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## THE PROBLEM OF WRITING KNOWLEDGE

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A simple practical problem within a single discipline began the line of inquiry that led to this book. As a university teacher of writing I was charged with preparing students to write academic essays for their courses in all disciplines. Since academic assignments bear a loose relationship to the writing done by mature members of the disciplines, a serious investigation of writing within disciplines promised to turn up information useful to teaching undergraduates. The investigation from the first was interdisciplinary by necessity, but only in a superficial sense, in that the writing examined came from a variety of academic disciplines. The concepts and analytical tools, however, did not extend beyond the typical repertoire of the English department.<sup>1</sup>

1. What constitutes the repertoire of the English department is no easy thing to categorize, nowhere codified, and nowhere discussed with methodological clarity. Rather, on the literary side it is embodied in the corpus of literary scholarship and criticism and in the seminar practices of textual discussion. Primarily it consists of close textual readings and historical contextualizing. The textual readings are all framed by recognition of traditional literary devices, and have been intensified by new critical insistence on the text in itself. However, other modes of criticism have suggested the application of interpretive frameworks from other disciplines, such as linguistics, psychology, sociology, anthropology, and philosophy. Such imported frameworks are justified in two ways: either they represent fundamental truths so that they cannot help but influence texts, or the writer on some level was aware of such ideas and constructed parts of the text upon them.

Historical contextualizing has served a variety of functions, from simply providing a decorative frame for a self-contained and independent text to offering a complete account for the creation and meaning of a historically bound text. On occasion text and context have been drawn more tightly together to view the text as a historical event within the unfolding context. Most often, contextualizing has served to make odd features of the text more accessible to the reader.

The recent concern for literary theory, while raising some fundamental questions, has done little to change the actual analytical tools of literary interpretation. Concepts such as self-referentiality, intertextuality, reader response, and binary oppositions simply put additional weight on existing analytical concepts and tools.

An extended repertoire of concepts and tools has also come out of the teaching of writing. The rhetorical approach to the teaching of writing has been particularly concerned with public argument; an approach loosely labelled composition has been con-

## One: Writing Matters

Very soon into engaging this problem, I found that I could not understand what constituted an appropriate text in any discipline without considering the social and intellectual activity which the text was part of. Too much of the texts directly invoked and acted against these contexts to treat the features of texts simply as isolated conventions. Moreover, the rhetorical gist of entire texts evoked the larger framework of meanings within the active disciplines. That is, I couldn't see what a text was doing without looking at the worlds in which these texts served as significant activity. Sociology of science became an inevitable resource for understanding how communication was organized in academic communities and how texts fit in with the larger systems of disciplinary activity.<sup>2</sup> And philosophy of science became important, not for the ultimate questions of epistemology, but for more modest ones of how people conceived of disciplinary activity.<sup>3</sup> Understanding what people think they are doing gives insights into how they use words to accomplish those things.

History as well loomed large as I began to see that current writing practices (in conventional, interactional, and epistemological dimensions) build on a history of practice and speak to a historically condi-

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cerned with the formal prescriptions of the school essay, but has in recent years also taken on a concern for the process of writing, as approached through a cognitive psychology model. Gary Tate, ed., *Teaching Composition: Twelve Bibliographic Essays*, offers the best and most current review of work in the field. I will discuss approaches to writing and the teaching of writing more fully in the final chapter of this book.

2. Robert Merton, in his personal generosity of spirit and his profound analytical clarity, has influenced my understanding of sociology deeply. As I will argue in chapter 5, his seminal thinking is consonant with much of more recent work, which has frequently attacked a straw man version of his work. Bazerman, "Scientific Writing as a Social Act," and Harry Collins, "The Sociology of Scientific Knowledge," provide reviews of sociological studies relevant to questions of text, language, and knowledge formation. I will refer to the literature of the sociology of science throughout this book, but see especially chapter 5.

3. Although my readings in the large and complex field of the philosophy of science have been limited, I have found myself most in sympathy with Thomas Kuhn's observation of communal interaction in the production of knowledge (*The Structure of Scientific Revolutions*), Karl Popper's concept of three worlds (*Objective Knowledge*), Imre Lakatos' relation of work to ongoing research programs (*The Methodology of Scientific Research Programs*), Stephen Toulmin's evolutionary view of the development of historically situated knowledge (*Human Understanding*), and Ian Hacking's emphasis on physical activity in science (*Representing and Intervening*). As will be evident throughout this book, I have been most profoundly influenced by Ludwik Fleck's *Genesis and Development of a Scientific Fact*. Further articles by and about Fleck appear in Cohen and Schnelle, *Cognition and Fact*. Explicit philosophic accounts of scientific texts include Joseph Agassi, *Faraday as a Natural Philosopher*; M. A. Finocchiaro, *Galileo and the Art of Reasoning*; and Edward Manier, "Darwin's Language and Logic."

tioned situation.<sup>4</sup> A political scientist or a medical researcher writes as part of an evolving discussion, with its own goals, issues, terms, arguments, and dialect. The history frames both the rhetorical moment and the rhetorical universe.

Psychology seemed also to have an important place. As a historically realized, social, epistemological activity, writing is carried on through people. People write. People read. What a text is must take into account how people create it and how people use it. The socially situated study of writing directly implies an interest in psychology, for in every situation, coming and going, writing vanishes into the black boxes of human nervous systems.<sup>5</sup>

All this contexting of writing as a multidimensional activity, finally, forced me to confront the traditional view of the word as a separable, textual fact. If the written word could only be understood within a historical, social moment, that would vex many of our habits of looking at language and texts as fixed structured systems of meaning. On the other hand, to conceive of meaning creation as fluid threatens to cast language loose on unchartable seas. Moreover, such an unmooring of language threatens to undermine the motivating impulse prompting this research. What does learning to write better mean if we cannot moor meaning to language? Thus I had to confront language theory.<sup>6</sup>

As the serious interdisciplinary base for the research broadened, fortunately the superficial interdisciplinary base narrowed a bit. Since context was becoming increasingly important to my understanding of knowledge texts, I sought some degree of uniformity of context by con-

4. Historical literature is cited throughout this book within the context of each study. Historical studies that specifically consider the role of text and language in the development of science include Peter Dear, "Totius in Verba"; B. Eastwood, "Descartes on Refraction"; Frederic Holmes, "Scientific Writing and Scientific Discovery"; Martin Rudwick, *The Great Devonian Controversy*; and Steven Shapin, "Pump and Circumstance."

This book can also be seen as part of the examination of the technology and consequences of literacy as historically developing processes. Landmark works in this area include Eric Havelock, *The Greek Concept of Justice*; Jack Goody and Ian Watt, *Literacy in Traditional Societies*; Jack Goody, *Domestication of the Savage Mind*; Elizabeth Eisenstein, *The Printing Press as an Agent of Change*; and Sylvia Scribner and Michael Cole, *The Psychological Consequences of Literacy*.

5. In social psychology I have been most influenced by the works of George Herbert Mead, Harry Stack Sullivan, and Lev Vygotsky. The latter has been of particular interest to me because of his analysis of symbolic behaviors as the concrete mechanism of social cognition. I will discuss some of his ideas in chapter 11.

6. Linguistic theory and its reflections in studies of scientific language are discussed in the beginnings of chapters 2, 6, and 7, and throughout chapter 11.

sidering the sciences, with physics, and even more narrowly optics, becoming a central research site.

This decision was in part fostered by an early and continued contact with the sociology of science which offered many contextual maps to guide my way. Examining the writing in science seemed a particularly important challenge for several reasons. First, the statements made through scientific discourse have been socially and culturally important in ways I hardly need elaborate; we are constantly rebuilding our world upon the statements of science. Second, scientific methods of formulating knowledge have been highly successful in gaining almost universal assent to claims hardly accessible or persuasive to common sense. Third, as a result of science's great success, habits of scientific discourse have influenced almost all other areas of intellectual inquiry. By unpacking scientific language one can come to understand important influences in all disciplines. Finally, scientific language is a particularly hard case for rhetoric, for sciences have the reputation for eschewing rhetoric and simply reporting natural fact that transcends symbolic trappings. Scientific writing is often treated apart from other forms of writing, as a special code privileged through its reliance on mathematics (considered a purer symbolic system than natural language). If one can show the workings of formulating practices in sciences on the kinds of statements science produces, one can begin to mine important depths of rhetoric.<sup>7</sup>

Of course the sciences, or even one science, or a single specialty within science, is far from a single, unmixed discourse community. The more I looked at varieties of scientific texts, the more I saw, with Darwin, that variation is everywhere the rule. So I narrowed my view further, on a single mechanism generating similarity throughout the wide expanses of variation: Genre, and one genre in particular.<sup>8</sup> The emergence and

7. By rhetoric I mean most broadly the study of how people use language and other symbols to realize human goals and carry out human activities. Rhetoric is ultimately a practical study offering people greater control over their symbolic activity. Rhetoric has at times been associated with limited techniques appropriate to specific tasks of political and forensic persuasion within European legal institutions. Consequently, people concerned with other tasks have considered rhetoric to offer inappropriate analyses and techniques. These people have then tended to believe mistakenly that their rejection of political and forensic rhetoric has removed their own activity from the larger realm of situated, purposeful, strategic symbolic activity. I make no such narrowing and use rhetoric (for want of a more comprehensive term) to refer to the study of all areas of symbolic activity. I elaborate these views later in this chapter and in chapter 12.

8. In literary studies, attempts to understand and define genre have a long history, dating back to the first literary critic, Aristotle. In general these attempts have been either formal or essentialist, defining genre by a collection of recurrent features or by comprehensive typologies of literary types. Sometimes the two have been connected,

transformation of the single genre of the experimental report runs as a common thread throughout the natural sciences of the last three centuries and the social sciences of this century.

Clearly, many other genres of great significance have emerged in the sciences. Important stories remain to be told about theoretical articles, reviews of literature, speculative articles, handbooks and other reference works, proposals, and various pedagogic genres—their separate histories and interrelationships. Yet the experimental report has a ubiquity that seems to overshadow the others. The experimental report seems central to many conceptions of the sciences as empirical inquiry.<sup>9</sup> The experimental report has developed as a favored solution of the problem of how to present empirical experience as more than brute fact, as a mediated statement of inquiry and knowledge.

While features of the genre may emerge as individual solutions to

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with the features seen as resulting from some more fundamental dynamic of the text, such as the structure of elegy derived from a psychology of grief and consolation (see, for example, Scaliger). Two recent volumes reviewing the debate over genre and adding many interesting observations about the workings of genre in literary contexts are Heather Dubrow, *Genre*, and Alastair Fowler, *Kinds of Literature*.

However, attempts to understand genre by the texts themselves are bound to fail, for they treat socially constructed categories as stable natural facts. Recently Ralph Cohen has argued against formalist and essentialist views and presented a more socially constructed view of literary genres as “historical assumptions constructed by authors, audiences and critics in order to serve communicative and aesthetic purposes” (210).

The most thoroughgoing analysis of genre as a social phenomenon, nonetheless, comes from rhetoric and not literary studies. Carolyn Miller in “Genre as Social Action” considers genres “as typified rhetorical actions based in recurrent situations” (159). The typification of rhetorical actions entails the emergence of recognizable text types marked by repeated formal elements. Recurrence of social situation is itself a socially constructed recognition. Thus the emergence of genre goes hand in hand with the emergence of generic situations, with the rhetorical action itself helping to define the situation. Miller, following Alfred Schutz, relates genre, as a social institution, hierarchically to other forms of social typification.

My analysis of genre follows Miller, both in the importance of social understanding of text and situation in the emergence of genre (see chapters 3 and 4) and in the interplay between typification of texts and typification of other social understandings (see chapter 5). A recent article by Paul DiMaggio develops important sociological consequences of a similar definition of genre. Unfortunately it came to my attention too late to be incorporated into my argument. In particular it has implications for the argument of chapter 5 here.

9. Theory testing through experimentation is a major premise of both positivist and Popperian philosophies of science and has roots going back to Isaac Newton’s concept of crucial experiment (see chapter 4 below). Although all these have come under vigorous and valid criticisms, experimentation has had a robust and enduring role in science. Hacking’s *Representing and Intervening* is a recent attempt to explain the central role of experiment in scientific practice.

various rhetorical problems, the regularities that appear in the genre come from the very historical presence of the emerging genre.<sup>10</sup> Writers find in existing models the solution to the recurring rhetorical problems of writing science. As these solutions become familiar, accepted, and molded through repeated use, they gain institutional force. Thus though genre emerges out of contexts, it becomes part of the context for future works. Thus the social fact of genre has given the study a peg to rest on. The emergence of the genre of experimental report is a social reality that helps shape discourse in a great range of disciplines. Now anyone with results to report must somehow address the context created by the social fact of this genre.

Yet we must be careful not to consider this genre as a unitary social fact. Formal definitions, expected features, institutional force, impact, and understandings of the genre vary through time, place, and situation. And that variation is an important part of the story. Each new text produced within a genre reinforces or remolds some aspect of the genre; each reading of a text reshapes the social understanding. The genre does not exist apart from its history, and that history continues with each new text invoking the genre. So the largest lesson that this study holds is not that there are simple genres that must be slavishly followed, that we must give students an appropriate set of cookie cutters for their anticipated careers, but rather that the student must understand and rethink the rhetorical choices embedded in each generic habit to master the genre. Although genre may help stabilize the multiform rhetorical situation of scientific writing and may simplify the many rhetorical choices to be made, the writer loses control of the writing when he or she does not understand the genre.

Since the genre I have chosen to study (like all genres) is no unitary thing, and since the canvas of scientific writing is vast and growing, this first inquiry is a spotty affair. I have investigated those spots which seemed to be crucial and about which I could gain some knowledge given my limited and happenstance resources. I did what I could. Major episodes of emergence and transformation are missing or only con-  
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10. A rhetorical problem is the set of constraints and goals recognized by a person framing a symbolic response within a rhetorical situation. A rhetorical situation consists of all the contextual factors shaping a moment in which a person feels called upon to make a symbolic statement. The identification and elaboration of rhetorical problem, situation, and moment are construed by the individual through that individual's perception, motivation, and imaginative construction, although the individual's desire to gain more information about the situation, problem, and moment can lead to more intimate understanding of these things (see Bitzer; Vatz; and Consigny). Jamieson makes an early (1974) connection between genre and regularization of rhetorical situation.



tured about; some parameters of variation are explored, others not; the range of variation is not mapped at all; some implications are explored, and others sidestepped. Further research may modify or reverse many of the claims made here. I see this work as a beginning, but a beginning that has afforded some insight into fundamental processes about writing in the sciences and about writing more generally. Using the tools and texts available to me, I have been seeing what kinds of things could be said.

## Writing as an Interdisciplinary Concern

This account of increasing intellectual scope and sharpening research focus overlooks many of the thickets I found myself in along the way. Borrowing material and ideas from other disciplines comes at a price. The work in each discipline is framed around the problems and discussion internal to that field. In order to understand what I needed from the sociology of science or the philosophy of science or the history of science, I had to encounter them in the context of their own problematics. To steal random parts of different engines leaves one with a junkpile, even if one can create the appearance of a coordinated assembly.

Yet entertaining the discussion of a new discipline offers continual temptations of novel and important issues. The problematics of each discipline contain their own intrigue and motive. Keeping my own problematics clear while still taking seriously the problematics of others, translating from one conceptual system to another without distorting ideas beyond good conscience, is a struggle I cannot ever be certain of having won. Nonetheless, the struggle constantly poses the question, What is the fundamental goal of the study of writing? To that question I have been able to find no better answer than the practical goal of helping people (myself included) to write better. That goal suggests a facilitating question: How does writing work? The assumption linking the two is the naive one that writing improves through intelligent choice of the linguistic resources in any situation; the more we understand how writing works, the more intelligently we can control our choices.

Unfortunately for writing researchers, but fortunately for human beings, writing works socially, historically, philosophically, and psychologically. Writing occurs in writers and readers living in complex worlds. The page is no more than a score is to a Scarlatti sonata performed in a Santa Barbara living room or than a script to a production of *Oedipus Rex* in a Hyderabad auditorium—an archive mediating between

an imagined event and a distant realization. To help people write more effectively we need to unpack the entire transaction and identify what the words are doing in the middle.

Nonetheless, as my findings started to take shape, I found they did start to reflect back on the problems of these other disciplines. Writing is a social action; texts help organize social activities and social structure; and reading is a form of social participation; thus, saying something about writing is saying something about sociology. In regard to philosophy, writing is the statement of what we know and reading is a way of learning; epistemological implications keep leaking out of the edges. Texts, as written and as read, are important historical events and the dynamics of the communication embody historical forces; in giving rhetorically sensitive accounts of historical events, we uncover new dimensions of history.<sup>11</sup> Any claims about how writing works are claims about how people handle words—a major issue in psychology and linguistics.

I found myself continually being drawn over the interdisciplinary cliff. I could not simply borrow without addressing. Particularly in the later chapters, as I draw the pieces of the puzzle together, the story becomes one that sits between disciplines, focused on an activity that is prior to the many branches of knowledge which are currently interested in it. The final conclusions I draw pertain to a praxis of writing, but a writing praxis so integrated with social, epistemological, psychological praxis and events-in-the-making that the problem of choosing which words to put on a page looks outward to the whole world rather than inward to a contained technology.

To anyone open to the gusts of intellectual zeitgeist, such an interdisciplinary location and import for the study of writing is hardly a breath of fresh air. Today, theory and research in many fields are claiming words to be the turtles upon which both the world and their disciplines rest. Wittgenstein, Derrida, Foucault, and other astral lights of the postmodernist pantheon remind us that we all talk in words, and words are just talk. Language is situated and ephemeral, a momentary realization of protean life forms. Rhetoric has again threatened, as in the scholastic middle ages, to become the queen of the sciences.

The academic atmosphere has been infused with linguistic structuring of textual organization, literary deconstructions of textual relations, sociological readings of social construction through language, historical reconstructions of rhetorical events, psychological restructuring of cognition, philosophical poststructuring of consciousness, and critical de-

11. See, for example, Hayden White, *Tropics of Discourse*, and D. La Capra, *History and Criticism*.



structions of entrenched discourse in all disciplines. The doings and undoings of language on all fronts have made this an exciting period in which to wonder about writing.

Yet it seems only in the last decade that such concerns have become general. Earlier in this century only a few philosophers, radical social scientists, and literary theorists seemed to hold these mysteries in their hands, despite the long preoccupation with rhetoric of the pre-twentieth-century world. When I began this inquiry, few people (except us drudges hired to teach composition) expressed any interest in nonliterary writing. Literary studies of nonfiction rarely ventured beyond belletristic biographies and autobiographies. Even linguistics had for a half-century abandoned written language as an unnatural phenomenon. Study of writing was considered necessary only for the grossly incompetent; the knowledge to be transmitted was of the kind already mastered by skilled junior high school students.

The renewed dignity for the written word, however, still maintains about it the aura of theory and philosophy. Rhetorical analysis has become the grounds for radical critique and epistemological ponderings. Concern for the role of the word in making our world has more often seemed a form of withdrawal or denial of the world, demonstrating that all these things we have once thought so solid were only the projections of evanescent symbols. The debunkers of illusions have exposed us all as charlatans of the word with only philosophic self-consciousness as a consolation. Proposals for the application of this new rhetorical self-consciousness to scholarly discourse recommend institutionalizing this critical disengagement in explicit required ironies and self-reflections, in encouraging fictionalizing freedoms and literary markers, in creating visible disjunctions and aporias.<sup>12</sup>

This apostasy from the world seems to me to miss the point of learning about language. For a writer the point of learning about language is engagement—doing it better. That words have great powers is hardly a secret to those who have wrestled with words to make worlds throughout history. Writers' self-consciousness about the power of words is what has allowed them to wield that power, to engage in the world

12. Two examples from sociology are Richard Brown, *A Poetic for Sociology*, and Michael Mulkay, *The Word and the World*. Some of the essays in *The Rhetoric of the Human Sciences*, ed. Nelson, Megill, and McCloskey, reflect similar views, but some present more balanced analysis and recommendations for rhetorical self-consciousness within the disciplines of the social sciences. Two of the contributors to that volume have published noteworthy books developing balanced views of language in the social sciences: Donald N. McCloskey, *The Rhetoric of Economics*, and James Boyd White, *Heracles' Bow*.

through their words. Self-consciousness, reflexivity, to a writer is simply knowing what you are doing, not undermining what you do. This spirit of engagement in the world through language characterizes composition departments, and this is perhaps why they have not gained the status benefits of the new dignity of the word, despite a significant scholarly activity within composition. Put bluntly, composition research is too much committed to aiding language do the work of the world to mesh easily with critical exposé.

On the other hand, writers do have a dyspeptic, despairing, and cynical side. They know how recalcitrant a medium language is, how difficult audiences are, and how easily language can lead writer and reader down foolish paths. Words often fail. Messages go awry. Books remain unsold and unread. Finely hewed portraits of the conditions of this world gain no attention, while mindless hack work plays upon mass illusion. Skilled writers and readers know that language is a slippery affair. Whenever a text actually manages to accomplish anything admirable, it is a hard-won achievement. High hopes must constantly confront limited realities.

The world the writer wants to bring into being through words is often frustrated by the world that actually emerges. One way out of that frustration is the cynicism that finds the world a phantasm, that finds language manipulation a set of empty tricks. Another way out of the frustration is to limit ambitions; a hack is a respectable occupation that simply rehearses already available solutions to well-known writing problems. A hack reinforces the existent world, but does not extend it. But that frustration also can drive a writer back to do better, get it right, bring that more satisfying world into being. That motivation can be said to be the exact one that drives some scientists back to find the right formulation, find the compelling argument that will create a more satisfying world of living knowledge in the human community.

This attitude of engagement and positive concern for the use of language turns many of the issues of postmodernist criticism inside out, even while sharing a number of assumptions. Both the writer and the postmodernist critic consider language as a human activity shaping human consciousness with no necessary connection with objects beyond consciousness. But for the writer that is the opening situation and challenge rather than the final critique. Similarly, where both see language as socially conditioned, to the writer that is again a starting fact for a dialectical relationship between social givens and individual experiences, motives and inventiveness. While both see institutionalized social relations in received forms, the writer sees those institutions as prior achievements forming opportunities for new achievements.

While both see reading and textual interpretation as having as much to do with the readers as with the text, the writer sees responsibilities for both writers and readers to find in the text as much meeting ground as they can, rather than cutting each free to make of the text what they will. While the writer is impressed with the world of human consciousness created from nothing and thus feels responsible to participate in that creation of the human world, the postmodernist critic finds the human world made from no more than phantasms of nothing. In short, the writer is always looking with delight and surprise at what can be done with this fallen state.

### **Scientific Writing as an Accomplishment**

The evaluative language of the last few paragraphs is no accident or methodological oversight. Writing is choice making, the evaluation of options. To view writing from the prospect of language users is to consider the benefit of some choices over others. Such an evaluative position would seem forbidden from both a social scientific objectivist position and a postmodernist relativist position—one would deny the propriety, the other the basis, for such judgments. Yet any praxis-oriented constructivist study cannot avoid evaluative assumptions built in somewhere. To mark human constructions as worthy of attention is to valorize accomplishments. To be curious as to how these things were accomplished implies a desire to imitate, incorporate, or outdo. To study choices is to notice what they accomplish and what they don't. To develop a praxis from such study is to encourage some lines of development for human society at the expense of other developments or nondevelopment. Finally, practical goals necessarily provide an evaluative framework for the entire scholarly endeavor.

A not-very-hidden assumption of this study is that the corpus of scientific writing is one of the more remarkable of human literary accomplishments. Innovation, complexity, intricacy, social influence, and simple extensiveness of the corpus make scientific writing interesting as an object of study and important as part of human society. The literary accomplishment is more narrow: the development of linguistic means for statements that move toward relatively stable meaning and assent among people sharing wide numbers of social variables (even while sharing participation in scientific activity). Moreover, these statements seem to give us increasingly immense control of the material world in which we reside. These symbolic representations have literally helped

us move mountains and know when mountains might move on their own.

To someone who approaches scientific writing from the point of view of rhetoric, it is no surprise that people have different interests in communicating, that they disagree, that they will understand statements differently, that alternative descriptions are possible, that different contexts will lead to very different kinds of statements, statements so different as to seem to be contradictory. What else would one expect from human beings in contingent human society? What is remarkable is that statements emerge over time, that for all practical purposes these statements represent an overwhelming consensus as the best of currently available formulations, and that these formulations are sufficiently reliable to be near infallible for most practical purposes, such as operating microwave ovens.

The more I study scientific writing, the more I see how much work, thought, intelligent responsiveness to complex pressures, and fortunate concatenations of events went into creating this evolving and manifold linguistic system that could do these things. For the purposes of science, it is a remarkable achievement. Such a successful discourse system within its own domain, however, does not necessarily displace other linguistic systems in theirs. Poetry, law, and rhetorical analysis have developed their own discourse systems to meet their situations and goals. Recurring themes of this book are, in fact, the variety of discourse systems and their relation to evolving communities.

One peculiar aspect of the accomplishment of scientific discourse is that it appears to hide itself. We know that poetry, laws, and newspapers are the active products of word-hagglers. The only ploy to minimize human linguistic agency in these endeavors is to invoke divinity, muses, or the depths of the human psyche. Yet to write science is commonly thought not to write at all, just simply to record the natural facts. Even widely published scientists, responsible for the production of many texts over many years, often do not see themselves as accomplished writers, nor do they recognize any self-conscious control of their texts. The popular belief of this past century that scientific language is simply a transparent transmitter of natural facts is, of course, wrong; the evidence presented in this book only confirms this conclusion argued so forcefully and frequently in recent years. It is nonetheless fascinating that such a misconception could have thrived so well in the face of the massive linguistic work that has gone into scientific communication. This attests to the success of scientific language as an accomplished system. So much has already been done, and hides so far behind the

scenes of current practices, that using the language seems hardly an effort at all.

The apparent transparency of the system to the latercomers is something then imputed back to the firstcomers and makers of the system. This book, examining the many rhetorical choices evidenced over the last three centuries, should help dispel the view that scientists never have and never will write. Sometimes scientists' rhetorical choices are self-conscious responses to perceived rhetorical problems; sometimes they are unselfconscious impromptu inventions; sometimes they are slow and imperceptible shifts. In whatever way these writing choices are realized and become institutionalized, they shape the kind of thing we consider contributions to knowledge. To unpack what kind of thing a contribution to knowledge is, we need to see what these choices originally were and why they were made. We need to see what kinds of mechanisms are embodied in current unreflective practice. And by bringing unreflective practice to attention, we reassert conscious control over it.

The concern for actual practice leads to a smaller role for rhetorical theorists than is usual in rhetorical histories. The actual writers of scientific texts take center stage. Although a number of chapters here focus on scientific language in seventeenth-century England, Bacon appears only in his influence on practicing scientists as they interpret and attempt to realize his ambitions in their writing. Spratt and Wilkins are only minor background characters. Newton emerges in the forefront of actual innovation in rhetorical practice, and Oldenburg by rearranging the context of communication seems to wield great force in shaping communication.

No attempt is made to reread and reinterpret the classics of rhetorical thinking, except as they shed light on the rhetorical climate. Too often the history of rhetoric has meant the history of prescriptions and theories; the actual living practice has seemed less real than the prevailing theories. Certainly, prevailing theories bear important relationships to practice as social facts defining an intellectual climate of attitudes and understandings. But the history of rhetoric must be read more subtly and dialectically than has been the case.

This overreliance on theoretical statements read without concern for their impact on praxis has led to mistaking ambitions and goals for accomplished realities. This has been particularly the case with theories of scientific language. Bacon's desire to expunge the language of science from the four idols does not arise from the ease or even absolute possibility of doing so; quite the contrary, it arises from the contrariness of

human language. Bacon's goal of finding better ways to describe that which is, rather than that which we imagine, helps create some interesting linguistic proposals, but it does not mean that epistemological magic has been performed. The attempt to realize these goals leads to particular kinds of rhetorical activity, even though the goals may be unreachable ontologically. Similarly, in epistemological terms Wilkins' attempt to create a philosophic dictionary of pure correspondence between words and things is a silly mistake, doomed to failure, but when we look at the project within the history of lexicography, we see his ambitions helping create the modern dictionary, which tries to establish the complete semantic range of a language, comprehensive of all words and meanings. Previously, only lists of difficult words had been compiled (Dolezal). What is important is the emerging practice; the contemporary theory is best understood as part of the historical dynamic—inspiring, encouraging, justifying, or hindering the practice.

## Synopsis

In the attempt to understand what scientific language has become in practice, this book consists of a series of case studies. In chapter 2 the analysis of three texts will suggest how much differences in writing matter. The differences are not just on the page, but in how the page places itself with respect to social, psychological, textual, and natural worlds. By examining texts from three different disciplines, we see what very different textual objects they are and what different worlds they reside in. The remainder of the book will look more exclusively into scientific writing, concentrating on the genre of experimental report.

The second part of the book looks at the early emergence of the experimental article. One chapter examines the changing form of the article over the first hundred and thirty-five years of the *Philosophical Transactions of the Royal Society of London*, pointing to the shaping role of conflict. The next chapter examines Newton's struggles to find a textual form for his optical findings to contend with the controversial dynamics of journal publication. The last chapter of the section examines how the organization of scientific communication in journals had impact on the social structure of the scientific community.

The third part looks at more recent developments in the genre of experimental article within physics. A historical examination of spectroscopic articles in *Physical Review* suggests how the increasing role of theory has reshaped the experimental article. A study of the forces



shaping an article by the early twentieth-century physicist Arthur Holly Compton considers how he used experiments as a resource and a constraint in arguing his views. An interview study of how contemporary physicists read research articles indicates how deeply their readings are embedded in their practice of science.

The fourth part examines the diffusion of the experimental report to the social sciences in this century. A historical survey of the development of writing in experimental psychology resulting in the American Psychological Association *Publication Manual* considers how the rhetoric of the experimental article is reshaped around the epistemology of the field adopting it. Finally, a look at some recent articles in political science reveals some tensions between the project of the discipline and the wholesale adoption of a transplanted form.

The closing chapters examine the implications of these studies for our understanding of language and our practice of writing.

These chapters are far from complete and I could just as well have written an anti-contents, of all the topics and issues not investigated. Yet the bits of the world I have tried to recreate here, I hope will begin a new world of rhetorical understanding of how we make statements about the world. It is for what comes after to give greater substance to that world or to let that world fade into the pale graveyard of failed visions.