Dynamic and Theological Models for Religion and Science

with Richard Olson, "A Dynamic Model for 'Science and Religion': Interacting Subcultures"; David J. Zehnder, "A Theologian's Typology for Religion and Science"

A DYNAMIC MODEL FOR "SCIENCE AND RELIGION": INTERACTING SUBCULTURES

by Richard Olson

Abstract: I argue that for psychological and social reasons, the traditional "Conflict Model" of science and religion interactions has such a strong hold on the nonexpert imagination that counterexamples and claims that interactions are simply more complex than the model allows are inadequate to undermine its power. Taxonomies, such as those of Ian Barbour and John Haught, which characterize conflict as only one among several possible relationships, help. But these taxonomies, by themselves, fail to offer an account of why different relationships prevail among different communities and how they succeed one another within particular communities—that is, they contain no dynamic elements. To undermine the power of the "Conflict Model," we should be seeking to offer alternative models for science and religion interactions that can both incorporate the range of stances articulated by scholars like Barbour and which can offer an account of the process by which differing attitudes succeed one another. As a step toward this goal, I propose a general "interacting subcultures model" and illustrate its applicability in a small number of mini-case studies from Early Modern Britain and France and with glances toward contemporary America.

Keywords: Ian Barbour; conflict model; dialog; Richard Hooker; independence; integration; interacting subcultures model; master narratives; Isaac Newton; science and religion interactions

---

The Problem

During most of the past century and a half, public understanding of the interactions between scientific activities and knowledge on the one hand and religious attitudes and beliefs on the other has been dominated by the

Richard Olson is professor of history and Willard W. Keith Jr. Fellow in Humanities at Harvey Mudd College, 301 Platt Blvd., Claremont, CA 91711, USA; e-mail olson@hmc.edu.

[*Zygon*, vol. 46, no. 1 (March 2011)]
 ISSN 0591-2385

image of conflict and warfare. One of the most colorful and vituperative expressions of the "Conflict Thesis" came from T. H. Huxley, writing in April of 1860, in the immediate aftermath of Darwin's Origin of Species:

> In this nineteenth century, as at the dawn of modern physical science, the cosmology of the semi-barbarous Hebrew is the incubus of the philosopher and the opprobrium of the orthodox. Who shall number the patient and earnest seekers after truth, from the days of Galileo until now, whose lives have been embittered and their good name blasted by the mistaken zeal of Bibliolaters? Who shall count the host of weaker men whose sense of truth has been destroyed in the attempt to harmonize impossibilities—whose life has been wasted in the attempt to force the generous new wine of science into the old bottles of Judaism, compelled by the outcry of the same strong party?
>
> It is true that if philosophers have suffered, their cause has been amply avenged. Extinguished theologians lie about the cradle of every science as the strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed, if not annihilated; scotched, if not slain. But orthodoxy is the Bourbon of the world of thought. It learns not, neither can it forget; and though, at present, bewildered and afraid to move, it is as willing as ever to insist that the first chapter of Genesis contains the beginning and end of sound science, and to visit, with such petty thunderbolts as its half-paralyzed hands can hurl, those who refuse to degrade nature to the level of primitive Judaism. (Quoted in Moore 1979, 60)

If Huxley's version of the conflict thesis had a certain literary flair, two American intellectuals, the chemist turned historian William Draper and the historian and educational administrator A. D. White, drummed up widespread support in their respective *A History of the Conflict between Religion and Science* of 1874 and *A History of the Warfare of Science With Theology in Christendom* of 1896.

Both Huxley and Draper pushed their use of the terms science and religion back at least to the beginning of the seventeenth century and the relationship between Galileo and the Catholic inquisitors at Rome. White went even further, claiming that "science" and "theology" were at odds at the origins of Christianity in the Hellenistic world (White 1965, 73). From at least one widely held historical perspective, all three authors and indeed anyone who uses the term "science," or "religion," or even "conflict," in describing events which occurred before around 1875 is using these terms anachronistically and should either avoid them altogether (Wilson 1996, 27; Cantor and Kenny 2001, 773) or remind the reader that they are concepts which were not available to the historical actors (Cantor and Kenny 2001, 766–67). Many scholars of the Early Modern world, for example, argue that "natural philosophy," which was a category used throughout the Early Modern period, should replace the term science whenever possible.

I acknowledge that historians writing for an audience steeped in the cultural practices of particular places and times may be able to, and should, explore the nuances of spatially and temporally local events in terms that do minimal violence to concepts and institutions available to historical actors. Nonetheless, if historical writing is to help current students in orienting themselves to their own present and future, which, like Carl Becker (Becker 1931), I believe is the primary function of history, then it must be done using terms that have meaning in their lives. Science and religion are such terms, and while salient differences between past concepts, activities, institutions, and attitudes should be acknowledged, I believe that the family resemblances between contemporary "science" and earlier traditions associated with such terms as natural philosophy, natural history, alchemy, anatomy, *scientia*, and even *episteme* do justify using science as a first approximation to the latter, just as the family resemblances between contemporary "scientist" and earlier terms such as philosopher, *savant*, virtuoso, alchemist, and, sometimes, "projector," *sophist*, or *mathematicus* justifies the use of scientist as a first approximation in identifying these categories from the past even though the term scientist was only coined in the 1830s. The use of religion raises very similar problems. Though it has been used to identify groups of persons bound together by adherence to specific creedal commitments within Christianity since the early sixteenth century, its frequent extension to non-Christian groupings who share kinds of rituals associated with significant events in both public and personal life, often seems justified, even while salient qualifications should be acknowledged.

The basic claim that secular intellectual life—represented by science—and religiosity are somehow at odds with one another is not new. It goes back within Christianity at least to the time of Tertullian; and if we are willing to consider religion and science as existing in the pre-Christian world, the conflict imagery goes back at least to its literary expression as a confrontation between the new philosophical knowledge associated with the sophists and traditional beliefs about the gods by the Athenian Playwright, Aristophanes, in the late fourth century B.C.E. (Olson 1978). Neither antiquity nor eloquence, however, guaranty the adequacy of historical claims; and twentieth-century scholarship clearly demonstrated the inadequacy of the conflict thesis in accounting for the vast range of complex and frequently symbiotic relationships between science and religion or their precursors (Brooke 1991; Yerxa 2009).

For a brief time during the late 1930s and early 1940s, the conflict thesis was challenged by an argument made by the American sociologist, Robert Merton (1971). In 1938 Merton's Ph.D. dissertation, which was published by the History of Science Society without revision, maintained that Puritanism played a key role in fostering modern science in seventeenth-century England by providing a system of values that

sanctioned scientific investigations (Cohen 1990). The combination of rationalism, empiricism, and utilitarianism that constituted the Puritan ethic also formed the essence of the modern scientific spirit, according to Merton. This hypothesis seemed confirmed by his study of the religious backgrounds of the early members of the Royal Society of London, which he found to be Puritans in overwhelming disproportion to their numbers in British society. Unfortunately, Merton's thesis has not stood up well to subsequent empirical analyses, which have challenged his notion of Puritanism as well as his particular identifications of individuals as having a Puritan orientation. It does still seem clear that some religious groups—most importantly, Latitudinarian Anglicans—were disproportionately represented within the early experimental-scientific communities in England; but the whole picture is much more muddled than Merton suggested (Cohen 1990).

A very important reinterpretation or modification of the conflict thesis was suggested by Frank M. Turner in 1978 in "The Victorian Conflict between Science and Religion: A Professional Dimension." According to Turner, conflicts between scientists and clergy have been less about science and religion as such than they have been about the realignment of power and status among various social roles. Thus, they reflect the same kinds of concerns as the conflict between physicians and midwives in early modern Europe as they competed for authority regarding the conditions of birthing or those between lawyers and physicians during the Renaissance when they were contesting over whether the Trivium or the Quadrivium should receive greater emphasis in university curricula.

It seems to me that Turner's argument has great merit; but while it may provide a very successful explanation for a few key episodes; its applicability is limited to those rare but important cases in which cohesive groups self-identify as distinct from one another and focus on issues of status; so there seems to be no appropriate general model for understanding science and religion interactions. In fact, if one looks at the textbook, *Science and Religion: Some Historical Perspectives* (1991) by John Hedley Brooke, one finds the following summary of science-religion interactions:

> Serious scholarship in the history of science [and I might add, the history of religion] has revealed so extraordinarily rich and complex a relationship between science and religion in the past that general theses are difficult to sustain. The real lesson turns out to be the complexity. (5)

Brooke is absolutely correct. Case studies of science and religion interactions have demonstrated a variety that has far exceeded the capability of any currently available generalizations or models to account for; but unlike John Brooke, I cannot rest comfortably with this awareness.

In spite of the hopes of some of my postmodernist colleagues, it seems to me that psychosocial considerations make it virtually impossible to

undermine well-established historical master narratives simply by piling up counterexamples and claiming that things are complex (Numbers 2009). Not only do master narratives satisfy our almost insatiable psychological craving for order, coherence, and a degree of control in our lives, but they also serve important political and social functions. Several years ago when I described what I hoped to do in my writing on science and religion—that is, to explore the complexity of science and religion interactions—Michael Shermer, a former graduate student who is the founding editor of *Skeptic* magazine, emailed me a response that underscores these social functions:

> I'm afraid we are up against a very powerful social force: the warfare model works too well for both sides. Dealing with lots of atheists, agnostics, humanists, etc., I find that they relish the conflict. It gives them a sense of collective purpose—you know, "we're saving Western Civilization." If you want to send out a powerful fund-raising letter; just . . . tell the reader that if they don't send in their $25.00 contribution, all of Western Civilization as we know it will collapse under the weight of dogmatism and repression, and count the checks pouring in. Of course it works the other way. For fundamentalists, science (especially evolution) is the cause of all manner of social evils, including abortion, pornography, drugs, illicit sex, AIDS, immorality, crime, communism, atheism, etc . . . . To abandon the conflict model requires deeper thought and analysis. And let's face it, for the average American it is just a lot easier to think in terms of us versus them. It works great in politics and ideology, why not science and religion? (personal communication, 3/13/96)

My own experience in teaching science and religion courses to undergraduates off and on for about thirty years now—and especially my unsatisfactory experiences in trying to use John Brooke's text as the structuring reading for such a course—confirms the power of the conflict model in a way that may be less spectacular but even more disturbing than Shermer's view warrants, because it applies to a more sophisticated audience that has made an effort to get beyond the conflict master narrative. Students almost universally arrive in my class—no matter what their religious or irreligious backgrounds—with their understanding of science-religion interactions shaped by some version of the conflict thesis or master narrative. I begin my course with a careful explanation of the inadequacies of the conflict narratives, requiring students to read one of the many powerful critiques—by Brooke, or James Moore, or David Lindberg (Moore 1979; Lindberg and Numbers 1986; Brooke 1991). Next, I focus throughout the course on a huge range of fruitful positive interactions among religious and scientific ideas, attitudes, and institutions. Finally, students write a substantial research paper; and when they do, in the vast majority of cases, their language and structuring principles revert back to the conflict model that I have spent much of my time controverting.

The students I get are extremely able and diligent; and I do not think I am an unusually ineffective instructor. So the frustration I experience, I

suspect, has to do at least in part with the power of master narratives in general and that of the conflict narrative in particular—given our inability to offer a compelling alternative. If we are ever effectively to reach an audience beyond a tiny group of scholars, we must almost certainly offer alternative models and master narratives which are capable of incorporating most of the new data as well as the bulk of material incorporated into the old master narratives.

Several students of science and religion have at least suggested ways of categorizing interactions so as to bring some degree of structure and order into discussions (Barbour 1990; Haught 1995; Bube 1995). Far and away, the most widely used set of categories is Ian Barbour's fourfold taxonomy that acknowledges Conflict as one possible form of interaction, but which adds independence, dialog, and integration. Independence implies that there can be no true interactions at all because the purposes and methods of the two domains are so radically disjoint. From this point of view, not only are those who see conflict in error, but so are those who claim positive interactions. Advocates of this position have included Immanuel Kant and Stephen J. Gould, whose *Rocks of Ages* (1999) provides one of its most articulate and accessible recent presentations. The only problem with such a perspective is that innumerable counterexamples abound just in the practice of organizing religious events through the use of astronomically based calendars, for instance (Heilbron 1999).

Virtually all recent historical treatments of the interactions between science and Christianity in particular fall into Barbour's Dialog category. Though advocates of this position insist that science and religion have different aims and some specialized vocabularies that do no overlap, they admit that because both are subcultures belonging to common larger cultures, they often interact through common personnel, some common language and ideas, and some common cultural assumptions and presumptions (Shapiro 1983; Harrison 1998). From this point of view, interactions can be mutually reinforcing or transforming as well as conflicting.

Finally, a few modern scientific figures have tried to create complete integrations of religion and science—such, for example, were the goals of Auguste Comte's Religion of Humanity (Brooke and Cantor 1998, 47–57) and Wilhelm Ostwald and Ernst Haeckel's Monist Religion (Hakfoort 1992). These attempts at integration were, at best, only moderately successful in terms of attracting large followings, but I would argue that integration of natural knowledge and spiritual beliefs was the norm in ancient civilizations and in later tribal societies, whether we believe that religion and science are completely appropriate categories to use for discussing these societies or not (Olson 2010, 83–98; Cajete 2000).

From the point of view of an historian, the taxonomies of Barbour and others are not very helpful because they do not suggest any dynamic

dimension. That is, they offer no help in trying to figure out why certain patterns of interaction dominate within particular groups at particular times and places, nor do they suggest how the dominant patterns change over time in any culture.

A Proposed Solution: An Interacting Subcultures Model

Although it is hard to imagine any alternative model or narrative that offers the emotion-laden language and drama of the traditional conflict thesis, I do think that it is possible to produce a theoretical structure or model for understanding science-religion interactions that has a substantial number of virtues. Most importantly, it hangs onto the central concept of conflict as a key driver of science and religion interactions. That is important not only for dramatic effect, but because many scholars today insist that competition and conflict are at the heart of all dynamic processes (Latour 1987). But it displaces the locus of conflict in the vast majority of cases away from the broad categories of science and religion onto conflicts within religious institutions or scientific institutions, or within political contexts. It draws from well-established traditions—though not necessarily the most recent fads—in sociology and cultural anthropology. It can explain the longstanding appeal of the conflict thesis and the important but more limited successes of the Merton thesis. It incorporates the Turner thesis as a special case. It provides an easy way to understand why there should be a substantial variety of science/religion interactions that have seemed anomalous to date; and it incorporates a significant dynamic element.

I will call this new model an interacting subcultures model. It begins from the following basic assumption that is part of an institutionally based understanding of cultural anthropology: Every complex culture incorporates many levels of partially overlapping and constantly interacting subcultures, institutions, or cultural specialties. The boundary of each of these subcultures is permeable and flexible, and what belongs inside or outside of the domain of each is constantly being contended over or re-negotiated. The relations among these subcultures can be of a variety of kinds. Though each subculture presumably exists to meet some specific needs of the broader culture of which it is a part, different subcultures may have greater or lesser overlap in terms of personnel, functions, and calls on societal resources. In modern America, for example, both religious organizations and governmental structures are involved in programs to provide food and/or shelter for persons in need; moreover governmental social workers are frequently to be found in those religious denominations that have the most extensive social justice programs. In this case, I suspect, overlaps in function and personnel lead to more cooperation and coordination than to conflict. Consider, on the contrary, the function of

transmitting fundamental social values—which is presumably shared in our culture primarily among families, churches, and secular educational institutions, though in recent times, gangs or social spaces on the internet may be more important. In this case, severe conflicts may emerge for a variety of reasons, including Turner's suggestion that clergy and secular educators both have interests as professionals in extending their influence in this domain.

Even more important for present purposes, each of the institutions or cultural specialties in turn is likely to incorporate a number of factions and subspecialties contending for power, influence, and support within its domain. If we consider the religious subculture in seventeenth-century England just after the Restoration, for example, there were at least six or seven major factions vying for support and influence—Catholics, High Church Anglicans, Latitudinarian Anglicans, Moderate Dissenters, Radical Dissenters (spanning the spectrum from the highly intellectual Unitarians to the highly antiintellectual Anabaptists), Deists, and Atheists. At the same time, if we consider the amorphous scientific subculture of Restoration England, there were also several competing factions, including the persisting advocates of Aristotelian approaches to natural philosophy; the followers of the Alchemist, Paracelsus; Rationalist-Mechanists such as Thomas Hobbes; and Experimental-Corpuscularians such as Robert Boyle. Each of these groupings brought its own metaphysical, epistemological, and methodological perspectives to the study of phenomena, and each had its own understanding of what constituted the "natural."

In what follows, primary attention will be focused on science and religion in seventeenth-century England, with a few glimpses at the contemporary United States, though it may often be useful to also consider both politics and education because in seventeenth-century Britain, the overlap—in terms of the fundamental values or norms that they expressed, in terms of the functions that they served in the larger society, in terms of the conceptual structures on which they built and to which they contributed, and even in terms of the particular individuals who constituted the different communities of cultural specialists or practitioners—among all four of these specialties would have been understood to be very substantial by most participants in each and by members of the broader culture and society of which they were constituents had they had the modern terms to use.

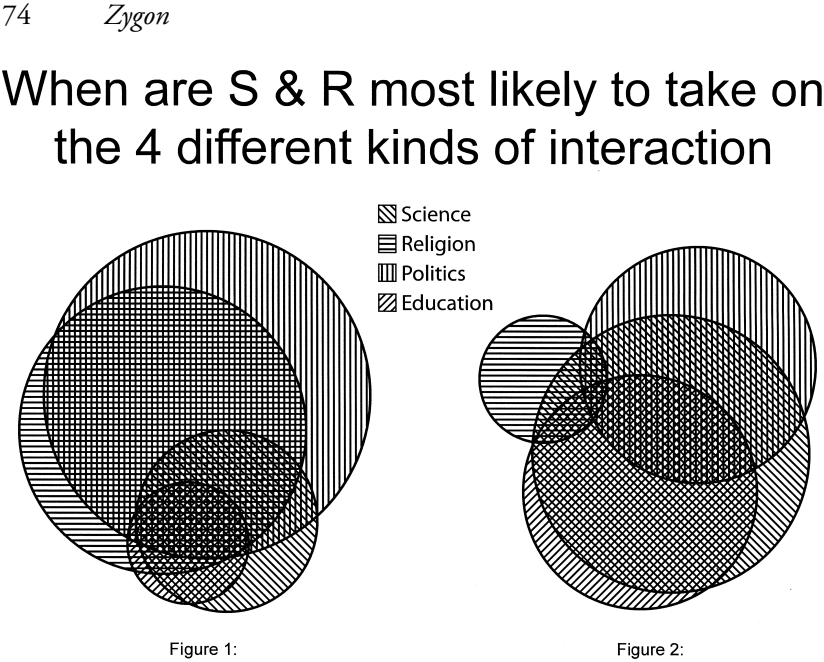
Within late twentieth-century American culture, there is little overlap between religion and science; moderate overlap between religion and education, between politics and science, and between religion and politics; and very great overlap between science and education and between politics and education. This situation might be represented visually as in Figure 2

(see page 10), where the size of each circle is a very crude measure of the importance and prestige attached to each cultural specialty and its practitioners by most members of the broader culture. That small region where religion, science, education, and politics overlap in twentieth-century America is the region in which factions among clergy, scientists, politicians, and educators contest (i.e., argue about) the meanings of such terms as "creation science" or issues such as the temporal locus of the origin of a "human life."

For most of the seventeenth century in England, both the relative degrees of overlap and the relative importance of religious, scientific, educational, and political institutions within the broader culture were very different than they are in twentieth-century America. Both science and education were rapidly expanding in terms of the numbers of persons that they directly touched and in terms of their importance to society; but they were both relatively small and of relatively minor importance as late as the middle of the seventeenth century when compared with the well-entrenched and hegemonic religious and political ones. Indeed, education had only recently emerged as a distinctive specialty from a position of near-total subordination to religion; and science had barely begun to emerge as a specialty whose boundaries extended beyond those of education. As a consequence, the boundaries of both science and education were shifting and expanding very fast. Religion and politics were also much more extensively interpenetrating in Early Modern England than they are in the contemporary United States. The Anglican Church was a state church, membership in which was a prerequisite for holding public office. Appointment of senior church officials was a prerogative of the Crown. And the clergy ministered to many of the material and social as well as to the spiritual needs of the people, managing poor relief and acting as agents of social control through their homiletics. The overall situation might be represented as in Figure 1.

In this diagram, the darkest region is one in which clergy, scientists, educators, and to a lesser extent, politicians, contended over issues. If this diagram appropriately represents the situation, then the large domain of overlap between science and religion would suggest that substantial portions of the scientific and clerical communities should have been involved in negotiating the meanings and importance of a very substantial range of issues. As we shall see, this was, in fact, the case in seventeenth-century England.

Though we will consider some case studies below in which three or more subcultures became involved, for purposes of exploring the simplest possible model, I offer both a schematic of the features of a two-subculture interaction here as well as one example to which this simple model presents a first-order approximation.



Figures 1 & 2. Late Seventeenth-Century England; Late Twentieth-Century United States.

Schematic Representation of Simple Two-Subculture Interactions

Let R be the religious subculture and S be the scientific subculture.
Let $r_1, r_2, \ldots, r_n$, be various religious factions competing for power and authority.
Let $s_1, s_2, \ldots, s_n$ be various paradigms, research programs, or otherwise defined scientific subsets of the scientific community (read natural philosophers if you must).

Suppose that a dispute arises between r_1 and r_n and that r_1 appeals in its arguments to some element or elements of s_i, initiating a science and religion dialog.

We now ask what are the possible responses of r_n, subject to the condition that only resources lying within S and R can be mobilized?

1. r_n claims that all of S is inconsistent with any faction in R and that therefore s_i is an inappropriate source of support for r_1 (i.e., S and R are in *conflict*).
2. r_n claims that all of S is irrelevant to R, and that s_i cannot, therefore, be called upon to support r_1 (i.e., S and R are *independent*).

3. r_n claims that r_1 has misinterpreted either s_i or its implications for R, so that it does not, in fact, support r_1 and may even support r_n (i.e., S and R are in *dialog*).
4. r_n claims that s_k, not s_i, is correct and that s_k fails to support r_1 and that it may even support r_n (i.e., S and R are in *dialog*).
5. In the special case when r_n is in conflict with all other r_i, r_n may claim that any or all elements of S are essential to r_n, but incompatible with all other r_i (i.e., S and r_n are *integrated*).

An Example from Early Modern England

Immediately after the ascension of Elizabeth I to the English throne in 1558 there were severe and potentially destabilizing tensions among religious factions. Some wanted to continue Mary's return of England to Catholicism. Some radical reformers—soon to be labeled Puritans—wanted to move the Church of England toward Calvinism, with a "priesthood of all believers," with services focused on preaching, and with no rituals not explicitly authorized by the Bible. Yet others, including Elizabeth and her Archbishop of Canterbury, John Whitgift, wanted to see an Anglican church that retained a church hierarchy with Elizabeth as the head of the church and with many liturgical features of the old Roman Catholic mass continued, but with no acknowledgment of Roman Catholic authority. Moreover there were small splinter groups of many kinds, including some that went far beyond Calvin into forms of Christian communism, as well as tiny numbers who openly espoused atheism. Elizabeth, in the hopes of holding the Anglican church together, appointed as bishops some who had served under Mary, some who had become exiles under Mary, and some who had stayed in England under Mary but opposed the Catholic presence; and she and Whitgift hired Richard Hooker, an Oxford trained and scholarly cleric, to justify their views on church governance and practices to all parties without driving out any major players. In order to accomplish his daunting task, Hooker produced *Of the Laws of Ecclesiastical Polity*, of which the first four books appeared in March of 1593. Since we will be concerned here only with book 1, we will not worry about why book 5 appeared only in 1597, books 6 and 8 in 1648, and book 7 in 1661, even though drafts of all came from Hooker's hand in 1593 and he died in 1600.

Hooker's strategy—worked out in book 1 *Of The Laws of Ecclesiastical Polity* was to shift religious authority away from both exclusive emphasis on the Bible and from Catholic church councils to natural human reason operating upon both God's word and God's works. Drawing heavily from a longstanding tradition of natural theology, Hooker insisted first that, "the minds of mere natural man have attained to know not only that there is a

God, but also the power, force, wisdom, and other properties God hath, and how all things depend upon him" (Hooker 1845, I, 176). Secondly, he argued that many of a Christian's duties can be learned directly from investigations of the natural world. Referring to Basil the Great, he wrote: "the knowledge of every the least thing in the world hath in it a second peculiar benefit unto us, inasmuch as it serveth to minister rules, cannons, and laws, for men to direct those actions which we properly term human" (Hooker 1845, I, 175).

To the Puritans, who insisted that God's commands could only be learned from Scripture, Hooker responded, "It is their error to think that the only Law that God hath appointed to men . . . is the sacred scripture" (Hooker 1845, I, 224). That Scripture is in itself inadequate to lead to salvation was, of course, a longstanding claim of the Catholic church, which insisted that humans need the support of the tradition of Church Councils and Fathers in interpreting God's word. But this claim, too, was anathema to the Anglican position; and Hooker evaded it in precisely the same way that he evaded scriptural exclusivism—that is, by appealing to natural reason and natural theology:

> There is in Scripture . . . no defect, but that any man, what place or calling soever he hold in the church of God, may have thereby the light of his natural understanding so perfected, that the one, being relieved by the other, there can want no part of needful instruction unto any good work which God requireth, be it natural or supernatural, belonging simply to men as men, or unto men as they are united into any kind of society. *It sufficeth therefore that Nature and Scripture do serve in such full sort that they both jointly and not severally either of them be so complete that unto everlasting felicity we need not the knowledge of anything more than these two may easily furnish* (Hooker 1845, I, 216, emphasis mine).

This passage was an unprecedented attempt to link the fortunes of a particular church to scientific knowledge. It constituted an invitation—which still informed the works of Anglican physicist and cleric John Polkinghorne and those of the biochemist Arthur Peacocke at the end of the twentieth century—to look into the natural world for support for religious beliefs and practices (Polkinghorne 1994, Peacocke 1996). Moreover, it turned out to be an invitation to alliance that had a dramatic short-term success in stimulating the blossoming of a period of outstanding and deeply connected scientific and religious thought during the seventeenth century in England in the works of such Anglican natural scientist/natural theologians as Robert Boyle, John Wilkins, Walter Charleton, Ralph Cudworth, Isaac Newton, and John Ray (Olson 1987).

It is important to note that Hooker's work, as it dribbled out through the last decade of the sixteenth century and the first half of the seventeenth century, was not linked to all forms of science, because Hooker had emphasized an additional important theme. In opposition to the Thomist

Aristotelian version of natural philosophy that dominated much early modern Catholic science, the Rationalist mechanical philosophy that was expressed through the later works of Descartes and Thomas Hobbes and their followers, or the alchemical tradition associated with Paracelsus, Hooker emphasized the merely probable character of both scripture interpretation and natural knowledge. For him and for the empirically oriented natural philosophers of the seventeenth century, the meaning of neither nature nor scripture was transparent. Neither an "inner light," which might be delusional, nor pure reason, which needed merely contingent and probable empirical evidence to work with, could guarantee certainty. According to Hooker, "in the defect of proof infallible, because the mind doth rather follow probable persuasions than approve the things that have in them no likelihood of truth at all," (Hooker 1845, I, 263) merely probable arguments had to be accepted for both religious and scientific claims. This denial of certainty was extremely important to Hooker for religious purposes because he had to argue that the justification for many Anglican practices was based on merely probable arguments; moreover he needed probabilism to undermine the claims of Puritans that they possessed certainty in their interpretations of scripture by virtue of direct divine revelation or "inner light"; so to the extent that Hooker sought support for his religious positions in natural knowledge, he had to argue that natural knowledge was merely probable as well.

Those theologian scientists who followed Hooker's views were very self-conscious about the alliance between experimental natural philosophy of a certain kind and "Latitudinarian," or liberal, Anglicanism. Robert Boyle, for example, wrote, "I dare not affirm, with some of the Helmontians and Paracelsans, that God discloses to men the great mystery of chemistry by good angels or nocturnal visions." Neither the secrets of nature nor the meaning of scripture could come from "a sudden and total revelation" (Jacob 1972, 16). Similarly, Joseph Glanvil argued in his *Skepsis Scientifica: Or Confessed Ignorance the Way to Science* that the new probabilistic mechanical philosophy would "dispose men's spirits to more *calmness*, and *modesty, charity,* and *prudence* in their differences of religion" (Shapiro 1968) and Bishop Thomas Sprat insisted in his *History of the Royal Society* in 1667 that the new empirical science created "a race of young men . . . who were invincibly armed against the enchantments of enthusiasms" (53). Thus a strong alliance was formed between the liberal Anglicanism that emerged out of Hooker's writings and the mechanical experimental philosophy of the mid-seventeenth century. In terms of the schematic above, a conflict among religious factions had lead to a claim by one faction that a particular form of science provided support to their religious position. That is, an r_i had drawn support from an s_j.

How, then did other religious factions respond? Some Puritans as well as some High Church Anglicans argued that natural knowledge was

simply irrelevant to religious truth—that is, that R and S were totally independent. A few, including Jonathan Swift and occasionally Samuel Johnson, among the High Churchmen seemed to argue that there was a core conflict between all forms of natural philosophy and religion—that is, that R and S were in conflict (Olson 1983). More members toward the radical end of the religious spectrum became students and advocates of the Paracelsan tradition of alchemy (Webster 1982), leading to a surge in the publication of alchemical literature by left-wing publishers during the mid-seventeenth century—that is, they argued that s_k rather than s_j formed a support for their religious position. And during the early eighteenth century, High Church Anglicans turned toward a new, biblical approach to natural philosophy articulated in John Hutchinson's *Moses Principia* of 1724 (Brooke 1991, 190), arguing that s_m, rather than either s_j or s_k, could supply and/or receive support to/from their religious position. Thus R and S were engaged in forms of dialog in the last two cases.

A Summary of Additional Case Studies

Issues for contention may, of course, emerge in or spread into a region of overlapping cultural specialties in a wide variety of ways; and a wide variety of strategies may be adopted by contending parties. In a very few cases, there is the kind of direct confrontation between subgroups of religious figures and subgroups of scientists that the conflict thesis effectively highlights—such, for example is the current confrontation between American biblical literalists and evolutionary biologists regarding the origin and modification of species—but even here, I would call your attention to the fact that literalists still represent a minority of American Christians and that for most biologists, the issue is primarily an issue of professional power and authority, a-la-Turner. The key question is, who shall have the authority to determine the criteria by which some claim is judged to be scientific, and to control science curricula—scientists or those who speak on behalf of a particular religious position.

At the other extreme, many positive interactions between scientific and religious developments occur because some persons belong simultaneously to both religious and scientific subcultures, and they are able to transfer ideas and attitudes developed in one subcultural context to the other—or perhaps more often, as they begin to develop some set of ideas; the applicability to scientific and religious issues reinforce one another. Such a process seems to have occurred in the thought of Isaac Newton as he gradually developed a set of intellectual strategies that he could simultaneously apply to natural philosophy and to biblical hermeneutics—especially to prophecy interpretation. The success of his methods in the *Principia* reinforced his commitment to them in his interpretation of Daniel and vice versa. Ultimately they were articulated as the "Rules of

Right Reasoning in Experimental Philosophy" in book 3 of the *Principia* and as the "Rules for Methodizing the Apocalypse" in a manuscript now held in Jerusalem as Yahuda Manuscript 1.1. The key to understanding both the word and the world, for Newton, was to assume that God and Nature alike operate in the simplest possible fashion (Olson 2004, 118–21). In natural philosophy, this strategic assumption takes the following form as rule 1:

> We are to admit of no more causes of natural things than such as are both true and sufficient to explain their appearances. To this purpose, the philosophers say that nature does nothing in vain, and more is in vain, when less will serve; for nature is pleased with simplicity, and affects not the pomp of superfluous causes. (Newton 1962, 400)

In Biblical Hermeneutics, it takes the following form as rule 9:

> We are to choose those constructions which, without straining, reduce things to the greatest simplicity. . . . As the world, which to the naked eye, exhibits the greatest variety of objects, appears very simple in its internal constitution when surveyed by the philosophical understanding, and so much the simpler, the better it is understood; so it is in these visions. It is the perfection of all God's works that they are done with the greatest simplicity. He is the God of order and not of confusion; and therefore, as they that would understand the frame of the world must endeavor to reduce their knowledge to all possible simplicity; so must it be in seeking to understand these visions. (Manuel 1974, 120)

Newton's insistence that nature and God act in the simplest possible way was a fundamental assumption that had to be accepted prior to any interpretation of phenomena or revelation in order to guide and control all interpretations; and it offered him the only opportunity that he could imagine to simultaneously derive unique meanings from nature and from scripture.

In some cases, when a conflict exists between members of two cultural specialties in some overlapping domain, the members of one attempt to resolve the conflict by mobilizing support from a third specialty. This pattern of interactions was beautifully exemplified in late sixteenth century France in connection with claims regarding demonic possession and exorcism. During the late 1590s, a group of Jesuits moved from town to town through provincial France literally staging spectacular exorcisms before thousands of witnesses (Walker 1981). One Martha Brosier was brought on stage exhibiting the classical signs of demonic possession—she showed no reaction to being pricked with needles—she convulsed when a passage of scripture was read, she spoke in tongues, etc. An exorcism was performed by one of the priests—and Martha became calm and normal—producing massive conversions from Protestantism back to the Catholic faith, whose power had been demonstrated. That night, the scaffolds were knocked down and the group moved on to the next town to exorcise Martha's demons once again. These exorcisms stirred up religious passions

and strife just at a time when the French Crown, through the Edict of Nantes, was trying to lower the level of religious unrest and to establish centers of official tolerance for Protestants. In order to lower tensions without openly embracing the protestant cause in the face of his largely Catholic nation, in 1598 Henry IV appealed to science. He requested that the physician, Michael Marescot, and a group of medical scholars investigate Martha's case in order to determine whether her "possession" was legitimate, a misdiagnosis of some natural disease such as epilepsy or hysteria, or a deliberate fraud. Under controlled conditions, Marescot showed that when she was read passages from the *Aeneid* expecting them to be Biblical, she still convulsed—that, while when she was in a convulsive state she could withstand extreme pain, but that this was typical of numerous forms of melancholia—etc. In the final sentence of his report—which was immediately translated into English—Marescot wrote: "Nothing from the Devil, much counterfeit, a little from disease" (Walker 1981, 35). Without formally denying the possibility of possession, Marescot and his colleagues were able to convince themselves, the King, and many intelligent readers that in the Brosier case, an initially deluded and psychologically unbalanced woman had been exploited by her father and a group of clergy for both financial gain and for the seditious purpose of stirring up anti-Huguenot sentiment. In the process, they laid out criteria for evaluating other cases of presumed possession and witchcraft, which were widely appropriated—especially in England—by members of the religious center to challenge witchcraft beliefs which were being used by the Catholic right and Radical Puritan left alike for proselytizing purposes. In part as a consequence of this alliance between political forces, medical science, and moderate religious forces, the witch craze was brought to an effective, though temporary, end in France and England during the second decade of the seventeenth century.

Conclusion

The interacting subcultures model suggested above does, I think, provide a framework within which a very substantial fraction of the complex interactions between scientists and religious figures can be understood even though it may fail to satisfy some of the political functions of the traditional conflict model of science and religion interactions. I am encouraged in this belief because after asking my students to read and discuss a draft of this paper early in my science and religion course recently, when time came to write their research papers, none reverted to the traditional science versus religion model and one even wrote a paper suggesting that the appeal to contending natural philosophical arguments by various religious factions during the Reformation and Counter-Reformation may have played a significant role in stimulating what we oldsters have called the Scientific-

Revolution in Europe (Garrett-Glazer 2010). While I may not yet be willing to subscribe fully to that view, the paper at least suggests that the interacting subcultures model is capable of shaping the explorations of a science student who was without a prior religious commitment and previously unexposed to anthropological or sociological perspectives.

The interacting subcultures model is also not only compatible with and capable of utilizing all of the taxonomic categories explored by Barbour, Haught, and others, it interjects a dynamical element into those taxonomic structures, seeing many claims about the relationships between science and religion as responses to prior claims that are often motivated when parties to a conflict within a particular subculture seek alliances outside that subculture. This capacity is particularly obvious in the discussion of seventeenth-century Anglicanism and dissenting views above.

Though I focused above on religious factions seeking alliances with elements of the scientific subculture and the reaction of other religious factions to those alliances, the search for alliances can go the other direction as well. In the early modern period, for example, mechanical philosophers, including Kepler (1859) and Boyle in their mature thought as well as Marin Mersenne, often sought support in their conflicts with neo-platonic interpreters of the universe as a living being by appealing to religious arguments that emphasized the need for a transcendent creator and energizer of the world that might not have been demanded in a living world that could be the source of its own motion.

Finally, though it lacks some of the simplicity of the traditional conflict model, an interacting subcultures model not only fits with the actor network theory that has become a staple of contemporary science studies, it offers many of the dramatic narrative elements of the traditional model, and it explains why episodes that have traditionally been seen as conflicts between science and religion now seem to be vastly more complex as Brooke has suggested. Within the new model, for example, Galileo and his Copernican views can be viewed as central to the conflicts between Thomist and Nominalist versions of Aristotelian natural philosophy, as reflecting professional conflicts between astronomers and natural philosophers within the early modern university, as caught up in the conflict between Jesuit and Dominican interpretations of the Trentine prohibition against reading scriptures contrary to the views of church fathers and councils "in matters of faith and doctrine," or, as a pawn in Urban VIII's attempt to negotiate a safe place for himself between Habsburg and Bourbon factions in Vatican politics. Galileo's inability to gain allies among factions within the Vatican whose support he might have expected adds an interesting additional element to the Galileo affair. Galileo became involved in a priority dispute regarding the discovery and interpretation of sun spots with a highly regarded Jesuit astronomer in 1613, and his intransigence in the face of apparently compelling evidence that he knew of the Jesuit's work before

he published on sun spots alienated a powerful group of astronomers who had been his strong allies prior to 1613. Finally, Galileo became involved in a destructive personality conflict with his former friend and ally, Urban VIII, brought to a head at least in part as a consequence of his sarcastic and insulting presentation of Papal views in his *Dialog Concerning the Two Chief World Systems*, a book whose very title the Pope had suggested. Here, we have conflicts galore. Each of them probably did play a significant role in the relationships between Galileo and various actors in the Catholic Church (Finocchiaro 1989), and together they provide an even more colorful and engaging narrative of events than one that posits a global "science versus religion" conflict. The story is indeed complex and grounded in local circumstances, but it is filled with drama and conflict, almost all of which is understandable in terms of interacting subcultures.

References

Barbour, Ian. 1990. *Religion in an Age of Science*. San Francisco: HarperSanFrancisco.

Becker, Carl. 1931. "Everyman His Own Historian," *American Historical Review* 37:221–36.

Brooke, John H. 1991. *Science and Religion: Some Historical Perspectives*. Cambridge: Cambridge Univ. Press.

Brooke, John, and Geoffrey Cantor. 1998. *Reconstructing Nature: The Engagement of Science and Religion*. New York, Oxford: Oxford Univ. Press.

Bube, Richard H. 1995. *Putting it All Together: Seven Patterns for Relating Science and the Christian Faith*. Lanham, Md.: Univ. Press of America.

Cajete, Gregory. 2000. *Native Science: Natural Laws of Interdependence*. Santa Fe: Clear Light Publishers.

Cantor, Geoffrey, and Chris Kenny. 2001. "Barbour's Fourfold Way: Problems with His Taxonomy of Science-Religion Relationships." *Zygon: Journal of Religion and Science* 36 (2001):765–81.

Cohen, I. Bernard, ed. 1990. *Puritanism and the Rise of Modern Science: The Merton Thesis*. New Brunswick, London: Rutgers Univ. Press.

Draper, William. 1874. *History of the Conflict between Religion and Science*. New York: D. Appleton.

Finocchiaro, Maurice. 1989. *The Galileo Affair: A Documentary History*. Berkeley: Univ. of California Press.

Garrett-Glaqser, Jason. 2010. "The Needham Problem: Why did the Scientific Revolution Occur in Europe Rather than China." Paper submitted to Richard Olson and Robert Cave in Religious Studies 184, Harvey Mudd College.

Gould, Stephen J. 1999. *Rocks of Ages: Science and Religion in the Fullness of Life*. New York: The Ballantine Publishing Group.

Hakfoort, Caspar. 1992. "Science Deified: Wilhelm Ostwald's Energeticist World View and the History of Scientism." *Annals of Science* 49:525–44.

Harrison, Peter. 1998. *The Bible, Protestantism, and the Rise of Natural Science*. Cambridge: Cambridge Univ. Press.

Haught, John F. 1995. *Science and Religion: From Conflict to Conversation*. New York: Paulist Press.

Heilbron, J. L. 1999. *The Sun in the Church: Cathedrals as Solar Observatories*. Cambridge, Mass.: Harvard Univ. Press.

Hooker, Richard. 1845. *The Collected Works*, ed. Isaac Walton. Oxford: Oxford Univ. Press.

Jacob, James. 1972. "The Ideological Origins of Robert Boyle's Natural Philosophy." *Journal of European Studies* 2:1–21.

Kepler, Johannes. 1859. *Opera, II*, ed. Ch. Frisch. Frankfort: Erlangae, Heyder & Zimmer.

Latour, Bruno. 1987. *Science in Action: How to Follow Scientists and Engineers through Society*. Cambridge, Mass.: Harvard Univ. Press.
Lindberg, David, and Ronald L. Numbers. 1986. *God and Nature: Historical Essays on the Encounter between Christianity and Science*. Berkeley: Univ. of California Press.
Manuel, Frank. 1974. *The Religion of Isaac Newton*. Oxford: Oxford Univ. Press.
Merton, Robert. 1971. *Science, Technology, and Religion in Seventeenth Century England*. New York: H. Fertig.
Moore, James. 1979. *The Post Darwinian Controversies*. Cambridge: Cambridge Univ. Press.
Newton, Isaac, ed. 1962. Florian Cajori, *Mathematical Principles of Natural Philosophy*. 2 vols. Berkeley: Univ. of California Press.
Numbers, Ronald L., ed. 2009. *Galileo Goes to Jail and Other Myths about Science and Religion*. Cambridge, Mass.: Harvard Univ. Press.
Olson, Richard. 1978. "Science, Scientism, and Anti-Science in Hellenic Athens: A New Whig Interpretation." *History of Science.* 16:179–99.
———. 1983. "Tory-High Church Opposition to Science and Scientism in the Eighteenth Century." In *The Uses of Science in the Age of Newton*, ed. John Burke, 171–204. Berkeley: Univ. of California Press.
———. 1987. "On the Nature of God's Existence, Wisdom, and Power: The Interplay between Organic and Mechanistic Imagery in Anglican Natural Theology, 1640–1740." In *Approaches to Organic Form*, ed. Frederick Burwick, 1–48. Dordrecht: D. Reidel.
———. 2004. *Science and Religion, 1450–1900*. Westport, Conn.: Greenwood Press.
———. 2010. *Technology and Science in Ancient Civilizations*. Santa Barbara: ABC-CLIO.
Peacocke, Arthur R. 1996. *God and Science: A Quest for Christian Credibility*. London: SCM Press.
Polkinghorne, John. 1994. *Faith of a Physicist*. Princeton: Princeton Univ. Press.
Shapiro, Barbara. 1968. "Latitudinarianism and Science in Seventeenth Century England." *Past and Present* 40:16–41.
———. 1983. *Probability and Certainty in Seventeenth Century England: A Study of the Relationships between Natural Science, Religion, History, Law, and Literature*. Princeton: Princeton Univ. Press.
Sprat, Thomas. 1667. *History of the Royal Society*. London.
Turner, Frank M. 1978. "The Victorian Conflict between Science and Religion: A Professional Dimension." *Isis* 69:217–28.
Walker, Daniel Pickering. 1981. *Unclean Spirits: Possession and Exorcism in the late Sixteenth and Early Seventeenth Centuries*. Philadelphia: Univ. of Pennsylvania Press.
Webster, Charles. 1982. *From Paracelsus to Newton: Magic and the Making of Modern Science.* Cambridge: Cambridge Univ. Press.
White, A. D. 1896. *A History of the Warfare of Science with Theology in Christendom*. New York: Appleton.
Wilson, David. 1996. "On the Importance of Eliminating *Science* and *Religion* from the History of Science and Religion: The Cases of Oliver Lodge, J. H. Jeans and A. S. Eddington." In *Facets of Faith and Science, Volume 1: Historiography and Modes of Interaction,* ed. Jitse M. Van der Meer, 27–47. Lanham, New York, and London: Univ. Press of America, Inc.
Yerxa, Donald. 2009. *Recent Themes in the History of Science and Religion: Historians in Conversation*. Columbia: Univ. of South Carolina Press.