31. Science

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Science is a complex term, being defined in the *Oxford English Dictionary* (Oxford University Press, n.d.) in about 6,000 words, and by scholars of technical communication and ***rhetoric*** in even more extensive presentations (e.g., Taylor, 1996; Longo, 2000). Science is expected to observe facts, extrapolate to universal truths, solve problems, and answer our questions about the universe through ***research*** and theories. For technical communicators, *science* can be one of the most important key terms of our careers, entailing a domain of knowledge and activity that supports millions of jobs. In our current landscape featuring the COVID-19 pandemic, catastrophes propagated by climate change, and increased human reliance on ***technology***, science ***literacy*** has become a fundamental need for all citizens.

Science as we understand it today is the distillation of intellectual traditions from multiple civilizations. In the 20th century, science was cemented as a key term of the Anthropocene by scientists themselves, including well-known authors such as Thomas Kuhn, E.O. Wilson, and Stephen Jay Gould. Science inextricably intersects with ***history***, ***knowledge***, research, ***ethics***, ***rhetoric***, and technology. Science is a dominant theme of our age, critical to the understanding of technical communication both as a discipline and a ***profession***, intertwined throughout all the greatest hopes for, and threats to, life on Earth in the 21st century.

The French derivation of the term *science* is glossed as "knowledge, understanding, secular knowledge, knowledge derived from experience, study, or reflection, acquired skill or ability, knowledge as granted by God . . . , the collective body of knowledge in a particular field or sphere . . . " (Oxford University Press, n.d.). These definitions lend an air of authority and immutability to science, an expectation that scientific knowledge is final and absolute. This perception has been challenged extensively in more recent scholarship and literature about science where the nature of the collective or the community is deemed important to viewing the workings of both science and scientific communication as culturally constructed enterprises (Kuhn, 1970). Thomas Kuhn (2000), notably, defined science as follows in *The Road Since Structure*:

> Science is a cognitive empirical investigation of nature that exhibits a unique sort of progress, [which] . . . cannot be further explicated as "approximating closer and closer to reality" . . . rather, progress takes the form of ever-improving technical puzzle-solving ability, operating under strict—though always tradition-bound—standards of success or failure. (p. 2)

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Kuhn (2000) refers to science as requiring "extraordinarily esoteric" and "often expensive" investigations which make possible "astonishingly precise and detailed knowledge" (p. 3). Kuhn (1970) also addresses the inherent difficulty in defining a concept as robust as science in a single definition such as a *Keywords* entry: "A concept of science drawn from [textbooks] is no more likely to fit the enterprise that produced them than an image of a national culture drawn from a tourist brochure or a language text" (p. 1).

Within the narrower field of technical communication, our research includes excellent scholarship focusing on various aspects of science. New theories of communication are developed based on the ways that science communicates findings and modern thinking. Such new theories include Kenneth Baake's (2003) metaphor harmonics and Maria Gigante's (2018) portal images. Examining contemporary and historical artifacts and ***genres*** in science enables us to better understand the influence of science on technical communication, and the interplay between fields (Brasseur, 2003; Gross et al., 2002). Case studies, pedagogical practices, and communication strategies involved in scientific communication comprise a robust area of scholarship (e.g., Fountain, 2014; Graves, 2013; Walsh, 2013; Yu, 2017; Yu & Northcut, 2018).

Some rhetorical theorists have sought to regularize and norm the ways we describe scientific thinking and logic. For example, Richard Lanham (1991), in the classical rhetorical text *A Handlist of Rhetorical Terms*, refers to "scientific proof" and cites Aristotle's classification of a type of knowledge that develops universally "true conclusions" (p. 122) proven by syllogistic (mathematical or deductive) logic and demonstration. Contemporary and emerging thought, by contrast, focuses on the ephemeral contingency of such "Truth," positing that scientific knowledge is culturally constructed and changes over time, both in response to new data and in response to cultural realities. As Kuhn (1970) theorized, science is paradigmatic, and paradigms are shared bodies of knowledge both reflecting and constituting community members (p. 176). Paradigmatic knowledge changes over time, supplanting the notion of singular, stable scientific Truth; paradigm changes can be abrupt and irregular, not steady and predictable. Such a philosophical bent is reflected in most of our field's rhetorical and critical scholarship about science and science communication. Understanding of paradigmatic changes in sciences is helpful when citizens struggle with what appears to be indecisiveness of scientists facing new phenomena, especially when adherence to ethical research or medical standards is the cause for delay or disagreement.

Canonical 20th century texts expand the argument that science is wholly dependent on and constructed by the human scientists who reify it (e.g., Latour & Woolgar, 1979; Taylor, 1996). Contemporary research builds on those themes. For example, in her articulate analysis of physics laboratory life, Heather Graves (2013) points out how the processes that enable scientific research are products of fallible and vested humans, and the experience of doing or understanding science is inextricably bound to the equipment, processes, and language used (p. 89). In another excellent book about the power of ***visual*** communication, Lee Brasseur (2003) explains both the over-valorization and the dismissal of scientific and technical visual communication through a critical historical lens. Brasseur's book enables students of rhetoric and technical communication to understand how our fields rely on science, while at the same time asking key questions about whether reductive scientific interpretations of the world shortchange humanity.

Further, the reputation of science and scientists has been tainted by a history of crimes against humanity, committed in the name of scientific research, and targeting the most vulnerable. One of the most famous incidents involved Nazis studying legitimate research questions about military operations, but through illegitimate means: painful, humiliating, and often lethal methods of torture carried out on Jewish prisoners at camps including Dachau and Ravensbrueck. The Nuremberg trials of 1946–1947 found 15 defendants guilty and led to the development of the Nuremberg Code, which seeks to proactively protect people from such victimization (Dunn & Chadwick, 2012). In the US, the African American population was exploited for a span of four decades in an extraordinarily long-term medical study of syphilis. Black men with syphilis were tracked by medical professionals, and long after antibiotics were known to cure the disease, were deprived of such treatments (Dunn & Chadwick, 2012). In cases of such abuses of the tools and methods of science, it has sometimes been an instrument of further marginalization of minoritized persons.

The belief that scientists are primarily engaged in "establishing true and absolute descriptions of the nature of things" is losing favor as sociological research reveals that "empirical research rarely makes direct claims about the unmediated nature of the world" (Taber, 2018, p. 6). Today, emphasis is placed on recognizing that the work of science is largely claim, not fact; proposing relationships and hierarchies; identifying laws that may not be final; and, sometimes, promoting and/or protecting the reputation and status of science and scientists collectively and individually.

Scientific communication, similarly, struggles with an identity crisis because it is also expected to be objective, under the faulty assumption that scientists themselves are objective (Yu & Northcut, 2018). Facts (and findings), no matter how important, literally do not speak for themselves. Therefore, scientists face the continuous challenge of first interpreting, then arguing for the importance and morality of their work and the reliability of their findings to each other, to stakeholders, to sponsors, and sometimes even to themselves. Scientists are not equally adept at doing so (Baake, 2003; Woolston, 2020), which is inherently fascinating to fields including technical and scientific communication, linguistics, and journalism. Studying the cultural and communicative processes of science and scientists gave rise to various social science and humanities subdisciplines in the 20th century, including sociology of scientific knowledge, rhetoric of science, and science and technology studies.

Aside from the nature of science, another interesting question with an answer that varies across historical periods is "who is a scientist?" Science was not professionalized until the early 19th century. The gate-keeping functions of professional science (e.g., licensure and formal membership) promote a culture of insiders and outsiders. The culture is reinforced by the requirements of independent federal agencies, such as the National Science Foundation, and the larger federal bureaucracy, such as the Department of Health and Human Services, which oversees the Office of Human Research Protections (OHRP) and the Food and Drug Administration (FDA). Both the OHRP and FDA require that research ethics boards include "scientist" and unambiguously "non-scientist" voting members, although the FDA's own guidance documents are vague about why the distinction is necessary or useful (FDA, 1998).

Other gate-keepers include academic institutions and the cultures of the academic departments within them. Gate-keeping serves to homogenize scientific thinking by requiring common credentials and education of practitioners, but it also tends to reinvent itself in repetitive and potentially damaging ways—for example, through bias and practices that maintain existing power structures (Cole & Hassel, 2017, Northcut, 2017). Scientific communication is an area where the gate-keeping function of jargon has been identified, and many scientific journalists and popularizers (both with and without formal science credentials) endeavor to make scientific knowledge understandable by the interested non-expert ***public*** (Woolston, 2020).

Dividing people through various gate-keeping mechanisms into categories of "scientist" and "non-scientist" feels artificial to social scientists and trans-disciplinary workers, and the constructed definition of scientist can serve to alienate non-scientists, presenting science as a clannish, closed culture hostile to outsiders. Placing, and keeping, much of the population on the margins has perpetuated understandings and definitions of science that may haunt us more than they help us.

In our current era of strict credentialing and demarcation of those who are qualified to call themselves scientists, great public tension has emerged between science and politics, starkly apparent during the COVID-19 pandemic. Although scientists (including national academies and the U.S. Centers for Disease Control and Prevention) knew by April 1, 2020 that face coverings (surgical masks, cloth face coverings, and hard plastic shields) were likely to reduce infection rates of the virus, Republican-led state and federal governments were slow to recommend and require them in the US. Initially, alarm about the virus led governments globally to either recommend or force schools, businesses, and transportation to shut down, and travel restrictions were imposed. Reopening began months later, despite little evidence that the virus was less of a global threat, and increased socializing led to outbreaks, particularly in the US. Not until July 2020 did the number of states with a mask mandate exceed the number of states without one, leaving the mask-mandate decision to municipalities and private businesses such as grocery and department stores. Political party identification was shown to be correlated to attitudes about the pandemic (Pew Research Center, 2020). The ongoing impacts of COVID-19 are attributed by many researchers to result from the failure of elected leaders to encourage scientifically validated precautions such as mask-wearing, at a time when evidence demonstrated efficacy of masks against transmission of a virus that travels and infects primarily as aerosolized particles or airborne droplets (National Academies of Sciences, Engineering, and Medicine, 2020).

The COVID-19 pandemic has clarified the perils of an anti-science population suspicious of, or hostile to, science, and enabled us to imagine benefits that might emerge if science were understood more richly and broadly, and if science were a culture that all citizens, regardless of vocation, were expected to understand, participate in, and critique. The COVID-19 pandemic illustrated the importance of understanding audience when conveying emergent theory (Baake, 2003)—in this case, the theory of transmission of a virus no one had ever studied. We also see the unfortunate consequences of ineffective communications about risk, as COVID cases in 2023 topped 676 million worldwide, and the US, with four percent of the world's population, contains over 15 percent of the cases, and has logged more than its proportion of the deaths (Johns Hopkins, n.d.). Technical communicators possess the academic and professional credentials to be ideally situated to facilitate scientific communication, especially if we are familiar with the history, epistemologies, and cultural studies of science that have shaped the current enterprise.

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