Volatile Perceptions:

The Power of the Public Sphere to Reshape Science

by

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ABSTRACT

This thesis examines the role of the media and popular culture in defining the shape and scope of what we think of today as "science." As a source of cognitive authority the scientific establishment is virtually beyond dispute. The intellectual clout of science seemingly elevates it to a position outside the influence of the general population. Yet in reality the emergence and evolution of the public sphere, including popular culture, has had a profound impact on the definition and application of science. What science is and how it relates to the life of the ordinary person are hardly static concepts; the public perception of science has been molding its boundaries since at least the 18th century. During the Enlightenment "natural philosophy" was broadly accessible and integrated nicely with other forms of knowledge. As the years passed into the 19th century, however, science became increasingly professionalized and distinct, until the "Two Cultures" had fully developed. The established scientific institution distanced itself from the nonscientific community, leaving the task of communicating scientific knowledge to various popularizers, who typically operated through the media and often used the mantle of science to further their own social or political agendas. Such isolation from orthodox science forced the public to create an alternate form of science for popular consumption, a form consisting mainly of decontextualized facts, often used in contrast to other forms of thought (i.e. religion, art, or pseudoscience). However, with the recent advent of "Web 2.0" and the increasing prominence of convergence culture, the role of the public sphere is undergoing a dramatic revolution. Concepts such as

"collective intelligence" are changing consumers of information into simultaneous producers, establishing vast peer networks of collaboration and enabling the public to bypass traditional sources of authority. This new hypermobility of information and empowerment of the public sphere are just now beginning to break down science's monolithic status. In many ways, it seems, we are entering a new Enlightenment.

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CHAPTER 1

INTRODUCTION

While vacationing in Victoria, British Columbia one summer, my family and I decided to spend an evening with a "ghost tour" of the city, a walking tour in which the guide relates some of the "haunted" past of various historical locations. Before starting, the guide introduced the tour with a brief summary of Victoria's ghost-hunting scene and told us why this city in particular was such a hotspot. I expected to hear a predictable account of the troubled and violent history of the island, but instead the guide told us that Victoria is haunted due to the effect of the surrounding seawater and basaltic bedrock, both of which were "proven" to insulate a location's paranormal energy. I was taken back by this unusual explanation and the guide's repeated assertion that "these are not just stories, these are *real*." What I thought was going to be a light-hearted evening of campfire-style ghost stories mixed with an architectural tour turned out to be a rather serious, professional sounding supernatural investigation.

Of course, nobody asked our guide to provide a reference for the supposed research linking ghost sightings and basaltic rock; it was simply a rhetorical maneuver; by using a very rational, scientific sounding explanation to validate something so thoroughly irrational and non-scientific. Our guide was able to provide her story with the illusion of "reality" that she later reiterated. When something sounds scientific, it appears that the debate is settled.

"Science" is a difficult notion to pinpoint. Modern culture often uses the term interchangeably to refer to either a singular, specific establishment, or a

whole set of loosely connected ideas. Science is at once seen as a tool for oppression and as a great equalizer of men, both as an unstoppable force of industrial assimilation and the only hope of the natural environment. The unique, even mystical, vernacular that science possesses can be utilized to convince shoppers to buy a particular brand of shampoo, or to lend even the most unusual of notions an aura of credibility. If a single thread exists which ties these concepts of science together, for most of American culture anyway, it seems to be in its distinct separation from that culture. Whatever science may be, it apparently is removed from everyday life. Such rhetorical distance situates science in a paradoxical position within modern society. On one hand it retains immense influence as a source of cognitive authority. "Simply labeling a piece of information as scientific," writes Daniel Patrick Thurs, "has often commanded attention and respect, if not assent" (1). The tendency of the American public to accept scientific pronouncements with childlike faith, however, is balanced by an increasing disinterest in, disconnection from, and perhaps even suspicion of science on the part of many Americans. For example, Thurs cites a study by the National Science Foundation that concluded that of all the most closely followed news stories in the past few decades, only around 2 percent were related to scientific breakthroughs or exploration (2). Despite the ubiquitous position science occupies in the lives of so many Americans, in any of its several forms, it seems hardly a secret that the average person's grasp of scientific principles and procedures is quite often very feeble. C.P. Snow addressed this schism between

science and the public in his "Two Cultures" lecture of 1959, and since that time the division has changed little.

How such a state of detachment came to be is a more complex issue. The division does seem to be a fairly modern invention. So where did things between science and the public go wrong? From the point of view of some within the scientific community, most of whom (but not all) we would label as "scientists," the fault ultimately lies with the so-called "popularizers" of science, those who seek to translate and pass on scientific findings to the general public. As John C. Burnham writes, "changes in the way in which science and health came to be popularized…ultimately reduced and frustrated the cultural impact of both science and scientists" (4). According to this view, once the job of keeping the public informed was largely given up by the "well-educated missionaries of science" it was picked up by journalists, advertisers, and others who sought primarily to exploit and sensationalize the once pure knowledge celebrated during the Enlightenment in order to suit less dignified purposes (Burnham 4). From the perspective of this scientifically orthodox mindset, the definition of "science" should be the exclusive property of those in the field, and should certainly exclude heretical notions such as pseudoscience or the ever-repulsive superstition.

Yet despite the desire of the scientific community to retain complete control of what is and is not considered science, we must not forget that science is "first and foremost a word. The ways in which we relate to science have a great deal to do with how we have learned to talk about it," and to the vast majority of people alive today, talking about it is all they *can* do (Thurs 2). "History of

science," writes Katherine Pandora and Karen A. Rader, "is more than the history of scientists: it is also the history of what 'science' and 'nature' mean to each one of us" (350). To many Americans, the boundaries of science may be quite flexible. Nonetheless, boundaries exist, and serve to isolate science from the ordinary rhetoric of the modern world. Such distinctness can contribute to the sense of authority science seems to possess, but it can also be turned around. Thurs notes that "a science more easily set apart has also been a science more easily set aside; greater distinctness has created novel possibilities for subversion and containment as well as celebration" (3). By labeling science as one of many different types of knowledge, to some it may become something akin to a single product in the marketplace of ideas and opinions. Circumscribing scientific thought and process also leads to a tendency to emphasize science's position in relation to other modes of thought and leads to such comparisons as "science and politics," "science and the humanities" or the ever-present "science and religion."

This latter coupling is particularly troubling to society and has been the fodder for an endless amount of acrimonious debate. This conflict, often called the warfare, of science and religion has gone on in earnest since at least the last half of the nineteenth century, and has changed remarkably little since that time. That the contest between these two "sovereigns" of the intellectual domain remains so potent today is a testament not to any major difference between them, but rather that science and religion are so similar. Theologian Richard Coleman even declares them "sibling rivals," primarily because they contend for the same intellectual property (4). The rivalry today shapes nearly every facet of "science

talk" and continuously bleeds over into other rhetorical arenas, such as politics and education. Sometimes it seems difficult to speak of either science or religion independently.

But rather than simply picking a side and going to war myself, I believe it will be of more value now to reexamine the points of attachment between science (or religion for that matter) and American culture. I argue that, in its never-ending struggle for the loyalty of the people, the scientific community mistakenly assumes that the public is passive. The conception of science as a separated realm of ideas from which society can reap the blessings of advancement is becoming altogether unattractive to a public increasingly defined by convergence. In other words, if we are seeing an increasing shift away from science or religion on the part of the general public, then it may not necessarily be the result of any sort of victory of one side or the other. If science and religion are the two traditional intellectual sovereigns, in recent years they are finding themselves in the path of a democratizing, revolutionary third force: the participatory culture of the social media.

This idea is not altogether new. In his book *How Superstition Won and Science Lost,* Burnham declares that in the modern day science's old nemesis, superstition, took the form of the modern media and ultimately conquered the orthodox notion of science (7). That was in 1987. Obviously, media has changed a great deal since that time; the flow of information now is vastly greater, due mainly to the rise of the Internet, and is much less unidirectional. This new hyper-mobility of information could be a great asset to science if it seeks to

engage the public in a more productive conversation. This will require scientists to stop viewing the "intellectual commons" of popular culture as an insignificant distraction but rather as a valuable avenue to collaborate and engage with the culture whose indifference they now lament.

CHAPTER 2

THE EMERGENCE AND ALIENATION OF MODERN SCIENCE

In many ways, the formation of what would eventually be modern, institutionalized science, as well as several of the public's perceptions of that science, began during the Enlightenment. The period's general emphasis on discovery, objectivity, and (relatively) secular thought elevated natural philosophy (the predecessor of what would become today's science) into a more public arena, to be used as a tool of social and intellectual reform. In the minds of these natural philosophers, as Thomas Hankins observes, "The most virtuous pursuit of all would be the creation of a science of man that, through reason, would destroy prejudice and superstition and build a new society on objective scientific principles" (8). The optimistic outlook on science's potential led to "a movement that grew out of Enlightenment rationalism, but largely transformed it, by bringing a new imaginative intensity and excitement to scientific work. It was driven by a common ideal of intense, even reckless, personal commitment to discovery," a movement Richard Holmes refers to as "Romantic Science" (xvi).

The equalizing, democratizing ideal of science common during the Enlightenment was reflected by the new accessibility of science education to those outside of the established authoritative circles. The Lunar Society of Birmingham, for example, was "an illustration of the claim that London's Royal Society was not the whole story of knowledge production outside of the universities in this period" (Chandler 89). This period "became the first great age of the public scientific lecture, the laboratory demonstration and the introductory

textbook…It was the age when science began to be taught to children, and the 'experimental method' became the basis of a new, secular philosophy of life" (Holmes xix). Stark divisions between disciplines had yet to fully form, and therefore scholars could move freely across academic boundaries, creating a harmonious picture in which all knowledge came together for the benefit of mankind. James Chandler argues that, "Before 1750, 'science' referred broadly to any systematically achieved knowledge…even the distinction between the sciences and the arts is a rather late development" (87). He goes on to say that the intellectual movers and shakers comprising the Lunar Society, men like Erasmus Darwin, "epitomized a knowledge culture in Britain in which the differentiation between what we now call literature and science remained productively messy" (Chandler 88). Men of science were free to comment on virtually any topic, and were very highly regarded by society. As Hankins observes, "Although science itself might be entirely objective and without ethical content, its very objectivity made the natural philosopher a man of virtue. Objectivity was the opposite of self-interest and ambition; the natural philosopher served mankind rather than himself" (7). The emphasis on the progression of civilization resulted in a push to develop new ways to improve the quality of life, and advance society. If we return to the Lunar Society for example, we find that "They were committed to practical matters – to making and doing things – and their impact on Britain and indeed the world is difficult to overestimate" (Chandler 89).

Enlightenment ideals had a strong presence in America as well. During the eighteenth century and up until about the mid 1800's, "scientific rhetoric

constructed images of science that were thus accessible on many levels, paving the way for Americans to wander unhindered through…[a] grand scheme of knowledge into which separate statements about the world were expected to fit together smoothly" (Thurs 49). Much of the "science" performed was by amateur practitioners, like Benjamin Franklin, often in public demonstrations or traveling shows, and usually emphasized the congruence of all types of knowledge, relying on its accessibility to provide authority. Even this very open view of science can be connected with trends in popular culture. Thurs notes how the rise of Jacksonian politics in America in the early 1800's coincided with "a general blossoming of new –ologies, -isms, and –pathies intended for use by nonspecialists and on whose behalf adherents claimed the mantle of science" (30). This same democratizing force affected religious institutions as well, resulting in a wave of formation of new religious groups that questioned the authority of orthodox institutions.

As for the relationship between science and religion at the time, it was largely congenial, at least at first. While early movements in popular science, such as phrenology, were sometimes accused of subverting religious authority, more often they were used "to show how scientific and religious truths were harmonious, how they always supported one another, and how they cooperated seamlessly in revealing a consistent picture of creation" (Thurs 43). Such blending of spiritualism and materialism prevented any large-scale conflict from erupting between science and theology, while also obscuring any potential boundary science may have had. Natural philosophers usually adopted, at least in

public, "either austere intellectual Deism…or else the rather more picturesque Natural Theology" in order to keep scientific and religious ideas from clashing (Holmes 450). Many during the period held to the belief that "The discovery of the laws of nature would necessarily lead to the discovery of God's intentions, which formed the foundation of moral law" (Hankin 6).

Indeed, the Enlightenment period of "Romantic Science" appears to represent a time when interest in science was high, its practitioners well regarded, and its outlook seemed markedly optimistic. No wonder so many scientists today seem to view this period as the high point of science and culture (Gross and Levitt 20). However this period also saw the beginning of the cultural conflicts that would soon divide science from the rest of society, a point made by Mary Terrall:

> As these experimental sciences were cultivating the public and developing a broadly philosophical and accessible language, the laboratory and theoretical practices of science were becoming more, not less, specialized…As science appealed to a growing public, its practitioners worked harder to define themselves as a meritocratic elite. (273-4)

This increasing specialization coincided with the emergence of a common conception that crystallized during the Enlightenment, and remains largely intact today: the "dazzling idea of the solitary scientific 'genius', thirsting and reckless for knowledge, *for its own sake and perhaps at any cost*" (Holmes xvii). This image fully matured with the creating of the term "scientist" in 1834, coined specifically to create a new comprehensive category for scientific workers as a

definite class (Thurs 33). Within this simple word lurked, as Holmes puts it, "the whole question of whether the new generation of professional 'scientists' would promote safe religious belief or a dangerous secular materialism," an alarming ideological state that many retrospectively viewed as responsible for the disaster of the French Revolution (450). Relations between science and religion were already tense due to recent scientific publications, most notably Charles Lyell's *Principles of Geology,* which problematized the congruence of scientific thought and literal biblical interpretation. With a new breed of professional practitioners at its helm, science began to separate itself from other realms of thought around the turn of the century.

The nineteenth century was also a period when scientific concepts became available to a wider audience. While it is true that before this time, natural philosophy was given considerable attention by certain portions of society, namely the literate and educated elites, there was little impetus to spread that knowledge to the lower classes; most intellectuals "accepted the inevitability of a society divided into classes, with the rural peasantry at the bottom" (Burns 93). This began to radically change during the nineteenth century. In *The Structural Transformation of the Public Sphere*, Habermas describes the restructuring of society that emerged during this period as the "public sphere," which served to mediate between the interest of the individual and the increasingly remote structure of the state, which was increasingly subsuming science (27). Alongside the industrial revolution that brought practical, applied science to the forefront of everyday life, a communications revolution shaped the way the world saw itself.

The ongoing professionalization of science increased the pace of scientific activity while decreased publishing costs provided greater availability of books, newspapers and pamphlets about their findings to a readership whose size had been hugely augmented by rising rates of literacy. (Pandora and Rader 355). The importance of this media revolution in redefining the cultural image of science is likely impossible to exaggerate.

With the release of groundbreaking and radical new scientific theories, evolution being arguably the most significant, science became a wedge that split society in two. Darwin's 1859 publication of *On the Origin of Species* ignited the conflict between science and religion in a way like nothing before (and perhaps nothing since). While Lyell and other geologists had already strained the relationship between science and religion, Holmes argues that Darwin's work was particularly disruptive because for the first time science could provide a convincing alternative to religious creationist dogma, thus making religion unnecessary. In Holmes' apt phrase, "Darwin had indeed written a new Book of Genesis" (451).

Science suddenly emerged as a totally independent realm of thought, one that could provide its own rational worldview. The result was an explosion of rhetoric across numerous forms of media that emphasized clearly distinguishable boundaries to science, spoke at length about a unique "scientific method," and severed science from other ways of thinking. Familiar phrases such as "science says" and comparisons such as "science and religion" became common by the 1870's, and presented science as an anthropomorphized, individual entity in the

realm of thought (Thurs 55). Such easy comparisons also altered the way people looked back at science. Thurs demonstrates how the story of Galileo, now seen as a mythical clash between science and religion, almost never implied any religious criticism until the 1850's; rather it was seen simply as an instance of society resisting new ideas (48). Meanwhile, Michael White argues that Victorian era biographers of Isaac Newton, a figure all but deified by the scientific community since the Enlightenment, habitually glossed over Newton's interests in alchemy and the occult, hoping to preserve his image as a man who stayed well within the newly reinforced boundaries of orthodox science (121). Such powerful "recodings" of science and its history reified its newly formed distinctness, and left the public to choose between two conflicting approaches to reality. They also demonstrate that science quite simply does not speak for itself.

The widening distance between the public and science caused some to see the necessity of intermediary voices to bridge the gap, and thus popularization in its modern form was born. These early popularizers were often men of science themselves, such as Huxley and Tyndall; professionals who sought to "cleanse scientific thought of those elements that previously had connected public and scientific culture, including anthropomorphic, anthropocentric, teleological and ethical views of nature" (Lightman 101). But eventually, and much to the chagrin of these men, an army of non-professional popularizers stepped in to capitalize on the newly formed market for science writing. One notable example is the Reverend J. G. Wood, whose best-seller *Common Objects of the Country* was released only a year before *On the Origin of Species* and outsold the latter by a

margin of nearly 7 to 1 (Pandora and Rader 357). As scientists began to pursue more specialized research, they became increasingly out of touch with the general public, and ultimately the field of popularization was almost entirely left to non-scientists. Burnham laments this fact, claiming that science lost its battle with superstition because those who "fought against the forces of occultism and self-interested authority," referring to scientists, left the field of popularization (247).

In any case, the orthodox, "learned" science of professionals grew increasingly distant from all other types of knowledge during the last half of the nineteenth century, including its sensationalistic doppelganger in the public sphere. The division had fully crystallized by the start of the twentieth century. This schism in society motivated C.P. Snow to give his famous "Two Cultures" lecture in 1959, observing that a "gulf of mutual incomprehension…hostility and dislike, but most of all lack of understanding" had divided academic authority into two broad camps, "Literary intellectuals at one pole – at the other scientists" (4). This two-party model of academia is, by Snow's own admission, overly simplistic, but for the most part it may be better to imagine these two cultures as science and everything else. After all, implicit in Snow's argument is the notion of a monolithic, detached science. Snow argues that culture fails to appreciate science's distinguished capacity essentially because it fails to understand science, and the inability of the lay citizen to recite the second law of thermodynamics is a particularly memorable example of this point (Snow 15). In short, before the mid 1800's, science was seen as something people *do,* but only a hundred years later it had become a calling, and the word "scientists" came to denote what people *are.*

CHAPTER 3

THE TRADITIONAL FOES OF MODERN SCIENCE

Snow's indictment of "literary intellectuals" touches on a recurring point of conflict in science's history, a point of conflict that has increased in intensity with science's increased distinctness. During the Enlightenment era, there was already division among literary Romanticists regarding the value of science. Some, like Percy Shelley (who was also a fearless atheist), were openly inspired by science and its potential to carry society into a more progressive age. Others, like William Blake, were considerably less impressed by scientific objectivity. Then, as now, literary critiques of science typically displayed anxiety about the potential dangers of a purely objective, naturalistic, dehumanized society (Burns 171). Still, one was more likely to find scientific notions blended into artistic texts, and vice versa, during the eighteenth century than in following years, no doubt due to the hazy boundaries of science during that time. As the lines on the academic map became darker, science and literature began to distinguish themselves as incompatible ways of thinking. By the latter nineteenth century the contrast was pronounced. Perhaps no better example of this in the Victorian era exists than the now famous (and friendly) exchange between Thomas Huxley and Matthew Arnold, an exchange that largely anticipated and informed Snow's later argument (Collini xv).

The modern form of the conflict between science and literature, or the humanities in general, is the perceived attack on science from what Paul Gross and Norman Levitt refer to as the "academic left," a vague category of

postmodern humanists from various ideological camps (that include feminism, environmentalism, and multiculturalism) who display a uniform and unambiguously hostile tone in relation to science (2). To be fair, Gross and Levitt do not question the validity of these theoretical schools per se, but rather their interrogation of scientific objectivity, to which the humanists tend to attach a notion of cultural constructivism that is wholly inappropriate in the eyes of orthodox science. This criticism goes beyond simply questioning the political or cultural power structure inherent in the scientific institution, but in many cases is openly critical of the actual content of scientific knowledge. Such censure, according to Gross and Levitt, "seem[s] often to escape mere inaccuracy and rush hell-for-leather toward unalloyed twaddle. Such words may strike the reader as splenetic; but they seem to us justified in view of certain recent developments" (43).

An even more striking condemnation of postmodernism occurred in 1996 when physicist Alan Sokal submitted an essay to the prestigious American cultural-studies journal *Social Text,* which was accepted and published, only afterwards revealing it to be a hoax. The article, entitled "Transgressing the Boundaries: Toward a Transformative Hermeneutics of Quantum Gravity" is a parody of postmodernist attacks on the objective knowledge of science, is replete with quotations from such notable theorists as Derrida and Latour, and makes such bold claims as "physical 'reality', no less than social 'reality', is at bottom a social and linguistic construct" (Sokal 213). The episode, according to Sokal and Bricmont, is indicative of the way in which postmodern theorists "exploit the

prestige of natural sciences in order to give their own discourse a veneer of rigor," but without really understanding the rhetoric they employ (5). Gross and Levitt similarly believe that the problem ultimately lies in the humanists' encroachment into the scientific arena by condemning scientific principles they do not comprehend. For example, Heisenberg's uncertainty principle has become a favorite metaphor among those seeking to undermine science's authority, essentially claiming that "since physics has discovered the uncertainty principle, it can no longer provide reliable information about the physical world, has lost its claim to objectivity, and is now embedded in the unstable hermeneutics of subject-object relations" (Gross and Levitt 51). Such a claim is in actuality a critical misreading of Heisenberg and demonstrates the connotative power of language. Gross and Levitt regret that Heisenberg chose such an evocative term for his theory, musing that all this misrepresentation might have been avoided with a different name (51).

But what are these scientists really afraid of? What threat does the "academic left" actually pose? Gross and Levitt concede that in the short-term science will not be affected by the supposed rebellion of the humanities, but that as their mode of thinking about science becomes perpetuated among nonscientists, the public will learn to approach science in dangerously distorted ways (4). Sokal and Bricmont make a similar observation, and hope that with increased education about what science "really" is, society could evolve into an "intellectual culture that would be rationalist but not dogmatic…open-minded but not frivolous, and politically progressive but not sectarian," essentially the ideal

society of the Enlightenment (211). These observations, along with the above concession about the power of language to shape perceptions about science, seem to contradict the overall message of these scientists. Despite their impassioned defense of pure, unconstructed and empirical reality, they fear that the way people talk about, and ultimately think about, science will alter or even corrupt the discipline, something that may have already happened to the formerly "pure" sciences of anthropology or sociology (Gross and Levitt 256). Furthermore, by situating the eternal and absolute truths they are defending against attacks from the "left," the authors employ a rhetoric that places their argument squarely in the protean and unstable realm of political ideology. Nowadays it seems at least as likely to find anti-science rhetoric emerging from the right. In short, they argue that science is beyond cultural constructivism, while fearing that if too many people begin to think otherwise science will be fundamentally changed.

Without question many attacks on science from the humanities, or anywhere else, overstep the appropriate bounds. Sokal and Bricmont rightly observe that science as a concept has several variations, from an intellectual endeavor to a distinct social group, and that criticisms of science often fail because they simply target the wrong aspect (202). There is nothing wrong with a desire not to be misrepresented by nonscientists. What does seem striking is the thinly veiled assurance among some in the scientific community that their methodology is the *only* type of valid epistemology, and how fiercely territorial they are of their knowledge. Science's defenders militate strictly against anyone venturing onto their playing field without the proper credentials, maintaining that

only they are qualified to comment on scientific matters. The attacks from outside the discipline are supposedly motivated primarily by a desire to bring down a critical pillar of the military, industrial and political structures of society, along with a healthy dose of personal resentment; as Gross and Levitt claim, "the aroma of sour grapes is in the air" (26).

Despite the animosity of these scientists toward postmodernism, if they seek to portray science as the victim of attack from the dangerous and overly respected humanities, they will have a difficult time. The annual budget for the National Science Foundation for the fiscal year of 2011 was $6.8 billion (Budget Request). The annual budget for the National Endowment for the Humanities in 2011 was $154.6 million (Appropriations Request 11). Such an immense difference in funding strongly suggests that contemporary society assigns a hugely disproportionate level of importance to each field. True, science may be a more costly endeavor, as research often requires expensive equipment and materials. Still, if the amount of government investment in an academic field is any indication of importance, science clearly comes out ahead of the humanities. Money talks, and in the competition for support between science and the humanities, there really is no contest.

Of course, an academic conflict between science and the humanities may appear to many as simply a battle waged across the university campus, with little significance to the greater population. For the majority of society, the most visible and formidable opposition to science comes from its old traditional nemesis: religion. No greater institution with which to situate science in culture

exists than religion. The two great intellectual sovereigns have been battling in the rhetorical arena for centuries, and each has exerted an enormous influence on the other. This conflict has produced libraries of investigation, reflection, and argument. But as I already indicated, what science and religion share, namely a claim to describe reality, seems to be a more useful object of consideration. Religion has, of course, been around much longer and has been subject to the shifts of public discourse in a way that science is now. Like science, the way we think about religion has a great deal to do with how we speak to each other about it.

Coleman states that science and theology were the only two "sovereigns" of the intellectual domain to exist in the modern age, being universally respected for the knowledge they possess, but that now there are none (4). How did this come to be? How did science manage to dethrone theology, and yet fail to occupy that throne itself? In the opening left by religion's overthrow, several missionaries of science have stepped up in an attempt to complete the revolution. Richard Dawkins is a very public example of just such a radical, antireligious ambassador of "pure science". To Dawkins' view, the "overweening confidence with which the religious assert minute details for which they neither have, nor could have, any evidence" leaves theology wholly unqualified to comment upon matters relating to the physical universe, or anything for that matter (34). He wonders why society gives such credence to the opinions of religious experts and not gardeners or chefs, who he views as having an equal claim on authority (Dawkins 56). The notion that reality is an observable phenomenon and that

literal, verifiable accuracy is the most important object to aspire to reverberates throughout Dawkins' argument. This ideal attachment to pure, unbiased objectivity is often referred to as the "religion" of science. Ultimately, believing in anything other than demonstrable and observable truth, in a very literal and tangible sense, hobbles society and can only lead to bigotry and oppression. Another well-known crusader for science puts it bluntly when he says that there exists a tendency to "suggest that science and religious belief are somehow related and should be treated as equals… The problem is, they are not" (Krauss).

Meanwhile, the argument from the religious side claims that theology provides a fully functional worldview, while science merely provides a view of the world. Science's materialistic and naturalistic philosophy is claimed to cause the erosion of fundamental values such as freedom and agency. William Dembski concisely summarized this view when he said that "naturalism promises to free humanity from the weight of sin by dissolving the very concept of sin…Yes, we pollute the earth and decimate rainforests…but all of this is in accord with nature's laws, not in violation of them" (qtd. in Thurs 174). Interestingly, Dembski's association of science with environmental destruction chooses to ignore the presence of environmental sciences like ecology. Rather, he chooses to focus on the aspects of science that will best serve his argument. Such maneuvers are common in this debate.

In this conflict there are also many who sit in the middle and try to reconcile these two modes of thought. The easiest way to accomplish this is perhaps with a concept like Stephen Jay Gould's "non-overlapping magisteria"

(5). According to this argument, science and religion are not really in conflict because they occupy two entirely different spheres. Science answers the "how" questions of the universe, while religion deals with the "why". However, this simple explanation fails to satisfy many of the proponents of either side. Dawkins asks, "Why shouldn't we comment on God, as scientists?...a universe with a creative superintendent would be a very different kind of universe from one without. Why is that not a scientific matter?" (55). Coleman, on the other hand, writes, "Gould would have us believe that we can produce a *pure* science and a *pure* theology, each queen of her own domain…[he], however, is trying to recreate a world of clear and distinct ideas…science operates with a methodology that is consciously and unconsciously social and political" (172). Furthermore, as with the position of science in the larger culture, the presence of intermediaries who try to bridge the gap between science and religion inevitably draw attention to that gap in the process. This is a discussion that will not go away.

Neither side seems to give much thought to the process of how the argument gets shaped by its consumers, or on the ambiguous nature of the vocabulary used. Coleman notes that pitting science against "religion" is misleading because it implies a cohesive, single religious body, preferring the term "theology" instead (5). Yet there is no mention that science is also a hugely discordant and fragmented body. Furthermore, the rivalry is in reality less between science and religion than between two versions of science, often being fought between scientists. Today, the most noticeable clash that is explicitly grounded in religion is in the debate over teaching the concept of "intelligent

design" in the classroom, a movement ostensibly started to provide more "objectivity" when teaching Darwinian evolution (Thurs 159). This desire for objectivity is interesting; the proponents of science have traditionally been the ones to accuse religion of lacking objectivity. Such a reversal of terms demonstrates the erratic nature of this "war" within the larger framework of American culture.

The vast majority of Americans still claim belief in some form of deity, and Judeo-Christian ideology in particular is representative of mainstream cultural values. With so much emphasis placed on religious tradition, one may expect that religious texts like the Bible would provide the most reliable source of wisdom on how to live. Yet, as Dawkins observes, there are many rules put forth in the Bible that, were they to be enacted today, would be viewed with universal horror (269). The point is that people choose what to believe, freely selecting the ideas that make the most sense to them out of a vast collection of rhetorical tools. Similarly, Dawkins notes the tendency of the religious to pounce upon any scientific discovery that they see as supporting their cause, while unequivocally shunning any that do not (59). While he is certainly not wrong in these observations, Dawkins' assertion that these tendencies display an inconsistency unique to religion is itself an example of seeing what one chooses to see. He gives very little attention to the possibility that perhaps people believe what they believe simply because it helps them make sense of their own lives. He only briefly mentions people who live a religious life because they "believe in belief" (Dawkins 14).

Science was able only to dethrone and not defeat religion in society because ultimately it could not provide a clearly superior worldview, even though it could provide an alternative one. Neither exerts total dominance as a rhetorical concept because both are constantly being reshaped and manipulated by the way they are consumed by the public, which utilizes the mantle of science and religion to direct its own complex and often conflicting social or political agendas. The transcendent, spiritual authority once held by religion has been shattered, unable to withstand the scrutiny of scientific inquiry, which reduced much of the former sovereign into a collection of anecdotal platitudes. Famed mythologist Joseph Campbell noted this, eloquently summing up religion's deprived status, saying, "When a civilization begins to reinterpret its mythology in this way, the life goes out of it, temples become museums, and the link between the two perspectives is dissolved. Such a blight has certainly descended on the Bible and on a great part of the Christian cult" (249). Science, meanwhile, has been steadily prevented from saturating society by the unyielding opposition of religious fundamentalism.

Whether in conflict with postmodern theory or religious dogma, science's contention with other realms of thought is typically over the authority to make pronouncements concerning the real world. Despite the claim that scientific truth exists wholly "out there," independent of human thought or influence, science is ultimately just one of many ways to see the world around us. The tendency to see science as a collection of ahistorical, packets of pure truth we call "facts" obscures this, but despite appearances to the contrary, scientists are people. Like all people, they attempt to construct a cohesive ideology that explains why things

are the way they are. Literary theorist Slavoj Žižek asserts that "ideology is…a fantasy-construction which serves as a support for our 'reality' itself: an 'illusion' which structures our effective, real social relations" (45). In other words, our ideology shapes our reality, not the other way around. Additionally, like all people scientists are limited to explaining that reality through the use of symbols. It may also be beneficial here to think of the "real" in a somewhat Lacanian sense: something that resists symbolization, that is eternally out of reach and yet always present. Without a doubt there really is a universe out there that exists independent of human thought. But the second we try to grasp it, to symbolize it by coining a new word or building a molecular diagram, we have altered it to fit a constructed ideology. Whether one tries to symbolize the "real" with mathematical equations, with God, or any other concept appears to make little difference in the end. Science is restricted to the same imperfect symbols that limit everything else.

But that does not stop many physicists from seeking a universal "theory of everything." With such a theory in place "[s]cience would no longer be an empirical matter, but a branch of deductive logic, with the laws of nature acquiring the status of mathematical theorems, and the properties of the world deducible by the application of reason alone" (Davies 165). Such an idea is certainly appealing, but reduces all of reality to a code that must be cracked, something to which we much align ourselves. Additionally, its pursuit is unlikely to garner much interest from the public, who can do no more than cheer from the sidelines. Many people in the world already have a functional "theory of

everything," namely religion. Religion may very well be a primitive belief system and responsible for many unsavory elements of culture, yet "primitive beliefs are functional, they maintain themselves and are hard to displace" (Burnham 11). When it comes to the "big questions" of life, religion provides answers that science does not, and to most people any answer is better than none. Quite simply, it may not be perfect, but it gets the job done. Religion also has the added advantage of allowing its adherents to be participants as well. As Cooter and Pumfrey write, "Although religion, like science, could be a tool of social control, unlike science it was open to popular movements which made appeals to the legitimacy of popular experience" (254). True, theologians and clergymen exercise a degree of authority, but their presence does not prevent lay citizens from getting involved in the religious experience, or actively choosing another one that better suits their needs. Even people who shun organized religion can still be "religious." Like early notions of science, religion is still something people *do*.

Science, the humanities, and religion have been crippled by each other and corrupted by the public. Now their rivalry is locked in a never-ending stalemate, endlessly debating about how we should choose to define something. While under attack on two fronts, the scientific community has become so engrossed in its crusade for cultural dominance that it seems to have overlooked the possibility that the public, for which it supposedly contends, may simply not want an intellectual sovereign anymore.

CHAPTER 4

THE PUBLIC'S REINTERPRETATION OF SCIENCE

The purpose of this brief account of the history of science popularization, and the rhetorical battle between science and its most common contemporary foes, is to demonstrate the power held by the public sphere in determining the shape and scope of the scientific institution. Though scientists like Sokal and Dawkins insist that science exists apart from the public, and do their utmost to fend off any intruders who seek to question this, the truth is that science is a human institution and subject to the vacillations of human cultural conditions. The concept of "pure," untouchable scientific truth is surely valid, but whether or not such pure science can be perfectly realized by, or integrated into, society is a more problematic question. Therefore, "science" is also a word thrown into the unstable sea of public interpretation, where it can function on a number of levels and be defined in a number of ways. Science in the Enlightenment was very different than in the Victorian era. Science today is unlike anything that came before, and not simply because scientific knowledge has become more intricate. Though religion and the "academic left" may appear threatening to science, in a strictly rhetorical war they ultimately pose little threat, and can at best impede its progress. The real danger to the institution, as Burnham makes clear, is the potential of being rendered impotent by a public that surrenders a strictly rational worldview, that is, "functional" superstition (11). "Superstition," used in this sense, refers not only to nonscientific supernatural or religious beliefs, but also to the way popular opinion overpowers science's authoritative voice.

The ways science is popularized have profound implications for how it develops. Yet considering the critical importance of science to society over the past several centuries, remarkably little scholarly attention has been given to the way science interacts with, and is in turn altered by, the public through the process of popularization. In a 1994 review of what work on science popularization had been done, Roger Cooter and Stephen Pumfrey wrote:

> Still shrouded in obscurity are the effects of even the most obvious mechanisms for the transmission of scientific knowledge and culture: the popular press, radio and television, to say nothing of science texts, museums, school curricula, and the overtly propagandist productions of the science lobby itself…our ignorance of both the low drama and the high art of science's diffusion and modes of popular production and reproduction is staggering. (237)

Without a clear understanding of how science is shaped by the public sphere, the diffusionist model became a common way to comprehend the transmission of scientific knowledge. This model suggests that as the scientific community acquires knowledge, that knowledge flows "downstream" to the public, where it is inevitably misunderstood or "watered down" for consumption by a public that lacks a rigorous scientific training. Cooter and Pumfrey (and myself) take issue with this model, however, saying, "Diffusion may be seen as passive 'trickle-down' or as osmotic, though in either case popularization is not being construed as dynamic…Preferable to the watery analogy…might be those of grafting,

appropriating, and transformation" (249). The diffusionist model presumes that popular science lags behind the scientific establishment, and passively collects the information that flows out of that fountain of knowledge. The consideration that scientific knowledge could be "recoded" with different significance does not fit in this model. "Successfully popularized natural knowledge may take on very different *meanings* within popular culture from those intended by its popularizers…In short, 'popular science' may diverge from 'learned science' not because the latter is poorly understood, but because it is developed by its recipients for different purposes" (Cooter and Pumfrey 249). Thus, an awareness of the networks of communication within society is critical to any attempt to discuss popularization. "Since 'popularizations' are communicative processes, their histories must attend to the history of communicative production, and hence to such discontinuities as those between print, electrical and electronic culture" (Cooter and Pumfrey 239). In other words, the media shapes the public's conceptions of what science is, or is not.

The passing of the torch from scientists to the media as the primary missionaries of science is a particularly sore spot for Burnham. During this trend of popularization, which he claims begins in earnest during the nineteenth century, those who used science for their own vain ambitions gradually replaced the well-informed advocates of pure science. Burnham succinctly lays out this pattern of popularization as follows:

> 1) Diffusion – when science did not need condensation, simplification, and translation;

2) Popularization – when men of science tried to share their vision of the religion of science;

3) Dilution – when popularization passed into the hands of educators, who represented science only at second hand, and, simultaneously, journalists;

4) Trivialization – when popular science consisted of impotent snippets of news, the product of authority figures. (226)

The terms he uses to define each step may cause some confusion, but the process seems clear enough. The final step is of particular interest as it involves the most significant method that the public uses to alter scientific knowledge. During this phase of trivialization, "science in the realm of popularizers changed from a coherent view of nature, including humans, into choppy, unconnected 'facts'" (Burnham 5). This development is critical to Burnham's argument, as it is in this decontextualizing of scientific principles that science and superstition become indistinguishable. Science essentially becomes a modern form of magic when it develops into an assortment of independent bits of information that more closely resemble incantations than products of intense investigation. In their significant work, *Laboratory Life: The Construction of Scientific Facts,* Bruno Latour and Steve Woolgar note that facts are notoriously difficult to contextualize because, "a fact only becomes such when it loses all temporal qualifications and becomes incorporated into a large body of knowledge drawn upon by others…it has, by definition, lost all historical reference" (106). The establishment of a fact as an irrefutable and isolated source of knowledge serves to increase the distance

between science and the public, who for the most part do not bother asking where the fact came from. Whereas early versions of science derived authority from their accessibility, the modern form achieves it through separation. Whether one sees this reduction of science into sound bites as the passive result of the diffusionist model, or as an active process of reshaping science, it successfully dismembered any cohesive scientific worldview the public may have had, and served to further alienate the formal scientific establishment from public discourse. Science still retained its voice of indisputable expertise, but now it did so beyond the scope of the average citizen.

Yet the public did not completely lose interest in science. Instead, it simply refashioned scientific discourse into the channels of popular culture, and without open access to the official scientific establishment, much of that pop culture took as its starting point that very distance between itself and science. The "mad scientist" motif so familiar to pop culture is an excellent example as it relies on the notion of the scientist being out of touch with normal life, often with dangerous or misguided ambitions. True, as an image the "mad scientist" has existed since at least the early nineteenth century, but its survival and proliferation in the modern day witness to the lasting appeal of this notion. Even representations of non-"mad" scientists portray them as being a breed apart. The image of scientists found commonly in film or other media usually consists of bespectacled men (representations of women scientists are a fairly recent phenomenon) in white lab coats, surrounded by impressive and expensive looking machinery, bubbling test tubes of colorful chemicals, and chalkboards filled with

incomprehensible mathematical notation (Frayling 222). Such exaggerated characteristics tend to make these scientists look less like men and women and more like modern wizards, busily unraveling the mysteries of the universe and other secrets far beyond the mind of the common man. As Christopher Frayling writes, "The gap between specialized knowledge and public understanding lies at the root of most fictional cinematic representations of the scientist…The gap has usually been filled by stereotypical representations of one kind or another" (11).

Of course, the forms of science created by popular culture were not limited to the entertainment or advertising arenas. The public's simultaneous fascination with and separation from science allowed for the formation of entirely new entities, such as what is now known as "pseudoscience." Though the term first began to circulate during the evolution debates of the late 1800's, it's usage was inconsistent, often being used by critics of evolution to devalue what was seen as an overly materialistic view of nature (Thurs 66). But by the mid 1900's, the definition of "pseudoscience" was much more specific, even if its boundaries were not. Everything from the search for Bigfoot, to astral projection, to extraterrestrial abductions, to the investigation of haunted houses fell under pseudoscience's jurisdiction. Such strange topics seemingly have very little in common, except for their position in relation to orthodox science, which views them as anathema. This enmity, however, fails to pose much of a hindrance to the practitioners of pseudoscientific inquiry, many of whom possess a "cheerful acceptance of a position outside of science, even [among] those intent on making serious statements about the material world" (Thurs 156). Ultimately,

pseudoscience represents a reaction in opposition to what was seen as constrictive and impersonal monopolies on the realm of belief, be they scientific or religious. Being, according to Burnham, "contemptuous equally of science and religion" pseudoscience can "freely kid around with either or both" borrowing scientific or theological terminology in order to validate their claims (10). Public interest in the bizarre certainly is not new. But the tendency of these strange offshoots to take on the appearance of legitimate (which is to say "official") science is a uniquely modern development.

Whatever the form, be it as entertainment or "weird science", the intentionally unorthodox science of popular culture usually seeks to impart a sense of importance or purpose into a science that has lost all relevance to normal life. As the public view of science became increasingly disconnected and fact-based, successful popularizers often became "storytellers who devised compelling narratives that allowed them to expound on the larger philosophical questions embedded within scientific discoveries" (Pandora and Rader 357). Not unlike the philosophers before the industrial revolution, modern popular science seeks to establish an overarching context wherein common citizens can make sense of science within their own lives, and avoids the use of specialized vernacular that would render it unapproachable. It also provides an outlet for various desires or anxieties unfulfilled by official science. Carl Sagan put forth the notion once that pseudoscience exists because of an unfulfilled religious need, and yet to that I would add an unfulfilled *scientific* one (Thurs 154). The search for the Loch Ness Monster could be appealing to a person who is concerned with a totally

materialistic and overly rational view of the world, and that person is likely comforted by an understanding (perhaps repressed) that the search will never end. Stories of people getting abducted and experimented upon by aliens might resonate with those who are struggling to make sense of ethical concerns and debates over how science should treat the natural world. Rather than dismissing pseudoscience as childish or, worse, dangerous, we should be asking *why* it appeals to the public and how that reflects on the position of official science.

Meanwhile, the diversification of new narrative genres like science fiction demonstrates the public's ability to use science as a backdrop against which to explore personal or societal issues. Science fiction, after all, is almost never about science. Instead, it creates a fantastical environment while disavowing the impossibility of that setting by its appeal to science and technology; it allows fantasy-like situations to exist in the "real" world. "People want to *believe* such fictions," writes Thomas Disch, "Hence, the authenticating 'science' in the compound 'science fiction,' with its implicit guarantee that this dream might come true, as against the surreal or supernatural events of fantasy or fable" (3). Essentially, the rockets and ray guns of science fiction become a believable replacement for the magic and mysticism of the fantasy genre, even if the science is given just as little explanation. This is hardly remarkable to a public that is inundated with the products of scientific production, yet with virtually no understanding of where they come from. Those products may appear miraculous to society, and indeed the phrase "miracles of modern science" is frequently used. Therefore, faster-than-light space travel, transporter beams and cybernetic humans

appear with very little comment in science fiction stories; to the lay reader those items are no less inexplicable than cell phones, GPS navigation, or Tylenol. Science already appears to have magically provided society with the wonders of technology; why not assume such progress will continue, all the way to the warp drive?

When compared to such captivating and unusual creations, orthodox science may seem awfully dull. Luckily, for those whom it bores, its aloofness allows it to be easily ignored. Accordingly, discussions of complex theoretical issues rarely emerge in public discourse anymore, usually appearing only as minor blurbs well away from front-page news. Consumer-driven demand for new products of science pushes the emphasis consistently away from theoretical science and toward its applied version. Technology and medicine in particular have become the major enterprise of science today, so much so in fact that they seem to have been rhetorically severed from the larger body of science. Terms such as "science *and* technology" or "science *and* health" permeate the media and imply the notion that technology and health are distinct from the irrelevance of science, as if applied science and pure science are totally unrelated. Thurs observes that the "rush to emphasize [science's] application easily led to a sense that there was no such thing as pure science, at least none worth talking about" (121).

This situation is deplorable to Burnham, who declares (in his book's closing paragraph) that the popular insistence on utility produced "'scientists' [that] were in fact narrow technicians who did a job without a calling…[who] did

not struggle with other population elements for possession of the public mantle of science…[and who] did not even know what civilization was, or perhaps science as such" (262). Interestingly, the media largely seems to share Burnham's opinion. Frayling points out that among cinematic representations of scientists the trait that virtually all "bad" scientists have in common is an affiliation with large corporate or government organizations (215). He writes, "Mainstream science has become thoroughly institutionalized…and the new scientific heroes are seen as heroes because only they have the special insight to prevent these institutions from distorting science" (Frayling 215). The idea of a scientist who selflessly promotes pure science without regard to political or monetary gain hearkens back to the Enlightenment's ideal natural philosopher, and seems to indicate distaste for the "big business" perception of science among the public sphere. Science itself is not necessarily seen as a bad thing; science with unchecked power and immunity from public accountability is.

CHAPTER 5

SCIENCE AND THE NEW MEDIA

No matter how we choose to talk about science today, we will be unable to escape the influence of the modern media. Whether on television, in print, online, or in pop culture, all discussion is framed within the body of the communication network that encircles the globe. The way the media packages information has profound implications on how we see science. In a way, we might even say that we have been conditioned by our connection to the media to think in certain ways about science. How do media icons such as the "mad scientist" or the chart of human evolution affect our beliefs? How do dramatizations like *Inherit the Wind* or *Jurassic Park* influence what the public thinks of science's role in life? How do documentaries like *An Inconvenient Truth* or *Food, Inc.* direct social pressure? And these are all examples of the "old" linear media, the media controlled by a relatively small segment of society in which information flows unidirectionally to a generally voiceless audience. In recent years a blossoming of digital technology has created a "new media," one marked by audience participation and convergence. If it ever was safe to assume that the public was a captive audience and would be the spoils of war to whoever won the battle of science and religion (marketed by the media with the same giddy anticipation of a pay-per-view fight), that time has certainly passed now.

Critical to Burnham's definition of superstition is the concept of the authority figure. "In any culture," he writes, "superstition involves the idea that some assertion has validity…by the mid-twentieth century, however, the

authorities for such superstitious belief as there was overwhelmingly consisted of television and peers" (Burnham 18). Recall that this was in 1987, and the shape of media is vastly different now. Still, "television and peers" is an interesting coupling; Burnham seems to have possessed a bit of clairvoyance.

The power of the mainstream media to alter content is no new idea, though it often goes unnoticed. Burnham forcibly points this out: "One of the myths of the twentieth-century was that the media controllers were passive vessels through which science popularization passed and that any distortions were mere institutional by-products or even accidents. The truth was otherwise" (240). Once journalists (a catch-all term for any media authority) got their hands on scientific popularization, so the tale goes, they "militated actively against the religion of science, even though the 'facts' of science and health may have been acceptable or useful to the journalists" (Burnham 241). For whatever reason, media pundits channeled scientific news in such a way that "the focus of science popularization should be science policy – which lay, of course, in the media world, where scientific findings could be 'controversial'" (Burnham 241). Burnham's dissatisfaction with the media seems to be in the tendency to drag the noble "religion of science" down to the social or political level. On one hand, he is right. The news media certainly gives disproportionate airtime to scientific stories thought to cause a stir, particularly if it can give them snazzy monikers like "Climategate" to encourage a maximum amount of water-cooler discussion. But Burnham's insistence that mainstream media is out to get science fails to

acknowledge that the ways science gets disseminated in the media could be necessary or even helpful.

One of the byproducts of science's relegation to the outskirts of culture was that science lost a human face in public discourse. That Einstein is still the archetypal scientist in popular culture is an indication of just how out of touch science has been for the last sixty or so years, and interestingly, even Einstein's rise to fame may be linked to a media campaign (Thurs 98). To remedy this, science needs patrons. "Patrons, who have to be actively enrolled by the learned scientific community no less than publics, do not merely fund science, but significantly determine its nature and purpose" (Cooter and Pumfrey 251). The hyper-professionalization of science, and the world in general, in this day makes it difficult to gain much attention as someone who can speak for science without some sort of credentials. Certainly those scientists like Hawking, Gould, or Dawkins meet this requirement. Yet one need not be a scientist per se to direct science. Consider the influence the politician Al Gore exerted on the issue of climate change. The concept of "global warming" had been a relatively ambiguous topic discussed mainly in non-mainstream media for years, but after Gore "popularized" it American culture raced into a "green" revolution. It had become a topic of conversation, and whether they hated him or applauded him, Al Gore had become the unlikely face of environmentalism to most Americans. Burnham possibly would see all this political controversy as detrimental to the impersonal "religion of science," but if nothing else it shows how to at least make the public *aware* of science in the first place.

The other issue Burnham has with the media is with its usurpation of authority from scientists. He is upset that the public believes journalists without question, while implying that they should be doing that with scientists instead. Anthropologist Jonathan Marks points out the irony that Latour was criticized for his exposition on the construction of scientific facts and his failure to distinguish between fact and mere *assertion* of fact. Marks asks, "How do we tell them apart? How can we distinguish between what's "really" there and what the experts tell us is there – whether it's the number of chromosomes in the human cell, the motion of the solar system, or the nature of subatomic particles?" (Marks 268). What about the mistaken old theories of science? They were once presented as "facts," how can the public tell the "real" from the "assertion of real"? The answer, of course, is that it only can be told what is a fact, and that is all. Pluto was a planet "in fact," until we were told that it was not. Nothing changed with Pluto, just our definition.

The scientific community could potentially gain valuable insight from the savvy approach of the mainstream media to this new media. Noting the difficulty in creating programming to satisfy the newly fragmented public, mainstream media instead chose to invest its resources into niche-marketing strategies that appeal more strongly to specific communities, a strategy that has paid off handsomely (Levin 257). Science could make use of this same concept by focusing its attention on specific groups that will be most receptive to it, a practice which could pay off monetarily (which scientists could always use) as well as creatively. The shift in the media is apparent in a number of cable

networks ostensibly devoted to scientific education, like the *Discovery Channel* or the *Science Channel,* which in recent years have altered their programming to accommodate one very unique form of television that has risen from the new media: so-called "reality" TV. Though the actual science content may vary in these programs, a noticeable shift away from more "hard" science programming is apparent to anyone who has tuned in over the past few years. Additionally, a large portion of the primetime lineup on these educational channels often contains recurring programing addressing pseudoscientific topics such as cryptozoology or UFOs. While this is surely distressing to orthodox scientists, this shift in programming simply demonstrates that the network is paying attention to the demands of popular culture. Science needs to learn how to utilize the mainstream media in more productive ways. After all, the motivation of that media is no mystery: profit. Science needs to sell itself. That statement would surely disgust scientific purists who believe science to be above such petty pursuits. But popularizers have been "selling" science for years now, and have even discovered the tricks to making it work. Rather than object that the public does not care about science, scientists should be more willing to meet the public half way.

The issue of authority has become infinitely more complicated with the rise of "participatory culture" over the last few years. The advent of "Web 2.0" in about 2002 marks a watershed moment, a revolution every bit as significant as anything the nineteenth century experienced. And like in that previous communication revolution, the very concept of science stands to be radically changed. This new media operates with a strong emphasis on collaboration,

collective intelligence, information sharing, and user-production. The entertainment, commercial and industrial worlds have already been rocked by this media paradigm shift, and now we are starting to see its effects in politics, and scholarship. At the heart of this shift is the transformation of the average citizen from audience-subject, to user-subject. Henry Jenkins addresses this:

> Convergence does not occur through media appliances, however sophisticated they may become. Convergence occurs within the brains of individual consumers and through their social interactions with others. Each of us constructs our own personal mythology from bits and fragments extracted from the media flow and transformed into resources through which we make sense of our everyday lives. Because there is more information on any given topic than anyone can store in their head, there is an added incentive for us to talk among ourselves about the media we consume…Consumption has become a collective process, that's what this book means by collective intelligence. (3-4)

The appearance of blogs, social networks, video sharing, cell phone uploading, and other phenomena across various platforms have given a voice to the once silent consumer, and given him or her an avenue to bypass the traditional sources of authority. Rather than finding themselves as the passive receivers at the end of a unidirectional cascade of information, people now can become isolated and yet integrated actors in a free flowing network of ideas and knowledge. This ability to become active agents in the processing and distribution of information has led

some cultural theorists to start using the term "prosumer" to describe the modern consumer of data. A "prosumer" is a simultaneous producer and consumer, someone who watches "Big Brother" as much as "Big Brother" watches him.

Paradoxically, popular culture has at once been fragmented and unified by this new media. Bohman, returning to Habermas' concept of the public sphere, observes that while early analyses of the web predicted a unified, democratized society, we have seen in actuality a "public of publics rather than a unified public sphere based in a common culture or identity" (152). By increasing individual participation, encouraging migration across media borders, and enabling the formation of specialized groups, it has partitioned society into distinct niches, groups of individuals with similar views and objectives, who develop a sense of collective identity. At the same time, inter-user collaboration and information sharing has created a public that can instantly distribute information across the globe. "Prosumers" create vast networks of peers with which to collaborate and share their viewpoints. With this new ability to communicate directly with one another and circumvent the traditional channels of discourse, "prosumer" culture has created and destroyed corporations, celebrities, cultural icons, and in recent years we have even seen it alter political elections, foreign policy and literally overthrow dictatorships.

This same dangerous potential hangs over orthodox science, threatening to expose any potentially embarrassing secrets it may have. The polemic of "Climategate" rocketed through the media in the winter of 2009, sparked by hacked email accounts of climate researchers that indicated a degree of

manipulation of data. The scientists were ultimately cleared of wrongdoing; accentuating certain data points in order to emphasize a single point is a common occurrence in the research field. The controversy came from the supposed lack of "transparency" in the research, something that scientists likely have never needed to worry about much until now. An editorial in *Nature Geoscience* magazine responded to the crisis by advising, "Along with greater openness, a much more nuanced and multifaceted discussion of the physical aspects of climate change needs to be presented to the public to avoid future accusations of cliquiness and gatekeeping" (509).

Of course, the forming convergent culture also holds remarkable potential for scientific advancement. In the last decade, a phenomenon known as "distributed computing" has become popular, through which individuals can "lend" a portion of their computer's processing power while the system is idle to various research institutions across the globe. This allows projects, with goals as diverse as cancer research to the mapping of pulsars, access to supercomputer-level data processing at a fraction of the price, while allowing interested nonscientists to become helpful, if uninvolved, participants (Bohannon 811). An even more powerful example of the creative potential that the new media may hold occurred in September of 2011. For 15 years, AIDS researchers have been unable to develop a model of a retroviral protease found in the Mason-Pfizer monkey virus, a virus related to HIV that causes AIDS in monkeys, which matched the crystalline configurations observed in the lab. So, in something of a social experiment, the question was given to the public in an online game called

"Fold.it," a puzzle-based game that encourages collaboration and competition amongst its more than 236,000 members as they construct digital models of proteins. The scientists gave the problem a three-week time limit online, but amazingly it was solved in just 10 days (Praetorius). The story was received with some interest in the media, one article opening with the line: "You no longer need a Ph.D. to make an incredible scientific breakthrough," but the implications of such an event seemed to go largely unsaid (Praetorius).

The "Fold.it" incident is an excellent demonstration of the power of collective intelligence, "a system built on community logics of re-use and permission rather than commercial logics of ownership and restriction. [It] relies on the belief that with enough size and diversity, the community can achieve 'more than a closed team of professionals'" (Green and Jenkins 216). Of course, this brings up a range of logistical questions, such as how will the notions of authorship, plagiarism, or peer review be affected? Perhaps an appropriate question to ask is, "What will happen to science in the age of Wikipedia?" Though it may be the curse of every high school science teacher's attempts to get students to cite "valid" sources, the discomfort with sites like Wikipedia on the part of official academic institutions originates less in the site's content and more from its lack of institutional control. It demonstrates the difficulty "learned science" is having with accepting that its authority to make intellectual pronouncements is not absolute. Whatever one thinks of Wikipedia, in terms of sheer volume of information it easily surpasses any other single source. An interesting trait of collective intelligence is that despite being comprised of

thousands or even millions of individuals with often-contradictory goals, the community as a whole often demonstrates an almost organic adaptability and singular consciousness.

The ways in which the new media landscape can and will affect how people relate to science are numerous and impossible to predict. Instances such as the "Fold.it" game may provide clues to where things are heading, but as to specifically *how* science should approach this change is still unclear. What is clear is that things have changed, and that the traditional, diffusionist model of science, with its emphasis on separation, control, and localized authority will surely not appeal to a public obsessed with connectivity.

CHAPTER 6

CONCLUSION

For too long, science has worked to set itself up as being something apart from the life of the ordinary citizen. With its self-congratulatory air of authority, science has assumed that the public has drifted away because of the ignorance, machinations, and corruption of popular culture, a juvenile repository of "paedomorphic" fantasies designed to make us feel better (Dawkins 350). What too often go unquestioned are the relative nature of reality and the process of "knowledge-making" in cultural discourse. Science does not have a monopoly on how to make sense of the world, on what "facts" mean, or how knowledge will be used. "The great paradox of modern science," writes Marks, "is that scientists are not trained to think about science; they are trained to *do* it, to carry it out…to collect data – but not to think about where knowledge comes from, or the relationship between science and technology" (266). Science can produce technology, but cannot predict how people will use it or how it will shape culture. Science's own risk of being marginalized by a technologic culture it helped create is evidence of that.

To be sure, science as an institution will never go away. Technology will continue to progress; medicine will continue to advance. But if scientists ever wish to be more than the "mere technicians" they are now, driven by commercialism and politics, they must learn to better integrate themselves into the larger public discourse of popular culture, "where something much more like multisided conversations about scientific topics take place, even if they do not

proceed in the orderly, organized fashion of the specialized norms of professional discourse" (Pandora and Rader 360). This new "intellectual commons," which is marked by "heterogeneity, dispersion, and contradictions," is a place where the various voices and concerns of the public can be addressed, and science can become something relatable once again (Pandora and Rader 360).

The way that popular culture has marginalized and reshaped science over the years, whether in entertainment, the formation of pseudo sciences, or the comparison with religion, have shown us all that no one definition of science is adequate. Science is whatever we believe it to be.

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