immensely to the physical needs (creature comforts) of human beings. *Religion satisfies spiritual/emotional needs:* Religion satisfies the more fundamental spiritual and emotional needs of human beings. No amount of comfort and convenience can console the bereaved one. For this we need systems that are different from the scientific. Religions play an important role here. Once again we note that science and religion become relevant in entirely different contexts in serving the total human being.²⁹

Science engenders a universal outlook: Science is the one human enterprise that transcends all national, racial, cultural, and political boundaries. When two physicists or chemists or astronomers or geologists discuss a matter related to their common discipline, all of their other affiliations are ignored. The international community of scientists shares a commonality that is independent of national or other boundaries. *Religion is culture centered:* Like art and music, religion is culture dependent. That is to say, people of the same religion (more exactly, religious subject) share a common culture with respect to which members of other religions and subjects are on the outside. This is not to be interpreted as meaning that one is broad-minded and the other narrow-minded but that a universal consensus among those who have explored a subject thoroughly is essential for clear and consistent *understanding* (as done by science); whereas *commonality* of backgrounds, beliefs, and practices *enriches* members of a group and adds color through cultural *multiplicity*. It is not a question of which is

right or wrong, which is good or better, but of realizing that as human beings we need to, and often do, interact at different and often unrelated levels.

COMPLEMENTARY/COMPATIBLE DEMARCATION CRITERIA

Science and religion also complement each other in a number of respects. Science may answer to one need and religion to another equally important need of the human being. And yet, they are quite distinct from each other as human endeavors. Let us now list these complementary demarcation criteria between science and religion.

Science offers piecemeal explanations: Scientific explanations are, for the most part, explanations of specific compartmentalized phenomena. There is, of course, a constant effort to relate different phenomena to common principles. But only in certain contexts (cosmology, high energy physics) does science try to give an explanation for the universe as a whole.³⁰ *Religion offers a global explanation:* Religious explanations are seldom for specific occurrences. Religious explanations of specific events are often given by mythologies. If one wishes to have a global, human-centered perspective of the universe as a complement to the piecemeal explanations of science, then the religious perspective can be helpful.³¹ The mere piecemeal explanations of the world make up the vision of only one dimension of reality. The holistic perspective provided by religions is a totally different one, and it may be taken as complementing the scientific one.

Scientific explanations are causal: Most scientific explanations are causal, that is to say, they try to associate observed effects with clearly discernible causes. In this manner science tries to explain how various phenomena arise.³² *Religious explanations are teleological:* Because of their grounding on purpose, religious explanations often tend to be teleological. When it seems difficult to recognize a purpose, many religions adopt the principle that God works in mysterious ways, meaning that even though we may not be able to see a purpose, there is a hidden purpose for everything.³³ Causal explanations are of one kind. But the question of whether the world has emerged for any particular purpose is a perfectly legitimate one for which we have no incontrovertible answer from the scientific perspective. However, religions do provide answers to this question that complement the material-cause-seeking question.

Science investigates the nature of absolute physical reality: The ultimate goal of science is to uncover the most fundamental entities and causes that give rise to the phenomenal world. In the current view, these are the various hadrons, leptons, and field particles.³⁴ These elements of fundamental reality are essentially physical, that is, subject to quantitative analysis and detectable through instruments and sense perceptions. *Religion describes modes of recognizing absolute transcendent reality:* The absolute reality of

religions is transcendental, that is, beyond purely physical reckoning and not subject to the constraints of space and time or to the principles of causality. The recognition (becoming aware) of absolute reality (called Divinity, God, or Brahman) can be brought about only by a deep religious outlook and spiritual efforts.³⁵ The intricacies of physical reality unveiled by science may well be only one aspect of a larger or deeper ultimate reality about which religions speak to us. The two can become complementary in this way.

Science is intellectual: Science is an essentially intellectual endeavor and is satisfying to the rational dimension of the mind. *Religion is spiritual:* Religion is spiritual at its core, and it contributes to the spiritual experiences of human beings. Again, these are two mutually complementary dimensions of the human being.

Science gives a reason for things: By its hypotheses and theories, laws and principles, science gives reasons for why and how things occur in the phenomenal world. *Religion gives a meaning for life:* Religion goes beyond the recognition of things and events and brings to our attention the significance and relevance of the world in the human context.

Science tries to comprehend reality: Because of its intellectual mode, science tries to understand the world.³⁶ *Religion tries to apprehend reality:* By its spiritual approach and sensitivity, religion tries to apprehend the world, that is, seize the world in its totality.³⁷

Attitudes engendered by science: The attitudes engendered by and associated with science are curiosity about the world, admiration for the world, and a sense of conquest at having unmasked the secrets of the world. These attitudes affirm the strength and capacity of the human mind to unravel, appreciate, and master the surrounding world.³⁸ *Attitudes engendered by religion:* The attitudes engendered by and associated with religion are awe, reverence, and humility. These affirm the capacity of the human spirit to appreciate and recognize a higher power and to understand its own limits.³⁹

INCOMPATIBLE DEMARCATION CRITERIA

There are a number of areas where science and religion are plainly irreconcilable. Their contradictory aspects are related to some of the results of the two enterprises and stem from their differing methodologies and attitudes.

Origins according to science: Questions of origins are always difficult. Scientific cosmology tries to explain the origin of the universe in terms of physical causes (symmetry breaking, Big Bang, and so on), accepting its inability to account for the first cause.⁴⁰ Science also tries to trace the origin of human beings to other fundamental life forms, which, in turn, are believed to have occurred quite accidentally as a result of brute forces and the principles governing matter and energy. *Origins according to religion:* Most religions trace all origins to the will and intention of a supernatural prin-

principle, often called God. Moreover, the goal of creation is taken to be the emergence (creation) of the human being. Indeed, in most religious traditions, the world itself was created (by God) for human beings to enjoy.⁴¹

Scientifically presumed truths (theories) are subject to change: Science regards its explanations as tentative in that they are based on the most carefully collected data available at a given period of human history. Because these are bound to change with time as a result of the accumulation and recognition of more data, scientific explanations are bound to change with time.⁴² *Religiously presumed truths (doctrines) are regarded as eternal:* Religious doctrines and explanations are to be found in the scriptures of various religions. The most that one can do is interpret them differently in different periods. But the statements themselves cannot be altered. This attitude is blatantly unacceptable in the scientific framework.⁴³

Science does not accept any authority as infallible: Science accepts no authority, however great, as infallible.⁴⁴ In this sense, there are no sacred texts in science. *Most religions have infallible authorities:* Infallible authorities do exist in most religious frameworks. Whether they be pontiffs or other religious leaders, or holy books, most religions have their supreme authority who cannot be questioned by the practitioners of the religion.⁴⁵

Doubt and questioning propel science forward: The advancement of science calls for a spirit of skepticism, of questioning what is held to be true, of doubting propositions that are put forward as the truth. When students do experiments in a laboratory, they are verifying what they are told in lectures or what they read in a book. This is equivalent to not trusting what is presented to them. Scientific papers are critically examined, and reported experiments are redone as if to say, "I don't quite trust you."⁴⁶

Faith keeps religious beliefs stable: On the other hand, faith (that is, accepting without questioning, and sometimes in spite of apparent logical inconsistency) is a requirement in religion, in the acceptance of the veracity of scriptures, and in the experience of spiritual truths.⁴⁷

Science tries to disconnect us from the cosmos: By its very nature science tries to separate human consciousness from the rest of the physical world, though it has discovered material connections between the stars and the chemical constitution of the physical body. Science consists essentially of the passing observations of an external observer of a changing panorama that has been going on for billions of years.⁴⁸ *Religion tries to connect us to the cosmos:* The religious view is that the human spirit is very much—indeed the most essential—part of the cosmos, which has dimensions beyond the physical. The goal of religion is to connect with that underlying cosmic principle. Religion seeks a wholeness of which we are intrinsic and important parts.⁴⁹

The criteria for acceptance of propositions in science are logical consistency, verifiability, and testable consequences.⁵⁰ *The criteria for acceptance of propositions in religion* are authority, sacredness, and faith.⁵¹

ON THE NATURE OF RELIGIOUS AND SCIENTIFIC TRUTHS

We become aware of the world around us through our sensory faculties. A fact refers to the existence/presence of a thing or an event as perceived (directly or with the aid of instruments) by our normal sensory faculties. Thus there can be unanimity of agreement as to the facts of a situation or phenomenon among people who have normal sensory faculties.

A truth, on the other hand, is the interpretation and apprehension of a fact. What this means is that truth is a function of the state and structure of the mind that interprets the fact. Thus one might say: facts are what there seem to *be*; truths are how they seem to *me*. Given this, the same fact may appear as different truths to different individuals. This is why there are honest disagreements among intelligent people of good will as to what constitutes the truth of a case. This is why there is no such thing as the absolute truth.

This distinction between fact and truth is important in any discussion on science and religion. Those who argue that science alone leads to correct knowledge tend to forget that science is essentially an interpretation of facts. Those who insist that religion provides us with the ultimate answers as to the nature of the world and of human existence tend to imagine that the truths proclaimed in their religion give the only correct reflection of how the world is. Thus, the world of science tends to equate fact with truth, while the world of religion tends to equate truth with fact.

There is another distinction between facts and truths. Facts are items of information about the world. They are static and outside the human mind. Truths, being interpretations of facts, are in human minds. There are things and events in the physical world, but they become truths only when there are thinking entities. Once a fact is apprehended as truth, it becomes dynamic; it is no longer merely an item of information in the external world; it can serve some purpose. Truths lead to consequences. Truths are potent.

Exopotent and Endopotent Truths. What is the essential difference between scientific and religious truths? Before we answer this question, consider two examples.

1. *The second law of thermodynamics.* In all natural processes, the entropy of a closed system tends to increase. This is a scientific truth. It can be used in, among other things, the construction of engines.

2. *The immortality of the soul.* After death, the human soul continues, and it will be judged some day—rewarded and punished for actions on Earth. This is a religious truth. The recognition of this truth can have a significant impact on one's life.

Let us consider how these examples illustrate the difference between scientific and religious truths.

A scientific truth can and often does have consequences (impacts) on our understanding and manipulation of the external world. We may say that scientific truths are *exopotent*. Exopotent truths are fruitful, that is, they lead to practical applications. It is important to realize that even mistaken interpretations of the physical world may constitute scientific truths. Thus, at one time, the phlogiston theory of heat and the (Newtonian) corpuscular theory of light were scientific truths.

A religious truth can have consequences (impacts) on our internal experience of life as individuals, especially in the context of our particular circumstances. We may say that religious truths are *endopotent*. Endopotent truths are fulfilling, that is, they lead to psychologically/emotionally/spiritually satisfying consequences. It must be realized that even atheism and other philosophical frameworks that do not belong to particular religious traditions (or which may be a synthesis of several) have endopotent truths. More generally, endopotency is the characteristic of truths revealed by the humanities—art, literature, poetry, and so on.

Two things become clear from this analysis: we need scientific truths for deriving practical benefits, and we need religious truths (truths from the humanities) for deriving inner peace and fulfillment. Inner peace, aesthetic satisfactions, self-fulfillment, and emotional security (endopotent factors) are more important than practical additions to creature comforts (exopotent factors). It is therefore not surprising that religion has always been a major factor in human culture and civilization. Contrary to the recommendation or desire of some rationalist thinkers, religions will never be completely eradicated.

Impact Potentials: Beneficent and Maleficent Impacts. Any truth, whether religious or scientific, has *impact potential*—it is capable of provoking impact of one kind or another through the actions it promotes. In every case, the action itself could be exopotent or endopotent or both. It must be emphasized that, whereas religious truths by themselves are only endopotent, the actions stemming from them could be endopotent or exopotent. Thus, for example, engagement in prayer is an endopotent action, and an act of charity or kindness toward a fellow human being is an exopotent action. Both are beneficent in nature. On the other hand, a superstitious fear arising from a religious belief is maleficent and endopotent, while religious persecution of heretics is maleficent and exopotent. Some actions may be beneficent in an endopotent way and maleficent in an exopotent way. The fanatical behavior of religious bigots who engage in holy wars are of this kind.

Similarly, in the realm of science, the manufacture and use of chemical weapons are instances of maleficent and exopotent impacts, whereas the use of vaccines is beneficent and exopotent. In some instances, it is difficult to foresee whether a particular scientific truth will lead to beneficent or maleficent impacts. Our understanding of the human genome is one such.

This analysis enables us to spell out criteria for the retention or rejection of truths, both scientific and religious. Those who argue eloquently against religion stress the maleficent exopotent potential of religion, and those who argue for science stress its beneficent exopotent potential—and conversely. It should be noted that it does not follow from all this that scientific truths are right/correct and religious truths are wrong/false; this is an easy but logically invalid conclusion. In fact, it could even be the other way around: there may exist a Creator, a transcendent God, an immortal soul—and our Newtonian view of gravitation, the classical view of an absolute space and absolute time, the caloric theory of heat, and the corpuscular theory of light have all turned out to be false. Current cosmology and the standard model may also turn out to be doomed.

PROPOSED FRAMEWORK

From these considerations we may list the following principles for understanding the relevance and importance of science and religion:

1. One must recognize that religion and science embody essentially different categories of truths: one is endopotent and the other is exopotent.
2. To ignore either of these would diminish the human experience. Furthermore, endopotent truths (provided by religion of one kind or another) are a deeper human need than exopotent truths (provided by science).
3. The validity of endopotent truths is a function of one's cultural background (upbringing) and the consequent intellectual framework. But that of exopotent truths is not.
4. The significance of truths is related to their impact potentials.
5. Individuals and societies may accept or reject truths on the basis of whether the impact potentials are beneficent or maleficent.
6. It is difficult to reach any consensus in science-religion dialogues when one ignores the factors discussed here.

NOTES

1. Discussions on this theme began right at the start of the scientific revolution, the initiators of which were very much interested in the topic. See, in this context, Osler and Farber 1895.
2. For a recent survey of books on this theme, see Raman 1996.
3. For a clear analysis of these various perspectives, see Barbour 1966, chap. 1.
4. Thus, the eminent physicist Victor Weisskopf wrote that "the Judeo-Christian tradition describes the beginning of the world in a way that is surprisingly similar to the scientific model" (Weisskopf 1977). On the other hand, we read in a book authored by a Hindu that "the observations [of ancient Indian physicists] tally with those of modern cosmogonists on . . . the origin of the Sun, its structure and fuel etc." and that "both the views, ancient and modern, are similar, based on identical grounds and arriving at the same conclusion" (Babu Ram Yadava 1987, 148). It is rare to find a committed Christian arguing in favor of Hindu worldviews and modern physics or a Hindu arguing for the Koran or Copernicus, for example.
5. Aside from *Zygon*, the journal devoted to exploring this subject, related articles may be found in a number of other scholarly journals, such as *Mind*, *Journal of the History of Ideas*, and the *British Journal for the History of Science*.
6. In recent years, the Templeton Foundation has been encouraging and funding the initiation of such courses.

7. This does not mean that only science invokes the intellectual dimensions of the mind. What it does imply is that science operates essentially at the intellectual level of mental activity.

8. Karl Pearson, in his *Grammar of Science* ([1892] 1937, 18), stated categorically that the goal of science is nothing less than the complete interpretation of the world.

9. Indeed, all scientific knowledge is a transformation of perceived reality to the conceptual plane where, like the map of a region, it can be more coherently, conveniently, and usefully analyzed, measured, and grasped.

10. Many physicists, who recognize the primacy of physical intuition and descriptions, have sometimes tended to regard mathematics as no more than a language. However, in the context of certain discoveries, whether at the microcosmic or the astronomical level, mathematics has been a powerful, often necessary, tool. Those who argue that scientific understanding is not the only correct mode of understanding the world usually ignore mathematical physics.

11. Like mathematics, certain instruments are indispensable for a richer recognition of physical reality. Here again, antisience philosophers who proclaim the limitations of science are usually unaware of the stupendous range of knowledge about the physical world that has been uncovered by instrument-based science. Our understanding of the world would be very limited if we did not have, say, the telescope, the microscope, or the barometer.

12. We must distinguish between *religion* (as an enterprise or an institution) and *being religious*, which involves certain attitudes and reactions to the world around us.

13. The definition I am suggesting here is applicable to any of the recognized religions of the world. There does not appear to be any culture where human beings have not experienced an intrinsic need for connecting with the world at large.

14. Sometimes it is stated that religion is a quest for spiritual truths, for communion with God, or for transcendent reality. More exactly, any of the established religions is the discovery that one or another searcher is reported to have made as a result of the quest. An adherent to a religion accepts the answer rather than undertaking the quest himself or herself. Alfred N. Whitehead drew a parallel between the dogmas of religion and those of science as being "attempts to formulate in precise terms the truths disclosed" by different modes on humankind (Whitehead 1926, 57).

15. Indeed, this is often the source of conflicts between science and religion. When religion moves from its spiritual domain of experience to the intellectual domain of inquiry, conflicts inevitably arise, because the demands of the intellect are quite different from the needs and concerns of the spirit.

16. Science attempts to envision a world where human beings, even if present, are merely accidental and are to be ignored in the overall appraisal. As a result, the question of meaning does not arise in the scientific quest. Religion takes human presence as primary, so meaning and value enter religious discourse inevitably. It must be realized that, like love for a person, meaning has great contextual and personal, but no absolute, significance. Yet, popularizers of science and bridge-builders between science and religion (like Paul Davies) have been propagating the impression that science gives meaning to life in the same way that religion does. I am not contending that there is no meaning to life but merely that this is not provided by the scientific enterprise.

17. If one can empirically detect any purpose at all to the universe as a whole, science would perforce accept an Intelligent Principle (God). Religions postulate (explicitly or implicitly) that the purpose of creation is humankind. Therefore it is easy and natural for religions to accept the idea of a Creator. Some scientific thinkers believe that this has been achieved. See, in this context, Templeton 1994.

18. This scientific position is discussed, for example, in Searle 1984. There can be neither science nor religion without human consciousness. Irrespective of any objective validity, both science and religion are reactions of human consciousness to impressed experiences. Whether consciousness itself is a consequence of impressed experiences on the neural system or is an enrichment of that system rising from elsewhere is open to question.

19. The recognition of peculiar coincidences in the values of certain fundamental constants that have been conducive to the emergence of life and mind has given rise to the formulation of the Anthropic Principle, which calls for a rethinking of this traditionally accepted scientific position. For a detailed discussion of this, see, for example, Corey 1993.

20. The Vedas, the Bible, the Koran, and most other ancient scriptures regard human beings as primary in the created world. Though this limits religions to terrestrial confines, it need not thereby diminish religion's relevance and centrality to human life.

21. The displacement of the human being from the center of the universe was the starting point of modern science. The enlargement of human vision from the self-centered to the all-encompassing is the starting point of the enlightened religious spirit.

22. Art and poetry are also descriptive, but science is descriptive in a different way. Art and poetry are *soothingly* (to our aesthetic senses) descriptive. Science is *fruitfully* (to our intellectual need for explanation and our practical needs) descriptive.

23. This is one of the many ways in which religions serve humankind. Indeed, there is no religion that has no ethical dimension to it. Thus, whereas science is descriptive, religion is prescriptive. In recent years, there have been several attempts to connect ethics with science. See, for example, Potter 1971; Cavanaugh 1996.

24. It is this aspect of science that leads to the stereotypical cold-blooded scientist. But it also contributes to science's enormous success. It is essential to be cold-bloodedly analytical if one wishes to discover scientific truths, just as it is important to be compassionate and caring when it comes to finding solutions for human problems and predicaments.

25. Because of the material successes of the sciences and the cultural prejudice that the intellect is superior to feelings in absolute terms, and also because of the fact that scholars are trained in intellectual exercises, there are many writings to justify religious beliefs and practices on a rational basis. Such attempts, however, are not always successful, because they cannot afford to ignore the emotional dimensions of religion that creep in surreptitiously in supposedly purely logical discussions.

26. In an age in which pseudosciences and superstitions are still rampant, it is important to distinguish the irrational from the transrational. Religion, like music and love, is a transrational mode of interacting with the world. At its highest level, therefore, religion can uplift the human spirit and enhance the living experience. Irrationality involves the acceptance of ideas that are basically illogical and blatantly contradictory to common sense, sophisticated logic, and/or experimental evidence. Thus, reciting the Bhagavad Gita, listening to Gregorian chant, going through a wedding ceremony, celebrating Passover, and bowing in reverence toward Mecca are transrational experiences, contributing to the richness of human experience, whereas fearing the appearance of a comet, avoiding a medicine because disease is a punishment of God, and predicting one's future on the basis of one's date of birth are examples of irrational behavior that diminish the human spirit.

27. The role of mathematics in contemporary physics and cosmology is completely ignored by authors who claim that ancient visions articulated pretty much the same things as modern S-matrix theory or symmetry-breaking processes. Erase all knowledge of differential equations, group theory, and matrices, and there can be no quantum physics or S-matrix theory.

28. The fact that some ancient rituals involved the use of numbers reflects the mathematical knowledge of the times and does not reveal anything of religious significance. For example, the fact that the number 7 is introduced in some contexts is irrelevant to the religious thesis pro-pounded. One could have expressed the same idea with any other number.

29. This fundamental role of religion is often ignored and undervalued. For a sound body we need proper nourishment and exercise; for a sound mind we need, among other things, a cultural, communal framework, which is provided by religion.

30. This is the most challenging problem for science in two respects. First, the sheer theoretical problem of accounting for the limitless variety of phenomena in terms of a single basic principle (the so-called Theory of Everything) is mathematically stupendous. Furthermore, even if one were to trace everything back to a single cause (qualitatively, the so-called Big Bang), one may still ask, What was the cause of that first cause? Why did symmetry breaking occur some 15 billion years ago and not, say, 50 billion years ago?

31. The religious explanation of God having instigated the whole world is certainly a better and, as Joseph Lagrange has said, a more beautiful hypothesis than no explanation at all (quoted in Bell 1953, 198). Some have argued that time has no origin, nor has the number system (positive and negative included), so why not the universe? This may be satisfying to some, but it is not any more logical than the "God hypothesis."

32. Here again, classical science runs into a difficulty. In the phenomenon of radioactivity, for instance, and more generally in all microcosmic (quantum physical) phenomena, strict causality does not come into play; only statistical (probabilistic) patterns are there.

33. This perspective arises from the fact that religious explanations are based on a parallel between human life and the universe. As human life has meaning and purpose, so must the

universe. Indeed, all great religious theories arise from analogies, which are sometimes taken as proofs in those contexts. What I call “proof by analogy” is quite pervasive in religious discourses.

34. Current physics accounts for all known phenomena in the physical universe by assuming that there are two families of elementary particles: the hadrons (strongly interacting) and the leptons (not strongly interacting), which interact by the interchange of certain field particles (gluons, W and Z bosons, photons, and gravitons).

35. This is the incontrovertible answer of the deeply religious to religion-denying atheists: “You are not sufficiently spiritually evolved to grasp religious truths, which demand a different category of faculties than logical analysis and mathematical reasoning. How can a person who is stone deaf ever understand the joy of glorious music?”

36. *Comprehension* is an intellectual process involving the logical-reasoning portion of the brain.

37. *Apprehension* is used here in the sense of grasping the totality rather than taking in piecemeal.

38. This is why scientifically awakened societies have tended to dominate the material aspects of the world.

39. Religion tends to bring out our nonaggressive tendencies vis-à-vis the world, though not always with respect to members of another faith.

40. It must be remembered that during the past three centuries scientific cosmogony has undergone several drastic revisions.

41. It is in the matter of the origin of life that science and religion hold (at the present time) major irreconcilable views, which well-meaning theologians, thinkers, and scientists are trying to bridge.

42. This is sometimes regarded as the greatest weakness of science: the unreliability of scientific truths over long periods of time. Yet, this is also its greatest strength, because it implies that science recognizes the fact that any human interpretation of the world of experience is a function of the information that has been currently gathered with great care. Since, over time, this information is bound to expand, our interpretations are also likely to change.

43. By holding on to this view, religion closes its doors to newly acquired knowledge, data, and consequent insights. “All there is to be known is contained in my Holy Book” is a view that may satisfy those who wish to ignore the fruits of the labors of later generations, but not the scientifically inclined.

44. Even the ideas of the most prestigious scientists of earlier centuries have had to be discarded when newer and more satisfying insights came along.

45. Asking for radical changes in one’s religion in some social attitudes and values is different from rejecting the basic doctrines of the religion. For example, to ask for women or noncelibate priests in the Catholic Church is different from wanting to revise the doctrine of the Holy Trinity.

46. Science too has its basic beliefs: the world is comprehensible, there is matter-energy conservation, and so on. But if there were overwhelming evidence to the contrary, science would give up any of these.

47. Faith, by definition, cannot be “proved” by logic. According to traditional Roman Catholicism, faith is “to precede knowledge.” Indeed, as Tertullian said centuries ago, faith should be there in spite of proofs to the contrary. But, in the view of some scholars, faith-based propositions are at a lower level. Hence the efforts to buttress religious faith with scientific findings and proofs.

48. The goal of any experiment is to study a phenomenon per se without its being affected in the slightest way by human interference. Prior to the rise of modern science there was a closer association between humankind and the rest of nature. Facile generalizations to the effect that Western culture is dehumanized and non-Western cultures are not are false in that people in the West prior to the rise of modern science, and many since (poets, artists, literary people, even some scientists when they are not doing science), have been just as connected to the world as any.

49. The etymological meaning of the word *religion* (Latin *re + ligare*) is “that which reconnects” (with the divine, that is, with the Whole).

50. Karl Popper’s *falsifying criterion* reminds us that, while we can confidently reject a scientific theory when it is falsified (that is, when observations contradict it), we can never be completely sure that it is correct when not contradicted by experiments, since there could be (as yet) undiscovered better explanations (theories) for the same phenomena (Popper 1959).

51. This is why religion is sometimes described as certainty without proof and science as proof without certainty.

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