# COMPARISON AND CONTRAST OF SCIENTIFIC AND RELIGIOUS PARADIGMS AND THEIR USE*

Bill Mundy
Dept. of Physics and Computer Science
Pacific Union College
Angwin, CA

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The meaning and characteristics of Kuhn's paradigm is reviewed and illustrated, highlighting the claim that science is a human endeavor involving metaphysical commitments and value judgments. The extension of the concepts of a paradigm to other fields, including religion, is discussed. While the subjective features of science are even more prominent in religion and the objective features of science are less apparent in religion, it still appears meaningful to discuss religion in terms of a paradigm. Comparison of scientific and religious paradigms suggest that major differences are associated with their metaphysical assumptions and epistemological emphasis.

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"Thomas S. Kuhn's The Structure of Scientific Revolutions may well be the most influential academic book of the past two decades," states a promotional for the book, Paradigms and Revolutions.[1] This claim is echoed by others.[2,3]

In his monumental book, Kuhn was seeking to understand how science is done and how scientific progress happens. To facilitate his analysis he introduced the concept of a paradigm, a scientific world view[4] that consists of "universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners."[5] Subsequently, in elaborating and refining the meaning of a paradigm,[6] Kuhn identified two components: "disciplinary matrix" and "exemplars." The disciplinary matrix "stands for the entire constellation

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of beliefs, values [and] techniques . . . shared by the members of a given community."[7] It is the "social and cognitive structure" in which we must become embedded in order to become "accredited practitioners of science" and to publish papers in journals "which carry the seal of approval of the scientific community."[8] It consists of symbols (such as equations, definitions, and relationships), metaphysical beliefs (the nature of ultimate reality and the kind of entities in the world), values (simplicity, consistency, measurability), and exemplars ("the concrete problem-solutions that students encounter from the start of their scientific education, whether in laboratories, on examinations, or at the end of chapters in science texts").[9]

Exemplars, the fourth element of the disciplinary matrix, is also the second component of a paradigm (a little confusion that remains in Kuhn's 2nd ed.). The working of these examples serves to initiate us, as science students, into how to do science and eventually determines the way we see the world.[10] This process molds our "thinking in such a way that it meshes with the generally received views that are dictated by the paradigm."[11] The examples "serve as norms of what constitutes good science."[12] Thus, according to Walsh and Middleton,

> the paradigm functions as the scientists' conceptual framework.... It provides the criteria by which theories are judged, evidence is deemed admissible, the nature of the demonstration is determined, and the elements of a true conclusion are constituted.[13]

Some authors appear to think of the paradigm in such a way that a person or community can have only one paradigm, a world view. Others seem to consider it to be little more than a theory

of which the community may have a number which are derived from a world view. Still other authors identify major paradigms and subsidiary paradigms which may compose a world view. But in any case, it is the shared paradigm(s) that create(s) the scientific community which has common assumptions and channels of communication. It colors our scientific assumptions about the kinds of entities that exist (metaphysics) and the appropriate methods of inquiry (epistemology).[14]

Kuhn departs from traditional science by 1) making values an important component of the paradigm,[15] thereby planting human subjectivity firmly in the center of science,[16] and 2) by letting the validity of a theory reside in the judgment of the scientific community rather than in "objective" rules,[17] thereby introducing a strong social dimension into scientific knowledge.[18] In addition, the acceptance of a paradigm itself is a collective decision of the community, a consequence of its intersubjective testing and debate.[19] Thus Kuhn has moved the "ultimate court of appeal concerning correct pictures of reality away from the world itself and toward the informed consensus of scientists."[20] He sees science as a decidedly human pursuit. In fact, Kuhn states in the postscript to the second edition of his book that, if he were writing the book again, he would "open with a discussion of the community structure of science . . . ."[21] For, he argues, scientific advances happen in a community which

> transmits demands and aspirations not fully reducible to rules; its members absorb them 'often without quite knowing' what their content is. [It] . . . binds its members together 'by influences and engagements which it is difficult for strangers to ascertain'.[22]

This subjectively developed paradigm filters what we see and know, which in turn shapes our paradigm.[23] But, in spite of this circularity and the subjective values used to assess theories, a claim for the objectivity of science is validated by the realization that the community that has developed the paradigm has also been very successful in predicting the behavior of natural phenomena as evidenced by the extent to which we are able to manipulate and explain nature.[24] This objectivity and rationality of science is preserved by the fact that the work and judgment of the scientist must be defended before the community.

Thus the concept of objectivity is reformulated in terms of intersubjective testability by which we mean an evaluation of a theory carried on by the judgment of scientists as responsible people. A second aspect of the ideal of objectivity is universality, a commitment to be led by the evidence in spite of our personal preferences and to subject our results to the critique of the community.[25] Barbour suggests that "because the scientific community is the context of all research, the activity of the subject does not lead to arbitrary and private caprice." He continues, "science is thus personal but not private."[26] Hence, verifiability is interpreted as agreement within the scientific community. This subjective verifiability is justified by the fact that though all our data is theory laden and conceptually interpreted, it does have a high degree of reliability and reproductivity. Successful theories consistently demonstrate their reasonableness by their fruitfulness and by conveying a sense of naturalness.[27]

For these reasons, well established paradigms are resistant to falsification. And fortunately, most of us are able to do meaningful and fruitful work within the framework of an accepted paradigm. Tenacity in a research program is normally scientifically productive, allowing the potentialities of the paradigm to be systematically explored and exploited.[28]

But, there is a stubbornness in reality that does not let us mold it in just any arbitrary way.[29] Although our perception is paradigm shaped, there is a limit to how much we can flex empirical data. While there are no rules for making choices between paradigms there are the criteria of assessment, most important of which are universal values such as simplicity, coherence, comprehensiveness and experimental evidence, including accurate predictions.[30] So while the basic assumptions of a paradigm influence our choices of models, the models lead to beliefs which we can evaluate by values which are partially independent of a particular paradigm.[31]

The consistent failure of a paradigm to comprehend and explain our experiences may precipitate a crisis - a scientific revolution.[32] This may happen because of radically different conditions, interactions with another paradigm, or discovery of unsolved problems.[33] Observation does exert some control. In fact, built into all scientific paradigms are the conditions which can bring about the paradigm's own demise. According to Gale, "these conditions are none other than those associated with its empirical epistemology."[34]

As an illustration of a scientific paradigm, consider Newtonian mechanics. Its disciplinary matrix can be tabulated as follows:[35]

symbolic generalizations - mathematical equations such as Newton's second law, F = ma

metaphysical commitments - matter in deterministic motion, absolute space and time

values - accuracy of prediction, measurability of results, observable subject matter

exemplars - scientific problem-solving techniques displayed in Newton's work

Its exemplars have been elaborated by standard examples and problems in textbooks and by lab activities such as free fall motion, swinging pendulums and planetary orbits. Its metaphysical commitments have a characteristic typical of all scientific disciplines today - a naturalistic metaphysics. And its value requirement of accurate predictions eventually spelled the downfall of Newtonian mechanics and its replacement by Einstein's relativity.

The discovery of the neutrino is an example of the virtue of the tenacity of a paradigm. Both Newtonian and Einsteinian physics have a metaphysical commitment to the homogeneity of time. A consequence of this assumption is the conservation of energy. In 1930 a phenomenon was observed which did not seem to conserve energy and a neutrino was hypothesized to account for this missing energy. For twenty-five years fruitless search was made for this particle. And yet physicists were so confident in their paradigm

that they spoke all along of the neutrino as if it were a familiar and well characterized entity. Not until 1956 was it discovered and the "faith" of the physics community justified.[36]

The history of plate tectonics, however, illustrates how the tenacity of a paradigm may hinder "progress." In 1915 Wegener proposed that the geometry and dynamics of the surface of the earth could be best explained by considering the crust of the earth to be like a spherical puzzle whose pieces move with respect to each other. This model was resisted and repudiated until the early 1960's when seismic and paleomagnetic data were obtained which seemed to overwhelmingly support the idea of plate tectonic motion.[37] Ironically, a small but vocal group of geologists are currently proposing an "expanding earth" model as an alternative to plate tectonics. But now, the thoroughly entrenched tectonic scientists are ridiculing it![38]

In a similar manner the paradigm of evolution has become so entrenched that biologists, geologists, sociologists, historians, and even theologians adopt its naturalistic, probabilistic principle of evolution of species and natural selection so that "adduced counterexamples are likely to be reinterpreted with auxiliary hypothesis protecting the principle that only the fittest survive."[39]

The discovery of the positron shows how paradigms may filter our perceptions. The quantum mechanical theory, created to explain phenomena at the microscopic level, suggested the existence of a positron, an electron with a positive charge. A search of cloud chamber photographs revealed that evidence for the

positron had been around for years, but had remained unnoticed or disregarded as an anomaly since it was not expected within the framework of the earlier paradigm.[40]

The recent report of "cold fusion" by Pons and Fleishmann provides an example of scientists who breached the channels of communication and avoided the critique to which the science community expects a scientific claim to be subjected. Physicists particularly have been critical that they failed to do control experiments, neglected to consult other scientists and went first to the public press rather than refereed journals.[41,42,43]

In summarizing our discussion to this point, we have shown that the paradigm provides an insightful way to look at science. This concept suggests that science is a human endeavor involving metaphysical assumptions and value judgments, and whose objectivity depends on intersubjective testing. Further, all current scientific paradigms assume a <u>naturalistic</u> metaphysics and an <u>empirical</u> epistemology.[44]

Kuhn developed the concept of paradigm for his discussion of the natural sciences. But what he says about scientific communities has been applied to other communities as well, such as history, philosophy, social science, the university and public policy.[45,46] For example, it has been suggested that Woodrow Wilson's international policies functioned as a paradigm for the conduct of American foreign policies from the 1940's to the 1960's.[47] The Constitution of the United States can be understood to be the basic element of a paradigm of American government in which congressional law, administrative policies and judicial

precedents are exemplars.[48] These applications definitely take advantage of the fact that Kuhn's science is a human endeavor that takes place in a community and depends on values and intersubjective testing.

The religious community has also been analyzed in terms of paradigms. The social, subjective and value elements allowed by Kuhn seem to make room for such a discussion which in turn seems to reinforce some of the characteristics of the scientific community,[49] encourage dialogue between these communities and perhaps provide guidelines for the "integration of faith and learning."

Religions are organized around a core cluster of concepts;[50] Christ and the cross, immortality of the soul, predestination, verbal inerrancy of scripture, and six-day creation are familiar examples from Christian traditions.[51] These are normally summarized in creedal statements.[52] If we can identify paradigm characteristics in these creedal affirmations (symbols, metaphysical beliefs, values and exemplars), then we can start looking for further similarities between science and religion. For example, Catholicism has an extremely well-articulated concept structure called "dogma" which can be considered as a paradigm. Similarly, the "27 doctrines" may be taken to form the basis of a Seventh-day Adventist paradigm. In Whitehead's opinion,

> The dogmas of religion are the attempts to formulate in precise terms the truths disclosed to the religious experience of mankind. In exactly the same way the dogmas of physical science are the attempts to formulate in precise terms the truths disclosed in the sense-perceptions of mankind.[53]

Here Whitehead affirms the analogy between religious activities, or dogmas, and scientific paradigms.

In seeking to ascertain what may be the components of a religious disciplinary matrix, we note that the church certainly has its symbols, the cross and the sacraments for example.

Experiences common to the Christian tradition include awe, reverence, numinous encounters, moral obligation, conversion, and reconciliation.[54] In fact, Polkinghorne suggests that "one of the strongest indicators of the validity of the claim that religion is in touch with reality is provided in the universal character of the mystical experience...."[55] These experiences have metaphysical implications, suggestions of a transcendent reality, a supernatural element. Also, some of these experiences implicitly involve an intuitive element, suggesting a characteristic of the epistemology that is to be used.

Values that could characterize the theological enterprise are coherence (the doctrines should hang together), economy and adequacy (the Great Controversy motif perhaps qualifies), relevance (a connection between theology and religious experience), and fruitfulness ("by their fruits you shall know them").[56] The intersubjective use of these values could provide the basis for rationality in religion. They would set the limits on the range of acceptable models used in interpreting the experience of the religious community.

Finally, Jesus Christ would be the normative exemplar;[57] scripture contains the examples. For Seventh-day Adventists, Ellen White would serve as an additional exemplar.

Just as for science, religious paradigms keeps before us the importance of community. Neither science nor religion is an individual affair.[58] Cardinal Newman, for example, takes issue with "radically individualistic" conceptions in the religious community just as Kuhn does for the scientific community:

> In science as in theology... the need for authoritative beliefs arises from the fact that the individual's perspective is too limited to encompass the long-term requirements of a historically evolving community. The authoritative character of beliefs resides in their exemplary force.[59]

Here a Seventh-day Adventist might think of Ellen White's comments about the authority of the General Conference.[60]

The validity and maintenance of a paradigm depends upon public discourse; according Polkinghorne, this saves the community from "personal preference and idiosyncratic experience."[61] However, Barbour argues that if a religious paradigm is to have any meaning, it does need to relate to our experience.[62] He proposes that experience should provide similar control over a religious paradigm as empirical data does for a scientific paradigm. Unfortunately, this personal experience is not subject to verification or falsification in the same way as for the sciences, for they do not offer the predictive skills of science. Rather, it is suggested, the theologian (the practitioner in the religious community) directs our attention to patterns of experience.[63]

Perhaps an example of the use of a religious paradigm may be helpful. Barbour discusses five models of God.[64] We will consider two of them: monarchial (a king and his kingdom) and deistic (a clockmaker and a clock). Recall that the beliefs of a

community are to be evaluated by criteria that are partly independent of its paradigm, universal values such as conformity to experience, simplicity, coherence and comprehensiveness.[65]

First of all, the monarchial model of God is consistent with experiences of awe and worship. But the suggested omnipotence seems to be inconsistent with the concept of freedom of choice and the existence of evil. Also, it fails to illuminate the relation of God and man to nature as suggested by science. So this model is not coherent or comprehensive.

The deistic model does establish a relation of God to nature. But it is not consistent with the probabilistic characteristics of quantum mechanics nor is its God an object of worship. So both of these models appear to be inadequate.

Taking pointers primarily from Barbour, we have been focusing on possible similarities between scientific and religious paradigms. However, some of us do not feel comfortable with some of the implications of the suggested parallels. (Of course, many scientists do not like Kuhn's science, either.) We could argue, for example, that revelation, not community values, should provide the criteria for evaluating the beliefs, that scripture, not experience, should serve as the norm for truth, and that historically the community is called and led by God (Abraham, the Exodus, Christ's selection of the disciples) rather than the community choosing and developing a paradigm. In short, it is God that takes the initiative, not the community of believers.

Let us continue by noticing other differences between the scientific and religious communities and their paradigms.

The subjective features of science are more evident in religion: the filtering of experience by the paradigm, the tenacity of dogmas and the ambiguity of rules for choice among paradigms.[66]

On the other hand, the objective features of science are less evident in the case of religion: the lack of common data and of shared values which are not paradigm dependent.[67] Therefore, a common consensus in religion is difficult to obtain. While scientists share common goals, standards and procedures, such common methodological assumptions are seldom found among religious communities.

We have already alluded to the fact that religious experiences suggest the transcendent and supernatural. Most Christian traditions do conceive of a transcendent God who is able to act in supernatural ways - miracles for example. This is in distinct contrast to the naturalistic metaphysics normally assumed by the current paradigms of science. As George Knight says,

> Christianity is a supernatural religion, and it is thoroughly antithetical to all forms of naturalism, to those . . . schemes of thought which do not place God at the center of the human . . . experience.[68]

Perhaps this contrast is clarified when we realize that in the natural sciences we are concerned with entities that in some sense we transcend whereas in our religious experience we are seeking to relate to that which transcends us.[69]

And we have already mentioned that some of the values shared by religious communities suggest an intuitive epistemology. In addition, the Christian paradigm includes revelation[70] which can

be formally identified with the epistemological categories of intuition and of witness or testimony. Again from Knight,

> For the Christian, the Bible is the foremost source of knowledge and the most essential epistemological authority. All other sources of knowledge must be tested and verified in the light of scripture.[71]

So while a religious epistemology may include empiricism ("experiencism") and rationalism, the categories of witness and intuition are important also. (The influence of the Holy Spirit is considered to be intuitive.) By contrast, while science makes use of witness (journal articles and society meetings) and intuition (the creative insight or sudden inspiration) the epistemological emphasis is on sense-data and reason.

The church member who publicly rejects the dogma - the Catholic paradigm, for example - is normally labeled a heretic. And the proposed alternate belief system is called heresy. If we relabel the heretic as a reformer and identify the change in beliefs as a reformation (or revolution), then we can compare scientific revolutions with religious reformations.[72]

Revolutionaries in science are often subsequently identified as heroes by the entire scientific community (Einstein, for example). But not so in religious reformations. (Luther has not been canonized by the Catholic church yet.) Thus, as Gale points out, "revolution in the religious community tends to divide, or fractionate, or proliferate the community into smaller subcommunities, which do not agree on which paradigm(s) to accept. But scientific revolution does not have this effect; . . . ."[73]

In conclusion it has been the purpose of this paper to compare and contrast scientific and religious paradigms and their

communities. Similarities include the fact that it is possible to analyze both in terms of the formal components of a paradigm, that a community is essential to both traditions, and that the intersubjective testing and universality, along with data and experience, are important for "rational objectivity" in both communities. However, for conservative Christians for whom the Bible is foundational, God takes the initiative in developing the community and experience is evidential, not normative.

Other distinctiveness between scientific and religious paradigms are due to fundamental differences in metaphysical positions (natural vs. supernatural), focus (the transcended vs. the transcendent) and epistemological emphasis (empirical and rational vs. testimony and intuition). These differences suggest a "vertical" dimension of reality to which religion must relate in addition to the "horizontal" level to which science limits itself.

Polkinghorne, a professor of theoretical physics (Ph.D.) and a Vicar in the Anglican church aptly, summarizes our discussion:

> Theology differs from science in many respects, because of its very different subject matter, a personal [transcendent] God who cannot be put to the test in the way that the impersonal physical world [which we transcend] can be subjected to experimental enquiry. Yet science and theology have this in common, that each can be, and should be, defended as being investigations of what is, the search for increasing verisimilitude in our understanding of reality.[74]

Perhaps these insights can contribute to an appropriate "integration of faith and learning," to a wholesome "interaction of science and theology."

## REFERENCES & NOTES

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[5]Kuhn, T.S., The Structure of Scientific Revolutions (Chicago: The University of Chicago Press, 1970 [2nd ed.]), p. viii.

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