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## Rhetoric of Science, Rhetoric of Inquiry, and Writing in the Disciplines

A third cluster of approaches to writing across the curriculum arises from various groups of researchers, theorists, and critics who have examined the specialized languages of the disciplines, professions, and sciences. This examination has been motivated by several different professional positions, goals, and assumptions—including disciplinary self-examination, postmodern critique of scientific authority, rhetorical critiques of epistemology, and first and second language instructional concern for the specialized forms of writing students must gain competence in. These inquiries have gone under various names—Rhetoric of Science, Rhetoric of Inquiry, Writing in the Disciplines, and English for Specific Purposes. Collectively, however, these differently motivated and framed inquiries contribute to a common picture of writing practices in the various disciplines and the relation of those processes to the production and use of disciplinary knowledge. They help us understand how different disciplines construct knowledge through different textual forms, and the kinds of challenges students must meet when learning to write within their chosen fields. They thereby provide a more precise focus for write-to-learn pedagogies by identifying the specific forms of disciplinary writing with the kinds of knowledge and analytical tasks the discipline requires of students.

## The Politics of Academic Knowledge— Anthropology's Self-Examination

Anthropology has had long awareness of the role of symbols (for example, Lévi-Strauss, 1975), language (Sapir, 1949), and communicative practices in the formation of cultures. It has also had long interest in the role of language and language practices in the distribution and attribution of power, and it also has had some small awareness of the processes by which work is assembled and texts produced (Bateson, 1958, or the parody “Body Ritual among the Nacirema” (Miner, 1956) often reprinted in freshman anthologies). However, in the late 1970s these issues came together in a reflexive examination of the way anthropological ethnography was written to create particular forms of authority and knowledge from the perspective of dominant western culture. Several articles around 1980 (Crapanzano, 1976, 1977; Clifford 1980, 1983; Marcus 1980a, 1980b; Marcus & Cushman, 1982) foregrounded the role of writing in the making of ethnographic knowledge. Further, several self-conscious experiments in reflexive writing attempted to put this awareness into practice by creating new forms of ethnography (Geertz 1973, 1976, 1980; Crapanzano, 1980; Rosaldo 1980). Because of the discipline's long practice in looking at the relations of language and culture and its cosmopolitan perspective, when the lens was turned on their own knowledge producing practice, the scrutiny and debate were intense. The critique took on rapid momentum and great force—focusing on the production, role, meanings, cultural authority, and power relations instantiated in the ethnography.

The discussion eventuated in a 1984 conference (Marcus & Clifford, 1985), and a consequent volume, *Writing Culture* (Clifford & Marcus, 1986), which has become widely cited as a central work in anthropology's reflection on its rhetorical practices. In one of the chapters of the volume, Mary Louise Pratt examines the ethnographer's self-portrayal as an authoritative investigator, particularly in relation to the opening scene of arrival in the exotic locale. Renato Rosaldo considers how the pastoral mode of ethnography both suppresses and reveals the interplay of power and knowledge by allowing the ethnographic narrator “to enjoy relations suffused with a tender courtesy that appears to transcend inequality and domination.” Nonetheless, “the figures of the inquisitor and the fieldworker still haunt the authors” (Rosal-

do, 1986, p. 97). James Clifford analyzes the narrative allegories of ethnographies, as they both evoke metaphorically familiar narratives and freight the narratives with allegorical meanings about the human condition. Stephen Tyler finds in ethnographies postmodern performances of the occult. Asad and Rabinow in their chapters consider ethnographies' relations to the western academic audiences for which they are produced, forming a textual representation of other cultures.

Geertz, in a 1988 volume *Works and Lives*, views a number of ethnographic classics as pieces of writing, produced by the particular writing habits and situations of their eminent authors. In 1989, Spencer provides a useful review of the discussion to that point. In the same year, Roth finds this reflective examination of ethnography less epistemologically consequential than others have found it; his challenge is followed by a number of responses by some of the key authors in this project, to form a pointed symposium (Roth, 1989). Sanjek's 1990 collection *Fieldnotes* examines the centrality, mythology, and detailed practices of making fieldnotes and their role in the production of anthropological knowledge.

As a result of this period of intense anthropological self-scrutiny, ethnographies have taken on new forms. Among other concerns, new ethnographies exhibit awareness of the stories they construct, sensitivity to the relation with the informants and local people who provide information, consciousness of the traps of considering "the other," and attempts to contend with the systems of authority and domination that support professional anthropology. Also new ethnographies exhibit awareness of the changing global environment, which brings all cultures into contact with each other and reveals all societies as always undergoing transformation. Part of this awareness that no society is an isolated exotic other is the development of the multi-sited ethnography, discussed by Marcus (1995).

### The Social Location and Purposes of Academic Writing—Sociology's Rhetoric

The earliest work to explore the rhetorical dimension of sociological scholarship appeared in the 1970s. Sociologist Joseph Gusfield (1976) used rhetoric to examine the knowledge produced in his own field and to develop a reflexive stance towards sociological knowledge as produced for social purposes within social circumstances. In his "Literary

Rhetoric of Science,” he challenged the long-held belief that language serves merely an ornamental function in the production of knowledge by analyzing an influential research paper on drunk driving through the critical lens of Kenneth Burke’s (1945) pentad. There he presents the development of knowledge as a social drama, beginning with the very definition of certain issues as social problems, requiring research to seek socially desirable answers. Although the research emerges as part of a social drama, the research papers are written, he notes, in the passive voice, effectively removing the author and creating the perception of objectivity. Agency is then attributed to the research methods, Gusfield notes, through personification, thereby seeming to provide the audience a privileged access to “external reality [which does] [...] the persuading” (Gusfield, 1976, p. 20). “The writer must persuade the audience that the results of the research are *not* literature, are *not* a product of the style of presentation. The style of nonstyle is itself the style of science” (Gusfield, 1976, p. 17). This analysis of the historically located rhetorical character of social knowledge sets the stage for his investigation of social problems research in his book, *The Culture of Public Problems: Drinking-Driving and the Symbolic Order* (Gusfield, 1981).

An additional interesting study of sociological writing is James Bennett’s *Oral History and Delinquency: The Rhetoric of Criminology*, which considers the historical conditions under which sociology turns from other modes of inquiry toward oral history (1981). Through a detailed study of major texts in the history of criminology, he finds that when industrialization leads to growth of complex urban societies, oral histories serve to explain and make meaningful the plight of lower class delinquent youth to middle class publics. The complex urban societies also lead to an increase of individualism at the same time freedom-restricting criminal punishments replace traditional communal values and controls. This tension makes for compelling personal stories. The emergence of such stories, however, also requires audiences who are unfamiliar with the lower classes without being repelled by them, ready to believe reports of lower-class life and be persuaded by their cause. Similarly, such stories need to find their champions in criminologist story tellers who identify with the people they report on, who are offended by hypocrisy, and who themselves are somewhat socially marginal sociologists to demonstrate that scientific papers were

argumentative, and not direct and unmediated representations of the “facts” of the laboratory.

Richard Harvey Brown in *A Poetic for Sociology* systematically examines the role of aesthetics in creating persuasive sociological texts. In particular, he examines point of view, metaphor, and irony as though sociological texts were novels. In the course of examining how a variety of influential sociological texts work, he concludes that these texts rely on a “relationship between logic and feeling, between science and art” (221). In consequent books Brown (1987; 1989; 1992) extends his inquiry into unconventional and individually creative elements of knowledge formation in the social sciences. Paul Atkinson in a similar vein examines the narrative construction of sociological ethnography in a wide range of sociological texts in *The Ethnographic Imagination* (1990). He particularly attends to the construction of authority, the representation of characters and social action. In a later book, *Understanding Ethnographic Texts* (Atkinson, 1992), he considers how the complexity of life becomes represented within sociological ethnography, including the role of fieldnotes and recording devices. Van Maanen’s *Tales of the Field: On Writing Ethnography* (1988) also examines sociological ethnographic writing (see also Van Maanen, *Representation in Ethnography*, 1995). Finally, the sociologist Howard Becker has written an influential guide to *Writing in the Social Sciences*, which reveals the perspective of a major working sociologist on what is really important in sociological writing (Becker, 1986). A follow up book on ethnographic technique, *Tricks of the Trade* (1998), also contains much insight into sociological writing.

### The Rhetoric of Economics and the Rhetoric of Inquiry

The rhetoric of inquiry movement was developed by a number of practicing scholars in the social sciences (with a core group at the University of Iowa) who were interested in the rhetorical practices of their own fields so as to open up the range and character of inquiry and knowledge making. They largely felt that standardized forms of argument in their fields hid their narrowness of perspective, delegitimized other important lines of inquiry, and obscured important issues that needed discussion. In 1985, Deirdre McCloskey’s critique of neoclassical economics in *The Rhetoric of Economics* joined the question of

rhetoric and epistemology within mainstream economic thought. The overarching iconoclastic thesis is simple: economics is rhetorical. Like mathematics, physics, and biology, economics is “a persuasive realm where the work [is] done by human argument, not godlike Proof” (McCloskey, 1985, p. xii). After criticizing modernism and introducing a small cadre of rhetorical concepts to her readers, McCloskey moves toward an understanding of economics in literary and rhetorical terms. The book examines the reasons economists believe in their flagship theorem—the law of demand—and argues that only the first three reasons are scientific, while the remaining eight are artistic and literary. Other chapters illustrate the rhetoric of economics through case studies of Paul Samuelson, Gary Becker, Robert Solow, John Muth, and Robert Fogel. Another chapter demonstrates how one young economist, Ronald Coase, appealed to a sort of Euclidean rhetoric of axiom, fact, and proof to compensate for his junior status and unknown reputation within the field. Yet all of McCloskey’s chapters work toward a common thesis: old-fashioned notions of scientific method do little to demonstrate the assent of economic claims within the field; instead, economists rely substantially on rhetoric—on creative analogies, thought experiments, aesthetic predilections for symmetry, quantification, metaphysical propositions, and authority—to persuade their readers of the veracity of their claims. That language constitutes rather than clothes economic knowledge, that rhetoric should replace the failed modernist methodology, and that new students of economics would benefit from a rhetorical awareness of their own field: these are the central themes of McCloskey’s influential book.

Before McCloskey there had in fact been some other economists who were developing awareness of the role of language and argument in their field. Nobel laureate George Stigler (1982) provides one of the earliest direct gestures toward rhetorical awareness in economics through his anthology, *The Economist as Preacher and Other Essays*. In “Textual Exegesis as a Scientific Problem,” for example, Stigler addresses the difficulty of interpreting a text that contains inconsistent passages. Rejecting the common practice of reconciling passages based on cursory similarities, Stigler encourages economists to adopt a more meaningful evaluation of each passage in question based on (1) its “consistency with the main analytical conclusions of the system of thought under conviction,” a concept he calls the principle of scientific exegesis, or (2) its consonance with the author’s underlying “style

of thought,” which he calls the principle of personal exegesis (Stigler, 1982, p. 69). It is a short lesson in reading and interpreting economics that Stigler has in mind, perhaps one of the first in the history of modern economic discourse.

Later essays in Stigler’s collection also focus on discourse practices but from a more sociological perspective. In “The Pattern of Citation Practices in Economics,” for example, Stigler examines a variety of citation practices in economic discourse from 1885 to 1969 and concludes that (1) successful economics scholarship quickly becomes embedded within the general corpus of science and stripped of its citational linkages back to particular authors or works, and (2) the quantity of an economist’s work plays a minor role in how often he or she is cited. In “The Literature of Economics,” Stigler focuses on the literature of normal economics (in the Kuhnian sense) and concludes, quite remarkably, that (1) adverse empirical evidence is not a decisive factor in a theory’s decline, and (2) roughly two-thirds of the published economic literature adds nothing to economic theory or findings.

Although Arjo Klamer’s (1984) *Conversations with Economists* highlights the argumentative element of economics, it took McCloskey’s (1985) *Rhetoric of Economics* to propel the rhetoric debate into mainstream economics discourse, touching off a heated debate concerning methodology and argument in economics. Typical of the work done in this vein is the fourth volume of *Economics and Philosophy*, published in 1988, in which four economic methodologists respond to McCloskey’s work with varying degrees of contempt. In “How to Combine Rhetoric and Realism in the Methodology of Economics,” Maki (1988), for example, mildly scolds McCloskey for muddling multiple conceptions of realism under the single term; Maki then proceeds, in seeming support of McCloskey’s main thesis, to differentiate among various forms of realism as a way to approach the concept of a rhetoric-with-realism more successfully in economics. On the other hand, Rosenberg (1988) vehemently rejects McCloskey’s entire platform; for Rosenberg, by attempting to reduce economics to a mere “genre” of literature, in which reality and knowledge need not exist, McCloskey’s work is best read as a “Sophistic invitation to complacency about economics and an attempted seduction of the discipline into irrelevancy” (Rosenberg, 1988, p. 130). Economists, not philosophers, according to Rosenberg, have much to fear from McCloskey’s disillusioned work.

In 1994, McCloskey published *Knowledge and Persuasion in Economics*, a full-scale philosophical response to her critics. Drawing from 20th century philosophers of science such as Popper, Ayer, Quine, Lakatos, Rorty, and Kuhn), McCloskey reaffirms the position she sketched a decade earlier. In the preface to *Knowledge and Persuasion*, she repeats the simple message, so misunderstood by her colleagues: "Let me say it again: the people like Arjo Klamer, Roy Weintraub, and me who want to see economics as 'rhetorical' are not advocating flowery speech or the abandonment of mathematics. We are advocating the study of how economists actually persuade each other and the world" (McCloskey, 1994, p.xv). McCloskey also pursued the role of narrative in economic reasoning (1990) and of gender in economic forms of argument (1996). Conversations along these philosophical or methodological lines, instigated by McCloskey's *Rhetoric of Economics*, continue (Amariglio, 1990; Benton, 1990; Heilbroner, 1990; Klamer & McCloskey, 1995; Rossetti, 1992; Samuels, 1990).

But not all of the discussion incited by McCloskey's book is philosophical. The second strand of work following *Rhetoric of Economics* takes on the task of rhetorically analyzing master texts and popular textbooks in economics. Tony Dudley-Evans and Willie Henderson's (1990) *The Language of Economics*, an edited collection of a half-dozen analyses of economic discourse, provides an early example of this scholarship. In "Dancing on Air," for example, Mary Mason analyzes a short passage from an economics textbook in terms of the concreteness and abstractness of its language. In "The Textbook Presentation of Economic Discourse," Arjo Klamer (1990) provides a rhetorical reading of the introductory chapters of 12 editions of Paul Samuelson's textbook, *Economics*. Some works, such as Roger Backhouse, Tony Dudley-Evans, and Willie Henderson's (1993) *Economics and Language* and David George's (1990) "The Rhetoric of Economics Texts," continue along this line of contemporary inquiry, while other scholars, such as Bazerman (1993) and Brown (1994), have undertaken rhetorical examinations of the classic work of Adam Smith.

The rhetoric of inquiry movement gained group visibility in the social sciences beyond economics with the publication *The Rhetoric of the Human Sciences* (Nelson, Megill & McCloskey, 1987), based on a 1984 University of Iowa Humanities Symposium. This collection of 22 essays by economists, historians, sociologists, anthropologists, philosophers, rhetoricians, mathematicians, and political scientists illus-



trates some of the rhetorical dimensions of scholarship ranging from theology to history to mathematics. While the motives and perspectives of the several authors varied, an underlying thesis remained the same, echoing Gusfield's then-decade-old critical perspective against those who would remove the substance of disciplinary knowledge from rhetoric, leaving rhetoric with at best an ornamental function. Rather, those who pursue the rhetoric of inquiry notice rhetorical purposes in the quixotic attempt to make social sciences appear to be objective inquiries: protecting the veracity of findings from tainted ideology or potential collusion and making apparently untainted findings speak for themselves on the pages of scholarly texts. Rhetoric of inquiry takes as its starting point that all scholarship—from biology to theology—is argument. Neither the facts of history nor the proofs of mathematics speak for themselves. Instead, historians and mathematicians must do the speaking, and the sooner we begin to recognize this rhetorical dimension in our scholarship, the sooner we can gain conscious control over our rhetorical decisions and thus improve the quality of our work. The work of disciplinary self-examination through a rhetorical lens continues to be carried out by *Poroi*, a center established at the University of Iowa, which now publishes an electronic journal *Poroi*, available at <<http://inpress.lib.uiowa.edu/poroi/>>.

A few other publications provide interesting perspectives on disciplinary writing in fields whose writing is less frequently examined. *Personal Effects: The Social Character of Scholarly Writing* (Holdstein & Bleich, 2001) presents a number of reflections on the personal in scholarly writing, particularly in the humanities. A. J. Soyland's *Psychology as Metaphor* examines through a series of case studies the role of metaphor in the disciplinary construction of such concepts as memory, development, emotion, IQ, and mind. Although a wide range of psychological literature is covered in each domain, the attempt is not to create a comprehensive account of the debates of the field, but rather to highlight a particular aspect of representational and rhetorical process in each case. Particularly interesting is the book's analysis of the way the metaphor of the promissory note is used to warrant research approaches that have yet to provide the results that would both establish the validity and value of the approach. Finally, *Writing and Revising the Disciplines* (Monroe, 2002) presents personal narratives by a number of eminent researchers in a variety of disciplines reflecting on their writing experiences.

## Scientific Knowledge as Humanly Written—Science Studies

Some sociologists, in the specialties of sociology of science and sociology of knowledge, have turned their eyes to the rhetoric of the natural sciences. They were particularly interested in demonstrating that scientific knowledge was socially produced for social purposes, from within social matrixes of beliefs and practices (Kuhn, 1961, 1962, 1996). Karin Knorr-Cetina (1979) argued from a laboratory study that a scientific paper was produced to appeal to audience interests and was not directly descriptive of scientific work. She expanded on this in her 1981 book *The Manufacture of Knowledge*. Her studies echoed the earlier observation of the notable biologist Peter Medawar (1964) that the scientific paper was a fraud because it created an after-the-fact idealized recounting rather than a detailed chronicle of laboratory events with all its mistakes, misturnings, and wastes of time. Other sociologists pursued similar analyses of the rhetorical reconstruction of scientific accounts (Woolgar, 1981; Yearley, 1981; Gilbert, 1977; Gilbert and Mulkay, 1984; Garfinkel, Lynch & Livingston, 1981), the rhetorical character of experimental work and technology (Collins, 1985; Collins & Pinch, 1982), the formation of the boundary between science and the authority of scientific expertise (Gieryn, 1983, 1999), and the role of representation within scientific practice (Lynch & Woolgar, 1990). Other sociologists (Cozzens, 1985; Small, 1978) were interested in the processes by which some claims got codified in the literature through citation practices.

The most influential sociologically based work in the rhetoric of science was Bruno Latour and Steve Woolgar's (1979) *Laboratory Life*. In this anthropological field study of the Salk Institute, Latour and Woolgar examine the process by which scientific statements gain assent and, ultimately, become accepted as facts by the larger scientific community. Central to this process is another process, "literary inscription": According to Latour and Woolgar, the raw materials within the laboratory are quickly transformed into symbolic currency by the scientists through the routine activities of labeling, coding, and classifying. The materials are further "inscribed" when the scientists subject them to various devices, such as scales, spectrometers, and bioassays, which produce a still more focused symbolic representation of the materials, in the form of graphs, charts, and tables of numbers. At each stage of this literary inscription process, explain Latour and Woolgar,

all previous activities are quickly forgotten; all that matters is the latest symbolic representation, which ultimately gets sent to the office section of the laboratory for incorporation into their primary product: the scientific paper. Latour elaborates the analysis of how technologists and scientists enlist allies through rhetorical means in his 1987 book *Science in Action*. Woolgar, along with a number of other sociologists of science, reflexively applied their findings to their own practices (Woolgar, 1988; Mulkay, 1985; Potter & Wetherall, 1987).

Historians of science, by examining crucial moments in the formation of modern science and the way science has been embedded in local belief and practice, also began to question the authority of scientific writing that represents itself as a historical, non-rhetorical, and disinterested. Steven Shapin and Simon Schaffer in the *Leviathan and the Air Pump* (1985) examine an important juncture of seventeenth century science when one form of argument based on material demonstration before socially credible witnesses that obscured its ideological assumptions (associated with Robert Boyle) was preferred over a more overtly politically grounded mode of argument associated with Thomas Hobbes. Shapin in a later book, *Social History of Truth* (1994), examines the social and ideological basis of trust in particular individuals upon which the credibility of scientific claims began to depend. Schaffer (1994) in an essay examines the rhetorical character of self evidence. Peter Dear (1985) has also examined the mid-seventeenth century moment when the Royal Society seemingly eschewed argument by privileging demonstration over words; he found both large verbal argument in attempting to create the non-rhetorical impression and in continuing a tradition of argument over claims. Dear (1987) also examines the shift from scholastic argument where multiple recurrences and typicality served as empirical proof to the form of argument in modern science where accounts of unusual single events began carrying major epistemic weight. Similarly, he has examined the rhetorical contrast between forms of seventeenth century scientific argument in Catholic countries where unique occurrences were attributable to miracles and were thus not taken into account in scientific explanations and Protestant countries where unique events not only had to be included within comprehensive theories but could serve as strong evidence because they revealed unusual aspects of nature (Dear, 1990). Mario Biagioli (1993) in *Galileo, Courtier* examines how Galileo pursued his science, represented his findings, and created his own

scientific identity as part of his advancement at court. Other historians of science examining rhetoric in the formation of science at different moments of history include Jan Golinski (1992), David Gooding (1990), Larry Stewart (1992), Adrian Johns (1998), and Mary Slaughter (1982). See also the collection *The Literary Structure of Scientific Argument* (Dear, 1991).

## Rhetoric of Science

Rhetoricians also entered into the examination of scientific writing during the same period. John Angus Campbell (1975) in “The Polemical Mr. Darwin” finds Darwin to be a brilliant arguer. Darwin’s persuasiveness starts with his presenting the facts he noted in his travels as obviously true. By then arguing methodically and inductively from those facts, Darwin appealed to his audience’s Baconian belief that “close, dogged observation rather than abstract theorizing was the principle key to scientific advance” (Campbell, 1975, p. 378). Equally important, by proceeding via analogy from the image of a domestic breeder in chapter one to the idea of natural selection in chapter four, Darwin advanced his revolutionary pronouncement within the guise of household Victorian terms. The strategy was effective, according to Campbell, for “so skillfully does Darwin interweave traditional and revolutionary elements that the Victorian reader may here be unaware of the extent to which Darwin’s traditional deference to nature concealed a revolution in the conventional conception of nature” (p. 382). Like the sociologists of Gusfield’s study, Darwin effectively deployed the rhetorical style of non-style, convincing his readers that the veracity of his *Origins* lay somewhere beyond style, somewhere beyond persuasion. For more of his work on the rhetoric of Charles Darwin, see Campbell (1974, 1986, 1989).

In rhetoric, Campbell’s essays were joined by Weimer’s (1977) and Overington’s (1977) philosophical essays, which argued in general theoretical terms for a nonjustificational approach to science and rhetoric. Alan Gross (1984, 1985, 1988), in a series of essays and analyses of scientific texts, followed suit in arguing for the rhetoricity of scientific writing and advocating of relativism as an intellectually respectable position and the creation of the rhetoric of science as a legitimate academic discipline. In his *Rhetoric of Science* (Gross, 1990), he advances

a more epistemologically radical claim: it is not that science has a rhetorical dimension, but that science is, “without remainder,” a rhetorical endeavor. “A complete rhetoric of science,” challenges Gross, “must avoid this accusation: after analysis, something unrhetorical remains” (Gross, 1990, p. 33).

The philosopher of science Shea (1972) had already analyzed Galileo’s arguments in *Dialogue of the Two World Systems* to show that Galileo’s form of argument was a rational procedure. Pera (1994; Pera & Shea, 1991) continued to advance the defense of scientific argument as authoritative and creating solid epistemic grounds for science. The philosopher Steve Fuller (1988, 1993) on the other hand wholeheartedly accepted the idea that science was historical and rhetorical, and that it was important for the public to understand this to allow for full citizen participation in setting science policy.

More concretely, Laurance Prelli (1989) examined the role of rhetorical invention, the rhetorical concept of stasis (or the joining point of arguments), and *topoi* (or lines of argument) in a number of scientific texts. Jeanne Fahnestock (1999) has similarly examined the role of rhetorical figures in science, such as antithesis, incremental series, and repetition. These figures serve as forms of thought as well as expression. Another rhetorical anthology of interest is Herb Simons’ (1990) *The Rhetorical Turn*, which examines the rhetorical dimension of texts in science, politics, and philosophy, among other fields.

The rhetoric of science movement was opened to further critique by Dilip Parameshwar Gaonkar (1990). According to Gaonkar, rhetoric, insofar as it is informed by the Aristotelian and Ciceronian traditions, is a productive art, concerned with generating and presenting speeches in the *agora*. It is not sufficient to be used as a theory of text interpretation, as a “hermeneutic,” as the rhetoric of inquiry movement demands. Second, this productive nature implies a strategic model of communication, which places a disproportionate portion of agency on the shoulders of a perpetually intentional author. Third, because the categories of rhetoric are abstract, rhetoric is “thin” from an analytic perspective. In other words, because terms such as the *topoi* or the tripartite scheme of *logos-pathos-ethos* elude precise definitions, they lack contestability. Consequently, without a more systematic or “deepened” (Gaonkar, 1997, p. 33) set of analytic terms, claims from such studies should not be classified as knowledge. Gaonkar’s critique became the center of a symposium, *Rhetorical Hermeneutics* (Gross

& Keith, 1997), which included responses from Steve Fuller, Deirdre McCloskey, Michael Leff, Carolyn Miller, and others. It is worth noting, however, that Goankar does not engage the analysis of the rhetoric of science coming from writing studies, as presented below—which include approaches that are distinctly more production oriented, that strongly locate text production within historical and social circumstances as well as traditions of communication, and that are empirically grounded.

Another distinct tradition of comment on the rhetoric and literary character of scientific writing comes from scientists and science journalists who are interested in explaining the vitality and thought of science as realized in its writing. This follows a long tradition of appreciation and anthologies of scientific writing (before Darwin, etc.). David Locke's *Science as Writing* (1992) explores essayistically such issues as science's affinity to literature, modes of scientific representation, personalization within scientific writing, rhetorical argument in science, and the reality of writing. Similarly, Scott Montgomery (1996) considers issues of jargon in science politics of scientific translation, and the history of scientific language. In a series of essays, Roald Hoffman (1988, 2002; Hoffman & Laszlo, 1991) has examined how modes of representation in chemistry grow out of different fundamental theories of the nature of chemical matter and processes

Critical studies of science, particularly concerned with gender and race issues, also looked to a study of the role of scientific forms of writing and forms of scientific expression in both fostering genred and racialized knowledge and in favoring particular kinds of participation and participants. Evelyn Fox Keller's biography, for example, considers how Barbara McClintock's style of work constituted "a different language." (Keller, 1983). One of the key themes is the role of situatedness and experience within disciplinary writing; a related theme is the relation between epistemology and expression (Tuana, 1989; Duran, 1998; Keller, 1985; Traweek, 1988; Treichler, 2000; Treichler, Cartwright & Penley, 1998; Harding, 1986, 1987, 1993, 1998). Finally, *Natural Eloquence: Women Reinscribe Sciences* (Gates & Shtier, 1997) presents a number of analyses of women's alternative styles of science writing.

## Writing and Language Focused Approaches to Writing in the Disciplines

Simultaneous with these studies, scholars in writing across the curriculum and technical writing began more intensive investigation of writing in various disciplinary and professional domains. Unlike the critical aim of much of the other work on the rhetoric of sciences, the aim of these writing scholars was pedagogical. By better understanding the literate activity of science, they hoped to be able to improve instruction in scientific writing and provide tools for students and other writers to better understand what they were doing.

The first essay to clearly set out the agenda of investigating the character and role of disciplinary texts was Charles Bazerman's "What Written Knowledge Does" (1981). This comparative analysis of prominent articles in biochemistry, sociology, and literary studies considers how they argue within differing landscapes of authorial role, audience stance, object studied, and disciplinary literatures. The relationships among these four elements represented in the text and how the texts stand in relation to disciplinary community and practice make each text distinctive, "different moves in different games" (p. 387).

To better understand the distinctiveness of those ways of knowing advanced within articles reporting scientific experiments, Bazerman explored the historical development and contemporary use of the genre of experimental article. *Shaping Written Knowledge: the Genre and Activity of the Experimental Article in Science* (1988; available online at [http://wac.colostate.edu/books/bazerman\\_shaping/](http://wac.colostate.edu/books/bazerman_shaping/)) situates the scientific article within its historical and social context and casts communicative success in the light of making effective literate choices in response to local historical circumstances. He found that the invention of scientific journals in 1665 created new argumentative dynamics within new structures of scientific community, making the earlier forms of scientific communication in books and letters less persuasive. Particularly influential in this early period was Newton's concern to create a more mathematical form of argument. The form of scientific articles rapidly evolved over the first century and a half to take on much of the modern shape by 1800, except for modern forms of reference and citation which didn't mature until the nineteenth century. In a later study, Bazerman found the origins of reviews of literature and modern citation practices in the late eighteenth century work of

Joseph Priestley (Bazerman, 1994). Priestley's concern to accumulate the collective experience of nature represents a more cooperative collaborative aspect that is as much a part of scientific communication as competitive argument. The new systems of intertextuality were closely tied to Priestley's social views about the collaborative nature of science and the advancement of the human community. The changes in the form of articles were closely tied to changes in the social relations, theoretical developments, and material practices within the various sciences. A more recent study (Atkinson, 1999) tied major changes in the style of seventeenth and eighteenth science to the replacement of a gentlemanly style of self presentation with a more agonistic professional scientific culture. Also, Battalio (1998a) has traced the changing discourse of American ornithology in relation to the professionalization of the field in the nineteenth and twentieth centuries.

As a consequence of this historical evolution of scientific writing, twentieth century scientists reading and writing such articles did so within well structured sets of concerns and goals with relation to the material world, the material and social technology of their laboratories, the intellectual structures of knowledge that evolved within their fields, and their perceived interaction with their colleagues. Articles in one physics specialty became increasingly organized around and embedded within theory as quantum theory became the standard explanatory tool of the field (Bazerman, 1984a, 1988). Physicists read the literature of their specialties through lenses of their own research projects, their estimates of the communal trajectory of their fields, and their evaluations of the approaches and quality of work of particular colleagues as well as their concrete understanding of the phenomena they were studying (Bazerman, 1985, 1988). And one physicist drafted and revised his essays sharply mindful of the epistemic distinctions made in his field and the kinds of critical evaluations his readers were likely to impose given the arguments current in the field. (Bazerman, 1984b, 1988) The most influential vehicle for the importation of the experimental article into the social sciences has been experimental psychology. The genre was transformed and mobilized through the behaviorist theory and epistemology of the leading figures in experimental psychology. This particular interpretation of the experimental article became institutionalized in the various editions of the *Publication Manual of the American Psychological Association*. (Bazerman, 1987, 1988).



Greg Myers' studies in *Writing Biology* (1990a) track how both research proposals and research articles are socially constructed within review and revision processes, so that the original authors become responsive to the judgments and perceptual frames of their peers in order to gain funding and publication. These processes have consequences for the scope of the claims being made, the theories being invoked, and the kinds of investigations pursued. Myers also considers how scientific presentations for more popular audiences construct narratives of nature rather than narratives of the construction of scientific knowledge. In other publications, Myers has examined how scientists use linguistic devices of politeness (1989) and irony (1990b) in order to soften the confrontational edge of disagreement. He has also examined the function and varying styles of reviews of literature essays by eminent scientists to reconstruct knowledge, suggest the trajectory of future work, and establish forward looking research programs (Myers, 1991).

Blakeslee (2001) has examined how scientists doing interdisciplinary work have come to know and argue to new audiences. This is an ongoing process of interaction and increasing alignment to the audience over time, rather than simply a one-time analysis to shape the rhetoric of a single text.

A good sampler of the many kinds of analysis of scientific writing that have emerged in recent years can be found in the collection of essays *Understanding Scientific Prose*, edited by Jack Selzer (1993). Each of the fifteen essays in this casebook analyzes a single unusual scientific article by Steven Jay Gould and Richard Lewontin (1979) "The Spandrels of San Marcos and the Panglossian Paradigm." The approaches of the analyses include narrativity, intertextuality, cultural studies, gender studies, reader response, classical rhetoric, and linguistic pragmatics. Stephen Jay Gould provides a final response. Another collection, *Essays in the Study of Scientific Discourse* (1998b), edited by John Battalio, equally testifies to the diversity in approaches, methods, and purposes among those who, for reasons pedagogical, epistemological, or other, find the literate activity of scholarly inquiry of sustaining intellectual interest. An archaeological approach to the discourse surrounding Chronic Fatigue Syndrome, a rhetorical approach to scientific discourse, as well as a statistical analysis of the writings of Joseph Priestly: Another collection, Bazerman and Paradis's (1991) *Textual Dynamics of the Professions* presents 15 in-depth analyses of

literate activity in contexts ranging from contemporary biology to medieval letter writing. The diversity of articles examine situatedness of writing processes and the particular ways in which writing is indeed a form of social action and constitutive of social reality. Socially situated approaches to writing have been strongly influenced by genre and activity theory (see Chapter 7); articles on academic writing from this perspective are reviewed in Russell (1997b), which is part of a special issue of *Mind, Culture and Activity* devoted to the Activity of Writing. Another collection taking this perspective is *Writing Selves and Societies* (Bazerman & Russell, 2003).

There have been fewer studies of writing in the humanities and social sciences. Susan Peck MacDonald (1994) has done the most extensive comparative study of writing in the social sciences and humanities. In comparing writing from literary studies, social history, and social psychology, she found that there were systematic relations between the grammatical and lexical features of the texts to the motives and epistemologies—how they frame and investigate problems—of the different fields. She finds greater compactness in theory and problem formulation in the social sciences than in the humanities. The humanities she finds concerned with detailed interpretive representations of their particularized objects of attention, while social sciences tend to be more conceptually driven. She finds these differences both at the level of larger argument structures and detailed sentence-level style structures.

In analyzing the rhetoric of literary studies Fahnestock and Secor (1991) found that literary arguments rely on the topics of paradox, appearance/reality, ubiquity, paradigm, *contemptus mundi*, and complexity.

Lucille McCarthy (1991) has studied the influence of the American Psychiatric Association's manual of mental disorders on the writing of articles in psychiatry, finding that the Diagnostic Statistical Manual has become in essence a charter document, shaping and underlying both research and practice genres in the mental health field. Berkenkotter has extended this work to examine how the DSM has developed out of the biologic tradition of taxonomy and the medical nosology (Berkenkotter, 2001, 2002). Berkenkotter and Ravotas (1997, 1998, 2001, 2002) have examined how that psychiatric language is applied through notes and reports to patients, and how it enters into the dialog

with psychiatric clients. Reynolds, Mair, and Fisher (1992) survey the genres within the mental health professions.

Another style of analysis of disciplinary texts has developed in the applied linguistic field of English for Specific Purposes. The research in this field is directed towards finding structures of professional texts that can be used to aid advanced English as a second language learners who have specific disciplinary or professional interests. Swales (1990) and Bhatia (1993) explain the mode of genre analysis used in this field, which seeks to identify a series of rhetorical moves by which content and reasoning is organized in professional texts. The most well known finding in this work is Swales' model of scientific article introductions, which he calls the CARS (or Create A Research Space) model. This model consists of three primary moves: establishing a territory; establishing a niche; and finally occupying that niche. The first move of establishing a territory can be realized by asserting the centrality of a claim, making topic generalizations, and/or reviewing the literature. The second move of establishing a niche may be made by asserting a counter-claim, indicating a gap, raising questions, or continuing a tradition. The final move of occupying a niche can be realized by outlining the purposes of the project at hand or announcing the present research, announcing the principal findings, and finally indicating the structure of the article to follow. Swales (1998) engages another mode of situated text analysis, which he calls textography, by examining the different forms of writing and texts to be found on the three separate floors of a small academic building. Another important work out of the ESP tradition is Kenneth Hyland's (2000) book *Disciplinary Discourses*, which examines both hedging and citation practices. The journal *English For Specific Purposes* carries much of the research in this field. Related work comes from the Structural Functional Linguistics tradition that has developed sensitive linguistic tools for the analysis of texts, including academic and scientific texts (see, for examples, Halliday, 1985; Halliday & Martin, 1993).