Interactions

If you asked a high-energy physicist what they study, they might say, “Particles: protons, electrons, quarks, leptons.” More probably would they say, “Interactions.” The function of modern particle accelerators and colliders is to orchestrate interactions among various types of particles and to observe the outcomes. As they sift through the myriad results of interactions produced with each particle collision, high-energy physicists discover clues to the most fundamental frameworks of the physical world.

This book is about interactions of another sort as well—communicative interactions among people who worked and visited Fermi National Accelerator Laboratory in Batavia, Illinois. Like interactions within particle accelerators, communicative interactions also produce exciting and often inexplicable results, and none more so than those shaped by the peculiar contours that the relationship of science and society takes within the space of the contemporary research laboratory.

Rhetoric in the Relationship between Science and Society

“No, I’m not a physicist.” I must have uttered this sentence at least a hundred times during my first seven-month stint conducting research at Fermi National Accelerator Laboratory. When interviewing visitors to the laboratory, they would invariably ask, “Are you a physicist?” I would explain that I was a communication studies scholar interested in what nonscientists think about science. Visitors’ reactions to this response were mixed. Some seemed relaxed and were even more eager to talk with me, relieved to know they would not be quizzed about their knowledge of physics. But others seemed almost disappointed, as if they had hoped to meet a “real scientist” during their visit.

Not surprisingly, the same question surfaced when I met with scientists and staff at the lab. Many inquired about my academic training and how I came to be so interested in physics and research laboratories. I would explain that I had always been fascinated by physics and that my own attempts to better understand the field had led me to make science communication a focus of my research. In these instances my interactions were defined as much
by my relationship to the laboratory, the field of physics, and science as a whole as by my relationship to the individual sitting opposite me.

Over the course of my travels through the laboratory system, I traversed not only the boundaries between self and institution, self and other, and self and science, but also the boundaries that distinguish scientist from citizen, laboratory from community, art from science, and, of course, science from society. Whether with a physicist, technician, receptionist, or visitor, it was clear that interaction was somehow both transformative and definitive. At times my presence as an outsider within the lab disturbed some well-established categories and boundaries. As a communication researcher, I was accorded a status and freedom greater than that of the usual visitors, and yet I didn’t fit neatly into any existing category on the organizational chart. Was I an outsider at all? After all, Fermilab is a federally funded facility, and I am a taxpayer. As I conducted my research, I often found myself awash in discourse intended to remind me this was “my” laboratory. Yet my greater access made me even more keenly aware of the dividing line between the world of the laboratory and world outside its gates. Even as the lab’s discourse reflected the importance and difficulty of sharing research with various constituencies, it also constructed and closely guarded the identity and boundaries of the laboratory—its inner life.

It soon became clear that to understand Fermilab I had to confront its boundaries and spaces. Some were material, such as the boundaries of the laboratory grounds and the spaces those boundaries construct and contain. Others were more clearly discursive, such as the boundary between “research laboratories” and “weapons laboratories.” Some seemed organizational and managerial, defining the contours of the laboratory’s research agenda and technology. All these boundaries are rhetorically constructed. They mark and constitute the laboratory, its employees and its publics. They define the world of high-energy physics and help determine the outcomes of economic, political, and symbolic disputes about the laboratory and its mission. Most important, these rhetorical boundaries help to determine the power and importance of the national laboratories as institutions, justifying their work and negotiating their symbolic importance in debates about the role and reach of science in society.

Although this is a book about boundaries, spaces, and interactions, it is also a book about the people who populate the spaces on both sides of the laboratory’s boundaries. I had the opportunity to interact with many of these people through interviews with lab employees and visitors. Some experiences were accessible only through extensive historical research or through the many stories that circulate in and around the laboratory. The lab has shaped the daily lives of many, particularly those scientists and staff members who
have devoted much or all of their professional careers to it and its work. Its boundaries are manifest in the narratives these individuals tell about the laboratory. But the laboratory’s influence is also felt outside its gates, from the communities adjacent to the Fermilab grounds to the halls of Washington. A legislator voting on the next federal science budget or a parent taking a science education program at the laboratory also have stories to tell about that laboratory. As I cataloged these many stories through the interviews I conducted and the documents I collected, it became apparent that there was no single or simple boundary that defined the space of the laboratory. Instead we find many discourses authored by a culture sometimes deeply conflicted about science. These narratives have shaped and reshaped the institution over the course of its forty-year history.

In sum this research fulfills two principal goals. First it provides a detailed description and analysis of the rhetorical situation surrounding modern high-energy physics research, one of the last bastions of “big science” in the United States. Second, by examining the rhetorics the community uses to protect its autonomy and authority and the public response to those rhetorics, this analysis enlarges our understanding of the rhetorical processes of boundary work and its relationship to other forms of scientific rhetoric.

Imagining the Laboratory

The rhetoric of Fermilab is dominated by image and narrative rather than argument. Rich in idealism and nostalgia, the laboratory’s discourse often seems focused on the maintenance of its connection to the technological sublime, a concept that will become clearer as we proceed. The boundaries of the laboratory are defined through its unique articulation of architecture, open spaces, artwork, and techno-scientific myth. Some of the most evocative images of the laboratory can be found in the illustrations of the laboratory’s resident artist, Angela Gonzalez. Brought to the laboratory by its first director, Robert Wilson, Gonzalez worked with Wilson to create a distinctive aesthetic for Fermilab. Offering an unusual mix of high-modernist illustrations and frontier mythology, some of her most striking contributions can be found among the hundreds of black-and-white illustrations that celebrate the people, places, technology, and achievements of the laboratory (fig. 1). One popular illustration depicts the laboratory as the incantations of a magician and his minions. Gathered around a caldron, they seem to have called forth the laboratory from the depths of imagination. The viewer may wonder about these characters or speculate about the spells or oblations that have been offered in support of their creative process. The fanciful nature of the creation, however, makes one thing clear—this laboratory is no mere instrument or research tool. The image does not celebrate practicality or parsimony, but
rather references the magical, even mythical, qualities of the laboratory and its work.

Many of her other illustrations have since disappeared from public view at Fermilab. Gonzalez’s creation images epitomize the mystery at the heart of our experience of the laboratory and in particular our cultural understanding of the federally funded system of national laboratories generally.1 How is a public scientific institution such as Fermilab created and sustained through action and perception? Gonzalez’s image strikes a chord precisely because there is indeed something magical and somewhat unbelievable about the fact that we, as a society, should choose to create and continue to support such an elaborate scientific and technological enterprise—a speculative creation with no obvious practical purpose.2 Some might argue that Fermilab is the predictable outgrowth of American technoscience—just one more link in a chain of ever larger institutions. It is difficult to refute that characterization, and yet such deterministic accounts tell us little about why or how society builds its scientific institutions. These and other images work to emphasize the distinctions between the work of the laboratory and the mundane world outside its boundaries. Put simply, the images depict the laboratory as a space beyond the realm of everyday experience, a liminal world between the mystical cosmos and the merely mundane.

The boundaries constituted by these images are reinforced in the many narratives that give meaning and structure to life within the laboratory. In a speech marking Robert Wilson’s eightieth birthday, Fermilab theorist Chris Quigg related a conversation with a colleague that seemed to echo the themes of fascination and mystery. Here Quigg pays homage to Wilson, undoubtedly among those stirring the pot:

Toward the end of a very cerebral, yet seductively earthy, bottle of Zinfandel, I asked Peter [Peter Limon, Fermilab accelerator physicist] to tell me what he likes best about the Tevatron. Peter chewed his Zinfandel meaningfully. Then he said, “The neatest thing is that you can actually store up all those antiprotons day after day after day and put them in the machine when you want to. . . . You say, I’m going to put p-bars in the machine at midnight tonight, and you do that, and you accelerate them, and you squeeze the beams into little tiny spots at B0, and you bring them into collision. I’m not only fascinated—every time it happens; I’m surprised.” Peter poured himself the last of the wine. “I think it’s really spectacular,” he said, “particularly since I know these people who are doing it.” He rolled his eyes, then became very serious. “You know, if Fermi and Feynman and the god were doing it, you wouldn’t think anything about it, right? But normal, everyday human
beings are doing this. What’s amazing is that regular people get
together and make these amazing things work.” To Bob Wilson on
his eightieth birthday, to all the builders and makers of this inspiring
place—this place of boundless horizons—thank-you for giving us
normal, everyday human beings the chance to discover, within
everyone of us, a little bit of the gods.3

This narrative does not celebrate the practical geniuses of the accelerator,
but rather its mysteries and other-worldly nature. The physicist’s relationship
to the machine is one of communion rather than use. His identity is simulta-
neously distinct from, and yet defined by, the machine and its magical prop-
erties. Although U.S. physicists have long celebrated the greatness of their
technological achievements, such ritual celebrations of the machine and its
makers have a special significance at Fermilab. The art, architecture, and sto-
ties of this particular laboratory honor the accelerator as evidence of the cre-
ativity and vision of American science. Not every lab does that, or even tries
it. But what are the consequences of the laboratory’s construction of its “other-
ness?” Is the rhetoric productive or problematic? Such questions can only be
answered through careful analysis of the images and narratives that mystify
the character and purpose of the laboratory and, as a result, obscure the insti-
tution’s roots in the history of physics and its sometimes-contested relation-
ships with the publics it serves. The laboratory’s consistent evocation of
sublime narrative and imagery stands in sharp contrast to more traditional
arguments offered in favor of basic research. This distinction raises questions
about how the history of this laboratory and also the evolution of hadronic
colliders have been informed by narratives that emphasize the mystery of
our cultural relationship to technology. While the lab’s very existence offers
evidence that such rhetoric has proved persuasive in the past, this book calls
into question the current and future efficacy of such a strategy, particularly in
the face of changing historical circumstances and counter-rhetorics that inter-
pret the laboratory’s spaces in new ways and define its publics through and
across different boundaries.

This study prompts reconsidering of many of our assumptions about the
relationship between science and society. For too long, researchers have
framed public participation in scientific decision making almost exclusively
in terms of “public understanding,” as though the only legitimate role for
nonscientists was to understand and, by implication, appreciate the work of
scientists. This study in no way rejects the importance of public under-
standing and concomitant efforts to improve both formal and informal modes
of science education, but I hope that its findings will stretch our interpretation
of the nature of public understanding and participation in science. First, the
comments of study participants reveal the degree to which many in the sciences hold stereotypical and often inaccurate opinions about the public’s interest level and capacity for intelligent deliberation about scientific issues and the fate of scientific institutions. Second, the study demonstrates the general public’s willingness to educate themselves about scientific issues and institutions. The very fact that so many individuals voluntarily tour FNAL on a yearly basis suggests that nonscientists of many stripes find the facility and its work sufficiently important to warrant their attention and thoughtful consideration. Last, the comparison of the comments of these two groups, in conjunction with the historical analysis offered, suggests that the lab’s decision-making processes are inevitably shaped by public discourse.

Imagining “the Public”

The chapters that follow focus not simply on rhetorics originating within the laboratory, but rather on the constitution of and communicative interaction among the lab and its publics. By studying discourse about Fermilab from the perspective of those both “inside” and “outside” the laboratory community, it is possible to understand better how publicly funded laboratories such as Fermilab are constituted and sustained through the rhetoric of scientists and nonscientists alike.

Some might question the choice of a high-energy physics laboratory as a site through which to explore the rhetorics that define the relationship between science and society. Fermilab was purposely built to reflect a constructive, positive, rather than destructive, application of physics research. Over the course of many years, however, the nature of public involvement in the laboratory system changed. As a result physics institutions of all varieties have seen their epistemic (or knowledge-producing) and social authority challenged. Early in its history, Fermilab attempted to make strategic use of public challenges in an attempt to secure a site and funds for the facilities that would determine the future of the field. Antiscience sentiment, growing strong at the time of the laboratory’s founding, was met by decidedly humanistic rhetoric that contributed directly to creating new audiences for physics. In 1978 Robert Wilson authored *The Humanness of Physics*, which epitomizes the ways in which FNAL’s rhetoric responded to problematic counter-narratives about physics. In doing so, it recasts the function of the laboratory and its relationship to the larger culture in a way meant to erase a negative image deposited by the militarization and commercialization of the atom:

> Does not it seem incongruous to be discussing the humanness of physics? For if one subject would appear to be lacking the quality of humanness, it is physics. Physics is characterized by precise measurement and abstruse mathematics, it is rigorous and austere; indeed it is
about as objective as a discipline can get. Yet, in spite of a prevalent belief that physics is cold and inhuman, a belief that it has to do only with thing, not people, a belief that its Faustian practitioners blindly follow the rites of scientific method to grind out a plethora of uninteresting facts . . . in spite of all of this, I am going to maintain that there is a quality of loveliness in the content and in the devices of physics, that it is beautiful creation which has meaning for man’s view of himself and his place in the world, and that these qualities of physics can appropriately be discussed under the rubric of humanness. 4
Richly illustrated with images from Greek mythology and drawings by Leonardo da Vinci and Angela Gonzalez, *The Humanness of Physics* acknowledged widespread critiques of institutionalized physics research in the United States and challenged directly the Faustian myth as it reemerged during the nuclear age, the myth of the scientist making a pact with the devil. Wilson made use of any and all available resources, blending classical and romantic imagery to give physics a new and deeper image. His rhetoric reveals the degree to which he understood the public’s real or potential influence on the laboratory and the course of physics research. The document also reveals the degree to which the lab was, and is still, positioned within a larger, more complex dialogue about the future of physics. The boundaries he inscribed favorably distinguish physics from other fields of science. More important, they make clear physics relevance and relationship to the larger culture.

Any attempt to understand the rhetorical boundaries that circumscribe and define the laboratory must acknowledge how these boundaries create “publics” and bring them into a relationship. In the case of the national laboratory system, it is clear that, although “the public” may not design the experiments or technology, their “participation” justifies the continued existence of large-scale physics research programs in fields ranging from weapons production to astronomy. The history of technoscience in the twentieth century demands that we acknowledge that nonscientists do relate, react, and contribute to particle physics (as do other sciences and bodies of knowledge). To see this, we must account for the impact of rhetorics that define, expand, or restrict the full spectrum of nonscientists’ social action and influence. Without question the laboratory’s publics represent a wide range of constituencies critical to the life of the institution. Such publics are frequently defined as taxpayers, whose dollars fund the national laboratory system. Some are also neighbors, whose home life is affected both positively and negatively by their physical proximity to the laboratory. Some are employees of the laboratory or one of its contractors. Others relate to the laboratory as a cultural, educational, or environmental resource. This wide range of perspectives should be regarded as a prism through which the larger meaning of contemporary physics research can be refracted. Far too often, however, these perspectives are simply ignored. When the influence of nonscientists is acknowledged at all, the full range of perspectives is too often reduced to that of a single monolithic public, defined solely in terms of the contribution of tax dollars or thought of as subjects for (or objects of) science education. Such assumptions oversimplify the complex and interesting ways that nonscientists make sense of the laboratory. They mask the laboratory’s significance and meaning in the lives of nonscientists and obscure the degree to which outsiders can and do actually influence the evolution of the laboratory.
As the laboratory’s many constituencies grapple with the facility, its technology, and its social meaning, they negotiate a relation with the lab and its work. This gradual accretion of publics eventually defines the lab’s boundaries and gives meaning to its spaces and its work. For the scientists and staff who work at the laboratory, publics are often defined according to budgetary needs and educational and environmental concerns. The resulting citizen-subjects of the laboratory are cast in a variety of roles. They are learners. They are neighbors. They are taxpayers. For each of these categories, there is a corresponding role for a laboratory employee. For the student of science, there is an educator. For the neighbor concerned about environmental or social impacts of the laboratory, there is an individual charged with explaining the realities of risk and the many benefits of the laboratory. For the taxpayer, there is a person with a job created by the laboratory. And there is a technology, an amalgam of metal, wire, and silicon that somehow speaks of the productive purpose of the laboratory and its people. All these characters are bound together by the rhetoric of the laboratory, those narratives and images that define its past, present, and future.

Unfortunately for scholars, many histories and analyses of modern laboratories fail to acknowledge the layers of rhetoric that structure the evolution of such institutions. The boundaries of the laboratory are defined according to the needs of real and imagined publics and the possible dialogues with them. Such dialogue is imagined in the public documents of the lab and discourse of those inside and outside its boundaries. The nature of this dialogue, however, reaches well beyond the boundaries of traditional argument to encompass the cultural experience of the laboratory. Examining the laboratory’s image and narrative provides clues to the constitution of the lab’s publics. It also produces insights into conflict negotiation and the resolution of controversy involving the lab. It took a series of complicated social transactions involving multiple publics, government agencies, scientists, and technologies to make Fermilab a physical reality.

Sadly much scholarship to date has not accounted for the work of nonscientists in the evolution of this and other scientific institutions. This limitation stems in part from an unsatisfactory understanding of the meanings nonscientists attribute to science. In order to better understand the social construction of scientific institutions, we must develop a more nuanced understanding of the meaning of science in society. While many researchers and philosophers have produced work that attempts to explain the value of science to society, far fewer have confronted its meaning. Work that does address questions of meaning rarely engages public controversy about the role of science in society. These shortcomings may result from our long-standing focus on the
public’s relationship to the products of science rather than the process of science. It is easy to see how fields such as medicine and chemistry produce products and procedures that both enhance and constrain everyday life, but it is far more difficult to see how physics might have a comparable effect for any but a few select individuals. If we shift our emphasis, however, and focus on the point at which research is conceived, funded, and sustained through the largess of the taxpaying public, we begin to see the complex dynamics at work among publicly funded physics labs and the public.

To address these and other limitations to our current understanding, this book explores the meanings and relationships that emerge from the rhetorical construction of laboratory spaces. This study is grounded in five years of ethnographic and archival research, interviews with employees of and visitors to Fermilab, and rhetorical analysis of the texts that mediate communication among the laboratories and the public.

The remainder of this chapter provides a narrative history of Fermilab and the field of high-energy particle physics. It details episodes of public controversy and explores the recurring narratives that mark the history and evolution of Fermilab. Chapter 2 surveys relevant research in the science studies and public understanding. It details the theoretical and pragmatic contributions that might result from further rhetorical studies of the laboratory. Chapter 3 examines the discourses that frame the laboratory and the discursive influence of its directors, Robert Wilson and Leon Lederman. Chapters 4 and 5 track important shifts in the laboratory’s rhetoric and detail the images and narratives that define Fermilab for its employees (chapter 4) and for visitors (chapter 5). The final chapter considers recent changes at the laboratory and ponders the past, present, and future role of rhetoric in the articulation of the laboratory’s boundaries.

Science and Society in the History of Government-Funded Physics Research

The National Acceleratory Laboratory (later renamed the Fermi National Accelerator Laboratory) was officially commissioned on 21 November 1967, by an act of the Atomic Energy Commission (AEC) and President Lyndon B. Johnson. Devoted to a single purpose and single technology, the laboratory was unique. Today it continues to herald its commitment to basic high-energy physics research in its mission statement: “Fermi National Accelerator Laboratory advances the understanding of the fundamental nature of matter and energy providing leadership and resources for qualified researchers to conduct basic research at the frontiers of high-energy physics and related disciplines.”

Explained more simply as “unlocking nature’s deepest secrets, and learning how the universe is made and how it works,” the mission of the laboratory is nonetheless difficult to define for the average taxpaying citizen.