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COMMENTARY

Toward An Understanding of the Roles of Scientific, Traditional, and Spiritual Knowledge in Our "Demon-Haunted World"

ERIC M. RIGGS

One afternoon while perusing the monthly book club catalog, I ran across the latest and unfortunately last work published by Carl Sagan during his lifetime, *The Demon-Haunted World: Science as a Candle in the Dark.* Intrigued by the title (and the author), I ordered a copy. Carl Sagan was definitely the most outspoken public champion of science and the objective study of nature in recent years, and this book explicitly addresses what Sagan perceives to be a great increasing threat to rational thought in American culture today.

After reading the book cover to cover and recommending it to many of my academic colleagues, a friend of mine who studies Native American history and oral tradition encountered a

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review of the work in this journal by Steve Pavlik,¹ which she thought I might enjoy reading. As it turns out, I do like and appreciate Pavlik's review, but at the same time I find there to be a few points made in the paper which reflect perhaps a misunderstanding of the scientific process, scientific knowledge, scientific goals, and the personal attitudes and beliefs of scientists in general. It is these misunderstandings that I would like to discuss in this essay, both in the context of Sagan's book and with an eye to the attitudes of many of today's practicing scientists.

The topic of science literacy and the public's ability to think critically are of great interest to me both professionally and personally. I am a geophysicist and also a teacher of geology, so I appreciate the value of a scientifically literate populace. The driving force behind my own research is both my own curiosity about the natural world and also my desire to contribute to humankind's better understanding of our earth. As a teacher, I also see how enriched my students' lives become when they learn to perceive the subtleties around them and to ask clear questions about their world, questions about natural phenomena or life in the modern age. I have also seen how their new understanding of scientific knowledge and scientific thought can be reconciled quite well with their spirituality, whether it be religiously, culturally, or personally inspired.

CARL SAGAN AND SCIENTIFIC CULTURE

I grew up on Carl Sagan's work and his very optimistic view of the role of science and its ability to solve many of humankind's persistent problems—an optimism I shared fully until I learned of the unfortunately all too common transgressions made in the name of science or improved technology. But this optimism was the optimism of an entire generation of scientists, of whom Sagan was one. This was the generation of scientists who responded to Sputnik and fed on the surge of public interest in the space program and the moon landing. This same group of scientists enjoyed many technological breakthroughs which led to unprecedented measurements and ensuing discoveries, including a new understanding of subatomic matter, the extent and age of the cosmos, and the first basic understanding of plate tectonics—the essential driving engine that still shapes the earth daily.

Riding a wave of public optimism and support, these scientists of Sagan's generation were and still are understandably confident in the importance of science to the human race. But this all-encompassing confidence is not without problems. It tends commonly to carry with it a sense of invulnerability, a sense of possible omniscience, and paradoxically a kind of narrow-mindedness. Strict scientific materialism,² a fully mechanistic view of the universe, is also born of this inflated sense of confidence in the power of science. I think most scientists and most people feel that a fully mechanical view of the world's workings is not entirely satisfying, and ignores much of the daily experience of being human.

Overall, Sagan's book is a worthwhile contribution to the study of the scientific method and is a clear narrative on how our popular culture today is drifting from rational thought and what can be done about it. One of Sagan's main points is that a familiarity with the scientific method is crucial to understanding the results of scientific work, and how often the public does not understand that the findings of science are always tentative until better evidence is uncovered. He also outlines how science is frequently over-interpreted or misinterpreted in popular culture. For example, I am an avid reader of science fiction and fantasy novels, but I understand that I cannot expect to run off to Starfleet and get beamed up to the Starship Enterprise or expect to be healed of a terminal disease by quartz crystals or special incantations. This is sadly not the case for an increasingly large segment of our population, and one of the main reasons for this is that all too often anything that sounds scientific or purports to be based on knowledge or proof is seen as unquestionably true. Alarm about this emerging trend is what motivated Sagan's book.

PAVLIK'S REVIEW: A SCIENTIST'S RESPONSE

After a brief discussion of Sagan's previous writings and a restatement of his perception of Sagan's goals in this work, Steve Pavlik launches his review of the book with an unfortunate and unnecessary *ad hominem* attack on "western science" and scientists themselves. I find it highly ironic that a self-described, "social scientist who works on a daily basis with Native Americans"³ should start a discussion about knowledge and value systems on such a stereotyped and contentious note. Despite one fairly hollow disclaimer, the tone of much of what he writes throughout his review continues in a rather divisive

vein, perpetuating a false dichotomy between "western science" and "traditional knowledge," which for my purposes here includes not only Native American spiritual and tribal knowledge, but also includes all belief systems in any religion among any people. Upon examining more carefully some of the literature on this topic, including some of that referenced by Pavlik himself, as well as polling the personal opinions of scientists and non-scientists alike, I think one eventually realizes that the only conflict between science and spirituality comes from those at the extremes of each.

Regardless of the rhetoric, the fact remains that there is a very real point to be raised about the treatment of Native Americans and their culture at the hands of those nineteenth-century Europeans who were driven by a newfound love affair with technology during the Industrial Revolution. Pavlik states that,

> [O]ne of my concerns is how Indian people can continue to survive within a larger mass-society whose value system is largely secular and is a product of the teachings and inventions of western science—a discipline with a long history of dismissing tribal institutions as being primitive and tribal knowledge as being merely superstition.⁴

There is no doubt in my mind or in many scientists' minds that this is a major issue for us as well. However, as Pavlik himself later argues, most of our American mass society is not at all secular. In fact, he later quips that "Recent surveys indicate that 95% of Americans believe in the existence of a God. Approximately the same number believe in angels. I can only assume the other 5% are scientists."⁵

It does not follow that the values underlying our laws and government structures must be motivated by secular thinking simply because these laws are largely administered by secular institutions. The laws and regulations themselves are actually built on primarily Judeo-Christian values—not strictly secular at all. While the values in our larger culture may be at odds with Native American values, there is no conflict with strictly secular pursuits. Pavlik is, however, entirely right when he lays blame at the feet of the imperialistic European culture possessed by a fascination with and blind trust in technology. This culture then and still today defines "progress" in terms of a linear increase in technology, technical achievements, and material wealth. The Industrial Revolution was a time of unbridled confidence in the products of science. It was a confidence unbridled to the point were any new data and contrary ideas from Native cultures were repressed or ignored in the relentless pursuit of material gain through technological means. In this respect, Western science may have a long tradition of dismissing tribal knowledge, but it is an old tradition not carried forward by most practicing scientists today. Science today is more humble than it was one hundred or even thirty years ago, evidenced by the increasing number of scientists actively willing to consider the limits and the place of our work in modern culture. Science is also much more readily accepting of the insights derived from centuries of practical experience garnered and passed on by Native cultures all over the world.

These changes in science can be seen, for example, in the exploration of the early seconds of the universe in the science of cosmology, a branch of theoretical physics. The equations that describe the space-time structure we see around us have a few constant values in them, values that have been measured by experiment and observation. It turns out that these few constants have a very large effect on the ultimate structure of the universe, leading some to question the equations that predict these changes. However, many physicists working independently have reached similar conclusions with differing mathematical constructions, leading some to suspect that these specific constant values must be "built in" somehow. Clearly, this leads to speculation that these are the signs of a greater design. It is also possible that we simply evolved to perceive this universe because the conditions were right, and that there is no grand design. Few scientists agree on the meaning of these findings, but it is a compelling issue that has fueled a healthy exploration of the implications.⁶

The input to science from native cultures has been perhaps less sweeping in scope, but ultimately much more practical and helpful in overturning Western notions. The clearest benefits so far have, for better or worse, been in the pharmaceutical industry. Many medicines used by native cultures, especially those living in tropical rain forests, have been found to work and work well for treating a variety of diseases. Another example of native cultural wisdom percolating into scientific knowledge is in the realm of forest fire management. Native cultures in areas prone to fires, such as in the southwestern United States and northern Mexico have long known that fires are normal and as such should be allowed to burn. Recent studies confirm the traditional knowledge that frequent, patchy, natural fires keep the ecosystem healthy and also keep the largest fire size to a minimum. The older scientific data, which led to the current and unfortunately entrenched practice of total suppression, was gathered in European forests and grasslands that simply do not exist in the arid Southwest, whereas the more recent studies have been motivated by observations of fires on lands managed by native populations in arid environments. Native populations know the land better and understand its behavior. Whatever the spiritual meaning or interpretation of these fires, the native cultures understand that they are not just destructive; they are necessary.

SCIENCE AND SPIRITUALITY: ANY REAL CONFLICT?

Science and spirituality, in any form, cannot be the simple antitheses of each other. They must be viewed rather as serving complementary functions, each of which contributes immensely to the knowledge of the human species. The only problems arise when one group transgresses the boundaries of what is appropriate and reachable by the methods commonly used by each discipline.

Science, for example, is concerned with finding natural or naturalistic explanations for the vast array of tangible, measurable processes at work around us. Science is interested solely in how and why things work, not why they exist or what their underlying meaning may be. To be a scientific question, any query must be testable, either by experiment or by logical reasoning based on the available evidence. Therefore, and by definition, science would never attempt to hand down an absolute answer to anything, because new evidence always has the possibility of reversing or modifying an earlier conclusion. Furthermore, also by definition, a question that cannot be tested in any tangible, measurable way is not a scientific question. Science can never answer a question such as, "Why does the universe exist?" because there is no test for this.

As an illustration, there is another passage of Sagan's book which is relevant here. Sagan relates the following portion of a conversation he had with the Dalai Lama, the Tibetan Buddhist leader, about reincarnation, a central principle of Buddhist thought:

In theological discussion with religious leaders, I often ask what their response would be if a central tenet of their faith were disproved by science. When I put this question to the current, Fourteenth, Dalai Lama, he unhesitatingly replied as no conservative or fundamentalist religious leaders do: In such a case, he said, Tibetan Buddhism would have to change.

Even, I asked, if it's a *really* [Sagan's emphasis] central tenet, like (I searched for an example) reincarnation?

Even then, he answered.

However—he added with a twinkle—it's going to be hard to disprove reincarnation.

Plainly, the Dalai Lama is right. Religious doctrine that is insulated from disproof has little reason to worry about the advance of science. The grand idea, common to many faiths, of a Creator of the Universe is one such doctrine—difficult alike to demonstrate or to dismiss."⁷

This exchange illustrates the fundamental limitation of the scientific method, and all scholars, historians, and scientists should be explicitly aware of this point. Any scientist who pretends to have absolute answers for anything, especially when the issue transgresses into the realm of the untestable, is being dishonest to the profession, and has also demonstrated a deep misunderstanding of the scientific method.

While through the 1950s and 1960s there may have been (and perhaps still is) a faith in our culture that science or its child, technology, could solve any problem and answer any question, I believe that most scientists today do not believe this is the case. Sagan himself states near the beginning of his book,

> There is much that science doesn't understand, many mysteries still to be resolved. In a Universe

tens of billions of light-years across and some ten or fifteen billion years old, this may be the case forever. We are constantly stumbling on surprises. Yet some New Age and religious writers assert that scientists believe that "what they find is all there is." Scientists may reject mystic revelations for which there is no evidence except somebody's say-so, but they hardly believe their knowledge of Nature to be complete.⁸

SCIENCE, SCIENTISTS, AND SPIRITUALITY

I would also like to address in more detail the notion that scientists personally are exclusively atheistic and are concerned only with the mechanistic and secular aspects of our world. A 1996 poll of active, working physicists, biologists, and mathematicians published in the journal *Nature* ⁹ found that 39.3 percent "have a personal god." I believe that this statistic is probably robust in all other fields of science as well. Such scientific greats as Einstein, Newton, and Darwin were also religious people and appreciated the spiritual implications of their contributions. These and many other possible observations clearly contradict Pavlik's implication that scientists must be atheistic or anti-spiritual. The journal *Science* also recently published a commentary by Gregg Easterbrook titled "Science and God: A Warming Trend?"¹⁰ in which the author surveys many of the current thoughts and feelings of scientists on this very matter. According to the article, many scientists find no necessary conflict between the advance of science and their personal spirituality.

It is simply not true that science and spirituality must be at crossed purposes. This is clear when one again considers the types of questions that are approachable by both types of thinking. Scientific thinking is restricted to testable hypotheses. This automatically precludes irreproducible phenomena of all sorts, which must include individual experience. By the very nature of being individuals we have unique feelings, experiences, and perceptions, and this point is made in many different ways by Sagan throughout his book.

Philosophers, theologians, and other non-scientists have previously constructed other metaphysical frameworks in which science and spirituality may coexist without friction and probably to each other's mutual benefit. In his 1990 book *Religion in an Age of* *Science*, Ian Barbour outlines three different approaches to the integration of scientific and spiritual knowledge. Barbour proposes three categories: natural theology, theology of nature, and systematic synthesis. Natural theology, in his view, is born out of science and evolves toward a spiritual understanding of the world. Scientific findings and the harmonious relationships between natural phenomena are taken by themselves as representative of the works of a creator, and are the justification for a theology based on scientific knowledge alone. Barbour's theology of nature adopts the opposite approach, creating a religious view of the world based on individual revelation and cultural experience tempered and modified by the ongoing accumulation of scientific facts. Finally, Barbour outlines a more philosophical than theological metaphysics of being , in which scientific knowledge and spiritual revelation occupy equal roles. As he describes it,

> Metaphysics is the search for a set of general categories in terms of which diverse types of experience can be interpreted. An inclusive conceptual scheme is sought that can represent the fundamental characteristics of all events. Metaphysics as such is the province of the philosopher rather than of either the scientist or the theologian, but it can serve as an arena of common reflection.¹¹

It is within the idea of unified spiritual and scientific knowledge that one realizes the folly of pitting science against any kind of spiritual knowledge. I have much sympathy with Barbour's synthesis approach, although he himself prefers a theology of nature. I think some version of systematic synthesis is what most scientists have constructed, if they have a personal spirituality, in reconciling their work with their own beliefs and personal revelations.

It is clear that spiritual questions and spiritual knowledge, intuition, the word of God, the teachings of the Great Spirit, or whatever one chooses to call it, is not by itself a scientifically approachable body of knowledge. It cannot be tested or proven to exist or not to exist by objective experiment, but only exists in individual subjective experience and collective cultural tradition. Spiritual knowledge, by its very nature, is perfectly equipped to deal with questions of purpose, meaning, and destiny. It captures fully the emotional complexities of human beings and the rich diversity of nature in a way that science cannot evaluate.

TRADITIONAL KNOWLEDGE AND THE SCIENTIFIC METHOD

In turn, this is not to say that spiritual knowledge has some omniscient view of the truth. In recognizing the specific limitations of the scientific method, it is equally important to look at the shortcomings of spiritual or revelation-based knowledge. Consider for example the rain dances of southwestern Native Americans. These dances were conducted as a request to supernatural spirits for rain, and as such fulfilled a spiritual need. I'm sure these rituals regularly provided hope and common resolve for the tribe, but they were not expected to produce predictable, tangible results. However, if one wanted to know the likely exact time, place, and amount of rain, one can now turn to meteorology and atmospheric science to give us quantitative predictions. These predictions are devoid of spiritual value, but they are extremely useful in our daily lives nonetheless. The meteorological forecast is based on scientific knowledge, and the rain dance is based on spiritual knowledge. They do not conflict in any obvious way and in fact represent nicely complementary bodies of knowledge.

This example is not meant to illustrate any superiority of scientific knowledge over spiritual knowledge, just to illustrate their different domains. In this respect it is worth revisiting a quote from Sagan's book presented by Pavlik about the role of the scientific method at work in native cultures. Pavlik highlights a passage in which Sagan relates how quinine may have been developed as a malaria cure by native cultures through many accumulated generations of trial and error. Pavlik then proceeds to grossly misinterpret this passage:

> Perhaps we are fortunate that Sagan does not attempt to provide further insight as to the activities of Native healers. The one example he does give conjures up visions of an Amazon jungle strewn with the bodies of Native test subjects—victims of primitive experimentation gone amok as a "witch doctor" from some nameless tribe seeks to find a non-lethal medicine by process of elimina

tion. While such an image might make a great Gary Larson cartoon, it serves a greater purpose in reflecting the lack of objectivity on the part of one of the world's most respected scientists.

This image is funny, but casting Sagan's argument in this light is poor rhetoric and does not do justice to his real point. Sagan's intent in this passage, and in the later discussion of the hunting methods of the !Kung bushmen was to illustrate his contention that much cultural or traditional knowledge is actually the scientific method at work. In no way does he envision test subjects lined up, waiting for extermination at the hands of some crazed experimenter. His point actually is that much of what is known by native cultures is a product of generation upon generation of living in their environment, all the while paying careful attention to the riches and dangers around them. It may be argued that this knowledge is exposed through spiritual means and/or that the new knowledge takes on spiritual significance and becomes tradition. This illustrates how spiritual traditions can become tempered and modified over time with the incorporation of scientific facts about the world.

What is needed also in this discussion is a reminder of what "objective" means. Pavlik accuses Sagan of not being objective in his assessment of traditional knowledge. My dictionary tells me that objective means: (1) of or having to do with a material object, (2) uninfluenced by emotions or personal prejudice, and (3) based on observable phenomena, presented factually. Presumably, Pavlik intends the second meaning from this list, but I maintain that scientists prefer the third definition. The reason that this is applicable to the story above is that we are evaluating observable phenomena. Using the story of the Native healer again, a patient either heals, dies, or shows no noticeable improvement. If some new type of plant was administered as medicine, this is a fact that someone will remember and as such becomes part of traditional knowledge and a de facto medical data set. Eventually and gradually over perhaps hundreds if not thousands of years, enough "experiments" will have been carried out that cures for common diseases will be well defined. This is an objective evaluation of data, which is the scientific method at work.

I hope it is clear from the discussion above that there is no conflict of spiritual interpretations and traditions with scientific fact. Finding bridges between these two realms is in fact one focus of the work of geologists working on and around native lands today. John Murray, a geologist and educator at the University of Manitoba, has worked extensively with the Cree First Nation in Canada and outlines a fascinating account in the Journal of Geoscience Education. He and tribal elders have arrived at a cooperative, dual interpretation of rocks on native lands which at the same time hold spiritual value to the tribe and have substantial economic value to the industrial world. and in so doing have averted a potentially nasty situation. In past decades or with less enlightened players, some mining concern might have simply overpowered (legally and/or physically) the Native population, leaving them both bereft of resources and any compensation. The key to the successful founding of this working relationship was the willingness of scientists to be flexible in how their knowledge was presented to the tribe.

> In a locally developed curriculum, the students and teachers experience the regional and local geology of their ancestral home for the first time using a model that gave equal status to the intellectual traditions of their elders and the geological investigations conducted by twentieth-century Canadian geologists. What emerged was a unique synthesis that had us sharing complementary systems of knowledge...¹³

A similar project is underway in a cooperative effort between the United States Geological Survey (USGS) and the Navajo Nation,¹⁴ which owns lands harboring vast reserves of coal. The Native-born teachers are well acquainted with the cultural history and geography of the area, and so the thrust of the USGS program is to provide a road to geologic information that will allow students in Navajo colleges and grade schools to better understand the geology of their native lands in the context of their traditional, cultural knowledge and ultimately to help the tribe better manage its own resources internally without undue external influence or interference.

What most clearly emerges from these stories is the need for scientists, native cultures, theologians, academicians, and governments to work together to solve these essentially cultural problems. Ignorance and hostility are only going to generate more bad solutions to sticky problems. We can ill afford these misunderstandings in a world that is largely enlightened intellectually only by the twenty-five-watt light bulb of network television, sound bites, and bumper-sticker politics.

The Demon Haunted World is an honest attempt at reconciling scientific and spiritual thought by delineating the appropriate realms of each. This work is not without problems, however. As I discussed above, Carl Sagan was a product of his generation and also held some unnecessarily narrow points of view about the role of science today. There are many places in this book where I found a discussion or a recognition of the role of spirituality sorely limited, but then again, one author cannot speak for all scientists. The purely mechanistic world of scientific materialism is yielding today with the realization that not all phenomena can be reduced to the laws of physics and chemistry. The reductionist approach still works well for solving problems that can be probed by experiment and measurement, but I believe it's going to be a very long time indeed before the Dalai Lama or any other spiritual leader really has to worry about the findings of science that is conducted properly and stays within its bounds. Some questions are certainly best left untouched by the scientific method.

Steve Pavlik concludes his review with the words, "This truth, however, can never be proven by way of the scientific method." I hope I have showed in this essay that he is only partly right. The truth of the sage or shaman is a fundamentally different beast than the truth of the scientist, and one should not pit them against one another or get them confused. Only when taken together do these types of knowledge combine into a view of the world that is the uniquely human perspective.

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NOTES

1. Steve Pavlik, "American Indian Spirituality, Traditional Knowledge, and the 'Demon-Haunted' World of Western Science," *American Indian Culture and Research Journal* 21:1 (1997): 281-293.

2. For a detailed discussion of the origins and evolution of strict scientific materialism, I refer the reader to Paul Davies and John Gribbin, *The Matter Myth* (London: Viking, 1991).

3. Pavlik, "American Indian Spirituality," 282.

4. Ibid., 282.

5. Ibid., 284.

6. This discussion touches briefly on the anthropic principle, a concept discussed and developed by many scientific and non-scientific authors, but most notably by John Barrow and Frank Tipler in *The Anthropic Cosmological Principle* (New York: Oxford University Press, 1986).

7. Carl Sagan, The Demon-Haunted World: Science as a Candle in the Dark (New York: Random House, 1995-96), 278.

8. Ibid., 27.

9. Edward J. Larson and Larry Witham, "Scientists Are Still Keeping the Faith," *Nature* 386 (1997): 435-436.

10.Gregg Easterbrook, "Science and God: A Warming Trend?," Science 277 (1997): 890-893.

11. Ian Barbour, Religion in an Age of Science: The Gifford Lectures, Volume One (San Francisco: Harper & Row, 1990), 28.

12. Pavlik, "American Indian Spirituality," 286.

13. John James Murray, "Ethnogeology and Its Implications for the Aboriginal Geoscience Curriculum," *Journal of Geoscience Education* 45 (1997): 118.

14. Russell Frank Dubiel, Stephen Tom Hasiotis, and Steven Christian Semken, "Hands-On Geology for Navajo Nation Teachers," *Journal of Geoscience Education* 45 (1997): 113-116.