

Science and Reason, Reason and Faith

A Kantian Perspective

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Reason in Dispute

During the week before the Christmas of 2005, Judge John E. Jones, III, sitting in the Federal Middle District of Pennsylvania, ruled against teaching a new form of creationism in the public high school. The case arose from a suit brought by parents against the Dover school board, which, in 2004 had instructed teachers to read a short statement about the inconclusive status of neo-Darwinian evolution theory and suggest that Intelligent Design might be entertained as an alternative explanation. After a long trial that delved into the nature of scientific theory and the questions of what constituted scientific knowledge, the judge ruled Intelligent Design was a ploy to bring religion into the classroom and accused certain board members of duplicity. Judge Jones only confirmed what the voters had already accomplished by throwing the errant board members back to church.

The country was riveted on the courtroom drama, some comparing it to Scopes circus of 1925, when Clarence Darrow confronted William Jennings Bryan in the famous Tennessee “monkey trial.” The 1960 movie “Inherit the Wind,” so well enacted by Spencer Tracey and Fredric March, captured my own imagination as a youngster, and then, as now, I was fascinated with the arguments about God’s presence or absence in nature. I can well understand how religionists regard nature with awe, and to find coherence, and perhaps more importantly, meaning, in the cosmos, they cannot abide placing their God outside His handiwork. If He is present in their daily lives, why should He be omitted from designing the greatest of creations, human intelligence? After all, the Bible describes how Adam was made in the image of God. Accordingly, His intelligence, like our own, must have some engineering capability dwarfing even our wildest conceptions. True believers maintain that orthodox scientists are blind to a deeper Reason, because they have yet to see His fingers at work. So what looked to Darwin and his followers as only a contingent, blind evolutionary process, is, in fact, only understandable as an act of deliberate design.

The Dover case took on a special luster during the summer of 2005, when in the *New York Times*, Cardinal Schönborn wrote a controversial op-ed piece. He claimed that he was protecting “rationality” against an ideological science:

The Catholic Church, while leaving to science many details about the history of life on earth, proclaims that by the light of reason the human intellect can readily and clearly discern purpose and design in the natural world, including the world of living things.

Evolution in the sense of common ancestry might be true, but evolution in neo-Darwinian sense — an unguided, unplanned process of random variation and natural selection — is not. Any system of thought that denies or seeks to explain away the overwhelming evidence for design in biology is ideology, not science...

Now at the beginning of the 21st century, faced with scientific claims like neo-Darwinism and the multiverse hypothesis in cosmology invented to avoid the overwhelming evidence for purpose and design found in modern science, the Catholic Church will again defend human reason by proclaiming that the imminent design evident in nature is real. Scientific theories that try to explain away the appearance of design as the result of “chance and necessity” are not scientific at all, but as John Paul put it, an abdication of human intelligence.

The slippage is evident: Schönborn propels his metaphysical reason, that which supports God's cosmological purpose, into the epistemological domain, where the preponderant scientific interpretation sees no design (and, incidentally, makes no comment about God's presence or absence). In other words, theological reason is conflated with scientific reason, and the boundaries are trespassed as if there were no difference. The Kantian lesson (discussed in detail below and elaborated in the Appendix) — how reason must make way for faith — is simply ignored. Rather than provide divine presence and teleology with its own reason, the Cardinal insists on projecting his faith into the natural world. In short, because his reasoned theology (as in the Church's persecution of Galileo) apparently could not accommodate neo-Darwinian blind evolution, Schönborn must dispute dominant scientific opinion. Given his first allegiance to his own religious tenets he had no other option.

What I am calling "slippage" is a result of these competing metaphysics, and here we come face to face with the challenge in its starkest terms: Schönborn's metaphysics demands divine intervention; science embraces a naturalism whose metaphysics are defined independently of teleology. Reason is simply the tool used by each to support its respective agenda. Unfortunately, "reason" is used by like-minded theologians as some kind of universal solvent for dissolving problems without acknowledging that it is not reason that is in dispute, but rather the metaphysics in which reason functions. The question of whether Intelligent Design might take its place in the scientific menu does not strike me as particularly interesting at this point.¹ We have witnessed endless and convincing rebuttal, but what intrigues me, and the question upon which I will focus, concerns the character of reason. Both sides claim a rational discourse, and, indeed, intelligent people espouse Intelligent Design, but given the pre-suppositions of each system, the conclusions of the respective positions are irreconcilable. Argument is stultified, because pre-suppositions are, as R.G. Collingwood described them, the suppositions that are closed to further analysis or revision (Collingwood 1940). They are the bedrock of the conceptual apparatus they support. Start with different presuppositions and logical progression will bring the disputants to very different ends. More to the point, scientific method, specifically its notions of objectivity coupled to empiricism, has asserted its own program at the expense of other modes of knowing. Indeed, scientific facts are not at issue, but rather their interpretation, so that we should recognize the instrumentality of reason: Science may be used by anyone; its technology applied for diverse social pursuits; its knowledge perhaps designed for one purpose, applied to another; its findings interpreted to support one metaphysics, or another.²

And now we come to the heart of the matter.

The Intelligent Design case exemplifies not only how science is in tension with different worldviews, but more deeply how the metaphysics in which science functions as an instrument of inquiry is in conflict with others. The drama is not about science per se, but about the metaphysics in which science functions. The classic examples are the religious disputes arising from Galileo's astronomical findings and Darwin's theory of common descent. In each instance, a religious orthodoxy disputed the science. Galileo's case has been settled, but Darwin's still lingers, not in the particulars of evolutionary findings, but as in the case of the Cardinal, the meaning of those findings.³ When the fossil record is placed within a fundamentalist reading of the Bible, a "meta-theory" has supplanted the scientific one. And the irony of our age is not that science cannot trump fundamentalist arguments, but rather that the wondrous picture science presents may be translated into religious terms and effectively employed against those who supported and developed the system for very different ends.⁴ We will not settle the matter by argument, rational or otherwise. The best we can do is support the liberalism, which allows communities with different belief systems to thrive next to each other. To that end, I will direct my comments.

Since science's understanding of the universe and our place in it, may or may not include a divine presence, God is besides the matter. If one wishes to impose a secondary layer of divine interpretation upon those findings, fine, but do not conflate two ways of knowing. Each has its place, and therein, its authority. This is my theme.

The Problem

Neo-Darwinism's non-teleological, materialistic view may be interpreted as denying major assertions of Christian theology, and much else. Indeed, each form of materialistic theory — from evolution to the origin of the universe, from the heart's beating to the brain's functions — rests on a denial of design, and consequently, a displacement of a master divinity. More than just rejecting religious doctrine, neo-Darwinism asserts its own metaphysical picture in contrast to it: a stark, materialistic universe with no telos. Such a view leaves humans the chore of defining significance and meaning within a human construct. I believe that challenge lies at the base of the conflict between secularism and religious ideology. In a sense, Nietzsche's challenge ("God is dead!") remains an abiding unresolved question: Can, or even should, Man define his cosmos? Beyond naturalistic explanation, can the values which govern society be truly based upon, or even derived from, human deliberation? Can we successfully assert our own significance? Can we meaningfully exist without divine revelation and live in a world navigated and created by human intentions and will?

These questions have rested at the heart of the secular enterprise throughout modernity. Indeed, they largely define the humanistic project, and when liberal society is confronted by such expressions of discontent as the Dover case, we are reminded that for a vast proportion of Americans, the world science presents cannot provide meaning that satisfies their existential needs. Indeed, they are correct. I readily admit that science requires some "framing" — aesthetic, spiritual, moral — to integrate its worldview with human experience. The fundamentalists aspire to integrate a scientific picture — evolution — with deeply held religious commitments. I also seek seamless connections between a materialistic universe governed by laws that have no personal enchantment and the various dimensions of my subjectivity. So I share with the fundamentalists a humane aspiration to understand my own identity — psychologically, sociologically, spiritually, and so on — as my identity is refracted from different perspectives. In short, all of us seek some kind of "placement." The difference between fundamentalists and me is that they have a scheme, revealed and doctrinaire, and I do not, at least not as a dogma. Instead, I firmly reside within a humanist tradition that attempts to provide responses to these existential questions within the framework of "Man as the final measure."

On this view, science not only provides the basis for technological advances, but answers to its deepest commitments of exploring nature as a response to our metaphysical wonder. In this, science and religion are closely aligned, but quickly separate, not so much because of reason, but rather as a result of differing metaphysical presuppositions (e.g., Marcum 2003; 2005). In contrast to a cosmos revealed by revelation, science was born as natural philosophy, and thus committed to a vast program of empirical discovery. Indeed, science as a branch of philosophy still adheres to the humanist tradition, and despite deep tensions, their broader agenda of promoting liberal inquiry must bring them again into close proximity. From this vantage, the science-humanist alliance, melded in philosophy, must be seen again as a key bulwark of modernity and its liberal program.

The tack taken here is guided by a sighting of reason; the winds are coming from starboard; we require a steady compass to hold our course. I suggest we find our bearings by looking back to the port from which we embarked. That safe harbor is the Enlightenment. From there, we must chart our present predicament. So let us begin with a review of some history.

The Call of the Enlightenment

What is Enlightenment? Kant's famous answer, "Enlightenment is mankind's exit from its self-incurred immaturity" or as he further extolled, "Have the courage to use your own understanding..." (1784, 1996). The essay goes on to celebrate the virtues of an independent mind, guided by rationality, moral forthrightness, and above all, a vision of personal freedom, which captures these moral and epistemological virtues of the philosophes. This is only a partial answer and we will have occasion to visit this conceptual question again, but for now, let me ask a simpler historical question: What is the Enlightenment? That, also, turns out not to be a trivial question, as I learned about 15 years ago, long before I attained my present level of alarm. I was presenting a report to a group of physicians, and dropped the phrase, "the Enlightenment," probably as a dangling participle to no good effect. In any case, the chief medical officer, a man in his mid-40s at the time (that is, a man about my own age), South African (and thus possessing an accent that smacked of erudition), and a rather general haughty air about him (no doubt from the authority of his position), stopped me by asking, "What is the Enlightenment?" I paused, not sure of his intention, but soon discerned that he was genuinely perplexed from a state of utter ignorance. At that moment, there in the boardroom of the big city hospital, I realized that we were in trouble, deep trouble. Shortly thereafter I initiated my career shift into philosophy, where despite encountering a universe of different kinds of problems, at least my colleagues knew such turn of phrases as "the Enlightenment" and could respond with a kindly nod or a disapproving frown. They knew how we are the products of that cultural moment, and how those values developed and continue to guide liberalism and the specific endeavor we call education.

I have often contemplated how I might have answered my physician inquisitor. Instead of sputtering some incoherent mumblings, I wish I could have quickly listed the key components of the Enlightenment: celebration of an unfettered reason; the relentless questioning of authority and doctrine; the promotion of individuality and free-choice; the centrality of selfhood and moral agency; the confidence in progress; the sanctity of secularism. In short, these precepts, refracted into the worlds of politics, law, social mores, and perhaps most evidently in theology, marked modernity's coming of age. Science played a singular role in promoting this enterprise and, in turn, was indebted to it. I would have explained that the clinical science that he practices is a product of a new way of thinking, born during the "Century of Genius" (Whitehead 1925) as an expression of a form of rationality that had become a tool for open-ended inquiry. Indeed, I would have emphasized the open-ended character of truth-seeking; the agnosticism about the divinity; and, not least, the fallibility of knowledge.

Modern science in many ways exemplifies the Age of Reason; specifically I am referring to its program of truth-seeking. Somewhat chastened by the postmodern critique of any final Truth, I still believe we make an important distinction between an understanding of reason that serves a predetermined goal (for instance one defined by religious faith that is constrained a priori by presuppositions deemed immune in advance to questioning), as opposed to the use of enlightened reason that is open-ended. Inquiry in this latter formulation has no telos other than the inquiry itself. In this sense, scientific knowledge is neutral; the process of study is putatively immune to bias and prejudice (at least in its theoretical prime state); fallibilism is assumed; objectivity is sought. I will be making the case that this view of epistemic accomplishment is fundamental to liberal thought and that this characteristic binds science firmly to the humanities. Each share the same critical values, and, in many respects, the same methods of analysis and tireless questioning of the fruits of their respective studies. That alliance may be directed towards secular ends, but not necessarily so.

Returning to my doctor colleague, I would have explained that his ignorance was symptomatic (a word he would undoubtedly have understood and would hopefully peak his interest) of the troubled status of this humanist-science alliance. Let us briefly review that recent history.

Science and Reason's Division

Almost half a century ago, the growing separation between science and the humanities prompted C. P. Snow to describe academic culture as comprised of "Two Cultures" (Snow 1959, 1964). He described mutual illiteracy, which prevented scientists and humanists to engage each other across the boundaries separating their respective disciplines. Because of its success and its independence of the larger philosophical context from which it emerged, science was regarded as an unruly adolescent: full of itself; brimming with confidence and even arrogance; overflowing with its power and promise. As Winfred Sellers noted (writing as a philosopher):

The scientific picture of the world replaces the common-sense picture...the scientific account of "what there is" supersedes the descriptive ontology of everyday life...[I]n the dimension of describing and explaining the world, science is the measure of all things, of what is that it is, and of what is not that it is not. (Sellers 1956, 1997, pp. 82-3)

Here, "common-sense" or "common-place" is a placeholder for all those modes of knowing eclipsed by the triumph of science's worldview.

Humanists feared an imbalance in two domains. The first was intellectual: Scientism was viewed as imperialistic, assuming to apply its methods and logic in arenas where, despite its authority, caution is required. Humanists were suspicious of claims that are by their very nature fallible and which history has repeatedly demonstrated are infected by pernicious cultural determinants. A particularly invasive scientific philosophy, positivism, asserted a rigid factuality to what constituted knowledge, and that standard as applied to the human sciences (Comte 1825, 1974), would devalue other hermeneutical forms of inquiry. Thus, as a purely intellectual conflict, most scientists and humanists found themselves on different sides of the demarcation lines outlined by the positivist program.

The second domain of controversy arose from the political and social consequences of the first. Despite the achievements of science, humanists rightly feared the imbalanced influence of the science "lobby," whose authority rested on the economic bounty indebted to scientific advances. The Two Culture divide was consequently also an expression of how science, largely as a result of its material success, increasingly dominated public policy decisions and education resources. The social apparatus that supported the scientific enterprise ranged from the educational reform stimulated by the Sputnik challenge to scientific industries promoting their vested interests. Beyond the technology sold to the domestic West, these were prominently energized by, what Eisenhower menacingly described, a "military-industrial complex," which prominently displayed its products in Vietnam and later in Iraq. Many were troubled by the danger of misplaced applications (like nuclear power) and, even more, a kind of political arrogance, which seemed to accompany the power of unbridled technology. These matters, while germane, are not our subject. Here, suffice it to note that by the end of the 1950s, science education dominated other forms of knowing, so that a gentle species of scientism seeped into the schools educating new generations of citizens.

Ironically, coincident with Snow's critique, the original cultural divide began to mend in an unexpected way, only to be broken again along different fault lines. Bridged by interdisciplinary studies of science, where philosophers, historians, and sociologists pursued an ambitious program to characterize the laboratory as an intellectual and cultural activity, science no longer was allowed to perform insulated from outside scrutiny. Indeed, science was wrenched back from its isolated status, and the Two Cultures were melded back to one, with a vengeance. The sacrosanct status of scientific rationality and claims to orderly progress was challenged by Thomas Kuhn's *Structure of Scientific Revolutions* (1962), which closely followed Michael Polanyi's exploration of a more comprehensive appreciation of scientific thinking than that offered by positivist philosophies of science. Indeed, Polanyi's *Personal Knowledge* (1958, 1962) marks the beginning of a new movement to study science

in a broadened humanistic context, which employed analytic tools quite alien to the then current “internal” approaches espoused by Rudolf Carnap and other logical positivists.

To place these developments in their historical context, I present a review of the original alliance of humanists and scientists, how they separated, and why a renewed effort to hold their common ground is incumbent on both. We begin with Kant, who responded to the 18th century challenge of understanding the legitimate claims of science, moral discourse, and religion in the face of rapidly changing notions of the divine and its place in a secular, liberal society. Revelation had been displaced by a critical stance oriented by new standards of what is factual and what is not; what is knowledge and what is opinion; what is objective and what is subjective. He specifically sought to define reason in its various guises so that the pursuit of knowledge and the faith of belief might proceed on their respective courses, confident that neither would conflict with the other. This project articulated the Enlightenment’s highest ideals.

We must also review some key historical features that highlight the parting of science from the humanities — very broadly and very briefly — and then I will return to explore the circumstances of a new alliance, now based on those who would still embrace the original Enlightenment values characterizing modernity. I am following the tradition initiated by Kant (Wein 1961) and then developed by Whitehead (1925), Husserl (1935, 1970), and Gadamer (1976, 1981), each of whom, despite the radical differences of their respective philosophies, profoundly understood that the bifurcation of reason bestowed a conundrum that could only be addressed by a synthesis of science and its supporting philosophical critique.⁵ Here, we will ponder in various ways how, reason must “be its own pupil” (Kant 1787, 1998, p. 109 [B xv]) and thus remain loyal to its own “character.” I will first review some key historical features that highlight the parting of science from the humanities, and then I will return to explore the circumstances of their continued alliance.

The Fractured Alliance

1. History

“Natural philosophy” became “science” in the mid-19th century, when practitioners, both natural and social scientists, distinguished their own technical and professional route from the more general concerns of humanists. The break was, however, already evident at the end of the 18th century, when both poets and physicists recognized a seeming chasm opening between them. Goethe, perceiving this division, sought a reunification of “science” and “poetry” in the realm of aesthetics (Tauber 1993). This strategy proved futile. In the same period, Kant conceptualized the split by dividing human cognition into what he called ‘pure’ and “practical” reason. “Pure” reason referred to the cognitive functions that humans apply to the natural world, and “practical” reason dealt with the moral realm (social or humanistic concerns). Kant’s formulation provided a model by which science and religion might co-exist secure in their respective domains (discussed further below). To do so, a new lexicon was required to distinguish practitioners of one sort from the other.

The term “scientist” was coined by a British scientist and philosopher of science, William Whewell (1794-1866). In 1840, writing in the *Introduction of his Philosophy of the Inductive Sciences*, Whewell commented, “We need very much a name to describe a cultivator of science in general. I should incline to call him a Scientist”(p. cxiii). What strikes me as noteworthy is not this definition, but the late date of its birth. After all, the word “science” is ancient. The Latin *scientia* means “knowledge” as opposed to *sapientia*, wisdom. In other words, *scientia* is knowledge of, or cognition about, the world, as opposed to the more self-reflexive domain of wisdom. And, *sciens*, “knowing,” originally meant “to separate one thing from another, to distinguish,” which also points to analysis of a particular kind. Certainly this etymology closely adheres to what we broadly understand to be what science seeks.

In short, the word “science” has an ancient etymology, but the word “scientist” is distinctly modern. Indeed, Charles Darwin, who wrote during the same period as Whewell, referred to himself as a “natural philosopher.” Darwin was very careful with his language and as a gentleman he had good reason to prefer the older designation. The term “philosophical” was not explicitly defined, but generally stood for an approach to the study of the natural world (Rehbock 1983), which included the search for laws in biology, a dissatisfaction with teleological arguments, a certain speculative or intuitive attitude in method (especially rampant amongst the Naturphilosophen) and idealist approach (ibid. pp. 3-11). In addition, “scientist” was too easily associated with commercial overtones of technical applications and thus the designation carried a pejorative connotation of someone who was inclined to look for the economic benefits of discoveries, in contrast to the pristine search for knowledge. Not until the end of the 19th century could the term scientist assume its current neutrality.

I mention all of this to make a simple point: Until the mid-19th century, science was a category of philosophy. The examination of the natural world was part of what philosophers did. Only as the methods of scientific inquiry became increasingly technical and a new professionalism took hold in its various disciplines, did a scientist emerge as someone different from a philosopher. If one examines the Western intellectual world as late as the 1850s, the educated classes were comfortably conversant with the latest scientific findings, and many pursued, what we would call amateur science (Tauber 2001). Chemistry and physics began to separate a bit earlier, but certainly natural history remained the province of a wide audience. And I am not referring to its popular mode: I mean specifically that gentlemen would go to natural history meetings well into the 1850s and 1860s without any professional encumbrances to their full participation. In short, until about 150 years ago, most scientists and most philosophers shared the same intellectual bed.

2. Methodological separation

Advances in scientific techniques and methods of study required specialization. The techniques developed in the 19th century reflected a growing sophistication, both in terms of material investigations, as well as the mathematics supporting them. The field of “biology” was invented as its own discipline in the first decade of the 19th century and by the 1820s, Claude Bernard and other physiologists were reducing organic processes to physics and chemistry. Concurrently, physics and chemistry were employing new mathematics, primarily statistical in nature, which by the 1870s created statistical mechanics and all that it spawned. In short, focused attention to the rapid growth of technical knowledge became a pre-requirement for active participation, and this demanded specialized training. Eventually this professional narrowing led to academic and professional segregation. By the 1870s, science was divided into various natural and social sciences, each of which assumed a high degree of technical competence and cognitive training (Smith 1997).

The fruits of that labor resulted in new industries derived from scientific findings and their successful application to material culture. Since the Renaissance, science has been sold as a package deal: Invest in scientific inquiry and the discoveries will be converted into economic, military, and social power. Indeed, the investment has been true to its promise, and few could dispute that the triumphs of technology are inseparably linked to the success of the underlying science. But I wish to note that technology is not science; the two are distinct. Technology builds on scientific insight, and much else, while science is based in another domain: Science seeks to discover the character of nature and is thus part of natural philosophy. On this view, technology is the application of knowledge for material innovation, while science underlies such engineering. It is the difference between second order and first order pursuits. But with the close identification of science and technology this distinction is often blurred. I mention it here to emphasize that science has been too often associated with its product as opposed to its deeper commitments to philosophical inquiry, albeit of a special kind.

More importantly, the intellectual discipline of each domain drifted apart. The hermeneutical methods used in the humanities, writ large, have their own standing. But the interpretations applied to human creativity are not suitable for the study of nature under the present scientific paradigm. The object of investigation determines different approaches and different truth criteria. Those who would separate science and the humanities would do so primarily on this difference. Indeed, these methodological differences are rooted in a deeper philosophical divergence.

3. Philosophical divide

During the Enlightenment, those who pondered the nature of knowledge were struck by a growing separation of investigative methods employed by those who studied the natural world, on one hand, and those who commented on the social, spiritual, and psychological domains, on the other. Distinctions between opinion and knowledge, always a central concern of philosophy in one form or another, by the mid-18th century had reached a critical crisis. David Hume, the great Scottish skeptic, drew these distinctions with particular sharpness. He presented Kant with the challenge of refuting a skepticism that placed in doubt the reality of the natural world, or at least the ability to know that world objectively. The place of reason, the role of emotions, the intuitions of the spiritual domain, and the ability to understand human psychology each required a model of the mind that would account for their respective claims to these particular forms of knowledge. On what basis could, for example, knowledge of the natural world or the moral universe be conceived as legitimate and well-grounded?

Kant began by offering a schema of the mind that made the natural world intelligible, and thus susceptible to scientific investigation. He conceptualized that to know the natural world and the moral domain required two different kinds of human cognition. He called these, respectively, “pure” and “practical” reason. “Pure” reason referred to the cognitive functions that humans apply to the natural world. Such knowledge is derived from appearances — the cognitive product or the phenomenon that we perceive. The noumenon, the thing-in-itself we cannot know, and thus our ontology is of a “second-order.” Kant was satisfied: “What the things may be in themselves I do not know, and also do not need to know...” (Kant 1787, 1998, p. 375 [B333]). In contrast, “practical” reason dealt with the moral realm, that is, with social or humanistic concerns. In other words, Kant thought that humans possess one faculty for knowing the material world, best exemplified by scientific inquiry; and he held that a second universe, the moral-spiritual-personal, was, in terms of the first form of understanding, unknowable. People might believe in the freedom of the will, the immortality of the soul, and God, but the means by which humans might know such metaphysical claims was not discernable by the same means humans knew the natural world. As Kant acknowledged: “Thus I had to deny knowledge in order to make room for faith (ibid. p. 117 [Bxxx]). Faith refers to metaphysics, by which Kant meant the possibility of going beyond the science of appearances to address moral pursuits. Thus one kind of knowledge was differentiated from the other, and in fact, the argument followed a strong Christian tradition: “Faith is the assurance of things hoped for, the conviction of things not seen” (Epistle to the Hebrews 11:1) (See Appendix).

The consequence of this division was, from Kant’s perspective, a way to save Belief. But what he in fact did (for those so inclined) was to legitimize one way of knowing as “real” and the other as “less real.” In short, science could claim a special legitimacy, albeit the Kantian transcendental claims were immediately attacked (Beiser 1987) and the philosophical basis of Kant’s theory of science led to unresolved debate (e.g., Brittan 1978; Friedman 1992). Any commitment to this configuration of reason required that some balance be sought between what Kant called the reason of the empirical domain and the reason of the moral. Specifically, where does scientific inquiry end and other modes of knowing take over? For instance, the hermeneutical disciplines, those that interpret, as opposed to analyze, employ a legitimate countervailing method of knowing. From this

perspective, only an interpretative stance makes any sense when assessing a work of art or determining the emotional meaning of behavior. Systems of justice, cultural practices, and the meaning of behaviors cannot be reduced to strict objective inquiry (the standards simply do not exist), but rather rest on different kinds of assessment and interpretation. And when religious knowledge makes its claims, on what basis might a scientific attitude allow for the spiritual?

These questions will not rest and, indeed, they frame the basic issues regarding the place of science in our pluralistic society. The general point, and the one to which I will return, is simply that when science is viewed circumspectly it becomes only one of several modes of inquiry, albeit with its particular strengths, but also with its limitations. The line separating objectivity from subjectivity is highly dynamic, historically contingent, and continuously contested. Despite the obvious importance of making these distinctions, the history of science is marked by the controversy of defining those margins. Indeed, from a philosophical point of view, this is a key component of science's epistemological mission.

Kant's warnings not to trespass into a realm best left to others were naïve. Analytically, we can separate the epistemological and metaphysical concerns of a philosophy of nature, but as modern science developed its distinctive epistemology, a new metaphysics also emerged. Indeed, it is disingenuous to insist that science has no metaphysics: As a branch of philosophy it has first principles, pre-suppositions, which dwell in the deep reaches of its conceptual structure. I call this aspect of science's metaphysics its "logical" structure and it includes such precepts as 1) the world is ordered; 2) we might discern this order by detached empirical observation, neutral rational description and objective analysis; 3) laws will emerge from this inquiry and they remain inviolable; 4) why nature corresponds to our human mathematical and objective descriptions is mysterious, but the empirical product of that method has been highly successful and thus approximates a depiction of the real as truth, and so on. Indeed, the technical product of this methodological logic, and the power of its predictability points to a new mastery of nature shared by all.

A second dimension of science's metaphysics concerns the abiding questions that direct its inquiry. Within its ontological domain, science embraced the basic questions ancient philosophers had inherited from even more ancient myth and religion: What is the world? How is it organized? Where does Man fit into that universe? What is distinctly human? Science presented cogent answers in its distinctive voice in terms decidedly non-metaphysical. Yet, while the terms of engagement had been radically altered and the ontological voice muted, the original metaphysical inquiry remained embedded (but hardly dormant) in the scientific enterprise. Given that the metaphysical questions remained, it is not surprising that the results science offered were construed as alternatives to traditional religious beliefs. Indeed, by the mid-nineteenth century, Whewell could assert with arrogant confidence, "Man is the interpreter of Nature, Science the right interpretation" (1840, xvii).

Into our own era, competing metaphysical positions have provoked conservative theologians to accommodate themselves to science's claims, when the integration of empirical study did not clearly coincide with the rational constructions of their dogmas. Discontent with a scientific worldview that had relinquished divine guidance, left fundamentalists resenting the scientist's independence (or better, insularity). In the United States this independence of religion led stalwart promoters of secularism (like the Robert Ingersoll and Cornell's founding president, Andrew Dickson White [Feldman 2005]) to denounce religion as an offense against science. Darwin's prescient early journal musings (July 1, 1838) soon became commonplace sentiments: "Origin of man now proved.—Metaphysic must flourish.—He who understands baboon <will> would do more toward metaphysics than Locke." (1987, 84e, p. 539). (Cosslett [1984] offers a rich compendium of the 19th century debate.)

The answers science provided were hardly neutral, inasmuch as the secularists regarded investigative findings with one set of lenses, while the religionists peered through another. In short, the borders were violated by both parties as they sought to bolster their own programs. Theoretically, a strictly neutral science would posture itself towards neither camp,

but given its historical and cultural affinity with the humanist tradition, science became a powerful instrument of secularization. Moreover, since neutrality was never a viable option, science found itself caught in the cross fire of an ideological war that has been waged for over five centuries. And no wonder, for no less than The Truth was at stake.

Binding the Sciences to the Humanities

The project of protecting liberal education requires the alignment of science with its humanistic origins, or what I am calling, science's deeper philosophical project. "Humanism," (like the word "scientist") was coined in the 19th century to apply to the rediscovery of the classical tradition in the medieval period. Humanists were originally concerned with a general education, which spans the classics to modern science. But humanists accorded particular importance to the liberal agenda: freedom of thought, tolerance, revision and correction of opinion, open communication, and a self-critical attitude. These underlying values tie together the central concerns of the humanities and science into a powerful alliance. In fact, one could argue that these values captured much of philosophy's pride and business. Accordingly, the scientific worldview could make its claims based on a long history of coupling its particular concerns to this much larger agenda.

Today the humanities are the direct heir of the original humanistic disciplines, and science seems far distant from those origins. But recall that science also originated as a contributing member of the humanistic faculty, and on this broad view, science is part of a larger historical development of humanistic thought. Although we are usually struck by how science followed a naturalistic philosophy, even its empiricism is based on a rationality that had deep roots in philosophy. Through ruthless self-criticism, the frame of reference is always in doubt; the historical record reveals fallibility; the place of objective knowledge as opposed to subjective opinion is tested and contested. And when opinion is held, it is open to revision through free argument.

These are the deepest values of science and the underlying philosophy guiding its methods and defining its aims. Science is sustained, indeed instantiated, by a self-critical philosophy, tested against the investigations of nature. Nature devoid of human value and human caprices demanded stark answers to starkly posed questions. In short, although science and humanities pursue different objects of inquiry, they support each other in common purpose and the same philosophical self-critical attitude. And beyond this kinship we find other aspects that link them.

Subordinate the difference of science's object of study, the natural world, as well as differing methodologies (the empirical basis of scientific investigations), and we are left with an essentialist core: Science, like the humanities, is a human-centered focus of inquiry — "human-centered" in two senses:

First, the standards of discourse are human-derived (as opposed to divinely inspired). Revelation has been displaced by a critical stance oriented by new standards of what is factual and what is not. What is knowledge and what is opinion? What is objective and what is subjective? The second component refers to knowledge directed at developing human industry. "Industry" does not refer here to material culture, but rather the more general understanding of industry as the systematic labor to create value. The study of nature is deeply committed to a personal comprehension of the world, a picture of reality that offers insight, and thereby an orientation, of Man in Nature.

Scientific findings alone are insufficient for determining significance, and thus interpretation is required (Tauber 1993; 1996; 1997; 2001). Commentators from Goethe (Tauber 1993) to Whewell (1840) to Michael Polanyi (1958, 1962) have understood that raw knowledge, a fact, is essentially meaningless. What is the significance of a scientific fact or larger theory unless it may be applied to human understanding? "Understanding" entails many layers of interpretation, and here the linkage to the humanistic disciplines becomes most evident. Science influences its supporting culture, the values that govern its use, and

ultimately the sense of meaning and significance ascribed to the scientific portrait of the world. Polanyi called this final step “personal knowledge” when he wrote about the same time as Thomas Kuhn about the limits of positivism. Both recognized, as did an entire generation following them, that scientific knowledge was ultimately human-centered in the sense discussed here. On this broad view, science is part of a larger historical development of humanism, and finds itself, ultimately, in its service.

Certain conclusions beckon: First, the “package deal” of doing science and placing science within its intellectual and social contexts argues that science and its study as a human activity cannot be separated. This interdisciplinary effort arises, because the boundaries of science cannot be circumscribed to the laboratory or technical discourse (Gieryn 1995). The findings seep into applications, which affect our material culture, medicine, the military, and virtually all aspects of our society. Only an educated public can make appropriate use of the fruits of scientific labor, thus a close coordination between scientists and lay public is required to reap the greatest harvest from the investment made in research.

Second, the critique of science is essential to its flourishing. Science gains its place at the table precisely because of its power to define a competing worldview. The “naturalization” of man, from the evolution of species to the biological character of the mental testifies to how successfully scientific explanations have been translated into potent theories of man and society. (For instance, how much of human behavior is determined by the genetic dimension? Why should we preserve natural resources? When does a fetus become an individual? Can vaccines be developed to prevent AIDS? To what use should nuclear energy be applied? And on, endlessly.) Notwithstanding the effective penetration of scientific theory into notions about the nature of our social and psychological existence, a careful scrutiny is required to apply the conceptual lessons appropriately. Closely linked to that application, the converse operation is also necessary, namely a critical view of the truth claims made by scientists. With these critiques, philosophy and history of science find their most pressing calling.

Perhaps not surprisingly, as science assumed its new independent standing, the disciplines of history and philosophy of science matured. They filled a gapping hole. After all, as Thomas Kuhn noted 40 years ago, scientists were not interested in their own histories, much less the philosophy undergirding their discipline (Kuhn 1962). In turn, the humanists lamented the scarcity of meaningful dialogue between themselves and their scientific colleagues. The sociologies of each group had radically diverged, and beyond this professional separation, the respective mode of discourse seemed foreign to the other. Thus cross-fertilization had become increasingly barren.

The mission of the humanistic disciplines to critique science, interpret its development, and assist efforts made from within the scientific establishment in its own self-critical evaluations seem to warrant historians and philosophers the status of bona fide adjuncts in science faculties. And more, the ability to translate scientific discoveries and theories into wider conceptual and social contexts, where their significance might be more fully appreciated, also requires an intimacy between the laboratory scientist and her humanist commentator. After all, science is only one system of investigation within that larger arena of human study of nature, man and society. As such it has proven to be a crucial means of discovering our world and characterizing our relationship to it. But like any mode of philosophical study, it is subject to criticism, and in that critique, scientific method itself is scrutinized and thereby improved. One might even say that self-critical scientists are themselves engaged in the philosophical project of ‘natural philosophy’ by carefully examining their methods and truth claims. This essentially philosophical self-criticism is probably the most fundamental shared characteristic of science and philosophy as generally construed.

Third, beyond the material fruits of scientific labor, the most profound effect is science’s worldview, or, as Heidegger (1977) noted, that there is a worldview at all! The theories and methods that have demonstrated the worlds of molecular biology, tectonic plates, quantum

mechanics, and so on, have markedly altered how we conceive the world in which we live and our relation to it. Further, the human sciences, for better and for worse, have bestowed their own theories on human character and conduct. Taking their lead from Goethe and Schiller, philosophers as diverse as Heidegger and Whitehead, Weber and Foucault, have repeatedly shown how science has effectively competed with earlier metaphysical systems, and thus has provided views of a reality replete with novel challenges for defining meaning and significance to human existence.

The crisis created by the ascendancy of a scientific material universe was aptly summarized by Schiller (1801, 1993: 121): "How are we to restore the unity of human nature..." in a disenchanted world? Viewed from the secular perspective, science joined other cultural forces to offer alternative definitions of human identity and Man's relationship to the larger universe — cultural, natural, and supernatural. Of course, science's worldview is not necessarily incompatible with a divine presence, but protecting free inquiry and open interpretation remains a challenge that can only be successfully accomplished by the strong alliance of those committed to the larger liberal agenda.

An Unholy Alliance

Until fairly recently, investigating the natural world was of one piece with the rest of philosophy. Natural philosophy, that part of philosophy which focused on nature, was easily integrated with the other concerns. This fundamental kinship remains. What have changed are the sociologies of science and the humanities, and the technical virtuosity of the modern scientist. But the intellectual drive is the same. At the foundations that set their respective agendas, scientists and humanists share the same set of basic values to govern their pursuits and their respective logics: a *telos* of inquiry that has no *telos* — the inquiry is done for itself. For those who wish to impose their own theological teleology on human knowledge, this position is unacceptable. Secularism is the object of dissension. And beneath that religious conflict, liberalism rests on the altar for sacrifice, a liberalism which advocates tolerance for each point of view.

Basically, science is agnostic about religious claims. It makes no attempt to address God, or to listen to Him. Whether the divine exists or not is simply not at issue, for science has no means to explore that dimension. Further, existence is mysterious enough to make room for both knowledge and belief. But science's neutrality is intolerable, to both secularists and religionists, and therein is the rub. Because the secularists were better able to employ science for their own ends, science, was guilty by association in the eyes of the true believers. And, indeed, if science must choose, it has little choice but to move with the secularists, who make no theological demands on its truth claims.

Secularization signals God's retreat from the everyday world of common experience and activities, and also refers to a major realignment of social hierarchies and the rationale for new political structures. Science partook in this social revolution in at least three ways: 1) the technology based on scientific discoveries revolutionized the material culture, revealing mysterious forces and events as natural and thereby open to human understanding; 2) this naturalized world view placed divine intervention increasingly peripheral to human understanding; and 3) the logic and standards of knowledge as applied to the natural world were extended to the social and psychological domains of human experience, thereby rationalizing a redistribution of power and authority from monarchical and ecclesiastical centers to liberal institutions. These developments placed God under a new lens of inquiry, and as God's place in the universe shifted, so did Man's.

The power of science's discourse rests in its powerful epistemology. The empiricist measures his findings against a natural object that "speaks" back to him in a public voice. Objectivity thus attains a new standing as communal witnessing has effectively replaced private inspiration and insight. Here we see the convergence of other cultural forces that combined in the rise of secularism: the re-alignment of authority; the autonomy of the individual; the claims for individuality; the rise of free agency. (And of course, strong

arguments have been made as to how post-Reformation Protestantism also contributed to rise of modern scientific epistemology [Harrison 1998].) Scientists embraced these new cultural values and enthusiastically declared that a more rigorous objectivity had replaced folk psychology, superstition, and other intimacies of the heart with a different logic and a different understanding of the world. And in this context, human nature also became increasingly naturalized at the expense of an older religious metaphysics. Scientific knowledge thus displaced opinion in every realm of knowledge.⁶

Instead of aligning science to the secularist project, the more judicious adopted an agnostic metaphysical orientation: Following Kant, science may allow a divine presence, but only one consistent with the best scientific interpretations. In short, various forms of knowledge must be differentiated from beliefs. Kant's formulation provided a model by which science and religion might co-exist secure in their respective domains. What we can know is one set of experiences, and what we feel, intuit, or opine is a set of different kinds of assertions. To know the difference and to keep them separate is the foundation of a liberal society. God may come and go as He likes, but Man must govern himself by human-derived standards and modes of knowledge that in our era reflect a certain kind of rationality. Kant thus alerted the natural philosopher not to probe into areas that scientific method had no ready access. He thus left a domain for belief that would originate in different human faculties of thought and emotion. He profoundly understood that science would not ask for, and thus would not offer, a basis for religious belief, one way or the other. Science erected a neutral picture that tilts one way with God, and another without Him. But which way the cosmos tilts is dependent on individual choice. That pluralistic option threatened those who could not claim the same kinds of certainty science exhibited employing a different kind of rationality and a different basis for objective judgment.

Unfortunately, Kant's suggestion has had only mixed success, because the growing hegemony of a non-revealed worldview continues to be intolerable to those who steadfastly champion their particular religious beliefs. If science was regarded simply as a tool for technological advancement, the debate would have been quelled, but all understood that much more was at stake than material gain.

Belief falls into the domain of personal choice; knowledge is what we agree is universally accessible. Following Kant, we call such knowledge 'objective' and we attain it by a form of reason fashioned by certain epistemological criteria. These may change, indeed, they do, but revelation is not one of them. Socrates specifically opposed reasoning directed to confirming revelation and opinion. By endless interrogation, he drove his interlocutors to face their complacent assumptions and lazy beliefs. He thus established the basic demand of philosophical inquiry. Fallibilism is the lynch pin of the entire enterprise, for the body of knowledge is assumed to be incomplete, if not in error (Popper 1963, pp. 228ff).

[A]ny thinking ... is under a standing obligation to reflect about and criticize the standards by which, at any time, it takes itself to be governed. ... [this] is implicit in the very idea of a shaping of the intellect. (McDowell 1994, 81)

The perfectionism of endless critique provides the scientist with the basic value of inquiry, a value which binds science to its philosophical antecedents. Doubt and skepticism remain the cardinal virtues of scientific theory as well as underlying its various modes of proof.

Derived from this self-critical foundation, science developed values that seek to legitimate interpretation by parsimony, coherence, and predictive capacities. And success is assessed by rationality oriented by criticism:

Entertaining a doubt adds up to little more than applying a question mark, or raising one's eyebrows; serious criticism, by contrast, requires fashioning an argument. To doubt is to suspect something might be amiss, to criticize is to argue that it is. Skeptical discourse requires a supply of interrogatives, critical discourse requires rich background knowledge and a developed logic of problem-seeking and solving. Criticism necessarily presupposes doubt, but is also a necessary prerequisite for positive action. In the face of suspected imperfection the first step toward improvement will always be critical. Hence the term 'constructive skepticism.' (Fisch 2006)

Rationality on this view becomes a category of action, a means to expose and solve problems, and how inquiry might gauge its success or failure is determined by a larger set of goals, and thus rationality assumes an instrumental quality.

This understanding of rationality might be equally applied to religious argument and scientific dispute, but the key difference is the object of inquiry: The theologian probes the human heart and soul; the scientist explores the natural world. The difference is telling: The values by which science defines nature have evolved during the modern period to attain a powerful means to separate human prejudice and belief from an objective account. Kant established this crucial distinction by disallowing “pure reason” to impose its own categories upon the metaphysical universe, thus “saving” belief from the tyranny of science’s power. By segregating religious insight from knowledge, he made room for belief. This lesson is a key precept of the liberal agenda, by leaving different kinds of rationality to explore distinctive domains.

Again we see the deep affinity of science and the humanities: Both must promote pluralism to protect free inquiry and critical analysis freed of doctrine. But with the vast social and intellectual forces that bestowed a unique mode of inquiry (and the rewards of technological success), science seemed to forget its humanistic origins. That amnesia has dire consequences given the new challenges of a postmodern era, where reason, in certain quarters, has been redefined by standards inimical to scientific ideals. Sharing a common ancestry, science and the humanistic disciplines are rivals and at the same time locked into the same “family,” a family that has shared goals and characteristics.

I believe that in order to understand the current attacks on science, we best understand the character of scientific inquiry within its larger context and defend it on the basis of its crucial role as a liberal institution, one that instantiates our highest ideals of unfettered inquiry. Science, more than other intellectual activities, has provided us with those standards. It is time for humanists of all stripes to train their collective sights on the real enemy. Whether their protection of liberalism, intellectual freedom and pluralism will be steadfast and successful represents the crucial test in these days so painfully marked by the fundamentalist assaults of the Taliban and Cardinal Schönborn.

Conclusion

So in the end, how should we regard the religionists’ project? Two attitudes beckon, one which is conciliatory, the other which is not. Let us begin with the latter, which is largely political, political in the broadest sense of the term. Like most Americans, I have become preoccupied with thinking about the fate of democracy since 9/11; about terrorism and torture; about our military exploits and conservative domestic politics; about stem cell research and creationism. From deeply blue Boston, I peer at the *New York Times* daily and conclude that it is hardly clear that the liberal program is thriving, or whether it can sustain assaults on its central role in democratic societies. Will the Enlightenment — with its commitment to the autonomy of reason — someday in the not too distant future be viewed as an anomalous event in world history? Can the values of tolerance, self-scrutiny and pluralism hold the ground against religious fundamentalism? In 1989, with the fall of the Berlin Wall, I doubt that many would have predicted the world in which we now live — a world full of ironies. Perhaps the view from Waco is more optimistic, but I can only share my own perspective that religious fundamentalism continues to haunt the liberal tradition, where pluralism protects free inquiry and critical analysis freed of doctrine. At stake is not only the standing of science in the American educational system, but the character of reason in a liberal society.

And on a more conciliatory note, I end by emphasizing that human reason apparently has a basic property, one demonstrated by myriad psychological and cognitive studies: Coherence of experience, coherence of belief, coherence of understanding seems to be a basic property of the human mind. Freud discovered numerous defense mechanisms

to hold the psyche together; cognitive scientists have demonstrated the ability to screen out or forget data or experience conflicting with more dominant experience; and metaphysicians jealously guard their presuppositions to hold their world together. But as we gaze at the deep chasm of a materialistic universe, we do well to recognize that the metaphysical wonder that lies at the heart of the scientific query originates with the very same religious questions that evolved into philosophical ones, and then into the domain of science. In that evolution, the questions remained, but the answers became increasingly circumscribed, so that now science admits it cannot address the original query, at least not directly. Accepting its limits, science resides within its own metaphysical strictures, and we thereby acknowledge that the drive for coherence requires a different kind of understanding, one which acknowledges science's own domain. That challenge is to find a way of cohering a world that has no obvious coherence. Indeed, many worlds comprise reality. May we engage each as best we can.

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Footnotes

1. The debate about the evolution of biological complexity has a long history (Ruse 1996), and a rich literature has recently developed on this question (Pennock 2001; Ruse 2003; Dembski and Ruse 2004; for a concise review, see Nakhnikian 2004) In the spate of letters following Schönborn's editorial (*NY Times* July 11, 2005), Robert Cone succinctly noted that "natural selection may be unplanned, but it is not unguided. It is guided by need, whether for shelter, reproduction, food, safety, or other vital necessity." Indeed, in the course of random mutations, more complex options are offered and these may be chosen to accommodate the stresses of changing environments and competition among other species. On this view, biological diversity, initiating sometimes more complex, and at other times, more simple "solutions," have appeared. According to neo-Darwinism, "design" is an unnecessary element in explaining evolution. Complex structures evolve, according to this view, by a step-wise process, where structure A is used for one function and may then be used as the basis for the evolution to structure B that addresses a different function, and so on. In short, a complex biological structure cannot appear *de novo*, but rather develops by myriad intermediate stages to appear as a complex entity.

2. Science's instrumentality has at least two dimensions: The first refers to how research is applied (perhaps, employed) to devise technologies. These might be put to constructive use (the usual case) or instead, employed as a tool for purposes quite at odds with the original intent of seeking knowledge for our social good. This instrumental quality of science (its technological power) holds one of its ironies: Instead of maintaining its original philosophical credentials, science, more precisely its technological progeny, too often has become so divorced from those earlier concerns that the basic research has become a tool that may be applied independently of the primary intent of the investigation. Co-opted by those whose own agenda has nothing to do with promoting the Western values that

spawned science in the first place, we have painfully learned how powerful technologies may be used as an instrument of power for socio-political ends at odds with our own.

A second sense of instrumentality refers to science's intellectual activity, a mode of discovery and knowing, where the findings are used like a currency to buy different goods. The goods are findings or ideas, which are then placed into a conceptual context. The competing context may be differing scientific theories, but in this discussion, I am interested in religious contexts. Where the physicist will admit that knowledge reaches a limit, the true believer will push the universe's origins back into the divine act. The question at hand thus may be simply defined: Where does knowledge end and belief begin? That border has again become an active battlefield, for no less than the authority of knowledge is at stake. Simply, science without its supporting liberal, self-critical foundations becomes instrumental, solely a tool for technology, or, as a tool for ideologies, competing with liberalism.

3. The creationists pose a somewhat different kind of argument, not one that acquiesces to the scientific findings, but rather a dispute over the facts themselves. They have stubbornly opposed contemporary Darwinism by insisting that creationism is a bona fide theory of life and that the findings documented by evolutionists assume a different meaning in creationist theory. Students of this controversy have concluded, and I think fairly, that the argument cannot be won by evidence (Sober 1993). The Darwinists point to myriad molecular, paleontologic, and organismic data to show blind evolution at work in the field and laboratory, as well as in the geological record. The creationists argue that God placed the history there by reason of His own wisdom; that evolution is directed and thus bestowed by God; that he created the world, or perhaps He continues to guide evolution, for His own purposes. Given the fundamentally different underlying presuppositions of each point of view, there is no meaningful debate.

4. Interpretation follows from a complex array of underlying suppositions and a tradition of supporting interpretations. For instance, in the 19th century those seeking a materialistic explanation of life to discredit vitalism measured heat production of contracting muscles to account for the energy exchange of muscle metabolism. Hermann Helmholtz, and others, could not fully account for the biochemistry of this process to argue effectively against vitalist forces. That episode was in a long train of laboratory findings that followed a reductionist strategy to establish a materialistic science of life. It was part of a revolutionary philosophical program (Galaty 1974; Moulines 1981). Darwin's theory of evolution and Pasteur's microbiological demonstrations against spontaneous generation were battles fought in the same war. Needless to say, the vitalists held to a radically different philosophy of the organic, so their interpretations wildly differed. They simply argued that Helmholtz's experiments were still too insensitive to detect the vitalistic element. Indeed, vitalism, even in respectable scientific circles, would not fully expire until the turn of the century, and again, its demise was supported by a large intellectual project of support that brought not only biophysical findings to bear, but invoked a cultural environment accepting a non-vitalist interpretation. In our own era, science for the creationist, or for that matter anyone holding to a conflicting metaphysics, may use research findings as an instrument for support of their own agenda. (See footnote No. 2)

5. How science might require a philosophical self-consciousness is an old theme, and, at least for me, builds from Alfred North Whitehead's own commentary about the need for scientists to become more self-aware of their philosophical debts: "If science is not to degenerate into a medley of ad hoc hypotheses, it must become more philosophical and must enter upon a thorough criticism of its own foundations" (1925, p. 24). I am not pursuing that agenda here except in the broadest sense, namely to remonstrate the place of science in the liberal university. Thus this essay might better be regarded as a contribution to the wider discipline of science studies.

6. The enthusiasts even argued that scientific methods were applicable to all domains of human need. As discussed, this caused controversy within the academy, because scientism not only became a method of investigating the natural world, it was regarded by some as representing the way we best construct a worldview from one end of human experience to another (Wilson 1998).

Appendix: Kant and the Unity of Reason

From our perspective, Kant occupies a unique position, poised between the Enlightenment's ideal of exercising pristine rationality and the Romantic confusion of a collapsed conviction in that project. As opposed to a romantic integration of man and nature, or at least the assumption of a harmony of structure between reason and nature, Kant perceives a tension. Although reason maintains its hegemony, albeit somewhat restricted to certain questions, its grounding has vanished. If the noumenal reality can only be refracted by reason's own laws, if the real is a synthesis of mind and nature, if the very self which knows the world is itself a noumenon and thus observed as any other natural object, what could reason's own foundations be? Kant's answer: "Reason operates according to laws that it gives to itself" (Neiman 1994, p.91), and these laws are distinctly human. Kant meticulously derived reason's "laws," which include the unrequited search for the Unconditioned (the ground of the world from a unified, single substance [ibid. p. 86]). This Kantian presentation of how "metaphysical wonder" drives human inquiry is formulated as a "regulative" (as opposed to constitutive) teleology. Simply, reason becomes "the capacity to act according to purposes" (ibid., p. 88, citing Kant's *Critique of Judgment*, #370), which is comprised by the search for its own grounding, i.e., nothing less than the pursuit of an all-encompassing ontology. Further, by seeking "its own reflection in nature" (ibid.), reason structures reality according to a human perspective, not as the world really is in any final sense, but only in reason's own terms. So both in its impossible search for the Unconditioned and its enclosure within the laws of its function, reason constructs a world delimited by its resources and faculties. And key to this formulation is the regulative principle of reason, namely, its pursuit of the Unconditioned. This idea, or hope, underlies every scientific investigation.

For Kant, reason's ends are practical, not speculative, and since the rational is not centrally concerned with cognition *per se*, but rather with ideas, so we might better understand the relationship of theoretical and practical reason as unified by another agenda, altogether. The schema calls for the Understanding to gather all that which constitutes knowledge, and Reason then applies its quest for ends (both metaphysical and moral) "to question experience and so to form constructions more interesting than simple aggregates of assertions about the data of experience" (Neiman 1994, p. 5). Science demands a subtle dialectic, where reason must judge the world and itself in interplay, where the demands of each are met:

Reason, in order to be taught by nature, must approach nature with its principles in one hand, according to which alone the agreement among appearances can count as laws, and, in the other hand, the experiments thought out in accordance with these principles — yet in order to be instructed by nature not like a pupil, who has recited to him whatever the teacher wants to say, but like an appointed judge who compels witnesses to answer questions he puts to them. (Kant 1787, 1998, p. 109 [B xiv])

Thus the "concepts of the understanding give order to experience; the principles of reason are the standard by which it is judged" (Neiman 1994, p.6). Those standards, as already mentioned, are derived from the regulative principle Kant introduces to guide the search to constitute experience. Indeed, according to Kant, "regulative principles of reason shape our actions in science, morality, religion, and philosophy itself" (ibid. p. 7).

Reason must be free of experience to accomplish its responsibilities, and on this view, science becomes an expression of this human freedom. As Kant wrote in the first *Critique*,

reason does not give in to those grounds which are empirically given, and it does not follow the order of things as they are presented in the intuition, but with complete spontaneity it makes its own order according to ideas, to which it fits the empirical conditions and according to which it even declares actions to be necessary that yet have not occurred and perhaps will not occur... (A548/B576, 1787, 1998, p. 541)

He goes on to maintain that “the ideas of reason have actually proved their causality in regard to the actions of human beings” (A550/B578, *ibid.* p. 542), and more radically, he regards reason possessing a freedom from natural causality that distinguishes it from the world that it examines. Unlike certain human behaviors that have an obvious empirical content and thus deterministic causality,

of reason, one cannot say that before the state in which it determines the power of choice, another state proceeds in which this state itself is determined. For since reason itself is not an appearance and is not subject at all to any conditions of sensibility [i.e., naturalistic], no temporal sequence takes place in it even as to its causality, and thus the dynamical law of nature, which determines the temporal sequence according to rules, cannot be applied to it. (A553/B581, *ibid.* p. 543).

In short, reason is outside the natural domain, which allows it to be free and autonomous. Thus reason’s freedom is not solely a moral characteristic, but constitutes its basic feature, which when extended to the study of nature, permits reason to function independently of nature and thereby engage in a science of discovery and understanding. Indeed, genuine scientific thinking is a product of reason, more specifically reason’s freedom to develop ideas based on experience, which, without the ordering reason provides, remains unprocessed and unstructured, recorded but unexplained.

Thus Kant’s description of reason would allow for rational self-determination in both the domain of theoretical pure reason and the ethical deliberations of practical reason. Seeing theoretical reason functioning analogously to practical reason, that is by being able to develop ideas about experience autonomously, by employing principles of organization of its own, and by adopting its own motives and purposes for its own actions, reason is unified. Reason possesses a general property, a capacity to surpass the confines of experience [that] allows theory to be extended to the realm of the unobservable,” (Neiman 1994, p. 71) and thus construct solutions whether posed naturalistically or morally.

The challenge of how reason might be regarded as unified, the “unity of reason” problem, does not first appear with Kant’s *schema*, but grows from modernity’s conundrum of determining how humans can be both part of the natural world of cause and effect, and at the same time exercise free will and thus assume moral responsibility. How Kant regarded reason as unified has been deliberated in three basic formulations:

1. they are *compatible* with each other, that is, insofar as the principles of one do not conflict with those of the other;
2. both can be derived as components of a unitary and complete system of philosophy, which has as its starting point a single first principle;
3. they possess an identical underlying “structure,” or constitute what is in essence a single activity of the subject. (Neuhouser 1990, p. 12)

As presented here, the autonomy of both theoretical and practical reason serves as the bedrock of Kant’s entire philosophy, a system that provides for freedom in both the apprehension of the natural world and the discernment of moral action in the social world. This fundamental characteristic seems best to address the unity of reason question, but

needless to say, neither this interpretation, nor the argument for others has resolved the issue. Suffice it to note that while Kant regarded reason as fundamentally unified, others did not, and at the very least, how theoretical and practical reason functioned in different domains remained a beguiling question.

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