READING MEDICAL PROSE AS RHETORIC:

A STUDY IN THE RHETORIC OF SCIENCE

by

JUDITH ZELDA SEGAL

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Department of English

The University of British Columbia
1956 Main Mall
Vancouver, Canada
V6T 1Y3

Date September 19, 1988
Abstract

Rhetoric, as the theory and practice of the discursive means of human influence, and science, as the observational study of the physical world, have traditionally been considered to exist in separate realms. In the past thirty years, however, theoretical convergences in the philosophy of rhetoric and the philosophy of science have yielded a discipline in the rhetoric of science—a discipline concerned with the discursive aspects of knowledge production and reproduction in the sciences. Rhetorical theory has argued convincingly in this century that all language in use is language for use and is therefore, to varying degrees, persuasive. The rhetoric of science begins from the assumption that persuasion is a factor in the construction of scientific knowledge, and from the belief that members of scientific communities (rhetorical communities in every sense) advocate versions of reality which are based in theory, formed in language, and dependent on the agreement of other scientists for their validation.

This present project contributes to literature in the applied study of rhetoric of science by analyzing, from a rhetorical perspective, thirty-five scientific articles published in the last six years in major medical journals. (All of the articles are on the subject of primary—or functional—headache.) The project uses a methodology based
on classical and contemporary theories of rhetoric to
discover persuasive strategies in these scientific texts. It
poses questions about how authorial intentions are
actualized in scientific texts, how scientific texts have
effects on readers, and how the texts affect the situations
into which they are introduced. While scientific texts, like
literary texts, could be analyzed from a variety of
theoretical perspectives, rhetorical theory provides a
particularly appropriate heuristic model for analyzing "real
world" texts.

The rhetorical analysis (which includes both an overview
of the complete sample and three case studies) begins by
questioning the extent to which the conventions of scientific
prose (for example, use of the passive, of nominalizations,
of complex sentence structure; use of statistical reasoning
and arguments from authority) actually produce a prose that
is objective and disinterested in keeping with traditional
ideals of science. The analysis shows that medical authors
in fact use a variety of persuasive strategies in their
articles (strategies which may be classified according to the
classical canons of rhetoric), and that the writing in
medical journals, is not simply objective and disinterested,
although on initial reading, because of its impersonal style,
it may appear to be so. The rhetorical analysis demonstrates
that the use of textual features promoting an appearance of
neutrality is itself a rhetorical strategy which argues for
the acceptance of particular claims in scientific articles.

The rhetorical analysis is significant for the theory and practice of science, for the discipline of rhetoric of science, and for the discipline of rhetoric itself. The analysis describes the complex rhetoric of scientific writing as a genre, probes the assumptions that underlie its conventions, and argues that scientific texts must be read critically, as rhetoric. To read scientific texts as rhetoric is to locate their arguments, scrutinize their forms, judge their authors, and evaluate their effects. The role of the rhetorician is to urge such reading, and everywhere to promote discussion of the ways of influence exerted especially by texts which appear at first not to be rhetorical.
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Introduction

The traditional separation between rhetoric—the study of the discursive means of human influence—and science—the observational study of the physical world—has been reconsidered in the last thirty years and this reconsideration has yielded a discipline in the rhetoric of science. Writings in that discipline have been largely theoretical, although a few authors have concerned themselves with analysis of scientific texts. The present study, an analysis of selected medical journal articles, focussing on their rhetorical (influencing or persuasive) features, is intended to further particularize and extend the study of the rhetoric of science. It will argue that there are convincing theoretical grounds for reading science as rhetoric, and that rhetorical theory provides an appropriate model for analyzing scientific texts. It will proceed to probe the nature of scientific rhetoric with reference to particular persuasive strategies isolated within the selected medical literature. It will end with a discussion of the generalizable findings of the discourse analysis and the implications of those findings.

The question which prompted the study is this: to what extent do the conventions of scientific writing—use of the passive, of nominalizations, complex sentence structure, and Latinate words—actually yield a prose that is not
rhetorical, but disinterestedly reportorial, void of personality, innocent of value? Such a prose has been the goal of the ideal scientific writer, based on seventeenth-century stylistic prescriptions, and consistent with the normative ethos of science—an ethos of universalism, communalism, disinterestedness, and skepticism. Still, can any prose be non-rhetorical or is non-rhetorical prose a contradiction in terms; might it not be more valid to say of scientific prose that part of its rhetoric (and part of its persuasive agenda) is to create the impression of the disinterested, impersonal, value-free scientist? Rhetorical analysis of scientific prose begins, then, with the hypothesis, established through the theoretical literature in science and rhetoric (See Chapter One), that scientific writing is necessarily rhetorical—that, as Wayne Booth has suggested with respect to fiction, the question to bring to the prose is not whether it is rhetorical, but how it is so.

The value of rhetorical analysis of scientific texts is twofold: first, it specifies and illuminates the nature of scientific texts in ways that can be useful for the writers and readers of those texts; secondly, it reinforces and expands the rhetorician’s understanding of rhetoric as the inescapable condition of language in use, the process through which, as Booth says, we are, each of us, made in symbolic interchange. By analyzing rhetorical structures in
particular scientific texts, it is possible not only to show that these texts work to persuade readers to regard reality in a particular way or to regard a particular set of constructs as reality, but also to show how authorial decisions with respect to Invention (the development of arguments), Arrangement (their disposition), Style, and Presentation, instantiated in texts, do their work on readers. The goal of discourse analysis here is description and prediction. In textual analysis, rhetorical strategies are isolated and described, and recurring strategies are abstracted and generalized, then used to predict the structure of rhetorical composition of other texts. The present study uses a comparatively large selection of articles (thirty-five rather than one or two), and this underlines the predictive potential of the rhetorical analysis.

Political discourse provides a useful analogue to scientific writing with reference to the rationale for the study. The case that political discourse is rhetorical was made long ago, before Aristotle formalized the discussion of "deliberative"—or political—rhetoric. Knowing that the discourse is rhetorical is a starting place for rhetoricians. The knowledge creates for the rhetorician the responsibility of penetrating the rhetorical structure of particular political texts in order to make generalizations and predictions about political rhetoric that are useful to
citizens. The purpose of discourse analysis is description and prediction; the goal of the exercise is to make a more critical and more literate public.

To say that the analysis of the rhetoric of scientific texts expands our understanding of rhetoric as the inescapable condition of language in use is to take up the contemporary view of rhetoric which argues that human beings are "essentially rhetorical" (Booth, MD 126) and that "reality=shared meanings" (Brummett 34)—and to reinforce the general argument with the particular case. It is possible to argue deductively that scientific writing must, by virtue of its being language in use, be rhetorical. (All language in use is rhetorical. Scientific discourse is language in use. Therefore, scientific discourse is rhetorical.) However, to be convincing, the case must also be made inductively, by demonstrating rhetorical strategies at work in particular scientific texts. Once the demonstration is made, it will be evident not only that scientific discourse is rhetorical, but that (as Aristotle would argue, what is shown to be true in the least likely instance is a fortiori true in more likely instances) all discourse, as the rhetorician would argue, is rhetorical.

As science has traditionally been separate from rhetoric, scientific discourse has traditionally been separate from public discourse. Scientific discourse has been seen as discourse related to specialized content in
matters pertaining to the natural world; public discourse has been seen as related to matters of general interest pertaining to public life and social intercourse. The nature of the separation is such that public discourse has been considered to be in the realm of rhetoric, while scientific discourse, reportorial on matters non-negotiable, is not. Aristotle formalized the distinction with this:

[R]hetoric is applied to recognized subjects of deliberation. It has to do with things about which we commonly deliberate—things for which we have no special art or science; and with hearers who cannot grasp many points in a single view or follow a long chain of reasoning. . . . [I]f we light upon true scientific principles, the art is no longer Dialectic or Rhetoric, but is the discipline based upon those principles. (12,14)

The separation of rhetoric and science was reinforced in the parallel evolution of the two disciplines. Rhetoric, in the sixteenth-century, became divorced from Logic and associated exclusively with the interests of Style. The seventeenth-century saw the development of a "reformed" language and an anti-rhetoric, as the concerns of rhetoric were seen to be antithetical to the goals of utilitarianism and objectivity and to the "naked" truth of science. Science, for its part, was dedicated to the study of an external universe, revealed through language as through a
The split between rhetoric and science, and between public discourse and scientific discourse, became a commonplace by the twentieth-century, but now the split is by no means unproblematic. Chaim Perelman, a rhetorician writing in this decade, proclaims the division between science and rhetoric, arguing that to rhetoric belongs "every discourse which does not claim an impersonal validity . . . " (Realm 162). The realm of rhetoric is established against the realm of science, to encompass whatever is not "objectively and indisputably valid" (TNR_512). Yet the nature of the division, as Perelman represents it, is ambiguous. Perelman's claim to a separate realm of rhetoric is contradicted by his statement that "the Newtonian formula of universal attraction, which was believed to be unshakable, was breached when people were given sufficient reasons to modify it" (Realm 160)--for he suggests here that even Newton's physics is not exempt from the effects of persuasion. Perelman even states that axioms in the mathematical sciences, "considered at first to be self-evident," have subsequently been shown to be "conventions of language" (Realm 158). Perelman's latter statements argue that scientific knowledge is itself subject to rhetorical process, and obviate the science/rhetoric split on which, at first, his treatise appears to be based.

A similar contradiction appears in the writing of rhetorician Richard Weaver. Weaver defines a realm of
rhetoric separate from science, and he decries the application of the methods of the second in matters belonging to the realm of the first. However, while Weaver opposes "scientism"—"the application of scientific assumptions to subjects which are not wholly comprised of naturalistic phenomena" ("Sermonic" 203)—he does not oppose the application of rhetorical principles to natural or scientific subjects. He argues that all discourse is necessarily suasive or "sermonic," all language being full of value and tendency. He writes, "there are degrees of objectivity, and there are various disciplines which have their own rules for expressing their laws or their content in the most effective manner for their purpose. But even this expression can be seen as enclosed in a rhetorical intention" ("Sermonic" 222). The apparent contradiction within Weaver's vision can be resolved by positing a picture of two concentric circles—the larger one containing rhetoric and the smaller one, science. Then science and rhetoric are separate—but while science is within the realm of rhetoric, rhetoric is not within the realm of science. The image of concentric circles illustrates that distinctions between science and rhetoric, and, more generally, between the certain and the contingent are by no means clear.10

The ambiguity in matters of boundaries—as between science and rhetoric, the certain and the contingent—is characteristic of contemporary intellectual thought. Despite
the salience of the science-rhetoric split, many contemporary theorists, especially in the context of an emerging interdisciplinary interest in social constructionism, have begun to argue that scientific discourse, no less than other discourse, is informed by value, is full of tendency, and is, therefore, rhetorical. Scientific theories, in this view, are "symbolic representations of 'nature' whose reality only comes about if their propounders can persuade enough people to regard them as real" (Kelso, 19).

Social constructionism is described succinctly in a recent article by composition theorist Kenneth Bruffee, as the "position in any discipline [which] assumes that entities we normally call reality, knowledge, thought, facts, texts, selves, and so on are constructs generated by communities of like-minded peers. Social construction understands reality, knowledge, thought, facts, texts, selves, and so on as community-generated and community-maintained linguistic entities—or, more broadly speaking, symbolic entities—that define or 'constitute' the communities that generate them" (774). Social constructionism implies a place for rhetoric in any discipline. Rhetoric here is the discursive process by which minds are formed and changed, the process by which the consensual agreement necessary to the establishment of reality is accomplished. The rhetoric of science is no more and no less than this process as it pertains to the realm of science. The emergence in the last several years of a
discipline in the rhetoric of science signals recognition of the blurring of boundaries on two fronts. First, with reference to science and rhetoric, the rhetoric of science recognizes that the process of producing, and winning adherence to, scientific knowledge is not different from the process of producing, and winning adherence to, other kinds of knowledge, including even axiological knowledge—and that the process is rhetorical. Secondly, with reference to scientific discourse and public discourse, it recognizes that scientific discourse, insofar as it pertains to matters affecting the public good and the welfare of citizens, is public discourse. Both these insights inform, for the student of the rhetoric of science, the study of scientific prose.

The rhetoric of science, as the study of the discursive means of influence in matters pertaining to science, has both internal and external dimensions. Internally, it pertains to scientific texts made and received within particular scientific communities; externally, it pertains to scientific texts which act in the larger community. The latter includes the work of "science writers"—as opposed to "scientific writers"—from book-length popularizations of science to journalistic reports on science in the mass media. The external dimension of scientific discourse is readily seen as public discourse, especially in a contemporary context in which laypeople increasingly rely on filtered
science to make decisions affecting their well-being—when science, as rhetorician Michael Halloran explains, "serves as warrant for many of the arguments about traditionally non-specialized, civic questions--war and peace, ways and means for promoting the public welfare" ("Molecular Biology" 81). Increasingly, our well-being requires an understanding of such "scientific" phenomena as acid rain, toxic waste, nuclear radiation, sexually-transmitted diseases. Increasingly, it is important to understand the ways in which scientific discourses influence what people believe and how they act, to reveal the means of scientific influence by identifying, and probing the functions of, rhetorical strategies in scientific texts.

The present project is a rhetorical analysis of a body of "internal" scientific literature--by and for medical researchers and practitioners. The project was undertaken to particularize the discussion of the rhetoric of science, a discussion which, so far, has been more abstract than concrete, more general than particular. Much of the work to date in rhetoric of science has focussed more on arguing that scientific discourse is rhetorical (persuasive, constitutive) than on illustrating how--in the specific case--it is so. Following the social constructionist argument in the philosophy of science, most notably in the work of Thomas Kuhn, a literature has grown up in the theory of scientific rhetoric. Recent theoretical contributors to the emerging
field include Paul Newall Campbell on the personae of scientific texts, Walter Weimer on science as rhetorical transaction, Michael Overington on the scientific community as an incarnation of rhetoric's "audience", James Kelso on the relevance of analysis of scientific arguments, and James Zappen on pluralism and the rhetoric(s) of science. Andrew Weigart has written on the "immoral rhetoric of science"; Cox and Roland have argued that "...Rhetoric Confuses Scientific Issues," and Herbert Simons has queried if Scientists are "Rhetors in Disguise." Although a theory is now in place that justifies the close, rhetorical reading of scientific texts, few textual studies have actually been done. Those that are now available fall into four categories. The first is the linguistic study which isolates lexical, syntactic, and semantic characteristics of scientific texts, without, however, connecting itself to any theory that would account for the authorial choices represented by those linguistic features. An example is Schindler's "Why Engineers and Scientists Write as They Do--Twelve Characteristics of Their Prose," which, despite its title, is essentially descriptive.

The three remaining types of analysis are theoretically-impelled, and can be classified according to the kinds of texts they analyze. Joseph Gusfield's "The Literary Rhetoric of Science: Comedy and Pathos in Drinking Driver Research" is often cited as the paradigm article in the rhetorical
analysis of scientific discourse, demonstrating that scientific writing necessarily incorporates rhetorical elements, aimed at persuasion. However, like Debra Journet's "Rhetoric and Sociobiology" Gusfield's article deals with soft (social) science, and thus treats material which has traditionally been recognized as contingent and therefore considered within the realm of rhetoric in the first place. This, despite the aspirations of the social sciences to the status of "pure" science.

The second kind of textual analysis focusses on the external discourse of science, the discourse of popular science. The value of this kind of study is evident, given the centrality of "filtered science" to public decision-making; and more studies are needed. Examples include Randall Bytwerk's "The SST Controversy: A Case Study in the Rhetoric of Technology" and Steven Del Sesto's "The Science Journalist and Early Popular Coverage of Nuclear Energy." The nature of the discourse studied here, however, is not science qua science, but science qua journalism.

The third kind of discourse study takes the discourse of hard science (including the physical and life sciences) as its subject and analyzes texts written by scientists for scientists. In doing so, it seeks to reveal what meaning is implicit in scientific discourse by virtue of the choices scientific writers make in composing text. A few recent studies offer this kind of treatment, and the present project
is meant to be a contribution to this body of literature. Work on the rhetorical analysis of hard science has been done by Michael Halloran (especially, "Molecular Biology"), John Angus Campbell, Steven Yearley, Charles Bazerman ("Written Knowledge" and "Modern Evolution"), G. Nigel Gilbert and Michael Mulkay (Pandora’s Box), and Greg Myers ("Two Biologists’ Proposals"). The present study distinguishes itself by using a comparatively large sample of writing in a particular scientific field, and therefore establishing a claim to some generalizability of findings and predictive potential with respect to other writing, at least within that field, and even within other scientific fields. The generalizable findings of the study will reveal aspects of the nature of scientific writing and suggest the implications of the nature of scientific writing for the theory and practice of science, for the study of the rhetoric of science, and for the study of rhetoric itself. The present study will identify and discuss persuasive strategies occurring in articles selected from current (post-1982) issues of mainstream medical journals on the subject of headache. Articles were chosen to form a single body of literature, constituting a coherent professional conversation within a particular discipline.

Medical science was chosen because it represents a clear set of intra-disciplinary values, so its assumptions are derivable and its nature, describable. Modern (post-1850)
Western medicine can be defined as a scientific discipline in contrast to pre-modern Western medicine and in contrast to non-Western medicine. Modern Western medicine has an essentially interventionist program, with treatment occurring not preventively but usually in the symptomatic stages of disease. Doctors rely on diagnostic instruments and "objective" tests (x-rays, blood analysis) and on chemical therapies and other interventions which have normally been tested in controlled studies and which are explicable in terms of reliable cause and effect relations. Experiments are performed; methods are recorded for replication; results are observed, quantified, and analyzed. Most importantly for the present study, the program is self-consciously scientific.

Within the context of contemporary medical science, the subject of headaches was chosen for this study because a preliminary review suggested much of the literature was penetrable and comprehensible. In order to increase both comprehension and the possibility of coverage within a specific subject area, the study of journal articles on headaches was further reduced to the study of articles on "functional" headaches, headaches which do not originate in a specific pathological process. (Migraine and tension headaches are considered "functional"; headaches due to brain tumour, cranial infection, or other specific pathology are considered "organic.".) The study was further restricted to
those articles which had, as their designated audience, the general physician.

From an initial resource of approximately 350 articles, approximately one hundred were found to be suitable for analysis. Approximately one-third or thirty-five of these were selected at random for special study. The study of authorial choice, of persuasive strategies in these individual texts will indicate rhetorical principles which can be used to reveal the nature of scientific writing. The nature of scientific writing can then be studied to disambiguate the relationship between rhetoric and science and to illuminate the nature of rhetoric itself.

The rhetorical analysis will be the subject of Chapter Three. Chapter One will describe in more detail the theoretical underpinnings of a rhetoric of science, while Chapter Two will develop the rhetorical model to be applied in the analysis. Chapter Four will review the findings of the analysis and discuss the significance of these findings for the disciplines of science, rhetoric of science, and rhetoric.
Endnotes

1. See, for example, Halloran ("Technical Writing and the Rhetoric of Science"), Kelso, Orr, Overington, Wander, Bazerman ("Literate Acts and the Emergent Social Structure of Science"), and Zappen ("Historical Perspectives on the Philosophy and the Rhetoric of Science: Sources for a Pluralistic Rhetoric").

2. For a discussion of various attempts at textual analysis, see pp. 11-12 below.

3. That these are the conventions of scientific writing is, of course, verifiable from the primary texts. However, the prevalence of these features has also been documented in Aaronson, Barber, Gopnick, Savory, Schindler and others.
4. Sociologist of Science Robert K. Merton, describes four hallmarks of an ethos of science. They are 1) universalism, the subjection of truth-claims to "preestablished impersonal criteria"; 2) communism, the ownership of the findings of science by the public; 3) disinterestedness, the personal noninvolvement of the scientist; and 4) organized skepticism, the temporary suspension of the scientist's judgment and the detached scrutiny of beliefs.

5. The original quotation is "The author cannot choose whether to use rhetorical heightening. His only choice is of the kind of rhetoric he will use" (ROF 119).

6. See Modern Dogma, especially pp. 101-139.

7. The history of Rhetoric pays special attention to the effect of Ramus (1556) and the "Ramistic split" which separated the realm of Rhetoric from the realm of Logic, attributing to Logic the classical rhetorical canons of Invention and Arrangement, leaving to Rhetoric the canons of Style, Memory, and Delivery.

8. Francis Bacon, in The Advancement of Learning, writes of the "naked" truth of science, in its plainest form, available only to the "sons of science." His rejection of any form of embellishment in the presentation of science was institutionalized by the Royal Society and recorded by Thomas Sprat in his History of the Royal Society. Sprat is well known for advocating a style of "primitive purity, and shortness, when men deliver'd so many things almost in an equal number of
words" (113). The Royal Society, which did not see this simplicity as itself a form of rhetoric, recommended the banishment of rhetoricians from the ideal society.

9. Useful discussions of this history are found in the works of Adolf, Andrews, Finocchiaro, Jones, Stephens, Francis Bacon and the Style of Science and Zappen ("Science and Rhetoric from Bacon to Hobbes").

10. In fact, Weaver, in an earlier article, "The Conceived Rhetoric of Scientific Sociology," seems to argue that Science and Rhetoric are, and should be, essentially distinct. "Rhetorical presentation," he says "always carries perspective. The scientific inquirer, on the other hand, is merely noting things as they exist in empirical connection. He is not passing judgment on them because his presentment, as long as it remains scientific, is not supposed to be anything more than classificatory" (141). ("Scientific Sociology" appeared in 1959; in "Language is Sermonic," which appeared in 1963, Weaver would argue that no language can "merely not[e] things as they exist in empirical connection.")

11. Note, however, that social constructionism does not name a unified body of theory; rather it refers to certain related anti-positivist or anti-absolutist epistemologies. A good discussion of theoretical differences within social construction theory appears in Orr.

12. For further discussion of Science and Public Discourse, see Wander.
13. Michel Foucault claims that modern medicine was born in the last years of the eighteenth-century, when doctors began to apply reason, rather than imagination, to what lay beneath the threshold of visibility. However, even as late as the second half of the nineteenth-century, the profession had little claim to "science." Infectious diseases remained uncontrolled and therapeutic interventions were unreliable.

Louis Pasteur's discovery of bacteria significantly changed the reliability and predictability of treatment, and by the end of the century, the development of diagnostic instruments such as the stethoscope and the laryngoscope "scientized" medical practice by reducing the physician's dependency on the subjective report of the patient in diagnosis. Later, the use of the microscope, the x-ray, and other diagnostic technology reduced the physician's dependency on his own subjective response, and permitted several physicians simultaneous access to diagnostic evidence.

Traditional Chinese Medicine, still practiced by one-third of doctors in China, also defines modern Western scientific medicine by contrast. Its underlying principles are not those of science but of holism and phenomenology. Diagnosis is performed by a physician who "reads" the tongue and the twelve pulses in the patient's wrist. Treatment is often a matter of the application of acupuncture, sometimes involving also the use of therapeutic breathing techniques and the prescription of specific herbal preparations (See also Eisenberg and Starr).
Chapter One. The Theoretical Basis for the Rhetorical Analysis of Scientific Texts

The purpose of this chapter is to establish the theoretical basis for the rhetorical analysis of scientific texts. In the past thirty years, the philosophy of rhetoric has expanded the realm of rhetoric, beyond the ground of the obviously opinionable, and has focussed attention on the ubiquity of rhetoric and the constitutive nature of symbolic interchange. In doing so, it has probed the processes of consensual agreement and the "advocacy of realities" (Brummett 31). At the same time, the philosophy of science has focussed attention on the social nature of scientific knowledge and has described the conceptual and discursive conventions of scientific communities. It has also concerned itself with the processes of consensual agreement and the advocacy of realities. In the convergence of theory in science and rhetoric are the theoretical underpinnings of the rhetoric of science and the argument for the rhetorical analysis of scientific texts.

A discipline in the rhetoric of science is very young, and aspects of its theoretical base remain unexamined. A few rhetorical theorists--particularly Michael Halloran, James Kelso, Michael Overington, Philip Wander, Stephen Yearley, and Charles Bazerman--have noted the significance of recent theory in philosophy of science (especially the work of
Thomas Kuhn) for the study of scientific texts. However, none of these critics has undertaken to align the two bodies of theory (in rhetoric and science) systematically to articulate the full theoretical argument for a rhetorical view of science. Such is the intention of the following discussion.

Specifically, this chapter uncovers the connections between the theories of Chaim Perelman, Kenneth Burke, and Wayne Booth in the philosophy of rhetoric and the theories of Thomas Kuhn, Michael Polanyi, and John Ziman in the philosophy of science. The discussion points to fundamentally compatible views in philosophy of rhetoric and philosophy of science, views which argue together that scientific writing is rhetorical. In summary, philosophy of rhetoric maintains that all language in use (ergo even scientific language) carries bias and tendency and is therefore persuasive; philosophy of science maintains that scientific inquiry is to some extent contingent (owing to a variety of factors from the theory-ladenness of scientific observation to the politics of funding and publication) and that scientists argue to win the adherence of their peers to particular versions of scientific truth. A review of selected literature in the emerging field in the rhetoric of science concludes the chapter, specifically that literature which sets the stage for an analysis of scientific texts informed by a coherent rhetorical theory.
For Aristotle, rhetoric is the "faculty of discovering in the particular case what are the available means of persuasion" (7) and it pertains to subject matters "about which we commonly deliberate" (12). Aristotle's definition itself points to some of the main features of his theory—his emphasis on persuasion as the goal of rhetoric; his focus on the particular case, the situations and audiences which guide the rhetorical act; and his privileging of the discovering aspect of rhetoric, that is, the process of inventing or finding the most appropriate arguments in the particular case. In formalizing a theory of rhetorical discourse based on this definition, Aristotle created a terminology and established a framework that has shaped, directly or indirectly, every subsequent theory of rhetoric.

Aristotle discusses rhetoric under three major heads: Invention, Arrangement, and Style (the last subsuming the subject of Delivery). Matters pertaining to the "invention" of arguments are most prominent in the discussion. Under this head, Aristotle develops his theory of the "enthymeme" ("the very body and substance of persuasion" [1]), the rhetorical counterpart to dialectic's syllogism. The enthymeme truncates the syllogism, leaving out whatever premise the rhetor ascertains already has the status of common knowledge in the audience addressed; enthymemes are "demonstrative" (based on consistent principles) or "refutative" (based on inconsistent principles). Also under
the head of Invention, Aristotle compares enthymemic arguments to arguments from example (dialectic's deductive and inductive reasoning) and contrasts invented, "artistic" proofs to found, "inartistic" proofs such as those based on evidence or authority. (These distinctions will be important to the rhetorical analysis of scientific texts in which, for example, arguments from evidence and authority are seen to be valued more highly than arguments Aristotle would consider "artistic.") With reference to Invention, Aristotle also identifies particular topoi or places to discover arguments (arguments from definition and from consequences are two examples of topoi in use); and establishes the three pisteis or modes of proof. Ethos describes the argument from the character of the speaker ("as a rule we trust men of probity more, and more quickly, about things in general, while on points outside the realm of exact knowledge, where opinion is divided, we trust them absolutely" [8]); pathos describes the appeal through the audience's emotions ("we give very different decisions under the sway of pain or joy, and liking or hatred" [9]); and logos describes the appeal from the argument proper ("when we demonstrate the truth, real or apparent, by such means as inhere in particular cases" [9]).

Throughout the Rhetoric, Aristotle's discussion is organized around general principles adapted to the particular case: rhetoric is of particular kinds for particular
occasions—it is deliberative, forensic, or epideictic (ceremonial)—and it is for particular audiences. These principles of particularity are no less central to Aristotle’s treatment of Arrangement and Style than they are to his treatment of Invention. The right disposition of arguments depends both on occasion and audience; Style as well must be appropriate to both. Aristotle’s discussion of metaphor, for example, underlines the relationship between Style and audience. Aristotle’s metaphor is clearly a truncated analogy, much as the enthymeme is a truncated syllogism, and its success depends on the extent to which an understanding of the second term of the metaphor is part of the common knowledge of the audience. That is, Aristotle describes a multi-dimensional rhetorical act, called forth in a particular situation for a particular audience. Given a rational audience and a rhetor who understands its needs and beliefs, that act will be successful (persuasive) as long as the rhetor uses all "the available means of persuasion." His text marries theory and practice.

Some debate has occurred recently about the extent to which classical rhetoric, specifically Aristotelian rhetoric, is different from, or not different from, contemporary rhetoric. Some theorists argue that Aristotle’s rhetoric is based on an adversarial model, is manipulative, and aims at unidirectional persuasion, while others argue that, like contemporary rhetoric, Aristotelian rhetoric is conceived
within the context of rhetors and audiences sharing community membership, is more constructive than manipulative, and aims more at consensus than persuasion. While the debate may continue, it is clear that Aristotelian rhetoric does provide a starting place for rhetorical discussion and suggest a model for understanding various kinds of texts. Aristotle's rhetoric was modified by Cicero and Quintilian in the Roman period, directed to the sermon by St. Augustine in the 4th century, narrowed to particular applications in the Middle Ages, truncated by Peter Ramus in the 16th century, redefined by Bacon in the 17th century, variously reinterpreted by the Scottish scholars of the 18th century, renewed by Chaim Perelman and others in this century; nevertheless Aristotle's rhetoric is intact and still viable as a theory of discourse. In fact, it is the theory against which other theories are defined and evaluated. Scholars may plumb the nature of rhetoric only by understanding both its classical roots and its contemporary descriptions.

Chaim Perelman is the contemporary rhetorician whose work is most closely based on the writings of Aristotle—and although Perelman (possibly because of his allegiance to Aristotle) is ambiguous on the nature of science/rhetoric connections (see Introduction above), careful reading of his 1969 and 1982 works on Rhetoric (The New Rhetoric and The Realm of Rhetoric, respectively) does yield a clear sense of what, for Perelman, rhetoric is and what it does. For
Perelman, whose interest in rhetoric comes from an interest in forensic argumentation, rhetoric is the discursive means of winning ("inducing" or "increasing") the adherence of an audience "to the theses presented for its assent" (TNR 4). Despite its forensic bias, Perelman's theory is expansive: it is not restricted to formal situations, it is not restricted to oral presentation, and, in terms of subject matters, it is not restricted to such subjects as Aristotle might have considered contingent. "The theory of argumentation," Perelman writes, "conceived as a new rhetoric or dialectic, covers the whole range of discourse that aims at persuasion and conviction, whatever the audience addressed and whatever the subject matter" (Realm 5).

Two central elements of Perelman's theory of rhetoric are directly connected to elements of theory in the rhetoric of science. The first is his emphasis on audience as the prime conditioning factor in the rhetorical enterprise; the second is his view of language as selective, emphatic, and non-neutral.

Perelman's rhetoric is by definition "addressed" and he describes three kinds of audience to which it appeals. The first, the particular audience which the rhetor wishes to influence by the discourse parallels the audience of traditional rhetoric. Perelman adds, however, an audience of the self (expanding the realm of rhetoric to include self-deliberation) and the "universal audience." The universal
audience is a collective of relevant judges—on some matters, a collective of all reasonable beings—and the value of arguments is measured against its standard.

The concept of universal audience resonates with other rhetoricians' concepts of rhetoric's recipients-participants; it also resonates with concepts of communities of relevant judges in the literature of the philosophy of science. The purpose of the theoretical construct in Perelman's case, and effectively in every other, is to create a public and a system for validating or not validating "facts." For Perelman—and this is tied to his notions of audience—there are no facts, only propositions which, because of general adherence to them, have the feature of having "fact status." The feature, having the status of fact, is won in the process of rhetoric, a process through which reasonable people are convinced that some proposition is worth adhering to. For example, in Perelman's terms, "the good is desirable" would have the adherence of the universal audience and therefore, strong fact-status, while "life in any form is good" would have the adherence of only part of that audience, incarnated in particular audiences, and therefore, weaker fact-status. The notion of communities of experts as arbiters of the factual is central also to the theories of Kuhn, Polanyi, and Ziman (see the discussion of the philosophers of science below).

Another aspect of Perelman's study of audience relevant
to the discussion of science is his understanding of the points of departure for arguments—the understanding that all argumentation must be based on theses to which audiences already adhere: "In fact," Perelman says, "the aim of argumentation is not, like demonstration, to prove the fact of the conclusion from the premises, but to transfer to the conclusion the adherence accorded to the premises" (Realm 21). The concept is essentially Aristotelian and recurs in some form in the theories of rhetoricians Kenneth Burke and Wayne Booth; it also emerges as central to theory in the philosophy of science—where it is acknowledged that scientific communities, the communities in which scientific discourse takes place, not only share a means of discourse, but are identified by the body of assumptions they hold in common—that is, by the starting place for their scientific conversation. The concept of moving forward from a shared base which, by that moving forward, increases, is essential to contemporary theories of science.6

Perelman's theory also intersects with theory in the philosophy of science at the point of description of language in use. For Perelman and for the philosophers of science (as well as for Burke and Booth), verbal language is not neutral, no author is merely a reporter, and the claim to pure objectivity in texts is not supportable. Moreover, the value-ladenness of language is complicated by the theory-ladenness of perception. That is, what is seen and
"reported" is as subject to unarticulated presuppositions as the language used to "report" it. So, Perelman says, "the very same action can be described as tightening a bolt; assembling a vehicle; earning a living; assisting the production of a favorable balance of trade" (Realm 41). To make the same point, he cites Aristotle's statement that Orestes is variously described as "the murderer of his mother" and the "avenger of his father" (Realm 45). With respect to scientific accounting, Perelman's most significant statement about the factors influencing language use and the consequent influence of language use appears at the end of The New Rhetoric:

All language is the language of a community, be this a community bound by biological ties, or by the practice of a common discipline or technique. The terms used, their meaning, their definition, can only be understood in the context of the habits, ways of thought, methods, external circumstances, and traditions known to the users of those terms. . . . Adherence to particular linguistic usages normally expresses the explicit or implicit adoption of certain definite positions which are neither the reflection of an objective reality nor the manifestation of individual arbitrariness. . . . An agreement on the use of terms, no less than an agreement about the conception of reality and the
vision of the world, even though it may not be disputed, is not indisputable; it is linked to a social and historical situation which fundamentally conditions any distinction that one might wish to draw between judgments of reality and value judgments. (TNR 513)

Perelman's rhetoric then, bound to the context of audience, formed willy-nilly in a language of some commitment, is a rhetoric which subsumes scientific accounting as that accounting is described in the theories of Kuhn, Polanyi, and Ziman.

Kenneth Burke's rhetoric is also directly pertinent to the discussion of the philosophy of science. Like Perelman, Burke offers a contemporary philosophy of rhetoric—in this case, one that both replicates and departs from Aristotelian theory.

In A Rhetoric of Motives, Burke defines rhetoric as an art of influence—"the use of words by human agents to form attitudes or to induce actions in other human agents" (ROM 41). "It is rooted," he says, in "an essential function of language itself . . . the use of language as a symbolic means of inducing cooperation in beings that by nature respond to symbols" (ROM 43). The goal of Burke's rhetoric is action (an attitude, he says, is an "incipient act" [ROM 42]) and its means is language itself, by its nature symbolic as opposed to simply representational. Burke says that while
the key term for rhetoric, traditionally, was "persuasion," the key term for a new rhetoric is "identification." He explains:

[W]e might well keep it in mind that a speaker persuades an audience by the use of stylistic identifications; his act of persuasion may be for the purpose of causing the audience to identify itself with the speaker's interest; and the speaker draws on identification of interests to establish rapport between himself and his audience. So, there is no chance of our keeping apart the meanings of persuasion, identification ("consubstantiality") and communication (the nature of rhetoric as addressed).

(ROM 46)

In "consubstantiality," Burke names the goal of rhetorical process--the act of identification itself in which rhetor and audience, having overcome the fact of their "division," act together, having "common sensations, concepts, images, ideas, attitudes . . ." (ROM 21).

This understanding of rhetoric as identification, and of identification as the starting place, the means, and the goal of discourse aligns Burkean rhetoric with theory in philosophy of science. Particularly pertinent to the discussion of theories of science are Burke's concepts of "tribe" and tribal membership and his views on the non-neutrality of perception and of the language in which it is
rehearsed.

Burke says, in *Language as Symbolic Action*, that "the human animal, as we know it, emerges into personality by first mastering whatever tribal speech happens to be its particular symbolic environment" (53). With this he summarizes both his sense of the context of community in which rhetoric as identification takes place and his sense of language as the conditioning feature of community membership and the acts which are motivated by it: "[O]nce an animal comes into being that [has an aptitude for language] the various tribal idioms are unquestionably developed by their use as instruments in the tribe's way of living" (LASA 44).

Scientific communities, as they are described by Kuhn, Polanyi, and Ziman, are particularized incarnations of Burkean tribes. As Burke suggests, the relationship of language to scientific communities is no different from the relationship of language to other communities:

The dramatistic view of language, in terms of "symbolic action," is exercised about the necessarily **suasive** nature of even the most unemotional scientific nomenclatures . . . . Even if any given terminology is a **reflection** of reality, by its very nature as a terminology it must be a **selection** of reality; and to this extent it must function also as a **deflection** of reality. (LASA 45)

Burke here effectively articulates the position vis-a-vis
non-neutrality that is found especially in those theorists who will be described below as the Weltanschauung philosophers of science (Polanyi is one). The Weltanschauung philosophers see all perception and experience as being constrained by a "world view" constituted of a tacit system of conceptual and linguistic sets. The sense of a powerful but unarticulated starting place for all experience is a fundamental concept for a new view of science, since it argues the impossibility of theory-free or un-informed acts of observation. The sense of such a starting place is also central to Burkean rhetoric:

Not only does the nature of our terms affect the nature of our observations, in the sense that the terms direct the attention to one field rather than to another. Also many of the "observations" are but implications of the particular terminology in terms of which the observations are made. In brief, much that we take as observations about "reality" may be but the spinning out of possibilities implicit in our particular choice of terms. (LASA 46)

The difference between Burke and the weltanschauung philosophers is essentially a difference in focus. "We must use terministic screens," Burke says, "since we can't say anything without the use of terms; whatever terms we use, they necessarily constitute a corresponding kind of screen; and any such screen necessarily directs the attention to one
field rather than another" (LASA 50). Burke sees all human action as being described in this "necessarily suasive" condition of language. He argues, then, like the weltanschauung philosophers, that our perception is so guided by assumptions taken for granted that we are incapable of assessing (objectively, neutrally) what we believe and what we know. The question, then, of how beliefs and even facts are agreed upon is essentially a question for rhetoric; that is, by the discursive means of identification, human agents induce other human agents to hold particular attitudes and perform particular actions. Burke would describe a rhetoric of science also in these terms, and his analysis illuminates the compatible analyses of the philosophers of science.

The ubiquitous and necessary rhetorical process Burke describes is elaborated in the work of Wayne Booth, especially in Modern Dogma and the Rhetoric of Assent. As a theory about the process by which communities construct and assent to "truth," "reality," "value," Booth's theory is social constructionist, in much the same way as are the more localized theories of Kuhn and Ziman.

Like Burke, Booth focusses on people as languaging beings and he establishes the notion of communities of relevant judges--populations of rhetors engaged in "mutual inquiry or explanation" (MD 137). Moreover, like Burke, Booth focusses on the primacy of language in shaping what people believe, and, consequently, in shaping who they are: "What an adult
man or woman is, in all societies, is in large degree what other men and women have created through symbolic exchange" (MD 114). According to Booth, the process of becoming human is rhetorical:

What is a "mind" and what is a "self" in this rhetorical view? It is essentially rhetorical, symbol-exchanging, a social product in process of changing through interaction, sharing values with other selves. Even when thinking privately, "I" can never escape the other selves which I have taken in to make "myself," and my thought will thus always be a dialogue. (MD 126)

Booth’s placement of language at the centre of human behaviour and his rhetorical view of language ("When anything is called to mind . . ." he says, "the mind is changed. There is always an implicit 'ought' if only 'You ought to attend to my way of perceiving and naming" [MD 125]) reveal his philosophical connections to Burke. The two theorists treat rhetoric as epistemic, as a process, not of persuasion in a simple sense, but of coming to belief and knowledge through language.7 The view, when applied to science, parallels the social constructionist philosophy of science. In the hands of Booth, the view is even more suggestive of contemporary views of scientific process (particulary Ziman’s) because it yields to Booth’s concentration on a rhetoric of assent--effectively the process of building
Booth's term "assent" asserts the primacy of consensus-building in the establishment of all reality. By arguing that "it is reasonable to grant ... some degree of credence to whatever qualified men and women agree on, unless one has specific and stronger reasons to disbelieve" (MD 101), Booth argues for a "truth" established by the agreement of relevant judges (constituting communities of discourse) and breaks down what he calls the "fact-value split." Moreover, Booth is explicit about the ways in which this process of "symbolic interchange" and consensual agreement extends to the realm of science:

What is ... demanded by the principle of systematic assent is more rigorous thought than is customary about who "we" are, the group of relevant judges, the axiological experts whose shared experience confirms what we know together. This is in formal structure ... the process of validation used even by scientists for a great share of their scientific beliefs. No scientist has ever performed experiments or calculations providing more than a tiny fraction of all the scientific beliefs he holds; the whole edifice of science depends on faith in witnesses, past and present—on testimony and tradition. ... Thus science is, in its larger structures, validated by the same social processes that I am arguing for in
Later, Booth writes:

If even the most austere, isolated laboratory scientist cannot even claim to exist except as a social self who was made and is still being made in symbolic interchange with others . . . then his very existence depends on the many values he affirms when he respects the truth, refuses to cook his evidence, relies on the traditions and methods taught him by his mentors, and so on. The supreme purpose of persuasion in this view could not be to talk someone else into a preconceived view; rather it must be to engage in mutual inquiry or exploration. (MD 137)

Booth argues that "modernism" (by which term he designates the whole of post-Cartesian Western intellectual thought) has destroyed the ability to "reason with the mind," and he presents his rhetoric of assent as a prescription for dignified survival in this century. His rhetoric of assent is uniquely a lifestyle rhetoric in the sense that it is more a design for collective living than it is a theory on the nature of persuasion. What is important, however, for the discussion of science, is the expansiveness of his rhetoric, for his rhetoric subsumes all of scientific discourse.⁸

What all three rhetorical theorists seem to be arguing is that reality—and truth and value—does not exist independently of human experience and human discourse, that
it is not perceived or transmitted in neutrality. Concomitantly, they argue that the purpose of rhetoric is not to win over an alien audience to a predetermined truth, but to arrive at truth in concert with other "rhetors" from whom one has in any case learned the language of in which truth is made.

Salient aspects of the philosophy of rhetoric, then, include treatments of rhetorical audience as discourse communities or communities of inter-influence; descriptions of these communities as composed of people who already share certain beliefs and assumptions which determine the possibilities of persuasion; views of language as symbolic, tendential, non-neutral, essentially constitutive of thought and belief; views of reality, not as external and objective, but as personal and consensual, constructed in rhetoric or in symbolic interchange; and notions of persuasion or argumentation or identification which imply that within discourse communities, people work strategically to win the agreement or assent of other people—and to strengthen the bonds of the discourse community and increase its common ground.

The same or compatible principles dominate contemporary thinking in philosophy of science, and suggest that when scientists write, they are not neutral, impersonal, value-free, but intent on winning the adherence of their peers, achieving recognition for their work, and participating in
the production of knowledge in their field.

The contemporary view of science is most easily understood as a critique of the traditional, positivist, view of science, with its roots in Cartesian rationalism and Lockean empiricism. According to the traditional view, reality is both independent and external, existing absolutely and apart from mind; and it represents itself unproblematically to observers, who are, in turn, neutral in their observations. A corollary of this view of reality is the view that language is a transparent medium, which allows scientific observers to present accurate translations of external reality to other scientists. These other scientists then apprehend external reality, mediated through the writer as a kind of scribe of nature (rather than as an author).9

A reconsideration of what might constitute scientific reality, and a re-viewing of the role of language in the conceptualizing that reality come from two theoretical positions—and rhetorical process is implicit in them both. The first is the social constructionist position, articulated clearly by Kuhn. Kuhn creates a role for rhetoric in the construction and transmission of reality by maintaining that scientific communities create competing versions of reality, and that to win adherents, supporters of any particular version of reality must persuade other people to regard their version as true. The second position is that of the Weltanschauung philosophers, and it is articulated by
Polanyi, for one. *Weltanschauung*, a term already mentioned in connection with Burke, means, basically "world-view," but it suggests especially the kind of world-view that is culturally solipsistic or similarly predisposing. The *Weltanschauung* philosophers of science describe the extent to which particular conceptual and linguistic constructs (the world view) dictate or at least constrain scientific observation and interpretation. The *Weltanschauung* position is, in some ways, close to social constructionism. With respect to science, the *Weltanschauung* position, like Kuhn's social constructionism, argues that communities of inquiry are defined by the assumptions they share and that all scientific observation is determined by the theory brought to bear on "real" evidence. The *Weltanschauung* philosophers, however, implicate the symbolic system of verbal language directly in their analysis, focussing on the ways in which our namings of things determine perception and the possibilities of perception. That is, they claim in part that language is constitutive of reality and that our terms themselves have a rhetorical or, as Booth would say, an "ought" dimension.

Kuhn's *Structure of Scientific Revolutions*, published in 1962, argues, against traditional belief, that scientific perception is not simply externally determined by the nature of reality; rather perception is informed by "paradigms," "disciplinary matrixes" of conventions and assumptions, that guide scientific observation and practice. (They describe,
These governing paradigms include not only what is considered to be knowledge (itself a matter of convention), but also particular vocabularies, problem-definitions, and methodologies. He writes:

By choosing [the term "paradigm"] I mean to suggest that some accepted examples of actual scientific practice—examples which include law, theory, application, and instrumentation together—provide models from which spring particular coherent traditions of scientific research. . . . The study of paradigms . . . is what mainly prepares the student for membership in the particular scientific community with which he will later practice. (10-11)

Scientific inquiry according to the currently governing paradigm, Kuhn calls "normal science." He theorizes that "advances" in scientific thinking are not evolutionary, taking place within a paradigm, but revolutionary—that is, in shifts from one paradigm to another.

Kuhn argues that there is no final or absolute reality even in the realm of the physical world, but that the theories and modes of perception we bring to bear on evidence determine what we make of what we see (effectively, then, what we see):

No part of the aim of normal science is to call forth new sorts of phenomena; indeed those that will not
fit the box are often not seen at all. Nor do scientists normally aim to invent new theories, and they are often intolerant of those invented by others. Instead, normal-scientific research is directed to the articulation of those phenomena and theories that the paradigm already supplies. (24)

Paradigms gain their status, according to Kuhn, because they are "more successful than their competitors" (23) in solving the problems scientists recognize as acute. A scientific revolution occurs when an "anomaly" presents itself, a problem which cannot be solved within the current paradigm. Then, Kuhn says, the discipline is in a state of "crisis" which forces a choice between paradigms: "The decision to reject one paradigm is always simultaneously the decision to accept another, and the judgment leading to that decision involves the comparison of both paradigms with nature and with each other"(77). That is, in the matter of competing versions of reality, one version will triumph.

While Kuhn never mentions the term, it is clear that paradigm shifts must inevitably involve rhetoric as the discursive means applied to win adherents to a particular version of reality:

[I]f a paradigm is ever to triumph it must gain some first supporters, men who will develop it to the point where hardheaded arguments can be produced and multiplied. And even those arguments, when they
come, are not individually decisive. Because scientists are reasonable men, one or another argument will ultimately persuade many of them. But there is no single argument that can or should persuade them all. Rather than a single group conversation, what occurs is an increasing shift in the distribution of professional allegiances. (157)

Kuhn continues:

[I]f the paradigm is one destined to win its fight, the number and strength of persuasive arguments in its favor will increase. More scientists will then be converted, and the exploration of the new paradigm will go on. Gradually the number of experiments, instruments, articles, and books based upon the paradigm will multiply. Still more men, convinced of the new view's fruitfulness, will adopt the new mode of practicing normal science, until at last only a few elderly hold-outs remain.

(158)

Kuhn's social constructionist theory of scientific revolutions, then, aligns itself with rhetorical theory not only indirectly, in terms of shared assumptions about the nature of discourse communities and starting places for inquiry, but also directly, because scientists, he says, have to persuade other scientists to regard certain versions of
reality as true. (In effect, during scientific revolutions, biases are explicit, whereas during periods of normal science, the same biases are implicit.) One of the implications of the theoretical alignment between rhetoric and science here is that the image of the impersonal, disinterested, value-free scientist is eroded. In Kuhn's model, scientific inquiry is itself sanctioned by membership in a scientific community. The acquisition and maintenance of that membership and maintenance of that membership despite the possibility of dissonance, all speak to the impossibility of neutrality in scientific accounting. Not only do scientific writers have to win adherents to their point of view at the moment of anomaly and crisis; but to maintain their status, scientists have always to convince other scientists of the solidity of their membership in the scientific community, and the consequent relevance of their research. They do this by affirming the values of that community, by demonstrating their identification with the assumptions of that community, by using the terms and arguments of that community. Only in these ways do scientists maintain membership and the right to be read or heard.

On the basis of Kuhn's theory alone, it would be possible to rationalize a rhetorical analysis of scientific texts that would uncover the strategies of influence in texts which, through their surface structure—and as part of their
conventional rhetoric—argue (against reason) that they are in fact disinterested, neutral, free of value. However the writings of Polanyi and Ziman strengthen the case.

The publication of Polanyi's *Personal Knowledge* predated the publication of *The Structure of Scientific Revolutions* by four years. Like Kuhn's text, Polanyi's stands as a critique of traditional science. Polanyi argues that reality is not impersonal and external, but conversely, personal and internal; that is, constituted by the perceiving and experiencing mind. Polanyi further argues that perception and experience are tied to a *Weltanschauung* (although he does not use the term); they are the effect and further cause of a world view. The stance clearly implicates contemporary rhetorical theory:

[A]s human beings, we must inevitably see the universe from a center lying within ourselves and speak about it in terms of a human language shaped by the exigencies of human intercourse. Any attempt rigorously to eliminate our human perspective from our picture of the world must lead to absurdity. (*PK 3*)

Polanyi says the condition of knowledge he describes is not regrettable; rather it is inevitable and it is crucial to scientific inquiry. Moreover, understanding it is crucial to understanding scientific inquiry:

[N]o scientist can forego selecting his evidence in
the light of heuristic expectations. And besides . . . he may well be unable to tell on what evidence E his belief in a hypothesis H is founded. It is a travesty of the scientific method to conceive of it as a process which depends on the speed of accumulating evidence presenting itself automatically in respect to hypotheses selected at random. (PK 30).

Scientific inquiry, then, is never neutral in the sense of being random or unfounded in theory. It is—and must be—guided by a theory. Furthermore, Polanyi argues, and the connections to rhetoric are obvious here, neither the language that informs scientific inquiry nor the language in which its course is described can be conceived of as neutral.

Crucial to Polanyi's thesis is his concept of "tacit knowledge"—the set of assumptions and understandings that inform our world views and constrain our perceptions. These assumptions and understandings are so basic that in the context of the communities in which they are shared, they are virtually invisible, not really questionable. To some extent they are not questionable because of the difficulty of using the language of a particular set of assumptions to frame questions that challenge those assumptions:

We are faced here with the general principle by which our beliefs are anchored in ourselves. . . .
I am not speaking of the specific assertions which fill the textbooks, but of the suppositions which underlie the method by which these assertions are arrived at. We assimilate most of these presuppositions by learning to speak of things in a certain language, in which there are names for various kinds of objects, names by which objects can be classified. . . . When we accept a certain set of presuppositions and use them as our interpretive framework, we may be said to dwell in them as we do in our own body. Their uncritical acceptance for the time being consists in a process of assimilation by which we identify ourselves with them. (PK 59)

The theory of tacit knowledge has clear implications for the progress of any discipline, including, of course, scientific disciplines:

To learn by example is to submit to authority. You follow your master because you trust his manner of doing things even when you cannot analyze and account in detail for its effectiveness. By watching the master and emulating his efforts in the presence of his example, the apprentice unconsciously picks up the rules of the art, including those which are not explicitly known to the master himself. (PK 53)

The communities of people sharing "tacit knowledge" are effectively the communities of people sharing (Kuhn's)
"paradigms"—and they are the communities and tribes of rhetorical theory. Specifically, rhetorical process is implicated in Polanyi's analysis in two ways. First, rhetoric is the name of the process by which tacit knowledge is acquired: people become members of particular communities by learning the language, and implicitly the conventional modes of distinction and concomitant ways of perception that identify those communities. Secondly, in emphasizing the degree to which scientific inquiry is guided by "tacit knowledge" and community membership, Polanyi not only argues that neutral language is an absurd idea, but he implies like Kuhn, that the neutral scientist is an absurd idea. In any discourse, the scientist affirms his allegiances and proclaims their value for readers, whose adherence he/she inevitably must court. In effect, then, Polanyi's text argues for the rhetoricity of scientific discourse.

A third major work in the philosophy of science, John Ziman's *Public Knowledge: An Essay Concerning the Social Dimension of Science*, also argues for the rhetoricity of scientific discourse. Like Kuhn, Ziman writes about the conditions of membership in scientific communities; like Polanyi, he writes about initiation into scientific communities, and the extent to which the process of initiation depends on the assimilation of a kind of tacit knowledge. More than either Kuhn or Polanyi, however, Ziman focuses on the establishment of scientific fact as a process
(clearly a rhetorical process, a process of persuasion in aid of assent) by which consensus is established within a scientific community. Kuhn’s scientific community sharing "paradigms," Polanyi’s community of shared "tacit knowledge" is particularized in Public Knowledge as a consensible group of scientists—an "invisible college," a "tenuous tribe." Ziman defines the "Invisible College" as people "who are conscious of working in the same field, as colleagues and rivals, throughout the world" (Public 108).10

If a discussion of Kuhn particularly recalls Perelman’s notion of adherence, and a discussion of Polanyi, Burke’s notion of terministic screens, then a discussion of Ziman particularly recalls Wayne Booth’s notion of consensual agreement. Ziman argues that scientific knowledge distinguishes itself from other forms of knowledge, not by the consensual process by which it is established, but by the degree of consensus it requires for validation. That which we call "public knowledge," he says, must survive a period of critical study and testing and found so persuasive, it is virtually universally accepted. The goal of science is "a consensus of rational opinion over the widest possible field" (Public 9). Furthermore, Ziman observes (consistent with other theorists in both rhetoric and science) that those who participate in scientific consensus must already share many beliefs, including belief in what constitutes a scientific problem, and a conventional form of inquiry in pursuit of a
solution:

The convention is that the scientific community consists of those persons who are able to speak its language. If you wish to pronounce on a scientific matter . . . you must show that you are already acquainted with current knowledge in that field of study. To change the consensus, you must, paradoxically, demonstrate that you understand and accept it as it is. (Public 64)\(^1\)

The scientist, he says, wishing to make a contribution to "public knowledge," "tries to direct his work so that it has relevance to the general notions shared by the scientific world" (Public 48). Like both Kuhn and Polanyi, Ziman argues that concerns which fall outside the general notion of what is scientifically acceptable are scorned, and that evidence which seems to support those concerns is overlooked.\(^2\)

Like Kuhn and Polanyi, Ziman believes that "experiment bridges the gulf between the empirical and the theoretical" and that "a theory provides a logical ordering, a pattern, for observations" (Public 38). More than Kuhn or Polanyi, however, Ziman is explicit in naming rhetoric as the process of arriving at agreement. "Rhetoric," he says, "... is the only word we may use, once we have dethroned positivism, and challenged the absolutism of 'scientific' proof" (Public 32). His question is "Why, in fact, do we believe a good scientific argument . . . ?" (Public 32)
In this context of a rhetoric of science, Ziman describes the scientific report. He writes:

The work as published is no mere chronicle of the research as it took place; it is a much more contrived document . . . . It is written in a curiously artificial 'impersonal' style, deliberately flat and unemotive, as from one calculating machine to another. The experiment is not now something that really occurred to me, the author; it is what always takes place, in principle, under the ideal circumstances set out in the paper. (Public 34)

Ziman argues that the abstract, impersonal style of conventional scientific communications is an attempt by the author to make his work seem already part of the consensus (Public 96). In other words, the impersonal style of scientific writing is not a reflection of the impersonal nature of the inquiry, but its opposite: impersonal style is rhetorically motivated. Ziman says, furthermore that scientific authors use citations rhetorically to validate claims made in the scientific paper and embed it in the preexisting consensus (Public 103). He adds to the rhetoric of science that the article appearing in a scientific journal "bears the imprimatur of scientific authenticity, as given to it by the editor and the referees whom he may have consulted" (Public 111). "The referee," he says, is the "lynchpin about
which the whole business of Science is pivoted" (Public 111); journal referees and editors are guardians of the consensus, gate-keepers of a sort.

Ziman, then, explicitly, and Kuhn and Polanyi implicitly, argue that scientific discourse—including formal scientific prose—is not neutral or strictly objective, but rhetorical, as "rhetorical" has been defined in the context of twentieth-century theory. Scientific discourse is, broadly speaking, impelled by the need to win adherence, establish identification among scientists and with dominant norms, and build consensus.

Ziman's analysis is particularly germane to the present project because it points to specific ways in which scientific authors use rhetorical strategies. What is particularly interesting about Ziman's comments in this regard is that they do not originate in an a priori notion of a rhetoric/science split. Ziman treats science as rhetoric, and his analysis begins from that premise.

Some current theorists—including P. B. Medawar, Sociologists Gilbert and Mulkay, and Joseph Gusfield—share Ziman's open critical stance. However, other theorists noting rhetorical strategies operating in scientific texts—including Andrew Weigert, Barbara Cox and Charles Roland, and Herbert Simons—argue against rhetoricity in scientific texts and claim that these texts should be free of rhetorical tendency. That is, among theorists and researchers who have
done rhetorical treatments of scientific and quasi-scientific texts, two attitudes prevail. One is the attitude (held by Weigert and others) that rhetoric is not appropriate to scientific accounting and should somehow be removed from it; the other—like Ziman's—is that scientific writing simply is rhetorical, and that what is worth investigating about scientific discourse is the way its rhetoric works. Both attitudes represent current scholarship in the rhetoric of science and deserve to be reviewed. The Ziman attitude, entirely consistent with theory in both rhetoric and philosophy of science, is the more productive.

The critical bias of Weigert, Cox and Roland, and Simons, is summed up by Weigert's term: "the immoral rhetoric of science." The critical bias follows the view, also Weigert's, that "a scientist qua scientist says only what 'is' . . . . A rhetorician qua rhetorician says whatever he wants." (111) Weigert argues that "if a sociologist practices rhetoric, but identifies himself . . . as a scientist, he renders his rhetoric immoral, the immoral rhetoric of identity deception" (111).

The negative attitude toward rhetoric impugns authorial use of persuasive strategies, both covert and overt. Weigert is concerned especially with the covert rhetoric of sociological reporting. Readers, he says, find rhetoric "masquerading" as science. He writes:

A professor told me that an article of his was
accepted by a leading journal on the condition that he supply more empirical data to support his argument. He proceeded to add a table distantly peripheral to the theme of the article. With the added baggage, the article was duly published. Such a table is a form of rhetoric. (Weigert 116)

The assumption underlying Weigert's argument is that science could exist independently of rhetoric, and that, if it did, its purposes would be more honorably served.\(^{13}\)

Weigert's concern about covert scientific rhetoric is matched by the concerns of other critics about overt rhetoric in science. Cox and Roland argue that articles appearing in scientific journals participate in scientific ethos of those journals and should be constrained by that ethos. That is, they are not read as rhetorical and therefore they should not be rhetorical. Cox and Roland argue that the "use of emotionally laden words in the scientific literature, especially on controversial topics, tends to undermine objectivity." Referring specifically to a series of medical journal articles on marijuana (published in 1971), they ask, "how scientific is it to speak of patients 'skin-popping' . . . or to describe someone who 'snorted' heroin . . ., or was an 'acid head' or who had a 'good trip' . . . or even to state that hashish may be rolled in to a 'joint'. . .? Would not a more objective tone be
achieved by stating that patients injected a compound intradermally, inhaled heroin powder, used LSD on a regular basis, experienced euphoria or pleasant hallucinations, or rolled hashish in cigarette papers? (141)

These authors express legitimate, if naive, concerns about the role of persuasive appeals in the forum of the scientific article: legitimate because scientific readers should be aware of authors' designs on them; naive because they maintain an ideal of objectivity that is simply unattainable, even if it were theoretically possible. Cox and Roland conclude their own emotional paper by recommending that "editors weed out the rhetoric in the material they accept, even if that means taking an unpopular stance." The editors, they say, can console themselves "with the thought that when the tide of public and professional opinion shifts, their journal will be remembered for its objectivity . . . the very foundation of science." In their diatribe against rhetoric, Cox and Roland do not say how, in the absence of anyone trying to persuade anyone of anything, it might happen that the "tide of public and professional opinion" would shift.

Weigert and Cox and Roland hold to an ideal, like the seventeenth-century ideal of the Royal Society, that if science could only be split from rhetoric, that is, if language could only be shorn of its rhetorical component, all inquirers would be closer to an independent truth.
The ubiquitous and often unconscious use of rhetorical strategies in scientific texts, as well as the theoretical inevitability of a rhetorical dimension in science reporting, diminishes the usefulness of the claim made by Weigert and others that scientific writing is suspect by virtue of being rhetorical, or that scientists are to be chastised for being, as Herbert Simons says, "rhetors in disguise." In fact, this kind of argument is a smokescreen obscuring the more significant issues in the rhetoric of science pertaining to the nature and means of scientific persuasion--issues which other critics have been more able to address.

The other attitude toward rhetoric in science, noted in Ziman, recognizes its inevitability and is more compatible with contemporary understanding of both science and rhetoric--although critics who hold this attitude are nonetheless concerned about the form and substance of scientific writing. "The scientific paper may be a fraud," says P. B. Medawar, "because it misrepresents the process of thought that accompanied or gave rise to the work that is described in the paper" (43). That is, the surface reporting of science continues to promote the ideal of objectivity of observation and purity of research, while the reality of science is that "every act of observation we make is biased" and pure induction in scientific inquiry is a fiction" (42).

Medawar's position is corroborated by a discourse analysis published recently by sociologists of science,
Gilbert and Mulkay. Gilbert and Mulkay compare the features of scientists' informal conversation (which, they claim, betrays unselfconsciously the "real" nature of their work) and their formal conversation—the discourse of professional journals. They first describe the formal talk of scientists:

"[T]he texts of experimental papers display certain recurrent stylistic, grammatical and lexical features which appear to be coherently related. . . . Neither the author's own involvement with or commitment to a particular analytical position nor his social ties with those whose work he favors are mentioned. Laboratory work is characterized in a highly conventional manner, as instances of impersonal, procedural routines which are generally applicable and universally effective. Although the content of experimental papers clearly depends on the experimenters' actions and judgments, such papers are overwhelmingly written in an impersonal style, with overt references to the author's actions and judgments kept to a minimum. By adopting these kinds of linguistic features, authors construct texts in which the physical world seems regularly to speak, and sometimes to act, for itself. (55-56)"

Gilbert and Mulkay explain that the formal writing of science, which "portrays scientists' actions and beliefs as
following unproblematically . . . from the empirical characteristics of an impersonal natural world," is selective (56), and they demonstrate the principle of selectivity by comparing formal scientific texts to the informal speech of the same scientists discussing the same acts of research. They report that what appears in journal articles to be objective observation is explained informally as guided by a commitment to a particular way of looking at data:

Scientists' informal talk about action and belief was often much more contingent, in the sense that speakers gave accounts in which it was accepted that their professional actions and scientific values could have been otherwise if their personal or social circumstances had been different. [This contingent repertoire] enables speakers to depict professional actions and beliefs as being significantly influenced by variable factors outside the realm of empirical . . . phenomena. When this repertoire is employed, scientists' actions are no longer depicted as generic responses to the realities of the natural world, but as the activities and judgments of specific individuals acting on the basis of their personal inclinations and particular social positions. (57)

Gilbert and Mulkay demonstrate, through their study, that formal scientific language does not accurately portray the
practice of science, even as that practice is articulated in other realms of discourse.

Medawar's position is corroborated also by Joseph Gusfield's "literary" analysis of a medical journal article on drinking drivers. Gusfield finds many persuasive strategies at work in the "scientific" piece, and is not so much disturbed by the presence of rhetoric in the article as he is by what he perceives to be the article's dishonesty. He writes:

The language is deliberate, nonevocative, meticulous and limited in imagery. It informs the reader that the persuasion is to come from an external reality not from the author or his use of language. The description is minimally metaphorical. The intent is made to seem cognitive and logical rather than affective or emotional. We, the audience, are to think and not to feel. Although the author is not anonymous and is identified as a scientist in a governmental organization, the style of writing grounds the action of the paper in the agency of methodological procedures of data collection and analysis. The agent is minimized and the drama of the paper is presented as following from the unfolding of the procedures of method, not from the interests, biases or language of the author. (21)

What is "fraudulent," then, about scientific writing (to
use Medawar's term) is not that it is rhetorical, but that the nature of its rhetoric is not always consistent with the nature of the enterprise it represents. Moreover, the persuasive power of formal scientific language is derived in part from the fact that it appears, at least at first, not to be rhetorical. Gusfield's comments on scientific writing, as well as those of Medawar, Gilbert and Mulkay—and John Ziman—suggest the need for further studies which explore the nature and implications of scientific rhetoric. Because the exploration must reveal the modes of functioning of persuasive strategies in scientific texts, such studies are best informed by an understanding of rhetorical theory, and use an analytical model based on that theory. It is the purpose of the following chapter to establish just such a model.

Theory in both philosophy of rhetoric and philosophy of science, then, argues for the rhetorical study of scientific texts. Philosophy of rhetoric brings to an enterprise in rhetoric of science a sense of the nature of audience as discourse community, the uses and the shapes of persuasion, the non-neutrality of any language in use, the ubiquity of symbolic interchange and its epistemic role. Philosophy of science brings to the enterprise a parallel understanding of discourse community, and a sense of the contingent nature of human inquiry at every level—from "empirical" observation to theory construction and the construction of knowledge
itself. For theorists in both rhetoric and science, language is value-laden and perception is theory-laden, and some notion of "weltanschauung," of beliefs and assumptions affecting both language and perception, goes some way to explaining human action.
1. No attempt is made here to cover theory in either rhetoric or acience exhaustively, only to use exemplary theorists to show the connections between them. Exhaustive coverage would include arguments, not only from other rhetoricians but from other contemporary textual critics, on the non-neutral and formative nature of language—as well as a history of theoretical opposition to traditional views of science.

Postmodern textual critics, from reader-response critics to deconstructionists, have made the case that language is neither neutral nor transparent, but informed and formative in relation to thought. For an overview, see, for example, Eagleton, Tompkins, Scholes, and Culler. It is important to note, however, the distinctions between contemporary rhetoric and other postmodernist views. The argument that language conditions how we think is not complete in itself. For the postmodernists, language is an impersonal and closed system, whereas for rhetoricians, language is full of value, and rhetors have some power, in their humanness, to use it well.

For purposes of the present synthesis, the basic texts for the Perelman discussion are The New Rhetoric and The Realm of Rhetoric; for the Burke discussion, A Rhetoric of Motives and Language as Symbolic Action, and for the Booth discussion, Modern Dogma and the Rhetoric of Assent. The three theorists are major figures in 20th century rhetorical
A useful secondary source for a discussion of "new science" is Suppe. For the words of the scientists themselves, see, for example, W. Heisenberg, and J. A. Wheeler. In science, the notion that the observed affects the observed argues that the physical world itself is not represented identically to every observer: "What we observe is not nature itself, but nature exposed to our method of questioning" (Heisenberg 75).

For purposes of the present synthesis, the basic text for the Kuhn discussion is The Structure of Scientific Revolutions; for the Polanyi discussion, Personal Knowledge; and for the Ziman discussion, Public Knowledge. All three philosophers of science became active in their discipline in the late fifties and early sixties, and the work of all three is now considered seminal and still central to the field.

2. The traditional rhetorical canons, Invention, Arrangement, Style, Memory, and Delivery—the five parts of rhetorical study—were enumerated by the Roman rhetoricians, probably first by the author of the Ad Herennium.

3. For a discussion of the differences between Classical and Modern Rhetoric, see Knoblauch and Brannon. For a discussion of similarities, see Lunsford and Ede.

5. Perelman says, "We see that [the] status of fact and truth is not guaranteed indefinitely unless we accept the existence of an infallible authority, a deity whose revelations are incontestable and who could guarantee these facts and truths. However, if we lack such an absolute guarantee, such self-evidence, and such necessity as would compel every reasonable being the facts and truths which are accepted by common opinion or by the opinion of specialists become open to question" (Realm 24).

6. The argument that scientific inquiry is itself a form of rhetoric is supported by recent work in the sociology of science. See, for example, Knorr-Cetina, The Manufacture of Knowledge and Knorr, Krohn, and Whitley. See also Latour and Woolgar, and Gilbert and Mulkay.

7. Crusius claims that Booth "has thoroughly confounded dialectic and rhetoric, arguing for the former well but under the banner of 'a rhetoric of assent.'" (23) According to Crusius, Booth's "rhetoric" is itself a dialectic--inquiring "into the truth by dialogue." (30) The conflation of rhetoric and dialectic, however, is characteristic of contemporary rhetorical theory (Perelman says "The theory of argumentation [is] conceived as a new rhetoric or dialectic. . . "[Realm 5]. See also Brummett, and Scott ("On Viewing Rhetoric as Epistemic" and "On Viewing Rhetoric as Epistemic: Ten Years Later").
8. Interestingly, Booth himself refers to both Polanyi and Kuhn in his discussion of science. See his footnote, MD 109-110.

9. It is important that this view of science, and similarly any view of science, subsumes not only a view of language, but an epistemology: it includes a theory of how we know what we know. Furthermore, an epistemology is necessarily implied in a view of language. It is not surprising, therefore, that theories of scientific knowledge and rhetoric would intersect in the contemporary intellectual context—and that a social constructionist view of science would be reinforced in a theory of non-neutral language and a rhetoric of consensual validation.

10. In a much later work, An Introduction to Science Studies, Ziman offers this expanded description:

   Scientists mainly interact communally with other scientists in their specialty—that is, with other members of the invisible college in their field of research. This is not, of course, a precisely defined group, since it consists simply of the research scientists who happen at the time to be trying to solve a particular scientific problem . . or who are using a particular experimental technique . . . or who are interested in some particular aspect of nature. . . . It is not institutionally, geographically or nationally localized. . . (75).
11. This view, in fact, is so characteristic of the prevailing paradigm in scientific thought that it is referred to and assumed in much the same way as principles of empiricism were referred to and assumed in writing about science to the middle of this century. In a recent book review, physics professor James Trefil remarks on author Gerald Holton’s use of the term "culture of science" in his book. The term, Trefil says, refers to "that tenuous web of shared assumptions and methodologies that characterizes the work of scientists and, to a large extent, determines how the scientific enterprise operates" (50). The concept "culture of science" is referred to rather than argued in the article, its validity assumed rather than asserted, and this is the mark of the maturity of a concept within a culture.

12. See especially Ziman’s discussion (Public 56-7) of Continental Drift and Polanyi’s comparable discussion (PK 158) of extra-sensory perception.

13. It is interesting in the context of Weigert’s objections to look carefully at Weaver’s "The Concealed Rhetoric of Scientistic Sociology." While Weigert does not cite Weaver, he makes many of the same points. In his 1959 essay, Weaver lists rhetorical strategies of writers in social science, not the least of which, he says, is calling themselves "social scientists"—according to Weaver, a contradiction in terms and a rhetorical expression. Sociologists, according to
Weaver, have rhetorically identified themselves with science, using the "eulogistic terms" of science. It is surprising that while Weaver is aware of a rhetoric of citations, linguistic obfuscation, and use of the signs of precision in "scientistic sociology," he never acknowledges that the same strategies might be at work in bona fide scientific writing.

14. For further discussion of the performance of science and the reporting of it, see Latour and Woolgar. Their ethnographic research involves observing scientists working in the laboratory to observe how the daily activities of science lead to the construction of scientific facts.
The discussion so far has established the following points with respect to the theoretical underpinnings of a rhetorical analysis of scientific discourse: 1) that science and rhetoric are legitimately interconnected, particularly insofar as scientific inquiry and scientific accounting are viewed epistemically (as the production of scientific knowledge) and rhetoric is viewed as an epistemic process (the discursive means of knowledge production); 2) that the study of both science and rhetoric entails investigation into the theory-ladenness of perception and the value-ladenness of language; 3) that scientific "truth" is arrived at consensually in the communication of scientists, and is not, at least not absolutely, objective or neutral; 4) that scientific language is not neutral or transparent, but textured by the belief systems of particular scientific communities; and 5) that scientific language can, for these reasons, be called "rhetorical." Moreover, these views of science and rhetoric have become "commonplace" in contemporary Western thought. They are, among initiated theorists, assumed to be valid; these views are no longer so much arguable as they are themselves matters of consensible opinion on which other arguments can be predicated.

The matter at hand is to develop a methodology of analyzing
scientific prose, in particular selected articles published in major medical journals over the last six years, for purposes of specifying the nature of their rhetoricity. Although the prose conventions associated with scientific writing have traditionally been thought to be non-rhetorical (the realm of science being considered separate from the realm of rhetoric), theory—as well as past rhetorical analysis (See Chapter One)—suggests that scientific prose is not simply reportorial, voiceless, neutral. The hypothesis for the analysis is that scientific prose, as language in use, is rhetorical, and that part of its rhetorical power comes from prose conventions which operate to create the impression of the disinterested scientist reporting acts of pure observation in transparent prose.

The ultimate purpose of rhetorical analysis is to illuminate the functions and effects of discourse. Kenneth Burke writes in "The Rhetoric of Hitler's 'Battle," that he has undertaken an analysis of Mein Kampf in order to discover the nature of its rhetoric, so that "we may know, with greater accuracy, exactly what to guard against," as a population in America (PLF 191). To draw an analogy between Burke's purpose and the purpose of this project is not to suggest anything sinister in the rhetoric of science in general or medicine in particular. The motive of the rhetorical critic is always to increase awareness of the ways of human influence by increasing understanding of language in use.

To develop a theory of scientific rhetoric and establish a
methodology for the rhetorical analysis of scientific texts, this chapter begins with a review of significant definitions of both rhetoric itself and rhetorical criticism as well as descriptions of particular programs of rhetorical criticism and the theories on which these programs are based. The review lays the groundwork for the remainder of the chapter which describes the common ground of rhetorical criticism, argues the appropriateness of applying a rhetorical model to the reading of scientific texts, affirms a definition of rhetorical discourse embracing scientific texts, and establishes a rhetorical model which suggests an analytic procedure, or a series of probes to be applied in the analysis of scientific texts.

The theorist on whose work models for rhetorical criticism have traditionally been based is Aristotle; and in the twentieth century, the century that has seen the greatest sustained interest in the subject of rhetorical criticism, the dominant form of rhetorical critical practice is neo-Aristotelian. Analysis according to Aristotelian principles is, in fact, the core program on which other programs have been based or from which they have been launched, and the program against which still others have reacted.

Not all rhetorical theorists have dealt directly with the rhetorical analysis of texts (Aristotle did not). Among the authors who have considered the practice of rhetorical criticism are Herbert Wichelns, Edwin Black, Donald C. Bryant,
Wayne Booth, and Kenneth Burke. A review of their approaches to texts, while not supplying a complete summary of the literature in rhetorical criticism, does cover major trends in this century and suggests a direction for methodology in the rhetorical analysis of scientific texts.

A distinction to keep in mind in reviewing approaches to rhetorical criticism is that between the criticism of rhetorical texts, in which the critic first defines certain texts as rhetorical and then discusses the analysis of those texts, and the rhetorical criticism of texts, in which the critic first defines a methodology as rhetorical and then discusses the application of rhetorical method to a variety of kinds of texts. While not all rhetorical critics necessarily choose between these approaches, the distinction between them is useful in providing one filter through which to examine various critical works. Some critical approaches, more than others, invite the treatment of scientific texts within the realm of rhetoric.

Aristotle's own well-known definition of rhetoric is the "faculty of discovering in the particular case what are the available means of persuasion" (7), and, in general, those who have used this definition as the basis of a program of rhetorical criticism have asked to what extent a particular author has been successful in finding and using the available means of persuasion in the particular case. The Aristotelian question itself suggests a "criticism of rhetorical texts"
model, since it implies that certain texts, by virtue of the features placed in them by the choice of an author with the intention to persuade, are rhetorical.

In the first quarter of the twentieth century, the neo-Aristotelian model of rhetorical criticism was articulated comprehensively by Herbert Wichelns, who then became somewhat of a mentor for other critics who would attach themselves to a critical base in Aristotelian theory.

Neo-Aristotelian critical methodology is essentially an application to specific texts of the terms of Aristotelian rhetorical theory (summarized more fully in Chapter One above). Neo-Aristotelian critics consider the particular situation, audience, and purpose for a "speech" (now, not only a speech but any discourse), and how the speech has been conditioned by the speaker's understanding of all of these factors of context. They organize analysis through the four major rhetorical canons: Invention, Arrangement, Style, and Delivery. They focus (as Aristotle did) on Invention, considering artistic and inartistic proofs in the speech, as well as enthymemes and examples and the topoi which operate in them. They delineate appeals of ethos (appeal from the character of the speaker), pathos (emotional appeal) and logos (the arguments themselves). They consider Arrangement, noting the disposition of the appeals and arguments in the speech, and identify and discuss the effects of devices of Style and Delivery. Aristotle effectively catalogued possible means of persuasion, and these
are used heuristically in the criticism based on his theory.  

Herbert Wichelns is considered to be the first person to formalize neo-Aristotelian criticism, drawing together the fragments concerning criticism that other critics had mentioned in the earlier part of the twentieth-century. His "Literary Criticism of Oratory," which appeared in 1925, was said to be the "first truly scholarly project in rhetoric for this century" (Stewart 3). Wicheln's commitment to an Aristotelian approach is apparent in the subjects he suggests merit the attention of the critic:

Rhetorical criticism is necessarily analytical. The scheme of a rhetorical study includes the element of the speaker's personality as a conditioning factor; it includes also the public character of the man--not what he was, but what he was thought to be. It requires a description of the speaker's audience, and of the leading ideas with which he plied his hearers--his topics, the motives to which he appealed, the nature of the proofs he offered. These will reveal his own judgment of human nature in his audiences, and also his judgment on the questions which he discussed. Attention must be paid, too, to the relation of the surviving texts to what was actually uttered: in case the nature of the changes is known, there may be occasion to consider adaptation to two audiences--that which heard and
that which read. Nor can rhetorical criticism omit the speaker's mode of arrangement and his mode of expression, nor his habit of preparation and his manner of delivery from the platform; though the last two are perhaps less significant. "Style"—in the sense which corresponds to diction and sentence movement—must receive attention, but only as one among various means that secure for the speaker ready access to the minds of his auditors. Finally, the effect of the discourse on its immediate hearers is not to be ignored, either in the testimony of witnesses, nor in the record of events. And throughout such a study one must conceive of the public man as influencing the men of his own times by the power of his discourse. (Wichelns 212-213)

According to rhetorical theorist and critic Donald C. Bryant, Wichelns' 1925 essay "set the pattern and determined the direction of rhetorical criticism for more than a quarter of a century and has had a greater and more continuous influence upon the development of the scholarship of rhetoric and public address than any other single work published in this century" (Bryant, Idiom 5). Yet despite his explicitness in articulating a critical approach based on Aristotle, Wichelns failed to produce a practicable methodology. This view is detailed by Charles Stewart in his historical survey of rhetorical criticism in twentieth-century America. Stewart
writes, "The majority of studies [following Wichelns] delved into one of Wichelns' topics—style, proofs, rhetorical devices, preparation—and authors turned to classical sources, usually Aristotle for further guidelines (Wichelns had not explained how the critic should analyze style, proofs, or other topics)" (6).

That is, at the most practical level of what the critic should do, Wichelns is less than explicit. His failure to bring his methodology to the level of generalizable practice may be seen as a reluctance to prescribe a procedure that might constrain the individual critic in the pursuit of rhetorical insight.

A similar failure of explicitness in methodology is found in the work of Edwin Black. As one of the most vocal opponents of the neo-Aristotelian critical stance, Black describes a situation in contemporary criticism which calls forth his alternative critical programme. "Our task," he says,

is to sketch an approach to rhetorical criticism that constitutes an alternative to neo-Aristotelianism, but we cannot approach criticism in a theoretical vacuum. There are assumptions behind any approach and these assumptions ought to be disclosed as candidly as possible. (132)

Black argues that any methodology must be based on a coherent set of theoretical assumptions; yet he, like Wichelns, weakens at the point of praxis. While his main theoretical assumption-
that rhetoric is transactive rather than argumentative—is a powerful one and has been maintained by other theorists\(^4\), his analytical method is neither comprehensive nor generally useful.

Black argues that the rhetorical transaction is characterized by relationships among rhetorical situation (extralinguistic factors influencing audience reaction to discourse), rhetorical strategies (characteristics of discourse), and audience effects (responses to strategy in the context of situation). He proposes that the rhetorical critic attend to ratios among these factors according to a "scale" which embraces the whole of the rhetorical process. Such a scale, he maintains, would account for "exhortative" discourse, which uses emotionalism to arrive at intense conviction, and argumentative discourse, which is aimed at "assent less intense than, say, exhortation, and more intense than, say, advice-giving . . ." (149) among other discourses, which are unspecified.

The problem with Black's approach is not only that it is vague and therefore difficult to apply, but that it rests on a definition of rhetoric which limits its scope in much the same way as the scope of Aristotelian rhetoric is itself limited—to discourse which is intentionally persuasive (despite, and possibly in contradiction to, Black's sense of rhetoric as transactive). According to Black, "the subject matter of rhetorical criticism is persuasive discourse" (14), and
"persuasive . . . refers to intent, not necessarily to accomplishment. Rhetorical discourses are those discourses, written or spoken, which aim to influence men" (15). His is not so much a program of rhetorical criticism as it is an interesting but limited tool to be applied in the criticism of certain kinds of rhetorical texts.

Like Edwin Black, Donald C. Bryant views the terms, "rhetoric," "criticism," and "method," as problematic, but his agenda in Rhetorical Dimensions in Criticism is more exploratory and process-oriented than Black's. Bryant covers the historical ground from Wichelns to his own contemporaries, including his own earlier writing, discussing a variety of approaches to rhetoric and rhetorical criticism. It is worth noting that, in his quotation of the Committee on the Scope of Rhetoric (of the National Development Project), he articulates the position referred to in this discussion as "rhetorical criticism of discourse." Bryant quotes from Lloyd Bitzer and Edwin Black, The Prospect of Rhetoric:

Rhetorical studies are properly concerned with the process by which symbols and systems of symbols have (i.e. exert) influence upon beliefs, values, attitudes, and actions, and they embrace all forms of human communication, not exclusively public address nor communication within any one class or cultural group. (208)

Bryant's dialectical method takes him to a crucial point
concerning the function of discourse, and that is the distinction between "the treatment of artifacts as significant primarily for what they are and the treatment of them as primarily significant for what they do (Dimensions 27). In this regard, Bryant acknowledges the significance of rhetorical theorist E.P.J. Corbett's definition of rhetorical criticism. Corbett defines rhetorical criticism as that mode of internal criticism which considers the interactions between the work, the author, and the audience. As such it is interested in the product, the process, and the effect of linguistic activity, whether of the imaginative kind or the utilitarian kind. When rhetorical criticism is applied to imaginative literature, it regards the work not so much as an object of contemplation but as an artistically structured instrument for communication. It is more interested in a literary work for what it does than for what it is. ("Introduction," Analyses xxii)

Once he has identified the function of discourse as central to the rhetorical perspective, Bryant recasts his own earlier definition of rhetoric as "the rationale of informative and suasory discourse" (Dimensions 11), converting it to, "the rationale of the informative and suasory in discourse" (Dimensions 29). A corollary of Bryant's recast definition is his choice, as he says, to discuss "rhetorical dimensions in
criticism" rather than "rhetorical criticism" (Dimensions 29). (Bryant does revert to the term "rhetorical criticism" in later discussion.)

As the province of literary criticism is the poetic --the fictive and imaginative, the beautiful, the enduring in poems and prose, the eloquence of public affairs and the pulpit--so rhetorical criticism treats of the illuminative and suasive in speeches and speaking, in pamphlets and pamphleteering, in controversy and debate, in editorials and editorializing, in Grapes of Wrath and Mother Courage and the vehicles and media to which they belong. . . . Rhetorical criticism is systematically getting inside transactions of communication to discover and describe their elements, their form, and their dynamics and to explore the situations, past or present, which generate them and in which they are essential constituents to be comprehended and judged. (Dimensions 34-5)

Like Wichelns and Black, Bryant is more focussed on the nature and quality of rhetorical criticism than he is on a methodology for it. Bryant says that rhetorical criticism is "analytical"; "it discovers how the object is made . . . " and then searches "into the potential working of the object in the situation" (Dimensions 38-9). However, Bryant does not go on to say how rhetorical criticism is done. Details of Bryant's
methodology can best be inferred from his own works of criticism.

The emerging sense that the "what" of rhetorical criticism is prior to and more important than the "how" of it is reinforced by the writings of speech professors Mark S. Klyn and Marie Hochmuth Nichols, and of rhetoricians Kenneth Burke and Wayne Booth. It seems to be the case, considering the shifting focus in "criticism of rhetorical texts," "rhetorical criticism of texts," and "rhetorical dimensions of criticism," that the term, "rhetorical" when applied to "criticism" suggests a peculiar kind of attention to texts rather than a particular form of practice.

In an article appearing for the first time in Essays on Rhetorical Criticism (1957) Klyn writes that "rhetorical criticism" only means "'intelligent writing about works of rhetoric'"

--or about works which are not 'rhetoric' in any formal sense but which can be illuminatingly treated from such a standpoint--in whatever way the critic can manage it. It does not imply a prescriptive mode of writing, any categorical structure of judgment, or even any judgmental necessity. (147)

Arguing for a pluralistic approach to rhetorical criticism against, for example, what he perceives as the monism of neo-Aristotelianism, Klyn says that the best critics, "in writing about persuaders or works of rhetoric," have functioned as
"free men,"
unfettered by any coercive critical doctrine,
unconfined by any pedagogical imperative, able to
reason inductively from their material and to explore
their insights as independent, disinterested
thinkers. (156)

Among rhetorical theorists and critics, Kenneth Burke
is credited with having developed a critical methodology
coherent enough to stand up against a neo-Aristotelian model.
"As a philosopher," writes Marie Hochmuth Nichols, Burke
has been searching for the assumptions on which
the art [of criticism] rests, assumptions pertaining
to language, the nature of meaning, the function of
language in producing cooperation, the meaning of
persuasion. As a critic, he has searched for a
critical methodology appropriate to this rationale.
("Criticism" 77)

According to Nichols, Burke finds the assumptions on which to
base a critical methodology and a methodology as well:

For the critic, Burke’s rationale necessitates a
system of classification, a naming of maneuvers that
are operating in any language situation, bringing
about either by calculation or by "unconscious"
appeal, social cohesion, that is, consubstantiality,
material or idealistic. It requires constant
attention to both the biological and rational
grounding of appeal. Burke's critical tool for locating the constituents of a situation is variously named, "dramatistic pentad," or 'dialectical substance.' ("Criticism" 81)

Nichols is referring to Burke's theory of persuasion as an action to enhance consubstantiality, elaborated in his *Rhetoric of Motives* (see Chapter One above), and his pentadic system for analyzing discourse rhetorically in terms of Act, Scene, Agent, Agency, and Purpose, elaborated especially in his *Grammar of Motives*. While Burke's theory of rhetoric as identification and his dramatistic approach based on that theory are both productive in terms of textual analysis, it is crucial to observe that Burke himself sees the work of the critic in very broad terms. Burke is concerned with the rhetoric of both poetic and non-poetic discourse, and referring here to "The Rime of the Ancient Mariner," he writes:

[T]o grasp the full nature of the symbolic enactment going on in the poem, we must study the inter-relationships disclosable by a study of Coleridge's mind itself. If a critic prefers to so restrict the rules of critical analysis that these private elements are excluded, that is his right. I see no formal or categorical objection to criticism so conceived. But if his interest happens to be in the structure of the poetic act, he will use everything that is available--and would even consider it a kind
of vandalism to exclude certain material that Coleridge has left, basing such exclusion upon some conventions as to the ideal of criticism. The main ideal of criticism, as I conceive it, is to use all that is there to use [emphasis mine]. (PLF 23)

In his own rhetorical analyses, Burke himself uses "all that is there to use." As a rhetorical critic, he brings to bear on a text the totality of his knowledge and experience, within a theoretical context in which persuasion is understood as the promotion of identification (consubstantiality) by the use of symbols. In his analysis of Mein Kampf ("The Rhetoric of Hitler's 'Battle'"), Burke is not limited, methodologically, to the application of the pentad or to critical observations suggested by Aristotle's Rhetoric. Eclecticism is at the root of his criticism. Marie Hochmuth Nichols writes of Burke:

His knowledge of psychoanalysis is useful in the analysis of the "sexual symbolism" that runs through the book. . . . His knowledge of history and religion is employed to show that the "materialization of a religious pattern" is "one terrifically effective weapon . . . in a period where religion has been progressively weakened by many centuries of capital materialism." . . . Conventional rhetorical knowledge leads him to call attention to the "power of endless repetition," the appeal of a sense of "community," "the appeal of security" resulting from a "world
view" for a people who had previously seen the world only "piecemeal," and the appeal of Hitler's "inner voice" which served as a technique of leader-people "identification." . . . Burke’s analysis is comprehensive and penetrating. It stands as a superb example of the fruitfulness of a method of comprehensive rhetorical analysis which goes far beyond conventional patterns. ("New Criticism" 143)5

Burke’s criticism is widely acknowledged to be "rhetorical." Yet in light of his eclecticism, and what seems to be the slipperiness of the term itself, it makes sense to ask exactly what makes it rhetorical. In fact, the rhetorical nature of Burkeian criticism lies not in his instruments of analysis, but in the assumptions which inform that analysis; not in his procedure per se, but in the attitude which causes him to formulate certain kinds of questions with respect to texts. Burkeian criticism—and indeed all that we agree to classify as "rhetorical criticism" is "rhetorical," not by virtue of subject matter or method--about which there seems to be no general consensus among rhetorical critics--but by virtue of point of view. Rhetorical criticism is a posteriori defined by the nature of the attention which the critic directs to the text.6

The rhetorical criticism of Wayne Booth provides another perspective on this concept of "attention." Booth’s approach to the discourse of imaginative literature has much in common
with his approach to the discourse of daily life, and his sense of the real-world consequences of "fiction" dictates the nature of his critical program. Methodologically, Booth proceeds without any particular analytical tool, but uses his own theoretical predisposition and his moral sensibility to locate and comment on the authorial choices that create the text as he reads it. ("The author," he says, "cannot choose whether to use rhetorical heightening. His only choice is of the kind of rhetoric he will use" [ROF 116].) Booth focuses on technique, on questions of authorial choice and strategy, believing—as Burke does⁷—that poetic literature is essentially rhetorical:

If the most admired literature is in fact radically contaminated with rhetoric, we must surely be led to ask whether the rhetoric itself may not have had something to do with our admiration. . . . The truth is that, if recognizable appeals to the reader are a sign of imperfection, perfect literature is impossible to find; in great works, not just of fiction but of all kinds, we find such appeals wherever we look. . . . (ROF 98-99)

At the very moment when [Henry] James exclaims to himself, "Here is my subject!" a rhetorical aspect is contained within the conception: the subject is thought of as something that can be made in public, something that can be made into a communicated work. . . . [R]egardless of how we
define art or artistry, the very concept of writing a story seems to have implicit within it the notion of finding techniques of expression that will make the work accessible. (ROF 105)

If Booth is successful as a critic, it is because he is committed to discovering what texts do, how they act, how they change people; his method is intuitive and inductive. Booth’s motive in *The Rhetoric of Fiction* is not to explicate a methodology but to demonstrate the rhetoricity of fiction and the consequent moral obligation of the writer of fiction. Booth’s theoretical starting place and his critical agenda separate him from many other rhetorical critics. Edwin Black, as we have noted, was concerned with the "criticism of rhetorical text," which he defined as text created with the intention to persuade; Booth is concerned with the "rhetorical criticism of text," in which rhetorical "attention" is applied to a wide range of texts, rhetorical by virtue of their textuality, irrespective of intention. He writes,

[T]he whole question of the difference between artists who consciously calculate and artists who simply express themselves with no thought of affecting a reader is an important one, but it must be kept separate from the question of whether an author’s work, regardless of its source, communicates itself (ROF, preface).

This review of rhetorical criticism, from Wichelns to
Booth, lays the groundwork for approaching scientific texts from the rhetorical point of view. The remainder of this chapter establishes an operational definition of the rhetorical point of view or rhetorical "attention"; argues the appropriateness of applying rhetorical attention to scientific texts; affirms a rhetorical theory that embraces scientific texts; and suggests a methodology for analyzing scientific texts from the rhetorical point of view.

A rhetorical theory comprises a collection of working assumptions about discourse on which a methodology for the analysis of texts can be based. A rhetorical methodology is a procedure for textual analysis; it may use a variety of analytical tools but is constrained by the terms of the theory on which it based. A rhetorical methodology directs a critic to make certain kinds of discoveries about a text. These discoveries illuminate the workings of particular texts on particular audiences; they also stand as evidence of the validity of the rhetorical theory which enabled them. Theories of rhetoric are thus essentially descriptive; as they are operationalized, they become predictive and are reinforced. The analytical work of a critic generates new theory when his or her insights about a text go beyond what could be predicted by traditional theory. Burkean criticism, for example, outstrips Aristotelian criticism, as Burke finds evidence in texts of his own rhetorical principles, such as Division and Identification, Dramatism, and Terministic Screens.
Irrespective of individual approaches among rhetorical critics, their contributions constitute a single body of work in textual theory and critical practice—for they share a set of assumptions prior to individualizing assumptions, which defines their work as rhetorical and specifies the nature of "rhetorical attention." The assumptions which identify and bind rhetoricians are so fundamental that despite pluralism, rhetoricians share what might be called, after Thomas Kuhn, a "paradigm," a shared way of looking at the world and the role of language and language-users in it. Burke, for example, seems to separate "old" and "new" rhetoric with this:

If I had to sum up in one word the difference between the "old" rhetoric and a "new" (a rhetoric reinvigorated by fresh insights which the "new sciences" contributed to the subject), I would reduce it to this: The key term for the old rhetoric was "persuasion" and its stress was upon deliberate design. The key term for the "new" rhetoric would be identification, which can include a partially unconscious factor in appeal. ("Rhetoric" 203)

Yet in Rhetoric of Motives, Burke adds, "there is no chance of our keeping apart the meanings of persuasion, identification ("consubstantiality") and communication (the nature of rhetoric as "addressed")" (46). From Aristotle to Burke, the rhetorical point of view has paradigmatic status by virtue of the basic assumptions shared among members of the discipline of
Rhetoric. Rhetorical critics can furthermore be grouped not only positively in terms what they share, but negatively as set over against other, non-rhetorical, critics.

In positive terms, rhetoricians have been concerned throughout history (though their concerns may be expressed differently at different times) with issues pertaining to the nature of reality and human nature, the relationship between thought and language, and the function of language and persuasive communication in society. Rhetoricians believe that the world is changed by human action, including the symbolic action of people speaking. Quintilian's view that the rhetorician is "the good man speaking well" has salience in the theory generally, and is extended in the belief that such a "man" could change the course of the world. The view is pragmatic and humanistic; and to the extent that it supports the notion of positive change, it is optimistic.

This conception of the workings of language and people, and the belief in the effectiveness of symbolic action in the world mark the rhetorical critic. The rhetorical critic believes that the structures of texts reflect the intentions of authors; that authors communicate to readers through texts; and that the rhetorical act is addressed to an audience and has an effect on the situation into which it is introduced. This is the model: that people use language in specific contexts to influence other people and alter their contexts. What follows, in a composite treatment, acknowledging pluralism, is
the rhetorical point of view:

[T]here will be a correspondence among the intentions of a communication, the characteristics of his discourse, and the reactions of his auditors to that discourse. This postulate is justified by the fact that to deny it is to deny the possibility of language, as we normally understand that term. (Black 16)

The rhetorical, unlike the poetic, includes the sayer as well as the said, the writer as well as the written; thus rhetorical discourse participates in the situation and alters or reconstitutes reality. (Bryant, *Dimensions* 36)

What makes attention to style peculiarly rhetorical is some attempt to relate the stylistic features not only to other formal and material elements in the work itself but also to the ethos of the author and to the effects the author is seeking to produce in an audience. For the rhetorical critic, style represents the choices that an author has made from the available lexical and syntactical resources of a language. A critic becomes "rhetorical" when he tries to show that the choices from among the available options were made in reference to subject-
matter or genre or occasion or purpose or author or audience—or some combination of these. (Corbett, "Introduction" Analyses xxvi).

Critical and imaginative works are answers to questions posed by the situation in which they arose. They are not merely answers, they are strategic answers, stylized answers. . . . So I should propose an initial working distinction between "strategies" and "situations," whereby we think of poetry . . . as the adopting of various strategies for the encompassing of situations. These strategies size up the situations, name their structure, and outstanding ingredients, and name them in a way that contains an attitude toward them. (Burke, PLF 1)

When human actions are formed to make an art work, the form that is made can never be divorced from the human meanings, including the moral judgments, that are implicit whenever human beings act. And nothing the writer does can be finally understood in isolation from his effort to make it all accessible to someone else--his peers, himself as an imagined reader, his audience. (Booth, ROF 397)

These quotations, excerpted from the works of major rhetorical critics, indicate a consistency in approach that
argues for the existence of an "ideal" rhetorical critic and a paradigmatic rhetorical point of view. Rhetorical "attention," in this context, may be defined as the beam shone on a piece of discourse from a source in the rhetorical point of view. Rhetorical attention illuminates ratios among authors, audiences, situations, and texts; it probes the motives of persuasion and the means and ends of discourse; it focusses on authorial choice--conscious or unconscious--as the available stuff of its analysis; and by zeroing in on the textual object (internal study), it penetrates questions of textual origins and consequences (external study).

Because the methodology of rhetorical criticism includes the close reading of texts, rhetorical criticism has been compared to New Criticism. The comparison suggests the refutative definition of rhetoric, the establishment of its paradigmatic nature by setting its assumptions over against the assumptions underlying other critical programs.

New criticism does share, to some extent, the analytical approach of rhetorical criticism. However, while the practice of New Criticism may be compared to the practice of Rhetorical Criticism, the two programs differ significantly with respect to theory and consequently with respect to the critical commentary each generates.

In his discussion of critical theories, using an encompassing model to categorize a variety of critical approaches, literary theorist, M. H. Abrams says rhetorical
criticism is "Pragmatic" since "it looks at the work of art chiefly as a means to an end, an instrument for getting something done, and tends to judge its value according to its success in achieving that aim" (15). The New Criticism, according to Abrams, would be "Objective" insofar as it "regards the work of art in isolation from all . . . external points of reference, analyzes it as a self-sufficient entity constituted by its parts in their internal relations, and sets out to judge it solely by criteria intrinsic to its own being" (26).

Since New Criticism disregards authorial intention as well as subjective reader response (and, in fact, makes theoretical issues of the "Intentional Fallacy" and the "Affective Fallacy"), it is clearly unconcerned with questions of authorial responsibility (or textual responsibility) or judgments about the effects of texts. These are central concerns for rhetorical criticism. In fact, delineating the New Critical model serves not only to strengthen the argument for the paradigmatic nature of rhetorical criticism, but to demonstrate how a critical model, by divorcing itself from the contexts of writing, can disqualify itself as an instrument for the analysis of real-world texts.

Extending Abrams' schema, it is possible to categorize both structuralism and deconstruction (both contemporary and influential critical programs with which rhetorical criticism can be compared) also as Objective, given the interest they
share in text as a closed system. What separates structuralism from rhetorical criticism is not simply methodology (since both involve close scrutiny of text and textual patterning); structuralism and rhetorical criticism are separated theoretically because they are based on entirely different assumptions about the purpose of texts and the force of organized language. Structuralists are interested primarily in signs and their structure (in the linguistic sense) as an intrinsic textual value, while rhetorical critics are interested primarily in communicative units of language and their arrangement (in the pragmatic sense) as an extrinsic textual value. A brief description of structuralist principles will both underline the paradigmatic nature of rhetorical criticism, and reveal the inappropriateness of structuralism as a model for probing the effects of real-world texts.

Structuralism is an attempt to apply the linguistic model of Ferdinand de Saussure to a variety of structured entities—from the world of mythology to the world of literature. The work of the structuralist critic is to identify the set of laws and relationships by which signs are organized in texts. This kind of analysis denies the mundane (and rhetorical) sense in which meaning is transmitted through form, and concentrates exclusively on form itself. Structuralist critic, Jonathan Culler, argues that the task of a structuralist poetics is to make explicit the underlying system which makes literary effects possible, to construct a theory of literary discourse.
which would account for the possibilities of interpretation. "Study of the linguistic system," he says, becomes theoretically coherent when we cease thinking that our goal is to specify the properties of objects in a corpus and concentrate instead on the task of formulating the internalized competence which enables objects to have the properties they do for those who have mastered the system. To discover and characterize structures one must analyze the system which assigns structural descriptions to the objects in question . . . . (SP 120)

Even considering a pluralism in approaches to both structuralism and rhetoric, it is clear that the fundamental principles on which a structuralist model is based are not compatible with those underlying a rhetorical model. The two critical programs differ even in problem definitions: "How does this text work to affect people and effect change?" is not even a structuralist question.

Deconstruction is generally considered to have more in common with structuralism than either approach has in common with rhetoric. In most ways, this is true: deconstructionists and structuralists both are concerned with signs in texts (as opposed to meaning-bearing "symbols"); both focus on text as extricated from writer and reader; both see language as a self-contained system, not responsive to the exigences of human beings; both see language itself as having power. Rhetorical
theory, on the other hand, places power in the people who use language, with language itself empowered only in use.

However, with reference to the present task—to identify features of contrastive critical programs in reference to rhetoric—deconstruction must be considered not as an extension of structuralism but as an act of violence against all critical programs, with no more allegiance to one than another, including those which, like structuralism, played an evolutionary role in the rise of deconstructive thought.

In fact, the deconstructive point of view has some elements in common with the rhetorical point of view. First of all, it directs itself not only to works of fiction, but to works of philosophy, criticism, linguistics—to any discursive construct, the foundations of which can be challenged and deconstructed. In the range of its interest and in its propensity to uncover how language does what it does, Deconstruction does resemble Rhetoric. Despite apparent similarities, however, there are theoretical differences at the level of paradigm, and the theories are finally incommensurable. The deconstructive attitude has critics examine textual structures to show where discourses become (helplessly) undone, undermining their own systems of logic.\textsuperscript{12}

The deconstructive critic might analyze a series of articles in medical journals and make revealing comments not only about them as individual texts but about them as specimens of a larger system of language which includes and creates them.
However, the critic who chooses to proceed from rhetorical theory rather than deconstructive theory does so for many reasons. The writing of rhetorical analysis is energized by the critic's belief in the power of the people who produce discourse to change a situation by changing their discourse, and by his or her belief in the ability of the critic to promote change by virtue of the work of criticism as discourse itself. In order to do the analytical work, the rhetorical critic sees him/herself as needing a place to stand—intellectually, morally, socially—in relation to the discourse under analysis. Rhetoric provides the sense of place, while Deconstruction shifts the ground under the critic, over and over again. Even while acknowledging the intellectual respectability of a stance which is really a kind of motion, the critic may choose the "governing gaze" of Rhetoric. Among critical programs, Rhetoric is uniquely suitable to a comprehensive analysis of real-world texts.

The discussion as a whole has now approached the concept, "rhetoric of science" from two directions. Chapter One has established, from the point of view of theory, that scientific writing could—indeed, should—be read as rhetoric. Scientific language and scientific composition, it showed, act persuasively on readers; and personal belief and community membership affect the substance of what scientists agree to and seek agreement to. (A constructionist model of science, to the extent that it asserts the reality of these processes is also a
rhetorical model of science.) From the rhetorical perspective, some existing theories, particularly of Burke and Booth, define all discourse as rhetorical since it all, in some manner, seeks the assent of audiences. The theoretical move to proclaim that scientific discourse is rhetorical is merely, from the point of view of Rhetoric, an act of foregrounding a proposition that already has a place in existing theory.

All critical theories and methodologies reviewed here share the belief that a special kind of textual information is available to those who apply a particular critical program—but (as in science) the nature of the theory informing the critical program and the concomitant bias of the methodology applied to a piece of writing determine the kind of information that is retrieved in analysis. An examination of a variety of critical programs has revealed that one could analyze scientific texts, as one can analyze literary texts, from a variety of perspectives; however, rhetoric supplies a particularly appropriate model for analyzing texts which have already been shown in theory to be persuasive in the world of human action. That is, the critic in search of rhetorical information should use a rhetorical model.

The rhetorical analysis of scientific texts is the practical dimension of a discipline in the Rhetoric of Science. Analytical resources must be marshalled not to claim naively that scientific writing is rhetorical and that its rhetoric impairs its scientific nature (See Weigert discussion, Chapter
One above). The rhetorical analysis of scientific texts rather, beginning from the assumption that all language is necessarily rhetorical, should reveal how scientific rhetoric works. That is, rhetorical critics should study the range of strategies scientific writers use to persuade their readers of the value of their work—for this act of persuasion is, after all, the main practical agenda in a piece of scientific writing, the ultimate value of which is nil if the author fails at the level of persuasion.

The nature of scientific rhetoric—the assumptions which inform arguments in scientific writing, the forms those arguments take, the organizational and stylistic strategies which express those assumptions and promote those arguments—is discoverable in the rhetorical analysis of scientific texts. Other critics (Halloran, John Angus Campbell, Yearley, Bazerman, Gilbert and Mulkay, and Myers have been cited) have probed the nature of scientific prose from the rhetorical point of view, and working essentially by induction and insight, they have begun to define the practical territory of the Rhetoric of Science and suggest the direction of its expansion.

The analytic chapter that follows is meant as a contribution to literature in the applied study of the rhetoric of science. Its methodology is also essentially to work by induction and insight. Rhetorical criticism, as has been demonstrated, is typically not formulaic, and the argument that it should not be is made convincingly by speech rhetorician Otis Walter:
To assume that rhetorical theory can furnish a formula complete with a step-by-step procedure to be followed by the otherwise thoughtless critic, is likely in error. Formulas may work well in elementary physics, but in the humanities, formulas somehow result in mindless mechanicalness, giving evidence sometimes of hard work but less often of brilliance. Scholarship and hard work are not the same thing; but criticism that is brilliant is always criticism that could not be easily prescribed, that is somewhat unexpected, that fits the unique speech for which it is designed and perhaps no other speech, that is the most appropriate thing to say at this time about that speech. (170)

Consistent with what Walter has said and with what other rhetorical critics have shown, this analysis proceeds by using as heuristic the principles of accumulated theory in rhetoric itself. It is a "naming of manoeuvers" and works through rhetorical theory to knowledge of the world--"to use all that is there to use" (Burke PLF 23).

Aristotle supplies the basic rhetorical theory; the theory is explicated and brought into a contemporary context by Perelman; it is re-viewed and expanded by Burke. Aristotle, Perelman, and Burke are the major theoretical resources for the analysis; the attention is rhetorical; the critical attitude is, for several reasons, most especially Burkean.
Burkean theory is seen as enabling the broadest inductive treatment of the texts for this study. The Burkean approach is separated from other rhetorical approaches most importantly by scope. Burke so expands the realm of rhetoric that he enlarges the rhetorician's gaze (looking, for example, to rhetorical motive), the nature of his instruments (using the dramatism of the pentad, for example) and the definition of what is an appropriate subject for rhetorical study. The usefulness, however, of a Burkean—or any other--critical approach is finally revealed in the quality of the criticism it invites. The role of the critic is to pose questions arising from theory in directing rhetorical attention to a text.

The questions which will guide the analysis of the selected medical journal articles are based not only on rhetorical theory but on assumptions about the articles themselves. First of all, considering their appearance in major professional journals, these articles are seen to be consequential in the world of human action. Secondly, it is assumed that the articles are rhetorical (persuasive) in some way, that their persuasiveness is covert rather than overt, and that they are, in general, written neither with the intention to persuade nor the desire to conceal persuasive intent. Furthermore, it is assumed that these articles, taken together, represent a particularly Western medical paradigm, a set of shared medical assumptions which the articles both reflect and perpetuate. Finally, these medical texts are taken to be samples of
scientific writing, and while not all findings with respect to
these texts will be pertinent to all scientific writing, it is
assumed throughout that because medical writing is scientific
writing, findings can be discussed in terms of scientific
writing.

The following represent the type of question that will
guide the analysis:
(1) What strategies of Invention, Arrangement, Style, and
Delivery are seen to operate in the texts?
(2) Which appeals (of ethos, pathos, and logos) appear to be
most persuasive? Is the notion that scientific writing is
essentially pure logos justified by reading the texts?
(3) How does Identification function in the texts--as a
starting place for argument, as a method of argumentation, as a
goal of argument?
(4) How is the authority of the author established in the text?
Through what strategies does the author establish his/her
credibility?
(5) What assumptions, according to the text, appear to bind
author and reader before the act of reading? How are these
assumptions reinforced by the text?
(6) To what extent do medical authors use the linguistic
devices commonly associated with scientific writing (passive
voice, nominalizations, complex sentence structure)? What is
the rhetorical effect of those devices where they occur?
(8) What is the role of metaphor in scientific writing?
(9) Is the surface structure of the texts consistent with the rhetorical structure of the texts? Does, for example, the presence of value-laden terminology belie the authorial neutrality suggested by other lexical and syntactic features of the text?

(10) What strategies account for the effect, where it occurs, that the author is discussing matters of fact rather than opinion or speculation?

(11) What kind of arrangement is typical of a medical article? Does arrangement itself contribute to the effect of the article?

(12) How is the canon Delivery represented in the medical text? The analysis will use the rhetorical canons as the organizing principles for the discussion. In Chapter Four, findings will be summarized and their significance discussed.
Endnotes

1. For a historical survey of rhetorical criticism, see Stewart.

2. See Stewart, Nilson, Walter.

3. A useful summary of Aristotelian rhetoric is provided by E.P.J. Corbett in Classical Rhetoric for the Modern Student. For a discussion of Aristotelian rhetoric in terms of textual analysis, see also his Introduction to Rhetorical Analyses of Literary Works.

3. See, for example, Brockreide.

5. All Nichols' quotations are from Kenneth Burke, "The Rhetoric of Hitler's 'Battle,'" PLF.

6. The notion of critical "attention" to contrast to explicit critical method is used also by Jonathan Culler in Structuralist Poetics: "There is no structuralist method such that by applying it to a text one automatically discovers its structure. But there is a kind of attention which one might call structuralist: a desire to isolate codes, to name the various languages with and among which the text plays, to go beyond manifest content to a series of forms and then to make these forms, or oppositions or modes of signification, the burden of the text" (259).

7. Booth's comments on the rhetoricity of all forms of literature echo to some extent these remarks of Burke, from Counter-Statement: "The reader of modern prose is ever on guard against 'rhetoric,' yet the word, by lexicographer's definition, refers but to 'the use of language in such a way as
to produce a desired impression upon the hearer or reader." In accordance with this definition, Burke says, "effective literature could be nothing else but rhetoric" (210).

8. See, for example, E.P.J. Corbett's Introduction to Analyses.

9. Abrams continues

There is, of course, the greatest variance in emphasis and detail, but the central tendency of the pragmatic critic is to conceive a poem as something made in order to effect requisite responses in its readers; to consider the author from the point of view of the powers and training he must have in order to achieve this end; . . . The perspective, much of the basic vocabulary and many of the characteristic topics of pragmatic criticism originated in the classical theory of rhetoric. (15)

Abrams proposes a schema for cataloguing critical theories according to the emphasis they place on each of the "four coordinates of art criticism," namely the work, the artist, the universe, and the audience. Critical theories emphasizing the work itself, he says, are Objective; those which deal with the work in terms of the artist are Expressive; Mimetic theories are interested in the truth or verisimilitude of the work in relation to the universe; and Pragmatic theories focus on the connection between the work and its audience.
10. Wimsatt writes:
The Intentional Fallacy is a confusion between the poem and its origins. ... It begins by trying to derive the standard of criticism from the psychological causes of the poem and ends in biography and relativism. The Affective Fallacy is a confusion between the poem and its results (what it is and what it does). ... It begins by trying to derive the standards of criticism from the psychological effects of the poem and ends in impressionism and relativism. The outcome of either Fallacy ... is that the poem itself, as an object of specifically critical judgment, tends to disappear. (21)

In his comparison of rhetorical criticism and New Criticism (see note 9), E.P.J. Corbett refers to Wimsatt's Fallacies directly, and here makes his point that rhetorical criticism is "more interested in a literary work for what it does than for what it is" ("Introduction" Analyses xxii).

11. See Levi-Strauss.

12. See, for example, the essays of De Man.

13. The term "governing gaze" is borrowed from Janet Emig.
Chapter Three. The Rhetorical Analysis of Medical Journal Articles

Part One. Rhetorical Overview of the Texts

Chapter Two has established that rhetorical criticism is defined, not by particular instruments of analysis or formulaic strategies for reading, but by fundamental assumptions about the purposes and effects of texts consistent with a rhetorical point of view. Kenneth Burke is, in this context, an "ideal" rhetorical critic because he has a clear theoretical framework for textual analysis, yet he follows, within that framework, a variety of paths to insight.

The guiding questions for a rhetorical analysis of medical journal articles concern the available means of persuasion in the production of those texts. These are questions about scientific writing as argumentation that can be categorized operationally in terms of rhetorical Invention (the discovery of arguments), Arrangement (the organization of the discourse), Style, and Presentation. These four areas of concern represent four of the five canons of classical rhetoric which have endured, even through Burke, as a productive heuristic for rhetorical analysis. (The fifth canon--Memory--is irrelevant to the study of written text.) Presentation is used here to subsume some of the issues related to Delivery in classical theory.

In examining medical texts, specific questions of
Invention concern the nature and relative uses of ethos, pathos, and logos, the quality of assumptions apparently shared by writer and reader, and the enthymemetic logic and topoi used because of shared assumptions. Questions of Arrangement focus, for example, on the placement of strong and weak material in the organization of an article, and the persuasive uses of Introductions or (in the case of scholarly papers) pre-Introductions, or synopses. Questions of Style consider the formal markers usually associated with scientific prose (passive voice, nominalization, complex sentence structure), and measure their effects in terms of the rhetorical effect of articles as a whole. Questions of Presentation (Delivery) concern, for example, the use of figures and tables in medical articles, or the use of author photographs to accompany some articles. Categories are not mutually exclusive.

The writing in medical journals, like all other uses of language—being necessarily symbolic and tendentious—is persuasive. However, since the scientific rubric for medicine has led to the conventionalization of a discursive style that is not overtly persuasive, the mechanisms of persuasion in medical texts are subtle, sometimes difficult to isolate, possibly invisible even to the writers of the articles themselves. Scrutiny of medical journal articles from the rhetorical perspective reveals the existence and the nature of persuasive strategies in those texts. Since a
study of the rhetoricity of the articles is really a study of their effects--on readers and on the rhetorical situations into which they are introduced--the analysis is concerned with those elements of Invention, Arrangement, Style, and Presentation which represent authorial moves having real-world consequences by influencing the beliefs of readers.

The material for analysis in the present study includes thirty-five articles selected at random (given limitations of readability and accessibility) exclusively on the subject of functional headache. The articles are taken from a variety of journals which, because of their interest to the family physician, are seen to constitute the organs of a coherent professional conversation. The journals in question include American Family Physician, The American Journal of Medicine, Canadian Medical Association Journal, Headache (the journal of the American Association for the Study of Headache), Journal of the American Medical Association, The Lancet, The New England Journal of Medicine, and Postgraduate Medicine. Articles under consideration concern the diagnosis, etiology (origin), and treatment of functional headache, and include reports on research, original observations, and review articles. All pieces examined are current, appearing after 1982. Functional headaches are those which, unlike "organic" headaches, do not originate in a specific pathologic process. Migraine and tension headaches, for example, are functional, while headaches due to brain tumour or cranial inflammation
are organic. Functional headaches are sometimes called "primary" headaches: when it is established that they are not symptoms of a higher-order disease process, these headaches themselves constitute the disease for which treatment is sought.

In general, articles in medical journals must be persuasive for two practical reasons. First, standards and competition within the profession as well as the politics of publication dictate that in order to win support for their research and a publication source for their findings, medical scientists must convince funding agencies and editorial boards that their work is creditable, and that they themselves are reliable reporters of their work. Secondly, once a piece of work is published, the reputation of the authors depends on its reception within the community to which it was addressed. If the authors fail to convince a substantial readership of the worth of their research (or observation or analysis), their work will not be cited in the publications of their peers and will dissolve into obscurity. Ultimately, unless a piece of writing is taken seriously, it will not further the progress of science or add to the scientific community's store of knowledge.

Studies which are not initially persuasive are not well funded; if done nevertheless, they are unlikely to be published by mainstream journals in the profession.¹ Normative criteria for scientific publication include not
only the perhaps obvious requirements of logical rigour and mathematical precision, but also replicability of research techniques, originality, and theoretical significance. At the very least, scientists must convince fellow professionals that their studies are worth doing, and their reports worth writing. In Chaim Perelman's terms, their goal must be to win the adherence of an audience to the theses presented for its assent (Perelman, TNR 4).

Within the field of headache, the degree to which certain scientific explanations fall in and out of favour over time testifies to the persuasive nature of the literature about them, both positive and negative. In the nineteen-seventies, for example, it became common to name temporomandibular joint disease (a disorder of the jaw, abbreviated as TMJ) as the cause of chronic headache in a significant number of patients. The diagnosis became so popular that one study found recently that fully a fifth of its "consecutive headache clinic patients" (i.e. not preselected according to previous therapies) had been treated for the disease. The 1985 article, "Unnecessary Dental Treatment of Headache Patients for Temporomandibular Joint Disorders" (Reik), reports that only twenty percent of the headache patients who were treated for TMJ actually satisfied diagnostic criteria for the disease. The author concludes that "increased patient awareness of the TMJ syndrome, inappropriate referral by physicians, and incorrect diagnosis
by dentists all probably led to the unnecessary dental treatment" (246). In other words, a large number of people, professional and nonprofessional, were persuaded that TMJ disease was a reasonable diagnosis for sufferers of chronic headache. By 1985, they were being persuaded that it was not.

The openness of the medical profession to both acceptance and rejection of new concepts in diagnosis and treatment testifies also to its commitment to monitor itself and to its willingness, in general, to abandon what does not work. There is no doubt, however, that headache experts view their work not as contingent (or subject in any serious way to the consequences of argumentation) but as "scientific." The editor of the journal, Headache, considers it to be a "scientific journal" (Edmeads [Nov. 1984] 343); articles which discuss headache in other journals are generally classified as "Scientific Articles"; meetings of the American Association for the study of Headache are considered "Scientific Meetings" (Kirn, "Discussion" 9). Still, a close reading of headache articles reveals that they are no less rhetorical for being scientific, and arguably no less scientific for being rhetorical.

Particularly important to the medical writer are strategies which encourage professional identification between writer and reader. Kenneth Burke’s terminology of Identification and Consubstantiality provide the key to this
rhetoric. Gestures of identification between writer and audience (the writer being in any case one of the audience) provide the starting place for the medical article as well as its means and its goal, which is the furthering of the sense of being consubstantial (or "acting together"). Consubstantiality here both comes from and solidifies agreement in the medical community—agreement about the most important aspects of medical research, including problem definitions, methodologies and instrumentations, research programs, and appropriate goals. The medical journal article, as an internal document, is used to affirm the shared values of the profession. Contributors to the journal have first of all to demonstrate their allegiance to the community's values, and secondly, to be so well-educated in the language and forms of the community that they do so properly and implicitly. This means that the ethos or apparent character of the author is an extremely important aspect of medical persuasion. The journal article itself is a vehicle for asserting the legitimacy of the author's place in the scientific community, and the effect of the article is inextricable from the author's credibility.

Several strategies of Invention are seen to recur in the headache literature, when the literature is evaluated rhetorically. Particularly salient ones include (1) use of a topos of size as a device of seduction at the opening of an article; (2) use of the quasi-logical argument by comparison,
to argue for the need for a particular study or report, and use of refutation for the same purpose; (3) use of arguments from example, especially in reports on research, to rationalize the whole of a study (This is characteristic of the scientific method itself); (4) use of topoi of definition and of classification and division, sometimes in order to form a new argument, sometimes to reaffirm what is shared among writers and readers; (5) use of pathos to establish an alliance between writer and audience, which excludes the patient in an implied we/they separation; (6) use of specific ethical arguments to create an image of the speaker-writer as knowledgeable and trustworthy. Additional types of proof are tailored to specific rhetorical purposes and occasions.

A close reading of the journal articles reveals a remarkable number of article Introductions (often opening sentences) which argue the significance of the problem of headache, in terms of number of patients afflicted by it and dollars lost, to justify interest in the field and effectively to seduce readers who might otherwise be less attentive to the article. That is, information on headache is not presented neutrally, innocent of value, but laden from the outset with a sense of significance. While variation in statistics might be concerning in itself, what is more interesting, from the rhetorical point of view, is that so many authors seek to win the attention of audiences with what Aristotle called the topos of size, "the relative greatness
and smallness of things" (147). The following is a sampling of claims appearing in the opening paragraphs of headache articles:

In the U.S.A., 24 million Americans are reported to suffer from severe headaches, contributing to lost time at work and decreased productivity, costing 15.1 billion dollars annually. (Szekely et al 86)

Epidemiological studies indicate that about two-thirds of adults in the United States experience headaches and that 40% of these suffer from muscle contraction or tension headache. (Bell et al 162)

Each year 550 million workdays are lost in the United States because of pain, which is probably the principal complaint presented by patients and the major determinant in their decision to consult a physician. (Diamond, "Treatment" 91)

Headache is a common problem, affecting approximately 70-75% of men and more than 80% of women in a year’s time. (Featherstone 194)

Headache is one of the most common of medical complaints and is presumed to affect more than 80% of the population. (Glassman et al 101)
Migraine headache is one of the most common neurological disorders, with an estimated prevalence of 5% to 25% in western society. (Stellar 2576)

Migraine is a common disorder, occurring in an estimated 5% of the general population. (Bending 508)

Once reader attention is secured, the relevance of the article at hand must be established, and (especially in the case of research articles) authors proceed to make the case for the particular appropriateness of their own work. One group of authors makes its case by focussing by degrees on its own research plan:

... [A]n increase in the incidence of headache around the time of menses has been well documented. [THERE IS A NEED FOR RESEARCH ON PARAMENSTRUAL HEADACHE.] Pharmacological agents have traditionally been employed in the treatment of headaches. There is, however, a growing body of literature on the positive effect of behavioral treatment ... on headache pain. [THERE IS A NEED FOR MORE RESEARCH WHICH INCLUDES BEHAVIORAL TREATMENTS.] Numerous studies show such treatment is significantly superior to placebo or waiting list control in reduction of headache pain. [HOWEVER] Such research
has been carried out almost exclusively on migraine, muscle contraction and mixed headache sufferers. [THERE IS A NEED FOR RESEARCH ON BEHAVIOR THERAPIES FOR PARA-MENSTRUAL HEADACHE SUFFERERS.] . . . In spite of well documented exacerbation in relation to menstruation, there has only been one study on the effect of behavioral treatment on menstrual migraine. [A NEW STUDY--THE PRESENT STUDY--IS NEEDED] (Szekely et al 86).

The overriding strategy here is the quasi-logical argument by comparison, essentially the comparing of the present study to those which have been done before; conventionally, earlier studies are found in the process to be lacking. The enthymeme is refutative: the validity of the study in question is established by the undercutting of previous research.

Other authors use the comparative argument refutatively to argue for their research as corrective. One research group, having pointed out that reports implicate stress in 80% of tension (muscle-contraction) headaches, says directly that it is "surprising that the role of stress in promoting or exacerbating recurrent tension headaches has received so little empirical attention" (Holm et al 160). Their study investigates the role of stress in recurrent tension headaches. Another team of authors, concerned with psychological aspects of headache, points out that while
numerous studies have focussed on the psychology of headache sufferers and of headache itself, "little of that research effort has gone to study patient attitudes toward the disorder" (Barnat and Lake 229). Their study, they go on to explain, is on exactly that subject. While the strategy of using refutation to argue for the relevance of a particular piece of work is, of course, not unique to scientific literature, neither is scientific literature unique for the absence of this rhetorical strategy.

The quality of the inductive argument also used in scientific reporting illustrates that certain assumptions so underlie scientific discourse that arguments based on those assumptions are widely considered to be not arguments at all, but statements of fact. It is a premise of scientific method that every instance of a phenomenon neither can nor should be observed, but that reliable conclusions can be drawn from repetitions of a phenomenon in a number of particular cases. This premise empowers the statistical reasoning in scientific articles, the appropriateness of which is never argued, but assumed. What is especially interesting, however, given the prominence of statistics in scientific accounting, is the way in which numbers are manipulated in some cases to appear in the best possible—or most persuasive—light.

For example, one group of researchers claims that "93% of 88 children with severe migraine" recovered on systematically
restricted, anti-allergy diets (Egger et al 865). Close reading of the article reveals that the study began with 99 subjects, eleven of whom withdrew from the study for reasons unstated in the article (possibly because their headaches were unaffected by treatment). Of the 88 remaining subjects, six did not improve at all, and eight who improved continued to do so even when presumably offending foods were reintroduced. (The authors say, rather indirectly, "all but 8 relapsed on reintroduction of one or more foods" [Egger et al 866].) That is, researchers demonstrated that 74 of a total pool of 99 subjects—approximately 75%—improved with dietary control. While the authors do not misrepresent their findings, they do represent their findings strategically. The fair manipulation of numbers is one of the most "available" of the "means of persuasion" the scientist can use.

Another study, which assesses the effects of behavioral treatment on sixteen women suffering from paramenstrual headache, mentions only on the second page of its report that subjects were selected from a pool of 93 potential subjects, 77 of whom were disqualified from participating in the study for various reasons (Szekely et al 87). Ironically, this article uses language which has the effect of obfuscating the common-sense "fact" that findings based on a sixteen-person sample is not of great scientific value. It reports, subjects "self-monitored 4 times daily for a 2-cycle baseline, then were matched on pre-treatment pain levels into 8 pairs and
randomly assigned to treatment. . . . Post-treatment group data analysis was by three-way analysis of variance with 2 repeated measures" (86). In other words, the study used two treatments on sixteen people suffering from four different headache conditions and then asked them to report how they felt.

Argument from example (manifested most often in science as argument from statistics) is just one mode of reasoning conventional in the scientific article. In the articles surveyed, scientific logos also relies heavily on arguments from the common topoi, definition and division and classification. Beginning with the assumption, generally unstated, that conditions must be diagnosed before they can be treated, medical researchers and practitioners have a special concern with questions of defining, dividing, and classifying disorders. This accounts for the large number of articles devoted specifically to these questions: "Classification of Headache," the seminal article on classification which appeared in 1962 (Ad Hoc Committee), "Are Classical and Common Migraine Different Entities?" (Wilkinson and Blau), "Is the Muscular Model of Headache Still Viable?" (Pikoff), "Diagnosis of Head Pain: An Idiographic Approach to Assessment and Classification" (Thompson), "Towards a Definition of Migraine Headache" (Blau), "Migraine and Muscle Contraction Headaches: A Continuum" (Featherstone). One particularly convincing
article uses the hypothetical syllogism as a substructure for the definitional argument. The case that "classical" and "common" migraine are different aspects of the same disorder is based, in part, on refuting the claim of other researchers that "classical" migraine originates in a physiological phenomenon called, "Leao's spreading depression." They write:

We know that the aura of migraine is painless and if the remaining symptoms were due to the spreading depression then the cortical changes, as would be expected, should also be painless. Therefore spreading depression cannot account for the [classical migraine] headache. (Wilkinson and Blau 212)

Definition and classification are important not only to articles which focus on those concerns exclusively, but to others which use them as topoi to support hypotheses or to argue for the validity of a research program. One study claims that pharmacological treatment of headache is haphazard, and not correlated closely enough to "subtypes" of headache (Thompson 221). Another study reports the results of a survey on dietary precipitants of migraine, expressing concern that "some investigators" have used the term "dietary migraine" as though it were an accepted entity (Blau and Diamond 184). In general, the need for a reliable system of headache definition and classification is accepted; a typical
article will, for its own purposes, affirm this shared interest of the profession:

Most of us consider migraine as a purely episodic phenomenon and when the headache occurs daily, migrainous process is ruled out straightway. Daily headaches are generally considered as muscle contraction or tension headaches. Such an approach might deprive patients of the benefit they might have received from specific treatment if the diagnosis was different. (Mathew et al 66)

While the appeal from logos is prevalent in literature surveyed, the appeal from pathos is less so. Direct emotional appeal is unconventional in the literature. Nevertheless, scientific authors must understand their audience; a powerful means of persuasion lies in the formation of an alliance between author and audience, an alliance which necessarily excludes the subject of medical articles—the patient, the subject made object.

The we/they separation which is maintained in medical journal articles suggests Burke's term, "scapegoating," although the separation is necessary to physicians and may even be a prerequisite to professionalism. In effect, one message implicit in the headache literature is that "they" (patients) get headaches and "we" (the author and the readers together) do not. One author refers condescendingly to "the hard-core headache patient" as "our specialty albatross"
(Edmeads [Nov. 1984] 342). In what becomes a kind of professional collaboration, the author, identifying with the reader, is dissociated from the headache patient, who is, at the same time, objectified. Dissociation is reflected in the language of the articles. One author writes, for example, that using biofeedback for pain management has the drawback of requiring special equipment, so that the physician "may need to refer the patient to a . . . clinic, which removals the patient--at least in part--from his care" (Gunderson 141). The patient in this case is not subject, but object, an entity which is referred then removed to another facility. What motivates this objectifying language is the same kind of dissociative impulse that is responsible for the common medical synecdoche through which the patient and the ailment (or ailing organ) are made one--as in hospital parlance, one speaks of the "pancreas in Room 252." 7

In the literature surveyed, there is only a single case in which the physician is not dissociated from the patient. In this article, the physician-author describes in some detail his own history of migraine. Following a personal account of his disorder, he writes, "perhaps some young physician-scientist with a similar problem will recognize in the condition an opportunity to study systematically the inputs that may generate the bizarre outcome known as migraine" (Creditor 1032). While the article has a certain persuasive appeal, derived in part from pathos--the sympathy the reader
feels for the plight of the author—it is not read as science. Self-observation is considered to be of limited scientific usefulness precisely because it blurs the distinction between the observer and the observed.

Ethos, the argument from the character of the speaker, is important to all persuasive discourse and consequently important to medical writing. The centrality of the ethical argument is explained succinctly by Walter J. Ong when he argues that voice is "a summons for belief" and that belief that something is true is secondary to belief in the person or persona sharing the information." Authors of medical articles have to establish themselves as knowledgeable and trustworthy, and they accomplish this in a number of ways.

Aristotle distinguishes between the impression of the rhetor that precedes a speech and attends it, and the impression of the rhetor created by the speech; he considers only the latter to be the ethical argument. In medical writing, both kinds of appeal—external and internal to the discourse—are seen to operate.

Initially, credibility accrues to medical writers that is borrowed from the journals in which their articles appear. Essentially, what appears in a respected scientific journal is read as both respectable and scientific. More specifically, readers of a professional journal assume that authors and their articles have been screened as to basic worth by editorial boards in place for that purpose. In
addition, some authors have the benefit of reputation creating an advance credibility, something they have earned by their publications and references to their publications by other authors. Most, in any case, have credentials that establish their right to be read, "credibility" and "credentials" being cognate terms. These are minimally a degree of Ph.D. or M.D., but several authors have titles which give them an added appeal: they are heads of departments or directors of clinics, well-placed academics or consultants to government. Some authors are represented in photographs accompanying their articles. The presence of a photograph adds to ethical effect by making available a visual image to which ideas and information may be attached.

The sense of an author created by reputation, affiliations, degrees, and photographs is often belied in the articles themselves which are characterized by a conventional authorial absence. Moreover, authorial absence is itself, ironically, a source of authorial credibility, for by identifying with the ethos of science, authors establish their own reliable character, declaring in their prose the conventional appearance of modesty (the sign of universalism) and the conventional appearance of neutrality (the sign of disinterestedness). The prevalence of passive voice is the most obvious stylistic strategy for removing authors from their texts, and it is common in medical articles, especially reports on research, to find that the majority of verbs are
in the passive. A typical study reports that "patients were invited" to participate; "informed consent was obtained"; "the diagnosis of migraine was made"; "the condition of each patient was evaluated"; and so on (Solomon, Steele, and Spaccavento 2500). In most articles, use of the passive helps obviate the need for a first-person speaker. One author refers to both himself and his readers in the third-person as "the physician" (Gunderson); in many articles, however, the third person reference is to "the study" or "the analysis." Typically, the agency or instrument of investigation is placed in the role of the agent. In one account, "the study [not the research group] demonstrates" the effectiveness of a particular drug (Stellar 2580); in another, "the analysis of items. . . demonstrated" an association between psychological factors and headache (Drummond 21).

The persona of the impersonal reporter itself carries a kind of ethos that in the scientific community inspires both trust and belief. The assumption underlying this inverse ethical argument is that the contributors to scientific journals are reporting on empirical events revealed through accepted methodologies with replicable results. What follows from this assumption is that authors should not implicate themselves in their findings nor make proprietary claims to their results. (Kenneth Burke sheds some light on the rhetorical effectiveness of scientific impersonalism: "If, in
the opinion of a given audience, a certain kind of conduct is admirable, then a speaker might persuade the audience by using signs and images that identify his cause with that kind of conduct" [ROM 55].) In a few articles surveyed, however, authors do deviate from what is generally considered to be the conventional indifferent scientific ethos. Whenever they do, the effect seems to be to increase reader confidence in the authority of the author(s).

One group of authors, claiming the importance of dietary manipulation in the treatment of some migraine patients, adopts a first-person speaker in the Discussion section. Here the authors anticipate reader objections to their argument by acknowledging that placebo effect is high in the treatment of migraine. They write, "We (except J.F.S. [one of the researchers]) embarked on this study believing that any favorable response . . . could be explained as a placebo response" (Egger et al 867). The authors go on to explain that placebo effect did not account for their results, but their confession has humanized the authors in a pleasing way. The rhetorical strategy is prolepsis, and it recurs in the sample of articles. Another author writes, "One can argue that the neurotic triad is the result of chronic pain [rather than the reverse] . . ." (Mathew 67). Thus are the readers' concerns anticipated, acknowledged as shared, and allayed. These effects combine to increase confidence in the authors.
Another author begins his article with a first-person speaker. His subject at this point is his own past research: "In 1979, we assayed the frequency of temporomandibular joint (TMJ) pain-dysfunction syndrome among our medical patients . . . " (Reik 246). The validity of this article, the purpose of which is to compare current (1985) findings on TMJ to the findings of six-year-old study, is enhanced by the continuity in research personnel. Use of a first-person speaker underlines that sense of continuity.

Whatever their specific rhetorical choices, however, published authors invariably remain within the discourse conventions of their discipline. In effect, their command of those conventions is itself an important aspect of the ethos of their articles, a sign of their membership in the professional community for which they write.

In addition to these common means of persuasion in logos, pathos, and ethos, medical journal articles use specific inventiveal strategies appropriate to their rhetorical purposes and situations. These include, for example, the use of rhetorical "presence," the use of Aristotelian inartistic proofs (arguments from authority), and the use of various applications of the principle of emphasis.

The case study, research which focuses on the individual patient (itself a kind of argument from example), is recognized as a method for identifying problems or generating hypotheses for scientific investigation. The rhetorical
appeal of the case study is in the appeal of presence--what Chaim Perelman, working from Aristotelian principles of style, describes as acting "directly upon our sensibility," by "choosing to single out certain things for presentation" (Realm 35). The case study effect is evoked whenever an author refers to the individual case, but it is used as the major mode of argument in three of the articles surveyed for this study. One, which states its purpose as "to highlight the association between deteriorating family situations and conflicts, and exacerbation of head pain" (Roy 360), recounts in specific terms the cases of four subjects, all of whom sought treatment for headache during or following some crisis in family life. Another, exploring the factor of estrogen in the pathogenesis of migraine, reports on the case of a "25-year-old right-handed white woman" who had her first migraine experience during her fourth pregnancy (Bending). A third article enters the debate about the relationship between diet and migraine by developing the case of a "married professional man in his late thirties" whose headaches ended "serendipitously" when he was placed on a bland diet to treat his gastric ulcer (Gettis). All of these articles are persuasive by virtue of focussing on the particular case, making it vivid to the reader who cannot then ignore its implications. While they overtly make no claim to scientific significance, these articles do suggest the example is representative of the universal case.
The autobiographical article on migraine discussed earlier (Creditor) may also be seen as an instance of case study, although the variation of self-reporting does distinguish it methodologically; rhetorically, the effect of the article, rooted in the principle of "presence," is similar to that of other case studies.

Inartistic proofs, according to Aristotle, are those which are not constructed by the rhetor but rather existed beforehand. In scientific writing, these proofs, which are, in effect, arguments from authority, take the form of citations and references to other scientists and other articles. So-called inartistic proof is, importantly, one of the mainstays of science: "No scientist," as Wayne Booth explains, "has ever performed experiments or calculations providing more than a tiny fraction of all the scientific beliefs he holds; the whole edifice of science depends on faith in witnesses, past and present--on testimony and tradition" (MD 108-9).¹¹

That scientists will refer to other scientists in developing their own arguments is, then, not only expected but required in scientific writing. However, the choice of whom to cite resides with the author, and the medical literature provides many examples of cases in which supporting testimony is cited freely, while testimony which might weaken the effect of an article is ignored. For example, the author who enumerates the physician's drug
choices in "managing" the migraine patient (Gunderson) does not refer to the authors who claim that narcotic treatment of headache is "one of the commonest antecedents to significant iatrogenic drug addiction" (Lane and Ross 302), or to the study which shows that withdrawal of all analgesics significantly reduced headache days in most patients who had been taking more than 30 analgesic tablets per month (Isler 28). Similarly, the authors who use a self-monitoring anxiety measure in their study of headache patients (Szekely et al) do not refer to the literature which claims that headache patients are poor witnesses of their own states of anxiety (Roy). The principle of selective citation has a certain pragmatic value: if authors had to cite every source related to their research, articles would never get written; still, what gets selected is most often a matter of what best supports the case at hand. Rhetorically, these citations function by "call[ing] to mind," to use Wayne Booth's terms, placing "some sort of value on what is not sensibly there" (MD 125)—or to use Richard Weaver's terms, the citations are persuasive because all language use is an "art of emphasis" ("Sermonic" 213).

A related matter of inventional strategy concerns the principle of emphasis itself. A corollary of the Burkean claim that language is symbolic action and that it "induces cooperation" by "directing the attention," is that discourse persuades also by the distribution of emphasis. While one
author spends pages of his article on pharmacological treatments of headache (Silberstein), another, interested in non-pharmacological treatment, approaches drug interventions summarily:

Although a plethora of methods is available for direct treatment, including analgesics, narcotics, tricyclic antidepressants, biofeedback, transcutaneous stimulation, surgery, and acupuncture, a reliable regimen for relief of chronic pain remains elusive. (Diamond, "Treatment" 91)

Similarly, while some headache specialists see classification as a primary concern of their discipline (Blau, "Definition"), one clinician dismisses the question of positively separating migraine (vascular) from tension (muscular) headaches with this: "[D]istinguishing between the two types can be overstressed, since a patient with muscle contraction headaches will seldom suffer from a well-planned trial of migraine management. . . " (Gunderson 138).

An exemplary case of comparative emphasis is in two solicited responses to a reader inquiry in the Journal of the American Medical Association. The query involved a patient experiencing "coital cephalalgia"—vascular headache associated with sexual intercourse. The journal published two responses—one from a neurologist, another from a psychiatrist. While both consultants insist on the need to rule out serious organic illness, the neurologist ends by
suggesting the prescription of ergotamine medicine (Joynt 254). The psychiatrist, whose answer is approximately four times longer than that of the neurologist, recommends, among other things, "at least three 30-minute visits with the couple . . to focus on the patient's unusual symptom and how it has affected their lives" (Renshaw 253). The question of emphasis as it pertains to medical writing in general illustrates the extent to which theoretical allegiances and problem-perception inform scientific observations, and throws into relief the claim of some medical articles to objectivity. Kenneth Burke discusses how different terminologies (and implicitly the predispositions which guide them) direct the attention differently and lead to a correspondingly different quality of observations. "In brief," he says, "'behavior' isn't something that you need but observe; even something so 'objectively there' as behavior must be observed through one or another kind of terministic screen, that directs the attention in keeping with its nature" (LASA 49). Thus would Burke explain—as rhetoric—the different medical responses to a single set of behavioral data.

Readers are influenced not only by arguments themselves but also features of their arrangement in a discourse. The following strategies of Arrangement recur in the literature surveyed: (1) the use of the synopsis as a device to promote the article which follows it; (2) the use of opening and
concluding sections of an article for frank persuasive appeals—and the embedding of the weakest material in the dense middle section of the article; (3) the use of the AGREED . . . INDEED rhetorical structure noted by Blanton; (4) the use of an organizational principle of disjunction, the formal separation of material the author does not wish to be considered together.

The use of synopses is conventional in scholarly literature, and medical literature is no exception. These short summary pieces, in any discipline, are functionally persuasive; that is, they inform a reader's decision as to whether to read an article and how to read it. Synopses are accordingly difficult to write: they must accurately represent the contents of an article and, at the same time, make it inviting to the right audience. Sentences excerpted from synopses of headache articles suggest their writers are aware of the importance of synopses as advertising. They tend to promise some significance of findings, and often originality as well:

Our studies of patients with chronic pain afflicting various body parts led to the delineation of a psychobiological profile . . . . (Blumer and Heilbronn 180)

Physical and/or sexual abuse in women with chronic headache has never been addressed. This pilot study
addressed differences in women with chronic headache who reported such a history, compared to a control group of women with chronic headache without a traumatic history. (Domino and Haber 310)

The present study was designed to help fill a gap in the existing knowledge of patient perceptions. (Barnat and Lake 229)

Although some headaches are doubtless caused by muscular hyperactivity, true muscle contraction headache is probably far less common than traditionally assumed. (Pikoff 186)

The study demonstrates that the beta-blocker timolol is a safe and effective treatment in patients with frequent migraine headaches. (Stellar 2576)

A small dose in intravenous chlorpromazine may provide an alternative [to narcotics in aborting headache]. It is relatively safe, gives exceedingly prompt relief, and has minimal addictive potential. (Kain 2037)

The attention that goes into writing a synopsis is rewarded, not only because some readers decide on their account that the ensuing article is worth reading, but also because a
segment of readers looks only at the synopses of some articles, along with introductions and conclusions, as a way of securing an overview of research in their field. The importance of a good synopsis is furthermore explained by classical rhetorical theory which makes the case that the opening of a speech must predispose the audience to receive it. "Men pay attention," says Aristotle, "to things of importance, to their own interests, to anything wonderful, to anything pleasant; and hence you must give the impression that your speech has to do with the like" (224).

Those readers who look only at the beginnings and ends of research articles are usually met with the most frankly persuasive appeals. It is in the opening section of an article that authors make the case for their research, and it is in the closing that they specify the significance of their results. If there are weaknesses in research design or methodology, or if findings are obscured by the circumstances of the experiment, these matters will be evident only in the middle of the article. That is, the disposition of the scientific article is typically Nestorian, "wherein," as Chaim Perelman explains, "we begin and end with the strongest arguments, leaving the others in the middle" (Realm 148).

The authors, for example, who address physical and sexual abuse in women with headache, report in mid-article that "none of the abused women identified abuse as a significant factor in pain onset" and that subjects were
(inexplicably) "reluctant to discuss this emotional trauma at all" (Domino and Haber 312). However, the authors fail to describe the conditions of their study by way of explaining why subjects might want to confide in the researchers. In the same vein, the authors who claim to have demonstrated that "timolol is a safe and effective treatment" for prophylaxis of migraine mention mid-article that "the total amount of concomitant medication required during drug treatment with timolol or placebo was not analyzed," and that overall response rates were only 14% higher with timolol than with placebo (43% vs. 29%) (Stellar 2579). Without sufficient explanation, experimental results are difficult to interpret; yet the authors, as they open and close their papers, seem to claim for their information the status of incipient knowledge.

This observation about the arrangement of articles implies no intent on the part of authors to mislead their readers. Articles are written to be read in full; interested readers read them in full; however, the reality of the medical conversation is that great quantities of information are directed to people who are too busy to receive it all. Readers consequently make choices about what and how they read. Whether known reader behavior influences the way articles are composed—that is, whether, reader behavior accounts for the special rhetoricity of article openings and closings—is a matter only for speculation.
What can be reliably observed about the structure of medical texts is that research articles are frequently composed as arguments, and frequently adhere to the "grammar" suggested by M. J-V Blanton in his article on "rhetorical maturity in the sciences." Blanton writes:

Modulating the mood of the entire text within the fixed form of the underlying grammar, the rhetorical strategy develops against the background of downplaying and highlighting ideas. Downplaying alternative or contrary ideas and assumptions in various sections of the discourse hierarchy of the paper is part of a larger scheme designed to guide the reader's attention and thought through the developmental shifts of AGREED, BUT, BUT SUPPOSE, THEN, INDEED. (136)

A typical research report can be paraphrased according to Blanton's shifts. For example, the article describing clinical experiments with the drug chlorpromazine for emergency-room treatment of migraine (Lane and Ross) can be structurally reduced as follows: AGREED: the use of narcotics to treat emergency room patients presenting with migraine is unsatisfactory. BUT: no effective alternatives have been established to date. BUT SUPPOSE: we found that a safe, non-addictive drug was effective in most patients with acute migraine. THEN: more experiments would be indicated to establish this new form of therapy. INDEED: the promise of
such a treatment could not be ignored.

Blanton's grammar can be shown to underly the structure of most research reports. The validity of Blanton's observations is further evidence of the rhetorical structure of scientific articles which appear initially to be disinterested accounts of objective phenomena. In fact, each article presents an argument and one carefully constructed to be the most successful at winning the adherence of an audience.

Unlike research articles, review or "update" articles tend to display a rather homogeneous organization: the pieces are not organized with persuasive Introduction and Discussion sections flanking a more descriptive middle; rather they are divided pragmatically according to topics. The review articles, "Management of the Migraine Patient" (Gunderson) and "Treatment of Headache in Primary Care Practice" (Silberstein), both manifest this kind of organization—with headings and subheadings directing reader attention to particular areas of clinical interest. Theoretically, sections of these articles could be read out of order; whereas in the case of the research report, sections are most informative when read in the order of presentation.

Review articles, however, are not less persuasive because of their relatively flat organization; they are simply persuasive in a different way and to a different end. Rhetorical Arrangement is traditionally the disposition of
parts of a speech based on the fundamental assumption that "the order of presentation of arguments modifies the conditions of their acceptance" (Perelman, Realm 146), so, for example, it is formalized in rhetorical theory that the proem (in medical journals, the synopsis and Introduction together) should dispose the audience well to the speech (Aristotle 224), and Refutation is best included in the Argument and not considered a separate division of the speech (Aristotle 235). In medical review articles, attention to conventional organization is dispensed with in favor of an organizational monotone of information. In effect, the absence of a conclusion, summary, or other real ending in "Management of the Migraine Patient" (Gunderson) gives the article an apparent shapelessness which contributes to the effect that it is simply and directly reportial. The article ends, "This phenomenon [a variety of vascular headache] seldom occurs on more than two or three occasions and is no longer believed to be a common presenting symptom of subarachnoid hemorrhage" (143).

Additional evidence of rhetoricity in arrangement is found in articles which use a strategy of disjunction in the deployment of information in the text. The term "disjunction" is suggested by Chaim Perelman's term "dissociation." Perelman means by "dissociation" the practice of separating, for rhetorical purposes, "elements which language or a recognized tradition have previously tied
together" (Realm 49). Disjunction is a strategy of formal separation based on the principle that matters discussed separately will probably be considered separately, and it is a strategy found to recur in the literature on headache.

The prime example of disjunction appears in the article which reports on the use of anti-allergy diets in the treatment of children with migraine. The authors explain early in the piece that their subjects will have had migraines "at least once a week for the previous six months."; they mention in a different paragraph that particular foods were reintroduced when subjects had no headache or "only one during the last two weeks" (Egger et al 865). The discontinuity between the two statements—one about subject selection and one about the length of clinical trials—discourages readers from making a critical connection: considering the baseline of the once-weekly headache and the fact, which the authors point out in still another section of the paper, that allergy reaction time could be up to one week, the clinical trials are too rushed to allow for significant results. The weakness in research methodology is concealed by a fact of organization which seems to discourage criticism by separating, in effect, the pieces of the methodological puzzle.

Style, like Invention and Arrangement, constitutes a category of persuasive strategies in a text—for, according to Aristotle, "it is not enough to know what to say--one must
also know how to say it. The right way of doing this contributes much to the right impression of the speech" (182). For the scientific writer, Style is especially important: not only is author familiarity with appropriate scientific style a prerequisite to credibility, but, according to John Ziman, appropriate use of an abstract and impersonal style has the effect of identifying a piece of writing with knowledge already accepted in the field—effectively begging the question by creating stylistically the impression that what is argued is already known (Public 97). Additional (and more specific) rhetorical uses of style are found in the medical articles. They include: (1) use of the passive voice to neutralize the presence of the author; (2) use of nominalizations to reduce the effect of human action in the account; (3) use of other conventional features of scientific writing, identifying the text with other works on science; (4) use of syntax in the direction of reader attention; (5) use of vague language, with various effects; (6) use of qualifying language, also with various effects; (7) use of the interrogative, representing a mood of inquiry; (8) avoidance of language which might be seen to be metaphorical or poetic.

Commentators on the style of scientific prose frequently refer to injunctions to the scientist, going back as far as the Royal Society in the seventeenth-century, to be clear, to offer scientific truth in language unadorned by stylistic
embellishment (that is, in the most limited, seventeenth-century sense of the word, unadorned by "rhetoric"). Most frequently quoted is Thomas Sprat’s statement in the History of the Royal Society that members of the Society should strive after "the primitive purity, and shortness [of language], when men deliver’d so many things, almost in an equal number of words" (Sprat 113).

In fact, directives to the scientific writer have not substantially changed in 300 years; if they have changed at all, they have become more strict, more purist—as this nineteenth-century pronouncement on style proclaims:

The scientific writer will constantly aspire to reflect objective reality with the perfect serenity and candor of a mirror, drawing with words as the painter with his brush, forsaking, in short, the pretensions of the stylist and the fatuous ostentation of philosophic depth.¹³

A typical contemporary (twentieth-century) writing text demonstrates the current view:

Science assumes a special posture and therefore requires a special kind of writing. The scientific posture is based on objectivity, neutrality, and observation; consequently scientific writing is primarily denotative and factual. (Winkler and McCuen 339)

Composition theorist James Kinneavy writes that scientific
writing is "referential" and focuses on "reality" as its subject matter and is characterized by the "nonintrusion" of the writer (174).

It is not surprising then that those who describe contemporary scientific prose do so in these terms: "A scientific paragraph says precisely what it means, and no more; it reads as if it had been composed by a robot . . . (Savory 133).

Clarity as a goal of scientific prose is commendable, but the limited and archaic view of clarity held in the sciences represents the attachment of scientific disciplines to the concept that clear language is not language appropriate to purpose and audience, but language that strives to be transparent, utterly impersonal, and value-free. The view that language can be as a window on reality is inconsistent with what is now known about its symbolic and necessarily tendentious nature. However, the conservative (preservative) institutions which dictate the style of scientific writing, hold on to acontextual, seventeenth-century notions of clarity and impersonality, and insist on the surface features of such a style, represented most obviously in the use of the passive voice.15

One language specialist rationalizes the passive voice as a way of avoiding "the seemingly boastful use of the active verb with personal pronouns or nouns" (Schindler 5). However, scientific modesty, representing the perceived
unimportance of the identity of the researcher, is a precept consistent with a traditional idea of science, but not with reality. The personal, proprietary claim of James Watson and Francis Crick to the structure of DNA has been well documented (Halloran, "Molecular Biology"), but less dramatic claims of priority and property are found throughout scientific literature, and examples are found in the contents of the synopses of the medical literature surveyed for the present study. In fact, one group of researchers, to argue the originality of their research question, makes a point of stating that the only other work on their topic was published "while the present study was already in progress" (Szekely et al). That is, while Style bespeaks disinterest, an examination of the ways in which scientists work to foster adherence to their claims suggests disinterest is no more than a shared fiction among scientific writers and readers.

Medical authors are advised by the style manual of the Journal of the American Medical Association, that "the primary purpose of medical writing is communication of scientific knowledge to other physicians" and that, therefore, "information must be presented with accuracy and clarity in a manner that can be read easily and rapidly" (Barclay, Southgate, and Mayo 9). The effect of such guidelines is to perpetuate the stylistic ideal of the Royal Society, and perpetuate the notion that language can meet that ideal; that is, that it is separable from rhetoric.
Certain forms, such as the passive voice, become conventionalized in the literature and their use a prerequisite to scientific publication. The *JAMA* style manual continues: "It is often said in books about writing that the active voice is preferred. This is not always true, and it may be true less often in medical writing than in some types of narrative prose" (9). Consequently, it is less accurate to speak of authors who use the passive for the purpose of neutralizing their presence in the text, than it is to speak of writing which has the effect of neutralizing that presence. A similar separation between intent and effect is implicit in the discussion of the use of nominalizations in scientific writing and other features of scientific style—such as the considerable use of long sentences and Latinate words.

The survey of medical articles verifies the dominance of the passive verb in scientific accounting. A typical paragraph in the Methods section of a research article reports that patients "were studied" and "were carefully analyzed"; analysis in this case "was done" in three ways; and a second group of patients "was analyzed in a similar fashion." Of the two active verbs in this paragraph, one is used in connection with the inanimate agent, "history" ("history revealed . . . " [Mathew 66]). The Methods section of another article contains eight verbs, six of which are
passive: patients were "referred" to the clinic, then "assigned" a diagnosis, and "assigned" again to the appropriate clinical category; their history "was recorded," certain items were "marked," and findings were "were recorded." Of the remaining verbs, one has the inanimate subject, "comparison" ("comparison demonstrated. . ." [Roy]). This pattern of passivization characterizes the middle sections of research reports, and is less apparent in the openings and closings of articles--where it is common for fewer than half of the verbs to be in the passive voice. The stylistic shift between the body of a report and its opening and closing sections is consistent with observations about the rhetorical arrangement of the research article.

The pervasive use of the passive in the descriptive middle section of the research report fosters the impression that methodology is in accordance with accepted scientific practice and that data made available through the methodology reflect phenomena that exist independently of the researcher-observer; that is, the passive argues that any scientist would have observed the same thing. This impersonality is a fundamental criterion of scientific "truth," and it is with respect to this truth-designation that the use of the passive is persuasive.

The effect of human action or of the individual scientist as agent is minimized again by the use of nouns in place of verbs--or nominalization--in the research report's
descriptive middle, where it is not unusual to find such a paragraph as this:

Recognition of underlying family conflicts is of utmost importance. Intervention and correct diagnosis and treatment of family issues often result in amelioration or reduction of head pain. (Roy 360)

Absent from this account is the human agent who recognizes conflicts, who intervenes and makes a diagnosis, who treats family problems, and thereby, ameliorates or reduces head pain. Thus, nominalization complements passivization in creating the impression of the disembodied investigator (now seen to be persuasive in itself).

Nominalization and passivization are stylistic features most commonly associated with scientific prose. Another widely acknowledged feature of scientific style is the use of Latinate words. In medical articles, headache attacks are "initiated," rather than started (Bending); headaches are "bilateral" rather than on two sides (Diamond, "Ibuprofen"); subjects' "responses" rather than answers are considered (Domino and Haber); and substances are "produced" rather than made (Solomon). The main effect of this word choice is that scientific articles are thereby made to sound scientific. In effect, scientific authors insinuate their studies into the medical canon by using the stylistic signs of belonging to
that canon. Another effect of scientific style is to convey the message that the language of a well-defined community of knowledge is impenetrable, open only to the initiated—in a sense, magical.

Syntax in scientific writing also has a rhetorical dimension, and is especially noteworthy for the way it is used to direct reader attention and to give a particular cast to assertions. An embedded clause may de-emphasize information which the author does not want to be considered as primary; minor syntactic structures function to reduce the effect of the information they contain—or imply the information is not new, but given.

In one study, for example, results of a treatment (which researchers hypothesized would not be effective) were diminished because subjects did not continue treatment in the follow-up period. Instead of confronting directly the experimental confounding of results, the authors focus, syntactically, on patient behavior, and mention only as an afterthought how results were affected: "During the follow-up, half of the behavioral group failed to practice their techniques regularly, which decreased some of the gains" (Szekely et al). Another group of authors alters the force of its advice about pharmacological management of headache by embedding a significant portion of its advice-content in relative clauses, and burying the rest in noun and verb phrases:
In patients who at times experience headache of the diffuse, steady, tension type reflecting muscular contraction, and at other times experience more focal, severe and throbbing headaches that are not clearly stress-related, a decision to advise the use of either 650 mg aspirin or 1,000 mg acetaminophen for headaches of the tension type, and a prescription drug for the tension-vascular headaches, is rational. (Peters et al 41)

One effect of their taking such an indirect approach to analgesic use is that these authors thereby avoid the issue of analgesic abuse. A related point, also of syntactic interest, concerns the use of the term, "iatrogenic drug addiction" (Lane and Ross 302) to describe drug abuse patterns begun during medical treatment. The noun phrase, without agent, without action, syntactically glides over the origin of the drug problem.

Another case of syntax bearing meaning concerns various authors' working descriptions of migraine. While the most widely accepted description of the disorder says that migraine is "often familial," and "in some cases . . . associated with . . . mood disturbances" (Ad Hoc Committee), some authors manipulate syntax to compose descriptions which seem to confirm what traditional descriptions only suggest. One pair of authors writes that migraine is a "familial
disorder" (Wilkinson and Blau); another describes migraine as a "stress-related syndrome" (Featherstone and Beitman). A similar process of suggestion becoming fact in syntax takes place when a researcher writes of the phenomenon of the "hot dog headache" (Daroff and Whitney) while specialists continue to debate the role of dietary triggers in migraine precipitation (Diamond and Blau).

Another way writers use style rhetorically is by using vague, instead of precise, language in their scientific accounts. While one might expect (from the history of clarity in scientific rhetoric) that scientific accounting would be fully precise, it is nonetheless vague in many instances. In some cases, paradoxically, vague language is used to ensure that what is written is accurate. That is, while it may be accurate to say that an experimental drug "would appear to be superior to the alternative modes of therapy available" (Lane and Ross 304), it might be less accurate to say that the drug is superior. Similarly, researchers can claim with confidence that "it appears that patterns of responses to emotional stress are significant correlates of outcomes of . . . therapy" (Featherstone and Beitman 110). The very vagueness of the claim enhances its truth-value.

Vague language not only protects writers from making inaccurate statements, it also facilitates audience adherence to their claims, by minimizing grounds for conflict. Yet an
additional rhetorical effect of vague language, and one that is concerning, is that vague statements may sometimes be read as reliable assertions. When readers are told, for example, that "some epidemiologists" report migraine in up to 25% of the population" (Gunderson 137), they do not normally (given a credible author) ask which epidemiologists say so and under what circumstances; the statement is taken as an assertion that approximately this percentage of the population does suffer from migraine. Similarly, when a group of researchers rationalizes their study by saying that a particular drug "appeared to offer promise" because of "theoretical considerations," most readers see the study as justified (Lane and Ross 302). That is, certainty itself is not a necessary condition for the effect of certainty. Some certainty is virtually a byproduct of textuality.

The use of qualifiers in scientific reporting is a special case of the use of vague language. Qualifiers are essential to scientific writing not only because they allow for accuracy in reporting, but also because they give authors a way of dealing with matters that are hypothetical, theoretical, or controversial. One author distills research on diet and migraine for the family physician by saying, "foods or alcohol can provoke occasional attacks [of migraine] in some patients" (Diamond and Blau 184). Another reports that the demands of child rearing can foster migraine attacks, and unresolved grief may play a role in some
patients" (Kirn, "Migraine" 12-13). The same author sums up controversy about the possibility of a "migraine personality" by writing that "most specialists admit under their breath that they believe persons with migraine tend to be perfectionistic, meticulous, compulsive and ambitious" (12). (All emphasis is mine.) In allowing scientists to make affirmative statements about unresolved issues, vague terms and qualifiers are crucial elements of the language of scientific inquiry. However, the rhetorical point of view suggests that vague terms and qualifiers pose potential problems to readers, who must be vigilant in their reading, taking care not receive as factual, statements which do not warrant the status of fact. With this in mind, it is worth reconsidering some of the assertions which were found to appear in the opening paragraphs of the headache articles under review. (See pp. 114-115 above.) All emphasis is mine:

In the U.S.A., 24 million Americans are reported to suffer from severe headaches . . . . (Szekely et al 86)

Epidemiological studies indicate that about two-thirds of adults in the United States experience headaches . . . . (Bell et al 162)
Each year 550 million workdays are lost in the United States because of pain, which is probably the principal complaint presented by patients . . . .

(Diamond, "Treatment" 91)

Headache is a common problem, affecting approximately 70-75% of men . . . (Featherstone 194)

Headache is one of the most common of medical complaints and is presumed to affect more than 80% of the population. (Glassman et al 101)

Migraine headache is one of the most common neurological disorders, with an estimated prevalence of 5% to 25% in western society. (Stellar 2576)

Migraine is a common disorder, occurring in an estimated 5% of the general population. (Bending 508)

While vague language and qualifiers serve important purposes in scientific writing, some scientific writing is nonetheless marked by a language of certainty which itself has great rhetorical power. One medical author writes, for example, that "all headaches should be initially viewed with concern, and every effort should be made to determine the cause of a headache" (Silberstein 65). As a statement of
common medical sense, this assertion has some valid claim to its tone of certainty. However, this statement from the same author is more problematic: "All patients should be treated prophylactically for cluster headache" (70). The second sentence has the same structure, the same syntax, the same authorial stance and rhetorical effect as the first, yet it is not a statement of common medical sense, but a statement of opinion, by no means uncontroversial, for it suggests that patients be consigned to taking drugs indefinitely, theoretically to prevent possible headache attacks. The linguistic signs of certainty here constitute one of the means in scientific writing of projecting authority without necessarily projecting an author.

In general, the probing, inquiring nature of the scientific enterprise would seem to be at odds with the claim to certainty in some scientific prose. This review of medical literature reveals, however, that a mood of inquiry is maintained overall in scientific prose by specific rhetorical means which balance the effect of certainty, where real certainty might be the end of inquiry. In addition to the use of vague terms and qualifiers, which may sustain the impression of ongoing research and ongoing professional conversation, some authors actually pose whole articles as scientific questions—"Diet and Headache. Is There a Link?" (Diamond and Blau), "Are Classical and Common Migraine Different Entities?" (Wilkinson and Blau), "Is the Muscular
Model of Headache Still Viable?" (Pikoff), "Is Migraine Food Allergy?" (Egger et al). These are not instances of the rhetorical question (erotema) per se, the purpose of which is to make a point rather than to elicit a response; rather they seem to be offered in the spirit of inquiry. Other authors achieve the same effect by appearing to present their articles as contributions to dialogue, as these titles suggest: "Dietary Factors in Migraine Precipitation: The Physicians' View" (Blau and Diamond), "Towards a Definition of Migraine Headache" (Blau), "The Mixed Headache Syndrome: A New Perspective" (Saper). Rhetorical analysis of scientific texts demonstrates that despite individual claims about the importance of particular research studies in the creation of knowledge, there is evidence in the style of the prose of the basic assumption that science is exploratory. The ultimate effect of a piece of scientific writing must be to invite response in the form of a question, a follow-up, a challenge, or a replication. The effect of medical discourse is to invite further discourse, as the proliferation of medical articles testifies.

Stylistic devices which the scientific writer seems intentionally to avoid are the figurative and metaphoric. Figures of speech and thought, catalogued in classical rhetoric and found everywhere in the discourse of the Humanities, are shunned by the scientific writer. The scientific writer, in keeping with a positivist tradition,
sees the use of stylistic devices as linguistic embellishment, sees linguistic embellishment as a method of obfuscation, and sees both as unscientific. Thomas Sprat asked, in *The History of the Royal Society*, "Who can behold ... how many mists and uncertainties, these specious Tropes and Figures have brought on our Knowledg?" (112) Sprat's suspicions continue to constrain scientific style.17

The scarcity of figurative language in scientific texts accounts in part for their known amenability to translation, which is in turn part of the impersonal, global image of the scientific enterprise. One linguist writes that scientific prose, "alone among all the different categories of prose . . . can be translated into languages other than the language in which it was first written, not merely satisfactorily but perfectly" (Savory 138).

Metaphoric language is not only relatively scarce in the medical literature, but also negatively noted. One author, reporting on a conference on headache, says that an expert compared migraine, with its many triggers, to a "freeway with many on-ramps." The reporting author comments that migraine is a "baffling disease," "though it seems ironic," he says, "that authorities would need to resort to analogy as the best description [emphasis mine]" (Kirn, "Migraine" 12). The author's view that analogy is inappropriate to the discussion of science, is consistent with the general view that scientific writing should not be
rhetorical. What is ironic is that scientific striving to arhetoricity is itself rhetorical: science's affinity to an unembellished style has the effect of persuading audiences that research, for example, is disinterested, unbiased, based on fact, and productive of fact. Avoidance of the appearance of persuasion is itself persuasive.

Although scientists strive for the arhetorical effect in their writing, some of the medical authors surveyed do use some rhetorical stylistic structures. These structures seem to be there because clarity depends on them. That is, the use of some rhetorical devices--usually the subtle as opposed to the clearly ornamental ones--is virtually unavoidable even in the plainest use of language.18

Subtle stylistic turns, then, are found scattered through the medical literature. One pair of authors uses the rhetorical question to articulate their concerns about headache classification: "Should all these [patient] groups be said to be suffering from classic migraine," they ask, "and if so what do we call the headaches that [two of the groups] have without an aura?" (Wilkinson and Blau 211). Rhetorical parenthesis is used by another writer, who interrupts the flow of his sentence to provide the service of explanation: "The vasoactive amines--serotonin, tryptamine, tyramine, dopamine, and norepinephrine--are present in significant quantity in the typical Western diet. . ."
Parallel constructions are common in scientific writing, often taking the form of lists. Sometimes these lists are integrated into the article as a whole ("In our clinical experience patients fall into three groups: . . ." [Wilkinson and Blau 211]); sometimes they are poised separately from the main text to highlight or summarize particular points. One author provides a quick guide to "Talking to Patients about Headache," recommending that physicians, "Encourage patient [sic] to maintain a ‘headache diary’. . . Advise patients to avoid afternoon naps . . . Recommend that patients wear sunglasses in bright light . . ." and so on (Silberstein 72). The trope, *litotes*, or rhetorical understatement, is also found in the medical literature. The use of understatement would be consistent with the general move in scientific articles to argue for the importance of a particular research effort. The author who writes, "It would be helpful to both physicians and patients if there were a treatment which was relatively safe, was not addictive and gave prompt relief" (Kain 2037) is not only courting audience agreement, but using understatement to enhance the importance of his ensuing report.

A number of authors, to make their points, turn to metaphor. The term, "aura," used invariably in descriptions of premonitory visual symptoms of migraine, is used metaphorically to suggest the ineffable quality of the warning. The term "topography" is used analogically to refer
to the study of the surface of the cortex (Wilkinson and Blau 212). One group of researchers relies heavily on metaphor, describing the phenomenon of the "turtle" headache, the curse of the late sleeper, who "retracts his head beneath the blankets" to avert the sun and is thereby deprived of oxygen (Gordon Gilbert 921). Metaphor and simile are frequently used also as pain descriptors, which is virtually unavoidable since the pain lexicon is itself largely metaphorical. One doctor describes patient complaints of "tightness" (Domino and Haber 310); another refers to the sense of "squeezing" or "the sensation of wearing a tight band" (Diamond, "Ibuprofen" 206); a third describes patients' "icepick-like" pains (Drummond 16).

It is possible to speculate that the more difficult a phenomenon is to describe literally, the more likely an author is to "resort to analogy" or to use figurative language. It is possible to speculate that, as a corollary, the more technical and abstract a scientific topic is, the more likely an author is to use theoretical constructs articulated as metaphors. An indication that this might be true is found in the theoretical discussion of neuronal as opposed to vascular genesis of migraine, where, for example, the term "nerve storms" is used to describe the behavior of neurons (Kirn, "Discussion" 11). That is, while metaphor is present but relatively uncommon in the medical texts surveyed for this study, metaphor may be more common in articles which
are more abstract or which attempt to describe the technology of theoretical constructs.20

What is, in general, however, an aversion to overt rhetoricity in the scientific writing of scientific authors is much less apparent in the unscientific writing of the same authors. For example, medical journal editorials constitute a different genre for medical authors, a genre with fewer (or perhaps different) stylistic constraints. In a Guest Editorial, one researcher uses analogy to suggest a theoretical explanation for headache. It is an explanation unlikely to appear in an "Original Article." He writes:

The word for the discomfort experienced when the heart is overwhelmed by demands placed upon it as a pump is angina--angina pectoris. Webster tells us that these are the Latin words for a painful suffocating contraction in the chest--a throttling. . . . Headache may represent a similar situation--but one resulting from suffocation or throttling or overloading of the brain, and maybe, even of the soul? (Graham 105)

This author's poetic license has more to do with the conventions of editorial writing than the conventions of science writing, and it is, in no way, unusual to the editorial genre. The regular editor of the journal, Headache, is here unabashedly rhetorical in his discussion of scientific controversy:
The intriguing thing is that some of these debates don't seem to have changed much over the years. Consider the vasogenic versus neurogenic controversy. Meyer and Olesen are clearly the champions of the contending faiths. Each has armed himself with years of research and with the accoutrements of high technology, and each has argued his case with grace and distinction. And yet, was not the same battle . . . fought between Latham and Liveing over a century ago? What was discovered then? What will be decided now? Can we ever know whether blood vessel or brain is the key to migraine? . . . And what about this "allergic headache" business? . . . If that tattered old hulk of "allergic headache" keeps looming through the fog, is it because it's real . . . or unreal? (Edmeads [Sept. 1986] 435)

These editorial writings supply good evidence that the "neutral" nature of scientific texts is a matter neither of the basic inclinations of scientific authors nor the nature of their subject matter; the neutral style is a cultivated style which has become conventionalized in a particular forum for scientific writing: the scientific article. Its use, like the use of research rationales and other arguments, is part of the rhetoric of science.

In the overall analytic structure for the rhetoric of
The final canon is Presentation (Aristotle's "Delivery"). The canon, in the Aristotelian framework, is a relatively minor one, subsuming matters which pertain, in oral presentation, to voice, specifically to volume, pitch, and rhythm. Yet the premise underlying the inclusion of Delivery in the study of Rhetoric is not minor: it is that what is presented well is presented convincingly. Delivery, according to Aristotle, has on the speech "the same effect as the art of acting has had on the drama" (184).

When the Delivery of the speech is transformed into the Presentation of the written article, the attention of the rhetorical critic turns to matters of article appearance—matters including paper quality, journal binding, typesetting, font size, article layout, column width, white space, documentation system, location of notes, use of headings, type, number, and quality of graphics. Although these have important rhetorical effect, they command relatively little critical attention—for decisions about presentation usually involve publishers rather than authors.

The impression an article makes does stem in part from ethos borrowed from the publication in which it appears. In terms of presentation, this means that whether an article is taken seriously depends in part on the professional look of the publication in which it appears.

Other factors of presentation are connected to
publishers' decisions concerning format, layout, and readability aids such as headings. Articles may be made inviting or not by virtue of their appearance as articles: as most Technical Writing texts claim, readers are drawn more readily to a piece divided by many headings and presented with adequate white-space. A full-length piece of uninterrupted text, or one which does not appear in columns of print, discourages all but the most determined readers. Similarly, charts and other graphics which break up blocks of print are effective additions to format. Moreover, tables which summarize information for quick reference—and these may be supplied by authors rather than publishers—add to the impression of accessibility of information.

The way articles present themselves is no less important than the way speakers present themselves. Issues of Presentation are invariably issues of appearance, rather than substance; yet appearance is persuasive. Those articles which include a photograph of the author are trading in some way on the rhetoric of appearance. It is worth noting at this point Kenneth Burke's anatomy of the persuasive appeal of the doctor's office, which, he says, "is not to be judged purely for its diagnostic usefulness, but also has a function in the rhetoric of medicine." Burke continues:

Whatever it is as apparatus, it also appeals as imagery; and if a man has been treated to a fulsome series of tappings, scrutinizings, and listenings,
with the aid of various scopes, meters, and gauges, he may feel content to have participated as a patient in such histrionic action, though absolutely no material thing has been done for him, whereas he might count himself cheated if he were given a real cure, but without the pageantry. (What McKeon calls "the crossing lines of rhetoric and medicine" would, in our terms, be "extending the range of rhetoric into medicine." A related popular term is "bedside manner," which Aristotle might have classed under topics that appeal by ethos). (ROM 171)

Burke's analysis is effectively a treatment of Delivery, of appeals from imagery, and the "bedside manner" of the medical person standing behind the published article is just what is at issue when an author's photograph is published with a medical article. To accompany the article, "Treatment of Chronic Headache," (Diamond), the journal Postgraduate Medicine prints a photograph of Diamond, literally at the bedside of a patient undergoing biofeedback therapy.

Scientific authors (and publishers), then, use a variety of strategies to make scientific articles persuasive. Rhetorical analysis of this body of medical literature suggests that while objectivity continues to be upheld as an ideal of scientific medicine, it only partly characterizes the real practice and transmission of it. Writers are not scribes, but authors, with biases both as witnesses and as
writers. Moreover, their writing cannot be separated from the motive to convince other scientists of the worthiness of their work.

A traditional sense of science, as essentially objective and non-negotiable, continues, however, to dominate the medical mainstream and inform the reading of medical discourse, and readers in general do not recognize the full rhetoricity of science—the similarity of scientific texts to all other discourses. Perhaps readers are unwilling to recognize the implications for science of the symbolicity and tendency of even scientific language; perhaps, however, they simply lack strategies for reading scientific texts critically, as rhetoric. Isolating rhetorical moves in medical texts enables critical analysis of other samples of scientific writing, and it invites discussion of the rhetoric of science, based not only on theory which says that scientific writing must be rhetorical, but on practical reading that says that it is, and how.

The rhetorical principles revealed by the analysis of medical journal articles are both descriptive and predictive of rhetorical moves in medical texts and may be applied heuristically in the critical reading of other articles. To precede discussion of the significance of the discovery of these principles, three case studies are provided to demonstrate the application of the rhetorical model in the critical reading of whole texts.
Part Two. Rhetorical Readings of Whole Texts: Three Case Studies

In this section, three medical journal articles are analyzed rhetorically, with the benefit of awareness of the strategies and structures revealed through the larger scale analysis.

The professed purpose of B. Szekely et al, "Nonpharmacological Treatment of Menstrual Headache: Relaxation-Biofeedback Behavior Therapy and Person-Centered Insight Therapy," which appeared in the journal *Headache* in 1986, is to contribute to "the growing evidence that menstrual headache should be considered and treated as a special clinical entity in headache" (91). The study uses two non-drug therapies (one behavioral, one control) on menstrually exacerbated headaches. It concludes, from the relative ineffectiveness of behavioral therapies in controlling the headaches (these therapies are effective in controlling headaches generally), that menstrual headache constitutes a special clinical entity, likely connected to biochemical change. The argument is essentially this: AGREED: menstrual headaches are a serious problem and non-drug therapies have been effective in treating headaches in general. BUT: almost no research has been done on the effectiveness of non-drug treatment specifically on menstrual headache. BUT SUPPOSE: we isolated subjects suffering from menstrual headache and treated them with non-drug therapies.
THEN: we would discover if menstrual headache was amenable to the same forms of treatment as other headaches. INDEED: resistance to such treatment would argue for the fact that menstrual headaches constitute a separate clinical entity.

The Szekely piece begins with a persuasive synopsis. (Authors who submit to Headache are instructed to send—with their article—a synopsis of under 200 words, including statement of the problem, method of study, results, and conclusions.) In the synopsis, the authors use information selection and emphasis rhetorically to direct attention and to positively predispose readers to their article. It begins with a declaration of importance using the topos of size: "Sixty percent of female headache sufferers have an increase paramenstrually" (86). It argues then, refutatively, for the need for study in the area of paramenstrual headache: "Although behavioral treatment of migraine and tension headache has proven effective in controlled studies, the effect on paramenstrual increases has rarely been isolated and observed [my emphasis]" (86). The greatest part of the remainder of the synopsis argues through the use of highly conventionalized scientific style that the group's research is bona fide science and the members of the research group, bona fide scientists. The authors report:

16 women with paramenstrual headaches self monitored 4 times daily for a 2-cycle baseline, then were matched on pre-treatment pain levels into
8 pairs and randomly assigned to treatment . . .

Post-treatment group analysis was by three-way analysis of variance with 2 repeated measures. (86)

The synopsis concludes with a positive statement made virtually indisputable by the use of vague terms and qualifiers: "Results suggest that nonpharmacological treatment has a lesser impact on menstrually associated periods than on headaches not associated with menstruation [emphasis mine]" (86). Vague language and qualifiers allow for some of the effect of positive assertion, without the commitment of positive assertion or the possibility of falsification. With respect to what the synopsis leaves out (it fails to mention, for example, that its 16 subjects were selected from a pool of 93 women, 77 of whom were considered inappropriate to participate), it is important to note that although information crucial to evaluating the study does not—and logistically, cannot—appear in the synopsis, many readers who look only at article synopses come away with a carefully constructed view of the research.

The authors' rhetorical acts of arguing logically for the importance and the priority of their research, of using highly scientific language to describe a quasi-scientific study, and of making careful linguistic choices to present its findings in the best possible light are all manifest to a
larger extent in the article itself.

The article opens with the sentence, "Headaches continue to be one of the common physical complaints of humankind" (86), a statement appealing for its intuitive truth and understated elegance. It goes on to say (citing a Report to the White House) "In the U.S.A., 24 million Americans are reported to suffer from severe headaches, contributing to lost time at work and decreased productivity, costing 15.1 billion dollars annually" (86). Once reader attention—and reader agreement as to the severity of the problem—is secured, the authors go on to make the case for the appropriateness of their own research. They do so by a process of accretion of adherence, through a series of arguments detailed earlier (p.115-116 above). Essentially, they build their case this way: that there is a need for research on paramenstrual headache; that there is a need for more research on behavior therapies for headaches; finally, that there is a need for research (that is, their research) on behavior therapies for sufferers of paramenstrual headache.

The rhetorical goal of the opening section is to secure audience agreement concerning the importance of the study in question. The authors argue that there is a void in headache research and that their research is undertaken to fill the void. By defining an area of needed research and claiming a dearth of available material in that research area (they
say, "there has been only one study"), the authors persuade their audience of the need for their own study.

Part of the perceived value of the Szekely article, according to the authors' own logic, is its originality, and part of the authors' rhetorical agenda, then, is to argue for the priority of their research plan. In fact, the publication of the Szekely article was predated, by almost two years, by a study entitled, "Menstrual Migraine Headache: Results of a Controlled, Experimental, Outcome Study of Non-drug Treatments" (Solbach et al) published in the same journal. The Szekely group is quick to point out (in the second paragraph of their own article) that this earlier research was published "while the present study was already in progress" (86). This direct claim to priority is clearly meant to persuade the audience of the added value of Szekely et al's research, and contradicts the persona of the disinterested, universalist scientist.

The sections which follow the Introduction of the report and precede its Discussion section (namely, Methods, Subjects, Therapists, Procedures, Dependent Measures, Statistics, and Results) are presented in the conventional style of scientific prose, and the scientific nature of the prose itself argues for the significance of the study.

Scientific style is characterized here especially by the use of passive voice and nominalizations. The Methods section, for example, consists of one paragraph of five
sentences. The sentences contain ten verbs, and of these nine are in passive voice. The tenth verb is "is." Any other action in the sentence is expressed in the form of nominalized verbs: the design is a "measurement" process with the "introduction" of experimental change—or "treatments."

Patterns of passivization and nominalization especially characterize the main body of the report. Verbs in the Procedures and Dependent Measures sections of the paper, for example, are typically passive: "Thus, it was decided to use an alternative treatment, accepted in psychological clinical practice, but not proven to be effective specifically on headache" (87); "Subjective reports of daily headache pain levels were gathered by means of a daily headache diary adapted from a version described by Blanchard et al, socially validated, and employed in over 40 headache studies" (88). On the other hand, active verbs are more common than passive verbs in the Introduction and Discussion sections, although the frequency of nominalizations remains approximately the same. The first paragraph of the Discussion section, for example, contains seven sentences, and only three of the total thirteen verbs are in the passive voice, although again three nominalized forms ("reduction," "exacerbation," and "assessment") are found in a single paragraph.

Variation in voice within the report seems to indicate some authorial attention to rhetorical distinction at the level of language. An attempt has been made stylistically in
the main body of the report to preserve the sense of the detached scientist observing what is external to him or her. The impression created by the pervasive use of the passive is, first of all, that methodology is accepted scientific practice ("the time-series experiment as described by Campbell and Stanley," the authors say) and that phenomena made available through the methodology exist independently of the researcher-observer; that is, the individual observer is unimportant because any scientist would have observed the same phenomena.

This is not the impression the authors have created in their Introduction. In the final section of the report, the reader again encounters Szekely et al as a group of committed researchers doing an important job. In this section, the authors are, as they were in their Introduction, more openly rhetorical, and they openly seek the agreement of their readers:

In conclusion, the inhibited responsiveness of menstrual headache to behavioral treatment has implications for treatment planning, suggesting also ramifications into headache classification. . . . This study has corrected faulty methodology by isolating effects of behavioral treatment on menstrually exacerbated headaches, and has given more attention to an understudied headache group. . . . It contributes to the growing evidence that
menstrual headache should be considered and treated as a special clinical entity in headache. (91)

The most overtly persuasive sections of the article then occur at its beginning and its end. This method of organizing arguments in the article suggests a Nestorian arrangement. In fact, Szekely et al's least convincing material is buried, organizationally, in the middle of the article. The authors, for example, mention, mid-article, that two of their sixteen subjects were "homosexual in preference" and that "this plus the high educational level of the group suggests that these women were not all traditional in acceptance of the female role, yet still suffered from distress associated with the menstrual cycle." No supporting literature is cited to substantiate the link between the attitudes of women toward the "female role" and the experience of menstrual distress. Later in the article (still mid-article), the authors offer this description of "Person-centered Therapy," their control treatment:

... the goal is to help the person eliminate anxiety which stems from the need to defend against accurate perceptions of experiences which are contrary to that person's introjected conditions of worth. Growth potential is released in a relationship in which the therapist is experiencing and communicating realness, caring, and a deeply sensitive non-judgmental understanding. (88)
One might infer from the description that, even if readers knew exactly what "growth potential" and "realness" meant, there would still be some difficulty in replicating Szekely et al's therapeutic conditions, although replicability is known to be one of the main criteria for evaluating a scientific study. The description of "Insight Treatment" points to a tendency to imprecision in the use of terms in the Szekely article—an imprecision which at times has the rhetorical effect of identifying the study with other studies in the field. The first problem is with the slippery use of the term "headache" itself—for while their article is indeed a discussion of menstrual headache, the authors repeatedly discuss their own research in terms of research on menstrual migraine. They cite one study, apparently to corroborate their own, which indicates that "non-drug treatments have a lesser impact on menstrual migraines than on migraines not associated with menstruation [emphasis mine]" (86) and another which concludes that menstrual migraine is "probably not merely a stress-related phenomenon, but one which is rooted in biochemical parameters" (91) and therefore, one would assume, more intractable in the face of non-drug intervention. That is, Szekely et al place their study in the context of accepted work on menstrual migraine although their own research is on the more nebulous area of menstrual headache. (The Szekely group used subjects diagnosed as suffering paramenstrually from four different types of
headache: migraine, muscle-contraction, mixed, and cluster headache.)

The second term which confounds for the critical reader the results of the Szekely study is "paramenstrual," a term which the authors use without sufficient discussion. They define "the paramenstrual phase" as being "15 days, plus and minus 7 days surrounding day one of menstruation." As Chaim Perelman explains, "a description which seems neutral reveals itself as one-sided when brought up against a different description" (Realm 45). Szekely et al (to continue with Perelman's terminology) create a liaison between their own study and the Solbach study on menstrual migraine, yet the Solbach authors use a significantly different definition of the paramenstrual phase: "menstrual migraine is defined in this study as any migraine headache which occurs 3 days prior to the menstrual flow, during the time of the flow, or three days following" (76). While the Szekely article, then, presents itself as reporting significant research in the field of paramenstrual headache, the authors are not sufficiently responsible in their use of both of their key terms.

Identifying itself with compatible studies, the Szekely study similarly dissociates itself from studies which are essentially incompatible with it. The strategy is simply one of selective citation. The authors, for example, ignore the body of literature that discourages a temporal classification
of headache types (and therefore the definition of headaches as paramenstrual) when biochemical, electronic, and other data offer more productive grounds for classification (Saper, Bruyn).

The Szekely article, it seems, derives most of its positive effect from authorial ethos—the external ethos of degrees and affiliations, and the internal ethos generated as the authors demonstrate that they have access to the language of the community for which they are writing, and access as well to the assumptions and beliefs that empower that language—assumptions about the nature of research, the structure of evidence, the value of numbers, the appropriateness of certain kinds of medical interventions. Szekely et al exhibit in the writing of their report a facility in dealing with an acceptable rhetoric of science, and the result is that their research, despite the tenuousness of its claim to pure science, is taken seriously by their peers.

Egger et al's "Is Migraine Food Allergy? A Double-Blind Controlled Trial of Oligoantigenic Diet Treatment" (The Lancet, 1983) is also a report on an empirical study. An "oligoantigenic" diet is a low-allergen diet; the Egger study used a series of clinical trials of systematically limited diets to control attacks of migraine in children. Their
article in *The Lancet* reports on their experiment, and argues that food-related migraine is a result of "allergic disease rather than metabolic idiosyncracy" (867). Structurally, their argument is this: AGREED: some people develop migraine after ingesting certain foods; BUT: although "food allergies have . . . been postulated, . . . none has been established by controlled studies"; (865) BUT SUPPOSE: a variety of foods were withdrawn and reintroduced systematically in a large sample of migraine subjects; THEN: offending foods could be identified and the quality of subject responses to withdrawal and reintroduction could be measured; INDEED: if subjects became headache-free with the withdrawal of a wide variety of foods, and were subject to attacks again on their reintroduction, allergic rather than metabolic pathogenesis of migraine would be indicated.

The Egger article uses both logical and ethical arguments to make its case; its major *topos*, consistent with scientific method, is argument from example. The article is headed by a persuasive summary and its organization is "Nestorian": it begins and ends with the strongest arguments, leaving the others in the middle. It uses disjunction in more than one case with the effect of diminishing the effect of weaknesses in research design. While the article is comparatively more direct and more personal than many other research reports, it successfully uses the conventions of scientific writing, including especially passive voice and
nominalizations. It avoids figurative language. A striking feature of the article's style is its use of the question (not the "rhetorical question," but the question posed apparently to invite response) and other strategies which create the effect that the article is inquiring in good faith.

Beginning from the understanding that would be shared among their audience that the subject of diet and headache is controversial, Egger et al. introduce their article into their discourse community more as a conversational turn than as a speech. They accomplish the dialogic effect in a number of ways—including the use of a question in their title and the use of qualifying language—particularly in their Introduction. By using qualifiers in their Introduction to emphasize the characteristic uncertainty of research to date on diet and migraine, the authors underline the mood of inquiry. Their purpose seems to be not to discredit other research (directly), but to demonstrate the unfinished, or ongoing, nature of work in the field:

Cheese, chocolate, and red wine sometimes provoke migraine, allegedly owing to an idiosyncratic response to . . . tyramine. This response is perhaps due to monoamine oxidase deficiency, which has been reported in some patients with migraine. Deficiency of platelet phenolsulphotransferase . . . has also been proposed as a possible basis for idiosyncrasy.
Food allergies have also been postulated, though none has been established by controlled studies.

(865) The use of qualifiers in the Introduction has another effect, and that is the conventional effect in research reports of making the present research appear to be needed. That is, while creating a sense of dialogue in controversy, the authors also manage to rationalize their study. The logic of their introduction argues by refutation that what is needed is a controlled study to investigate the causal relationship between food allergies and migraine; what is needed is their study.

A strong and unqualified Summary preceding the Introduction has the effect of positively disposing the audience to the study, for notwithstanding any weaknesses in design of research or interpretation of results, the Summary proclaims, "93% of 88 children with severe frequent migraine recovered on oligoantigenic diets . . ." (865) and "In most of the patients in whom migraine was provoked by non-specific factors . . . this provocation no longer occurred while they were on the diet" (865). Moreover, the authors' association with the Departments of Neurology and Immunology, Hospital for Sick Children and the Institute of Child Health, London has been made clear at the article's head. Thus, the article, while appearing exploratory, also sets itself up as a strong autonomous piece of work. This means not that every
word of the article will be accepted uncritically, but that the article as a whole will be received as believable.

The effect of linguistic and syntactic choice in promoting an appealing scientific attitude of inquiry is underlined in the contrast between the title of the Egger article ("Is Migraine Food Allergy?") and the title of another article on migraine and diet appearing in The Lancet almost exactly one year later. The latter article reports on the effectiveness of a particular drug in preventing migraine when administered with foods usually known to cause migraine. Its title proclaims, "Migraine is a Food-Allergic Disease" (Monro et al).

The difference in attitude between the articles, suggested in the syntax of their respective titles is sustained to some extent in the language of the articles themselves, but the rhetorical differences between the main texts are less remarkable than the differences between their titles. The reception of the articles in the scientific community, however, seems in part to be a reception of the tone of each. The letters in response to the Egger article continue the exploration, pointing out strengths and weaknesses of the study, discussing it in terms of other, related research, and raising further questions for investigation. Sample letters begin as follows:

Dr. Egger and colleagues' paper . . . will doubtless become a definitive text, since it confirms in a
double-blind trial . . . what has been described many times in earlier years. (Hearn and Finn 1082)

The criteria used by Dr. Egger and colleagues . . . to define migraine are not specific enough and will include patients falling outside the scope of internationally accepted definitions. (Cook and Joseph 1256)

Dr. Egger and his colleagues have established, in scientific double-blind trial, that foods are a common and important cause of migraine. Physicians should now try to identify in children the food(s) and inhalants . . that trigger attacks of migraine. (Gerrard 1257)

The letters in response to the other piece are less exploratory than argumentative. The first writer accuses the researchers of drawing "unwarranted conclusions" (Blau, "Letter" 926); the second writer states that the researchers' claim "is a dramatic declaration." "But is it true?" he asks (Pearce, "Letter" 926). The letters of response suggest that scientific readers have reacted not only to the research in each case but the rhetoric of the report.

The attitude of inquiry which characterizes the Egger article is enhanced also by the use of the first-person speaker in the report. (This is the article, referred to
earlier in Chapter 3, that confesses, "We . . . embarked on this study believing that any favorable response . . . could be explained as a placebo response" [867].) The authors' cautious attitude here is also an example of the rhetorical use of prolepsis, in which a speaker presents an objection to which he or she is eager to respond.) The use of the first person helps the writers establish a professional identity, and their article, consequently, takes on some of the effect of a personal communication. Furthermore, the authors extend the effect of dialogue, the effect of professional identity, and the effect of positive ethos by discussing directly the place of their study in the larger research picture. They mention the need for tests to identify reaction-causing foods; they discuss the implications of their study for other allergy-related disorders; and they cite their own earlier work on dietary control of skin disease in the context of assessing "empirical diets." Their self-reference, rhetorically understated, has the effect of promoting author credibility.

The characteristic openness of the Egger report accounts for some stylistic features which distinguish it from many other research reports. Passive voice is used less frequently here than in other research articles. In a typical paragraph, even in the Methods section, 7 of the 12 finite verbs are in the passive voice, and readers are less likely to find "the data" speaking for itself here than in many
other reports. Still, the reporting persona is inconsistent through the report: the human intelligence which inhabits the Introduction and Discussion sections of the article is less apparent in the middle section of the piece; the first person of the Discussion section is not present at all. Readers are informed that patients "were selected" and "treated"; foods "were introduced," "withdrawn," and "systematically reintroduced"; symptoms "were provoked" and "investigated." Nominalized verbs—"provocation," "reintroduction," "identification," "discussion"—sustain the impression of agentless action (the substitution of Agency for Agent). The use of conventions of scientific language affirm the claim of the authors to membership in the scientific community, and promote the reading of their article as science.

In the less personal, less exploratory—and rhetorically weaker—middle of their report, Egger et al also tend, if not to conceal some of the more troubling aspects of their research, then at least to make them a little inaccessible. (Interesting from the perspective of Presentation is the fact that the Patients and Methods section of the article appears in smaller print than that used in the rest of the article, in the Summary, Introduction, Results, and Discussion sections.) The researchers, for example, report that they depended for evidence of treatment success on each patient's diary of symptoms. They also report—but a page later—that some of their subjects were as young as three years old.
Even if parents were recruited to keep records for the youngest subjects, readers might question the reliability of subjective reporting in patients that age. Instead of confronting that issue directly, however, the authors avoid it by disjunction, by textually separating rather than connecting related points. A similar problem plagues the authors' conclusion that "during the diet period smoke and perfume still provoked migraine, but only 3 patients still had symptoms after exposure to other [provocations]" (867). In an earlier section, the authors mentioned that patients "were encouraged to continue full activities" (865). Presenting related points in separate sections, the authors avoid the question of how they isolated the almost infinite number of variables that would affect 88 children living in their normal environments. Thus, a conclusion which has the appearance of empirical truth derives that appearance from disjunction. In order to conclude that 93% of 88 children with severe frequent headache recovered on oligoantigenic diets," they the authors must engage in the rhetorical process of selecting and emphasizing some bits information and suppressing others in order to gain the most support from their claim (the inquiring attitude of their article notwithstanding) that migraine is a food-allergic condition.

Another instance of the use of rhetorical disjunction in the article concerns the selection of subjects and the length of clinical trials, and was discussed in detail earlier in
this chapter. In this case, the organization of the discussion of clinical variables drew attention away from the fact that subjects who normally got migraines approximately once a week would be moved to the next experimental phase when they had not had a headache for only two weeks. Also discussed earlier is the persuasive handling of statistics in the article, with the effect that a positive result affecting 75% of 99 patients (according to one person’s "neutral" calculations) is reported as affecting 93% of 88 subjects.

The Egger study appears to be unexceptional in making implicit claims to validity and significance connected to employment of scientific method. Understanding the field of diet and headache, the researchers developed a research hypothesis subject to empirical testing and developed a methodology to test it. They noted results as if they were disinterested observers. Then in the language available to them as initiated scientists, they reported their observations. Throughout, they assumed and argued implicitly that what was found to be true for the few (their subjects) would also be true for the many (in this case, other children with food-related migraine).

The effect of Egger et al’s report is that it is persuasive. Its Introduction persuades readers that an allergy study for headache is justified; its Methods section persuades readers that the particular study is consistent
with scientific method (the "double-blind controlled trial") and therefore productive of reliable results; its Discussion section persuades readers that the study is successful in demonstrating "that most children with severe frequent migraine recover on an appropriate diet, and that so many foods can provoke attacks that any food or combination of foods may be the cause" (867). Well-placed qualifiers encourage reader agreement. Reader agreement is secured also in the Discussion section by the authors anticipating reader objections and responding to them. (This is true not only in the authors' dismissal of a significant placebo effect, already noted; the authors also point out that "the observations that 8 patients who responded to the diet did not relapse on reintroduction of foods . . . could be due to spontaneous recovery of allergy on diet, . . . to a change of the family diet resulting from general dietary advice, or to a placebo effect" [868].) The article as a whole also persuades readers that the researchers are reliable witnesses and reporters of their study. Reading the article from a rhetorical perspective demonstrates the means by which strategies of Invention, Arrangement, Style, and Presentation work persuasively on readers.

Carl H. Gunderson’s article, "Management of the Migraine Patient," American Family Physician (1986)—is not a report
on research, but one of the summary articles which appear periodically in the generalist journals to discuss care of the headache patient by the family physician. Summary articles do not purport to be original; they purport only to be reliable and authoritative. Unlike reports on research or other original articles, summary pieces tend to be single-authored; they are sometimes solicited by journal editors to meet reader demands for clinical reviews in specific areas. Gunderson's article is typical of the genre.

The apparent purpose of the Gunderson article is to keep the primary-care physician apprised of recent advances in the diagnosis and treatment of a disorder which, as Gunderson says, "may occur in up to 25% of the general population" (137) and is "among the most common disorders seen in office practice" (137). However, two essential observations about the article call that simple purpose into question and suggest the usefulness of a rhetorical analysis to reveal more subtle authorial purposes. First, the article is remarkably similar in basic content to other review articles on headache by other authors in other journals; secondly, the Gunderson article and the other similar articles deal largely in what the practicing physician reader already knows. (They all say essentially this: that migraine must be distinguished from a symptom of organic disease on the one hand and from other forms of functional headache on the other; and that, following diagnosis, treatment should include behavior
therapy and/or the prescription of one of one or more of the following kinds of drugs: analgesics and narcotics [for pain], ergotamines [to abort the headache], and certain drugs used prophylactically against frequent, incapacitating headache, notably beta-blockers and tricyclic antidepressants.) From a rhetorical perspective, what is interesting here is that the Gunderson article, in covering basic content most of which is already known to the physician, has the effect not so much of being informative as being affirmative. While the article seems to be an update, it is more realistically a declaration that little is new in the field of headache of consequence to primary-care physicians; the rhetorical agenda is to reassure the family doctor that little is new; to be "true" by virtue of affirming what the doctor already knows. The review article is a kind of epideictic rhetoric. A selection of Gunderson's statements of what is already known—not as the starting place for argument but as the argument itself—attest to the nature of the rhetorical purpose:

The physician must distinguish migraine from muscle-contraction (tension) headaches, headaches associated with serious intracranial disease and other forms of vascular disease. (138)

Treating headaches in a patient who is terrified that he is harboring a brain tumor is of little benefit
unless adequate reassurance is also provided. (139)

Aspirin's effectiveness in relieving migraine may be enhanced by the addition of other barbiturates or antihistamines for sedative and antinauseant effects. (140)

This is not the only kind of statement which appears in the article; others are more genuinely informative. Still, the high incidence of statements of what is already known is no more than redundancy if the real purpose of the article is to inform.

Although summary articles are similar in basic content, they do vary significantly in terms of emphasis and value. The articles, then, perform a complicated rhetorical function: they are read as "true," affirming what doctors already know and hold in common, and, at the same time, they are necessarily evaluative. Indeed, physicians often read journal articles as a way of consulting another physician on a specific topic.

The issue of author bias or implicit judgement is especially important in review articles because readers of these articles are in the business of primary care, of translating what they read into practice. (The articles are no less considered to be "scientific." The Gunderson article appears in American Family Physician under the heading, "Scientific Articles.") While one review author (Kirn,
"Migraine") spends several paragraphs discussing accurate headache classification, Gunderson (as was indicated earlier) is unconcerned with classification because, he says, "a patient with muscle contraction headaches will seldom suffer from a well-planned trial of migraine management . . ." (138). Furthermore, while many authors see the relationship between diet and migraine as crucial to migraine intervention (Diamond and Blau, Egger et al, Monro et al, Gettis), Gunderson simply writes, diplomatically: "a number of dietary factors have been associated with changes in headache frequency [emphasis mine] (143). It seems situation and rhetorical purpose invite summary articles in generalist journals which are tendentious in important ways within the limits of consensus and acceptability.

Gunderson’s own views are revealed also in his use of terms. The very title of the article, "Management of the Migraine Patient [emphasis mine]" reveals a tendency to objectify the person with migraines. According to ethicist Hans Teifel, medical language is essentially objectifying: patients are "managed" with the hope they can be "salvaged" although their organs may be "defective" (Tiefel). Gunderson, in addition, was the author referred to earlier in Chapter Three who objected to forms of therapy which would "remove" the patient from his care.22 Gunderson’s lexical choices in describing patient care indicate the salience for him of a we/they dichotomy (not argued but assumed),
reinforced by his tendency to refer to himself and his readers together as "the physician": "The physician must distinguish [among types of headache]" (138) or "The history of migraine may be presented to the physician in many guises" (139).

Gunderson overall establishes a positive ethos with respect to his physician-readers. He uses the first person readily, although not to refer to himself as practitioner (in relation to patients), but to himself as authority (in relation to readers). He says, for example, "I agree with [. . .] that the dangers of the ergot preparation have been overstated" (140), or "I have been most impressed with hydroxyzine parmoate . . . [administered] intramuscularly" (141). In general, Gunderson develops his relationship with his reader by using a direct style. He is authoritative but not authoritarian. While he sometimes advises readers directly ("Special attention should be given to the nervous system and the patient's blood pressure" [139]) he is just as likely to make an assertion that simply has the indirect force of advising. When he says, for example, that "If a headache develops extremely rapidly . . . or is associated with neurologic findings . . . subarachnoid hemorrhage may have occurred" (138), his speech act is indirect. Gunderson finally has the ethos of the trusted physician: aloof but concerned, helpful but firm, calm but cautious. His photograph, which appears on the last page of the article can
have no purpose but to reinforce this ethos. Gunderson, Chief of Neurology at Walter Reed Army Medical Center, and consultant in neurology to the Surgeon General of the Army, appears in uniform.

Like most other review articles, Gunderson's is arranged topically according to a principle of access to information. In just under six pages of text, the article covers four topics, each under a different heading: Differential Diagnosis, Treatment, Prevention of Migraine Attacks, and The Long View. Each section is further divided into at least four subsections. The article begins with a general statement about the unknown etiology of migraine, and ends, rather abruptly, with a statement about vascular headaches originating with orgasm. The article's overriding impression of being informative is enhanced by its apparently flat profile.

Still, the rhetorical analysis continues to reveal the ways in which Gunderson's article is not simply a vehicle for "scientific" information. Having established the persona of the trusted physician, Gunderson uses a "trust me" ethical argument under his material to buoy it up. "Some epidemiologists" he says, believe that migraine may occur in up to 25% of the population (137); but he does not say which ones. Later in the article, he announces that "some studies suggest that the use of widely advertised brand-name agents may have an additional placebo effect" (140). Again, he
provides no documentation.

In fact, many of Gunderson's statements owe their influence to an underlying "trust me" argument, meaning that certain assertions which are in fact unsubstantiated do not have the effect of unsubstantiated assertions. Examples occur throughout the article:

The peculiar ability of sleep to relieve migraine is well known. (141)

[Relaxation and biofeedback techniques] are most useful in patients who have mixed tension-vascular headaches rather than classic or common migraine. (141)

Migraineurs should remain under long-term blood pressure surveillance, especially if their headaches become more difficult to control. (142-3)

Two factors make the unceremonious presentation of these statements of "fact" acceptable: one is that the statements may subsume points of "common knowledge" within the field; the other is that a summary article does not, by definition, require formal attribution for every one of its statements. What is important, however, is that the tone of the unsubstantiated-but-substantiable assertion is carried through to other statements in the article which are more questionable, such as these:
Unusual stress or depression is perhaps the most likely cause of a change in migraine pattern. (142)

[Antidepressants] are . . . of value, especially in patients whose headaches have a muscle-tension component or are triggered or exacerbated by depression. This is particularly true when increases in migraine frequency are associated with menopause or retirement. (141)

Simple analgesics, such as aspirin and acetaminophen, are probably more effective than most authors believe them to be. (140)

Gunderson offers a range of propositions from the scientific to the speculative; yet it is characteristic of his writing that he homogenizes assertions such that they all appear to have approximately the same truth value. The article is a monotone of content as it is (because of its organization) a monotone of form.

In addition, Gunderson uses omission as a rhetorical strategy. Some of his statements appear to be true because of the absence of any opposing information. Gunderson's biases are apparent especially to the reader who knows what he leaves out. For example, it has been noted that the author spends about a third of his article talking about drug
treatments for headache; his presentation seems straightforward, but what Gunderson does not mention is the considerable body of research now available which suggests that narcotic treatment of headaches is "one of the commonest antecedents to significant iatrogenic drug addition," (Lane and Ross 302) and that headache drugs themselves have been implicated in the perpetuation of headache problems (Isler).

Of course, no author can present all available information in a single article in any medical area. Authors are necessarily selective and, by the same token, necessarily rhetorical. Furthermore, those authors who undertake a review a large area of research are also, necessarily, reductive—and, by the same token, rhetorical.

A final point about the Gunderson article concerns the way in which it addresses the needs of the busy physician, who might benefit from having material reduced and encapsulated. Gunderson provides a small (2" x 4") table of the features of the five main kinds of migraine. The table acts as a "quick reference" and, interestingly, its caption tells us it is adapted from Gunderson's book, Quick Reference to Clinical Neurology. Publication data is provided. In effect, the article advertises the book, which readers may presume is as conservative, reductive, and benevolent as the article.

These analyses demonstrate the extent to which the
findings of the general rhetorical study can be applied heuristically to the study of specific scientific texts. The main finding of the general analysis—that scientific writing as represented in medical journals is highly rhetorical—is confirmed in the analysis of specific texts.
1. For a discussion of the considerations of scientists preparing funding proposals, see Greg Myers, "Two Biologists' Proposals."

2. See Janet M. Chase. Chase lists the following publication criteria ranked according to the proportion of respondents marking it as essential:
   1. Logical rigor
   2. Replicability of research techniques
   3. Clarity and conciseness of writing style
   4. Originality
   5. Mathematical precision
   6. Coverage of significant existing literature
   7. Compatibility with generally accepted disciplinary ethics
   8. Theoretical significance
   9. Pertinence to current research in the discipline
   10. Applicability to 'practical' or applied problems in the field

3. See, for example, section headings in American Family Physician.

4. This is Chaim Perelman's terminology which brings together Aristotelian topoi dealing with comparison and contrast. See Realm on "Weights, Measures, and Probabilities,"
199


5. The Aristotelian notion that the speech must be conditioned by the beliefs of the audience—and may start from what the speaker and audience hold in common (that is, as fact) is elaborated for purposes of the present discussion very clearly by Chaim Perelman. All quotations are from The Realm of Rhetoric: "Dialectical reasoning begins from theses that are generally accepted, with the purpose of gaining the acceptance of other theses which could be or are controversial" (2). "The speaker can choose as his points of departure only the theses accepted by those he addresses" (21). "When we address groups which, by their profession or commitment, are supposed to adhere to certain theses, we may assume that as given. The lawyer can assume that the judge is respectful of the country's legislation and of all legal statutes. . . . A scholar who addresses his colleagues can assume that they recognize what constitutes the core of their discipline" (31).

Another dimension of the subject of starting places for argumentation is articulated by Paul Newall Campbell with specific reference to the rhetoric of science and scientific revolutions. Campbell writes, "... [A]fter the adoption of a particular paradigm, the scientists' work follows the model, the point of view, the outlook implicit in that paradigm. All that happens is that what was contested, what was questioned at
one stage is accepted without question at a later stage; an explicit bias, an explicitly rhetorical viewpoint becomes an implicit bias and point of view..." (392).

6. Burke writes that the "purest rhetorical pattern" is "speaker and hearer as partners in partisan jokes made at the expense of another" (ROM 38).

7. See Tiefel on the "stark, objective, and impersonal language of science" (11).

8. In fact, Ong extends his analysis to the realm of science. He writes:

   The knowledge of scientists themselves is almost all grounded in faith . . . . Of the scientific knowledge which any many has, only a tiny fraction has been achieved by his own observation. For the rest, he has good reason to believe that it is true because, within the limits of their competence, he believes in his fellow-scientists reporting on their work or reporting on the work of others. Thus, even in the most "objective" of fields, in actuality the word of persons is more pervasive than factual obervation. (91-2)

See note 11 below.

9. This feature of scientific writing was pointed out by S. Michael Halloran in "The Birth of Molecular Biology."
10. Burke's pentad, elaborated especially in his Grammar of Motives, lists the five heuristic elements of dramatistic analysis, of analyzing events (including linguistic events) as human action. Burke's five terms are Act, Agent, Agency, Scene, and Purpose. The pentad applied to scientific style suggests there is some motive of avoiding responsibility or at least making the locus of responsibility ambiguous when, in the place of the Agent in the description of an action, Agency is highlighted.

11. It is interesting to compare Booth's words to the words of Walter J. Ong, quoted in note 8 above, and to these words from Michael Polanyi: "... nobody knows more than a tiny fragment of science well enough to judge its validity and value at first hand. For the rest he has to rely on views accepted at second hand on the authority of a community of people accredited as scientists" (PK 163).

12. One source reports that there are now more than 40,000 professional journals of science alone and that researchers contribute to them at the rate of one every 30 seconds, 24 hours a day, 365 days a year (Bracey 9).


14. For a discussion of clarity and context, see Lanham.

15. Coetzee points out that the passive itself is not treated as a rhetorical device in classical theory but may be considered to be subsumed under the strategy of style which
inverts the conventional order of words. The change in grammatical topic, then, is the key function of the passive voice, the effect of which is to suppress the agent of the action.

16. See Aronson, Gopnick, Savory, Schindler.

17. For discussions of the history of scientific plain style, see Stephens, Jones, Paradis, Adolf, and Halloran and Whitburn.

18. Halloran and Whitburn point out that Cicero’s "plain style," was more sophisticated than the plain style of the 17th Century scientists. Cicero, as they explain, did not call for the abolition of all rhetorical devices in his plain style, a style distinguished not by genre, but by purpose (the purpose of plain language was to instruct). In Cicero’s view, only "noticeable ornament" and "cosmetics" needed to be absent in the plain style, which would simply be more subtle in its use of the figures of speech.

19. Halloran and Bradford are first to note that the list with bullets is a visual counterpart to the oral device of parallelism.

20. For a discussion of the uses of metaphor in scientific accounting, see Halloran and Bradford on the metaphors of DNA research and the extended metaphor of the "genetic message."

In this regard, it is interesting to note that users of the medical system are called "patients," (according to the OED, people who are suffering, sick, passive), rather than, for example, "clients," people who, for their own benefit, seek the advice or services of experts.
Chapter Four. On Science, Rhetoric of Science, and Rhetoric

The rhetorical analysis of medical journals articles demonstrates that scientific writers use a great range of rhetorical strategies to persuade readers of the credibility of their authorship and the value of their work; at the same time, it shows there is a veneer in formal scientific writing which seems to deny that science is in any way personal or that it depends on persuasion for agreement. Furthermore, the analysis suggests that the veneer itself may be read as a rhetorical strategy, one of the effects of which is to argue that a particular piece of writing is consistent with the norms of bona fide science. (As Kenneth Burke writes, "In its simplest manifestation, style is ingratiation. It is an attempt to gain favor by the hypnotic or suggestive process of 'saying the right thing'" [PC 50].)

Specifically, the rhetorical analysis reveals that medical writers use strategies of Invention, Arrangement, Style, and Presentation to show their research or their professional view of information in the best possible light. Their strategies of Invention include—with respect to the appeal from logos—use of the topos of size as a device of reader seduction; use of quasi-logical arguments of comparison and use of rhetorical refutation, especially to rationalize research studies; use of statistics as arguments from example; use of the topoi of definition and of classification and division to support observations; and use of selected
division to support observations; and use of selected "inartistic" arguments--or citation--to strengthen the force of logical arguments. Strategies of Invention also include appeals from pathos, arguments which use the appeal of presence and which establish a sense of identity between author and reader, and ethos, implicit and explicit arguments pertaining to the credibility of the author.

Strategies of Arrangement discovered in medical texts include the use of the proem--the Synopsis and Introduction together--to promote, and positively predispose readers to, the article which follows; the use of a Nestorian ordering of arguments, such that the strongest and most overtly persuasive arguments appear at the beginning and end of an article; the use of a progressive argumentative form (described in the analysis, after Blanton, as the AGREED-INDEED model); and the use of formal separation of certain related pieces of information, effectively to discourage readers from drawing unauthorized conclusions.

Strategies of Style revealed in medical texts include the use of the passive voice as well as nominalizations and agency-(rather than agent-) subjects to neutralize the presence of the researcher-author; use of vague language and qualifying language, both to enhance accuracy and to allow for positive assertions in areas of some uncertainty; use of the signs of certainty in statements of professional opinion; use of syntax rhetorically as an instrument of emphasis; avoidance of
metaphor and other figurative language to promote the effect of fact in an article; and use of all of the above and other conventions of scientific style (complex sentences, Latinate words, for example) to identify a text with other works on science and to make a piece of work seem part of the body of existing scientific knowledge. Strategies of Presentation found in medical texts are more variable, depending at least in part on conventions of specific journals, but include the use of a small typeface in article midsections with the effect of discouraging close reading of all but the Introduction and Discussion sections of an article; use of headings to draw reader attention to article highlights; use of graphs and tables not only to provide information but to "scientize" an article and effectively to break up bodies of text; use of author photos to add a quality of personality and "bedside manner" to an article.

By applying a rhetorical critical methodology, the analysis has demonstrated by induction what theory in rhetoric and philosophy of science have argued by deduction: that scientific writing is persuasive and that scientific writers are real authors, not scribes for an empirical reality. Philosophy of rhetoric has argued the impossibility of neutral perception or neutral discourse in any field, and described the processes of building consensus and meaning itself, and of winning agreement to propositions. Philosophy of science has argued that scientific communities (rhetorical communities in every sense)
advocate versions of reality, and that these versions of reality are based in theory, formed in language, and dependent on the agreement of other scientists for their validation. The rhetorical analysis, which began from the premise, based on theory, that scientific writing would therefore be tendentious and persuasive, has shown, by applying rhetorical principles heuristically to medical texts, that science is not separate from rhetoric but made in it. In light of the analysis, it is no longer possible to hold the traditional view that scientists are simply unbiased and disinterested, that their projects uncover objective truths through unmediated acts of observation, and that their writing is transparent as a window on their work.\(^2\)

The purpose of this chapter is to further describe the rhetorical nature of scientific writing as a genre, instantiated in medical journal articles, and to suggest the significance of the nature of scientific rhetoricity in three areas. First, because the rhetoric of science has consequences for the "real world" of science, the significance of the findings of the rhetorical analysis for the theory and practice of science is explored. Then, because the present rhetorical analysis operationalizes a model for the critical reading of scientific prose, the significance of the study for the rhetoric of science is discussed. Finally, because the findings of the analysis serve to disambiguate the relationship between rhetoric and science, the significance of the study for
the discipline of rhetoric itself is discussed.

The term, "rhetoric of science" has become more generative the more it has been used. It refers, in its basic sense, to the accumulated conventional strategies scientific writers use—not only stylistic strategies such as passive voice and qualification, but invention strategies such as recourse to statistical proof. When John Ziman asks, "Why, in fact, do we believe a good scientific argument . . .?" (Public 32), he is asking a question about the rhetoric of science. (Ziman says, in this regard, that the scientific method itself is a powerful rhetorical strategy.) In the same vein, when rhetorician Charles Bazerman asks, "How does one convince a critical audience that something happened when they didn’t see it?" ("Literate" 302), he is asking a question about the rhetoric of science. Persuasion, Bazerman says, depends not on the "presentation of selected, displayed brute events to others, but on the symbolic representation of events in the published report" (302).

The present rhetorical analysis has extended the meaning of "rhetoric of science" by indicating the rhetorical complexity of scientific texts, using the term to describe the variety of persuasive moves revealed when scientific prose is studied from the rhetorical point of view. Following the rhetorical analysis, the term "rhetoric of science" refers not only to the use of special textual features in scientific prose, but to
the ways these features are marshalled in texts to carry out the multi-dimensional intentions of scientific authors. Scientific texts, the rhetorical analysis has shown, are the result of a negotiation between two purposes—to promote the acceptance of specific scientific claims and to support certain more general claims, including claims about the nature of science itself. That is, the goal of scientific texts is not only persuasion in the particular case with respect to particular claims; it is persuasion to the continuation of the whole scientific enterprise, its assumptions affirmed and reinforced in every instance of its prose, its identity confirmed and renewed in the publication of texts.

Revelation of the complex nature of scientific rhetoric is significant, first of all, to the theory and practice of science. Rhetorical analysis is concerned with the "real world" effects of discourse, with how texts act in the world. Rhetorical analysis foregrounds issues in the consequences of conventional forms of accounting in scientific texts, and, in doing so, suggests issues for discussion within scientific communities and provides a framework for such discussion.

Some of the consequences of standard scientific writing are well known. Scientific prose conventions function primarily to maintain an ideal standard of scientific inquiry and scientific reporting. They discourage the privileging of personal opinion and support scientific impartiality (which may be distinguished from the more loaded term "objectivity"). The goal of
replicability in scientific accounting, always aspired to in scientific writing, serves to promote scientific universalism and to minimize the possibility of scientific fraud. In the realm of medicine, it can be added that certain prose conventions, particularly the conventions associated with professional distancing, also function to make the intolerable (the forms and the range of human suffering) sufficiently tolerable to be studied.

There are other, less obvious, consequences of scientific prose conventions, and these are worthy of the attention of scientists. The rhetorical analysis has shown that certain unarticulated principles and assumptions (both personal and disciplinary) are perpetuated in scientific prose partly because of the nature of the prose itself. The nature of the prose itself, therefore, raises certain issues for the theory and practice of Science: (1) the potential in scientific texts for concealment of author-researcher responsibility for scientific acts; (2) the tendency of scientific texts to promote a cult of authority in matters of science; (3) the tendency of certain prose conventions to perpetuate uncritically particular features of scientific paradigms.

Several language theorists and rhetoricians have commented on the relationship between scientific style and authorial responsibility. The consensus is that absence of a first-person speaker in scientific writing leaves ambiguous the source of responsibility for scientific acts. The impersonal
style of scientific writing is seen to allow scientific authors to relinquish responsibility for their writing and, by extension, even to relinquish responsibility for their work. Dallas High argues that language must be self-reflexive to be responsible— that the "I" is a necessary ingredient for ethical communication behavior (309), and Philip Rubens condemns directly the reluctance among scientific writers to use the first person:

One can use the phrase, "I found that the sample weighed 128 grams" without destroying the factual nature of the observed measurement. Such a statement not only identifies the author, it places responsibility and, I suspect, is exactly what makes engineers and others apprehensive about using first person pronouns. (334)

Paul Newall Campbell contends there can be no prose without persona and that the recognition of personae in scientific discourse would call for an admission of the humanness of the observation made, of the point of view or frame of reference underlying that observation, and a similar admission of the distortion involved in the act of observing. (401)

Campbell maintains that while scientific writing comes from a perceiving and interpreting agent, this very feature of it is at odds with what he says are the god-terms of science:
objectivity, predictability, and control. Campbell also argues that the objective stance in science is in any case not "neutral" because he says "the bias-free, neutral view is dramatically impossible to enact" (404); in objectifying, he says, scientists de-value what they study.

The present study, noting the stylistic correlates of authorial absence in medical articles, corroborates concerns that the conventions of scientific writing obscure issues of authorial responsibility. Ambiguity in matters of responsibility does seem to be a consequence of conventional scientific prose (particularly the avoidance of the first person and the use of passive voice)—a byproduct, in effect, of scientific modesty and the notion of scientists as neutral—and therefore theoretically interchangeable—observers.

As long as the rhetoricity of scientific prose remains generally unacknowledged and scientific writers are perceived more as articulate witnesses than as motivated authors, there is no need for scientists to openly proclaim responsibility for their observations—or for the events that led up to their observations, or for the stylized prose that describes them. The rhetorical analysis has demonstrated that the non-rhetoricity of scientific prose is a fiction; yet it is a fiction which, according to the texts themselves, scientists agree to share. Research on the composing processes of scientists shows that scientific writers are knowingly persuasive in their own composition of both grant proposals and
articles for publication (Myers and Rymer); other research (Bazerman, "Physicists")—as well as common sense—indicates that scientists are selective and critical in their own reading, receiving other people's work broadly as rhetorical (without, however, having the means to read it thoroughly as rhetoric); in their laboratory talk, scientists acknowledge the importance of non-neutral aspects of their research—their inclinations, their hunches, their allegiances to hypotheses (Gilbert and Mulkay, Latour and Woolgar); in conversation, scientists confess to all that is personal and even political in their work and engage in a kind of metadiscourse about their own writing that reveals some consciousness of its rhetoricity. Still, scientists continue to write as though they were articulate witnesses rather than motivated authors.

To examine scientific texts rhetorically is to recognize there is conventionally no significant authorial presence in the prose. Irrespective of the reasons for this, all of which may be in keeping with the highest ideals of science, the consequence of authorial absence for Science is that scientific authors continue to conduct research with the knowledge they will orchestrate the concealment of their own identities and biases in their reports. If the rhetoricity of scientific writing were generally acknowledged, writers and readers would benefit by openly approaching scientific texts from the rhetorical premise, the premise that all texts embody choices made by authors, that these choices are conditioned by
purposes, audiences, and situations, and that these choices act on situations by influencing readers.3

The rhetorical analysis also notes some consequences of the trend to joint authorship in scientific prose. Nearly two-thirds of the thirty-five articles examined for this study were authored by more than one person. Joint authorship seems to have two effects in the rhetoric of science: one is to confirm a sense of scientific community and reinforce the scientific ideal of "communalism," the notion that scientific discoveries are not the property of individuals; however, the other is potentially to further diffuse the ethical effect of a piece of writing—as any authorial responsibility is transferred from individual researchers to groups and to the institutions which sponsor their research. This study suggests that joint authorship may underline the problem of the projection of authority sans author in scientific texts.4

The effect of authority itself in scientific, and especially medical, texts, is another issue in the "real world" consequences of scientific prose conventions. The present study has demonstrated that medical prose is characterized by a tone of certainty derived from the accumulated conventions of scientific writing, a certainty so pronounced that even the most qualified statements convey a tone of authority. For example, "the demands of child rearing can foster migraine attacks, and unresolved grief may play a role in some patients" (Kirn, "Migraine" 13) is presented as a wholly creditable
statement, the more so for its use of qualifiers. Some authors, in keeping with other scientific conventions, avoid using the qualifiers which would signal that their statements of opinion are statements of opinion. The statement, "All patients should be treated prophylactically for cluster headache" (Silberstein 70) is an example.\(^5\)

The consequences of authority in medical writing are especially direct. The authority of medical writing reinforces and perpetuates the authority of the medical doctor who applies in the practice of medicine what he or she reads in textbooks and journals. (Medical practice is to some extent mediation between texts and patients.) Sociologist Aaron Cicourel writes that medical diagnosis is a process by which professionals armed with "schematized knowledge" (to a large extent, the knowledge of texts) "convert the often idiomatic and sometimes ambiguous language . . . of patients into unambiguous declarative knowledge using a systematic notion system" (94). That is, physicians turn patients' accounts into acceptable or interpretable narratives; they do not revise their knowledge structure to accommodate the patients' accounts--and so original (textual) classifications are sustained (96). Authority is a significant feature of medical practice as it is a significant feature of medical texts,\(^6\) and it is important to note that the authority of medical persons is borrowed from medical texts even as medical texts are credible because of the authority of medical persons.
A final point in the "real world" consequences of scientific prose concerns the degree to which prose conventions reflect certain biases in scientific paradigms and in reflecting them, reinforce them uncritically. The process, a difficult one to penetrate, is exemplified for Medicine in the article, "Serendipity and Food Sensitivity" (Gettis), considered in Chapter Three above. Readers of this case study are inclined (and expected) to agree it is fortuitous that the headaches of a patient who was being treated for gastric ulcers improved when he was placed on a restricted diet for his ulcers. The patient's ulcers had in fact been caused by his ingestion of thousands of aspirin tablets for his headaches. However, the "subject" is viewed in the article implicitly as the product of two disease processes rather than as a whole person whose health was undermined by the treatment for one of his symptoms. Unstated assumptions in the article pertain to the appropriateness of an interventionist (rather than preventive) approach to health care and a fragmented (rather than integrated) view of patients. While all discursive acts begin with some unarticulated assumptions shared between writer and audience, the objectifying assumptions of Western medicine are reinforced in the stylistic signs of neutral observation, and are particularly well accommodated in scientific prose. The scientific article is persuasive, then, not only explicitly by virtue of what it claims, but implicitly by virtue of features of the prose itself.
Rhetoricians studying scientific writing are studying also the tacit assumptions of the communities which produce it. Yet rhetoricians are constrained in their analyses by the limits of their own understanding of the scientific texts they examine, since they are not themselves members of the discourse communities out of which those texts are produced; they are further constrained by the relative novelty of a discipline in the Rhetoric of Science, such that every discourse study is a foray into uncharted territory. Still, the role of the rhetorician in society is to study the discursive means of human influence and to illuminate the workings of rhetorical texts. Because scientific texts ultimately affect the lives of all people, the rhetorician's responsibility with respect to scientific texts is great. Notwithstanding a necessary cautiousness in approaching specialized texts, the rhetorician must study scientific writing and must promote discussion of the rhetoric of science, especially and at first among scientists, to help them become more literate users of their prose.

The findings of the rhetorical analysis of medical articles are significant also for theorists in both Rhetoric of Science and Rhetoric itself. With respect to a discipline in the Rhetoric of Science, the study has established that scientific writing has a complex rhetorical nature, and it has suggested a methodology for plumbing the complex rhetoric of scientific
texts.

When analyses of scientific discourse fail to acknowledge the complexity of its rhetoric, they may suggest many pertinent issues for the Rhetoric of Science, but they fall short of fulfilling the rhetorician's obligation to reveal the multiplicity of ways texts work on audiences and influence the situations into which they are introduced. Authors such as P.B. Medawar and Gilbert and Mulkay, for example, argue that the rhetoric of science, with its persuasive appearance of objectivity and neutrality, and its implication that facts speak for themselves, misrepresents the real nature of scientific practice. In Gilbert and Mulkay's terminology, scientific writing is "empirical," while scientific practice is "contingent."

Both Medawar and Gilbert and Mulkay contribute a great deal to the Rhetoric of Science. They acknowledge, first of all, that scientific prose should not strive to be more "empirical" than it is (that scientific writing would not be improved by seeming less contingent). Furthermore, they indicate the extent to which scientific writing is the objective correlative of the continued salience of a scientific ideal of "pure" observation and "pure" reporting. However, neither Medawar nor Gilbert and Mulkay go far enough in their analyses.

The rhetoric of science, insofar as it is rhetoric of unbiased observation or empiricism, does, as Medawar and Gilbert and Mulkay suggest, misrepresent the real practice of
science. However, when read as complex rhetoric, scientific writing reveals itself to be functionally consistent with the contingent nature of scientific practice--for within the context of their published professional conversation, scientists do engage in many behaviours which reproduce the contingent quality of scientific activity. Scientific writers argue in their texts to establish their right to be heard; they rationalize their studies; they claim priority for their research; they assert the value of their past work; they flatter and court their peers and associate themselves with the best of them; they propose particular ways of looking at data, and deploy statistics to make their arguments convincing; they identify with the larger enterprise of science and demonstrate facility with its conventions. The scientific article, read as complex rhetoric, is not, then, as misrepresentative of scientific inquiry as Medawar and Gilbert and Mulkay suggest. The scientific article has many contingent features; its contingent features are simply not overt. Scientific authors are not candid, as Medawar says, about the biases affecting their observations or about the "by-ways of thought" which lead to their hypotheses (42). Yet read as complex rhetoric, with its persuasive manoeuvres revealed, the scientific article is a fitting discursive counterpart to scientific inquiry. In fact, the rhetoric of science deconstructs the shared fictions on which scientific texts are built.

Some of the complexity of scientific rhetoric is suggested
in a recent report by composition researcher Jone Rymer. Rymer did a protocol analysis of an "eminent scientist" in the process of writing a scientific article. She had her subject compose aloud, using an audio tape-recorder to preserve his verbalized thinking process. Rymer found that the scientist's commitment to using scientific conventions needed to be reconciled with his desire to use language that would promote his own research. (For example, the scientist returned repeatedly to the term "dramatic" to describe the findings of his research, knowing that using such a term would violate conventions of scientific modesty.) Rymer argues that the scientist-author works simultaneously in the "business of science" (which she says has "contingent" features) and the "profession of science" (which she sees as "empirical"). Rymer's description of scientific composition suggests some of the complex layering of scientific rhetoric; however, the usefulness of her analysis is limited by the fact that it does not consider the contingent quality of scientific inquiry itself. Rymer seems to believe in a pure science which is tainted by the impure contexts in which it is practiced.

Scientific rhetoric is more complex than Rymer suggests. A description of scientific rhetoric, based on the rhetorical analysis, recognizes context itself as formative, and considers as well the author, the audience, and the purpose of texts. Scientific texts are, in every case, the result of attempts by authors to shape their preconceptions, definitions,
observations, and interpretations into some discursive form which meets their own needs for professional satisfaction and integrity, and for funding and recognition; which meets reader needs for information, supplied in some consistent format and unencumbered by what may appear to be extraneous accounts; and which meets the needs of their discipline for discovery and progress within the constraints of the normative ethos of science.

The present rhetorical analysis suggests such a complex description of scientific prose and suggests as well the means of extending the description through the analysis of other scientific texts in further research which applies the principles of rhetorical theory heuristically to other examples of scientific writing. This analysis worked inductively from a text base of thirty-five articles, and because of the relatively large size of the sample, it is meant to be not only descriptive, but predictive of strategies occurring in other medical texts in particular and other scientific texts in general.

To the extent that the analysis expands the meaning of "rhetoric of science" and suggests a methodology for further rhetorical analysis, it is significant for the emerging discipline of Rhetoric of Science. The revelation of the range of rhetorical strategies operating in medical texts is also significant for the discipline of Rhetoric itself, especially because it serves to clarify the relationship between Rhetoric
and Science, disciplines which have been historically either separated or ambiguously and problematically brought together.

Rhetoric was, for Aristotle, "applied to recognized subjects of deliberation . . . for which we have no special art or science" (12), and where artistic or enthymemetic proofs were more to be valued than inartistic proofs, such as the testimony of witnesses. For Bacon, Science was a matter of inartistic or unartful truth, while Rhetoric, for its part, was a matter of Style; the paths of the two intersected only because not all "men" were receptive to the "naked" truth. While Rhetoric and Science have not remained clearly split in twentieth-century theory, some intellectual discomfort with their relationship still prevails. Chaim Perelman and Richard Weaver claim that Rhetoric is the condition of all language, yet both seek to define a realm for Rhetoric against the realm of Science (see Introduction above). While Kenneth Burke and Wayne Booth clearly acknowledge the marriage of the realms of Rhetoric and Science, they, neither of them, completely embrace Science. While Burke, for example, proclaims that "even the most unemotional scientific nomenclatures" are "necessarily suasive" (LASA 45), he does not subject particular scientific texts to the same rhetorical scrutiny he applies to other texts in his critical writings. Yet when particular scientific texts are subjected to rhetorical scrutiny as they have been in the present study of medical articles, the relationship between Rhetoric and Science is fully disambiguated, compelling a
rhetorical theory which does completely embrace Science and scientific texts.

Rhetorical analysis clarifies the relationship between Rhetoric and Science not simply by dissolving the boundary which traditionally has separated them, but by suggesting the nature of the relationship between Rhetoric and reality. Rhetorical analysis demonstrates that while there may indeed be an empirical and sensible world, of tables and chairs and even viruses and bacteria, any attempt to describe or to account for that world in symbolic language is necessarily, and to varying degrees, rhetorical. As literary theorist Terry Eagleton writes, even to say "This cathedral was built in 1612" betrays an interest in dates (13). This is the inescapable act of implication of language in use, an act which does not however presume to deny the existence of any external and apprehensible reality.

Traditional views of Science and Rhetoric have upheld the notion that certain kinds of assertions, thought to be scientific, were outside the realm of Rhetoric. "This cathedral was built in 1612" would be an example of that kind of assertion, pertaining to the factual nature of time and records and evidence. In the medical literature "Subjects self-monitored 4 times daily for a two-cycle baseline" would be another example of that kind of assertion. Terry Eagleton may be understood as saying that the fact that the cathedral was built in 1612 does not make the statement that it was, neutral.
The fact that the subjects in a particular experiment self-monitored 4 times daily for a two-cycle baseline does not make the statement that they did, non-rhetorical. The rhetorical analysis shows, for example, that the statement itself is part of an argument from example, and that the highly conventional scientific language used to report the research has the rhetorical effect of increasing the credibility of the researchers, and drawing attention away from weaknesses in the experiment itself.

In fact, the scientists who wrote the medical articles analyzed in the present study designed and performed their experiments, made their observations and recorded them, all with attention to the ideals of neutrality and objectivity in Science. Still, from the language they used to compose the proposals that raised the funds for their research, to the language they used to write their articles for publication in major professional journals, those scientists were engaged in rhetorical process.

If Science is thus bound to Rhetoric, then the Rhetorician, no less than the Scientist, must come to terms with the marriage. What this means initially for Rhetoric is that it must ipso facto include scientific texts in its purview, addressing to scientific texts those questions and those challenges that Rhetoric at its best has addressed to other texts as they have acted in the world. Rhetoric, conceived as a humanistic discipline with ties to Dialectic,
Epistemology, Psychology, and Ethics, is not indifferent to the texts it engenders or the texts it describes. It views Style not as recipe for effect but as a quality of substance; it evaluates the means of a speech with regard to the ends of a speech; its most honoured speeches are not only effective but somehow "good." These concerns of the discipline suggest the fullness of the rhetorical critique that must be brought to bear on scientific texts once they are treated as legitimate rhetoric.

The framework for the discipline of Rhetoric has traditionally included an understanding of the occasions for the practice of the art—and it is the limits of this understanding that a contemporary study of rhetoric must redress. In classical theory, occasions for—and kinds of—rhetoric were identified as Deliberative, Forensic, and Epideictic. As the political, economic, social, and cultural contexts for rhetoric changed over time and place, occasions for rhetoric also changed. They came to include military speeches (at the time of the Roman Empire), addresses from the pulpit (with the spread of Christianity), and by the Middle Ages, rhetorical occasions included also the writing of letters and the composition of poetry. From the time of the Renaissance to the twentieth-century, occasions for rhetoric were not expanded in any notable way, although of course the attention of rhetoricians turned to written texts.

Now, in the late twentieth century, a complete theory of
Rhetoric must self-consciously identify all the contemporary occasions for rhetorical process. The expansionist project has begun, but it must continue. Rhetoric is still occasioned by politics and jurisprudence and in the realm of the church. Epideictic rhetoric, especially with the work of Chaim Perelman, however, is now seen to extend beyond the ceremony of the funeral oration or the after-dinner speech. Perelman argues, for example, that formal education is a kind of epideictic rhetoric. Both the epideictic speech and the rhetoric of the classroom, he writes,

appeal to common values, undisputed though not formulated, made by one who is qualified to do so, with the consequent strengthening of adherence to those values with a view to possible later action.

(TNR 53)

In this century, a new rhetorical occasion has emerged with the recognition of a generic rhetoric of advertising. Also in this century, Kenneth Burke, Wayne Booth, E.P.J. Corbett, and others have described a rhetorical view of imaginative literature (see Chapter Two above). Burke in addition has expanded the realm of Rhetoric to include even non-discursive forms, such as architectural structures. With all of this work in rhetorical theory, the realm of Rhetoric has become more encompassing.

In many ways, the present project, in analyzing scientific texts from the rhetorical perspective, parallels Wayne Booth's project for imaginative literature in *The Rhetoric of Fiction*.
Booth's purpose in *Rhetoric of Fiction* was to identify imaginative prose as a rhetorical genre and to argue that because fiction was rhetorical ("The author cannot choose whether to use rhetorical heightening. His only choice is the kind of rhetoric he will use" [119]), it had consequences in the real world; it had a moral dimension, and its authors had a moral responsibility. The rhetoricity of fiction, according to Booth, called for an understanding of how readers are persuaded by arguments in fiction, and for the knowledge of how to tell a good writer from a bad or a morally indifferent one. The rhetoricity of fiction meant that audiences had to look critically at the arguments of fiction, their representations in form, and their sources. Booth writes:

> What is needed is . . . a repudiation of all arbitrary distinctions among "pure form," "moral content," and the rhetorical means of realizing for the reader the union of form and matter. When human actions are formed to make an art work, the form that is made can never be divorced from the human meanings, including the moral judgments, that are implicit whenever human beings act. And nothing the writer does can be finally understood in isolation from his effort to make it all accessible to someone else--his peers, himself as imagined reader, his audience. (*ROF* 397)

To view science rhetorically is similarly to locate its
arguments, study its language and its forms, and judge its speakers. Like fiction, scientific writing has consequences in the real world, and therefore a moral dimension and a strong element of authorial responsibility. In principle, the Boothian questions for fiction are appropriately directed to scientific texts.

The present study and other examinations of scientific rhetoric—especially because of their attention to particular texts—continue the expansion of the realm of Rhetoric, not only in theory but in practice, and suggest furthermore that if the texts of Science, which have traditionally been considered out of the realm of Rhetoric, are demonstrably rhetorical, then a fortiori all texts will be found to be, to some degree, rhetorical. (Indeed, with the realm of Science entrenched in the realm of Rhetoric, rhetoricians may ask if there is any type of discourse which might still claim in any significant way not to be rhetorical.) To arrive at a complete description of the contemporary occasions for rhetoric, rhetoricians must not only go forward in the rhetorical examination of texts of science, but must study as well the texts of other specific discourse communities in order to describe and predict the nature and degree of their rhetoricity.8

What, however, is the immediate responsibility of Rhetoric, once its purview has been expanded to include the texts of Science? First of all, it must suggest the precise ways in which scientific texts may be read as complex rhetoric.
A study such as the present one begins to accomplish that purpose. Secondly, it must suggest directions not only for the education of scientists as the primary users of those texts, but for the education and empowerment of all "citizens", for all are ultimately affected by what scientists write and how they write it.

The revealed rhetorical nature of scientific texts has implications for a general rhetorical education because it is the nature of scientific discourse to be not only rhetoric within the confines of a particular community, but Public Discourse as well. Michael Halloran has noted the ways in which science "serves as a warrant for many of the arguments about traditionally non-specialized, civic questions" ("Molecular Biology 81). Also on the subject of scientific discourse as Public Discourse, Speech Communication Professor Philip Wander argues that with scientific discourse becoming increasingly specialized, laypeople are discouraged, indeed prevented, from participating in certain decisions about their own well-being. He writes:

Reliance on technical language in public debate is rhetorically significant, for in a democracy, whatever its imperfections, people have a right, on the important public issues, to know the relevant social and economic facts as well as the policy conclusions to be drawn from them. When the language of public debate becomes too specialized, the laity
Both Halloran and Wander argue that in order to participate in decisions affecting their own lives, people need to understand—and to discuss—scientific information.

It might be argued that this external discourse of science, the discourse brought to the public forum, is the only discourse of science which concerns "citizens" and is therefore the only discourse which should concern rhetoricians. It might be argued that there are, in effect, private conversations among scientists, and that while the substance of those conversations may be relevant to laypeople, their form (and their internal rhetoric) is not. A single reference to a recent article on the language of nuclear technology (applied physics) dramatically makes the point that the internal rhetoric of science is also of consequence to citizens. In an article for Bulletin of the Atomic Scientists, psychologist Carol Cohn writes about "technostrategic language," the inside language of nuclear technologists, a language which, she says, "both reflects and shapes the American nuclear strategic project" (17):

Technostrategic language articulates only the perspective of the users of nuclear weapons, not the victims. Speaking the expert language not only offers distance, a feeling of control, and an alternative focus for one's energies; it also offers escape from thinking of oneself as a victim of
nuclear war. ... I suspect that much of the reduced anxiety about nuclear war commonly experienced by both new speakers of the language and longtime experts comes from characteristics of the language itself: the distance afforded by its abstraction, the sense of control afforded by mastering it, and the fact that its content and concerns are those of the users rather than the victims. (22)

What is significant about Cohn's analysis is that she is not talking about how the technologists represent technology to laypeople, but how, for their own purposes, they represent it to themselves and to each other. Her argument (she goes on to say that using technostrategic language actually prevents one from articulating, and even from formulating, a critique of the technology and its uses) is particularly striking because of the enormity of the consequences of the science and the technology on which she is reporting. It is additionally striking, for purposes of this discussion, because it demonstrates that rhetorical critics have an obligation to write about the rhetoric of science that is as great as their obligation to write about the rhetoric of mass movements such as Nazism (See Burke, "The Rhetoric of Hitler's Battle, PLF).

The existence of a complex rhetoric of science argues the responsibility of rhetoricians to educate people to evaluate
scientific notions as rhetorical representations, receiving critically such concepts as "safe doses of radiation" or "permissible levels of toxins." As both philosophers of Rhetoric and philosophers of Science would agree, facts do not hold still and they do not speak for themselves. Moreover, not only do accounts of reality change, so that the drug, for example, that was reported helpful yesterday is reported harmful today, but reality itself changes, so that what was "in fact" a safe level of exposure to the sun 20 years ago is simply not "in fact" a safe level any more. Science must habitually be read as rhetoric, and the role of rhetoricians must be to demonstrate how that is done—and to demonstrate this within the context of a theory that recognizes all occasions of language use as occasions for rhetoric.

Perhaps to read science as rhetoric is also to meditate on the flux. Perhaps to do this, to be cognizant of the uncertainty of even scientific knowledge is, as Kenneth Burke suggests "like peering over the edge of things into an ultimate abyss" (LASA 5). Yet it is necessary to look. The role of rhetoricians is to study the persuasive moves at work in all forms of discourse, even the most sacred; and, because so much is at stake, to engage people, both specialists and laypeople, in talking about them.

Throughout the history of Rhetoric, the discipline has characteristically focussed attention on a series of related concerns--about the relationship between thought and language,
the nature of knowledge and how it is acquired, the nature of truth (or reality), the role of persuasive communication in society, and the obligation of a society to educate its people in the means of persuasive communication. This analysis has addressed all of those concerns with respect to scientific writing, the rhetorical nature of which is no longer to be argued, only further explored.
Endnotes

1. Ziman says "impersonal phraseology is an attempt to make the work seem already part of the consensus" (Public 118). See Ziman discussion, Chapter One above.

2. The physicist Heisenberg argued that phenomena are changed in the process of being observed--so that what is observed is never observed as in nature; philosophers of Science have argued furthermore that theoretical preconceptions and expectations influence all perception; rhetorical theory has argued in addition that no language is without tendency. In examining scientific texts, the critical reader is examining the work of a person necessarily biased as observer, as inquirer, and as author.

3. Rhetorician and composing theorist Dorothy Margaret Guinn provides a pertinent example of rhetorical scientific writing (albeit for a more general audience). Guinn's excerpt from Lewis Thomas' Lives of a Cell is, as she says, an example of writing with a positive authorial ethos; it is also an example of scientific writing which acknowledges its own rhetoricity. Lewis writes:

   In a recent study of the reaction of the dying in patients with obstructive disease of the lungs, it was concluded that the process was considerably more shattering for the professional observers than the observed. Most of the patients appeared to be preparing themselves with equanimity for death, as
though intuitively familiar with the business. One elderly woman reported that the only painful and distressing part of the process was in being interrupted; on several occasions she was provided with conventional therapeutic measures to maintain oxygenation or restore fluids and electrolytes, and each time she found the experience of coming back harrowing; she deeply resented the interference with her dying.

I find myself surprised by the thought that dying is an all-right thing to do, but it should not surprise. It is, after all, the most ancient and fundamental of biologic functions, with its mechanisms worked out with the same attention to detail, the same provision for the advantage of the organism, the same abundance of genetic information for guidance through the stages, that we have long since become accustomed to finding in all the crucial acts of living. (quoted in Guinn 32-3)

In this excerpt, Thomas observes many of the prescriptions of conventional style. He uses passive voice and some standard scientific vocabulary. Yet the effect of the piece is that Thomas, as a scientist, has made certain observations, and now makes certain assertions with respect to those observations, and claims responsibility for those assertions. He implies through his style that while his observations are based on
evidence, they are based also on his own interpretation of evidence, and his assertions are subject to the evaluation of a critical reader. Moreover, Thomas' prose is clear—not in the sense that it can be seen through, like glass, but in the sense that it communicates, without obfuscation, a sense of the author and what he means to say. It is more, rather than less, clear because of its use of such stylistic devices as metaphor ("the business" of dying), analogy (to "all the crucial acts of living"), and repetition ("the same attention . . . the same provision . . . the same abundance"). Thomas' excerpt stands here as an indication of the direction that scientific writing, acknowledged to be rhetorical, might take.

4. A confounding problem is that in many jointly authored articles, a noted researcher attaches his or her name to a piece of work largely done and written up by graduate students or post-doctoral fellows. (Very disturbing questions of ethos and authorship have been raised recently in politics with the revelation by U.S. President Reagan's ex-spokesman Larry Speaks that he (Speaks) routinely attributed to Reagan words the president had never uttered. When the name associated with a text is not necessarily the name of the person who actually authored the text, the problem of responsibility becomes acute. It may be possible that, in its own way, Science faces such a problem of ambiguous attribution.)
5. In addition, scientific texts—like all texts—have authority by virtue of their textuality alone, irrespective of authorial pretensions to certainty, as has been discussed in literature on orality and literacy. See Olson.

6. Medical authority is known to account at times for the success of medical treatment. In this regard, medical doctor, Herbert Benson notes that faith in the physician is an important aspect of placebo effect in the care of some patients (placebo effect being "any nonspecific aspect of treatment") (Benson 12).

7. Elsewhere in ROF, Booth writes: "... although the author can to some extent choose his disguises, he can never choose to disappear" (20).

8. Computer software can, for example, be examined rhetorically. One might examine software, for example, with respect to the kinds of thinking pathways it forges and their epistemic effect—since particular programs encourage certain kinds of thinking and discourage others. The formative effect of computer terminology and computer metaphors is also worth examining from the rhetorical point of view. Technical writers might be interested in considering the ethos of particular programs, most obviously interactive programs, but others as well. They might also be interested in considering the difference, rhetorically, between an instruction that says, "Remove the disk from Drive A before turning off computer" and one that says, "CAUTION: Remove your disk from Drive A before
turning off your computer."
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