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ABSTRACT

Recognizing that the past study of the rhetoric of science has focused on the link between the public and scientific realms and on the alleged ideological nature of science, this paper proposes the development of a problematic and methodology for the rhetoric of science which focuses on rhetoric internal to the natural sciences. The paper examines the rhetoric of science literature to illustrate the predominant focus and limitations of the problematic that emerged in the 1970s from the "Weltanschauungen" perspective; discusses a new emerging synthesis based on pragmatism and realism that reshapes the problematic; and sketches an outline of a new realist methodology specifically designed for the newly focused problematic and suggests how it might be employed to arrive at improved insights into the rhetoric of science. Four general regulatory rules for method selection and application which appear to be consistent with concerns raised in a review of the literature on the rhetoric and philosophy of science are: (1) methods for study of internal science communication should be consistent with the most evolved understanding of the philosophy of science; (2) some of the methods should serve to reveal perceptions and understandings of science and rhetoric that scientists have as individuals; (3) methods should be specifically appropriate to an understanding of internal scientific communication; and (4) applications of methods should distinguish between the physical/natural sciences and the social/behavioral sciences. (Seventy references are attached.) (NH)

REALISM, RATIONALITY, AND RHETORIC IN SCIENCE:

A "NEW" FOCUS

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ABSTRACT

This essay argues for a new problematic and methodology for the rhetoric of science that focuses on rhetoric within the natural sciences. Dependence upon Weltanschauungen assumptions and limitations is revealed in the preponderance of the rhetoric of science literature. A new emerging synthesis based on pragmatism and realism is suggested that reshapes the old problematic, and a suitable methodology and an example of its employment is outlined.

> The rhetoric of science would be subdivided into a rhetoric of the communication of discoveries, a rhetoric of scientific digests and surveys, and a rhetoric of applications of science to special kinds of purposes. Charles S. Peirce (c. 1904)

Charles S. Peirce recognized the importance of studying the rhetoric of science and began developing a methodology for its study more than eighty years ago. Unfortunately, inquiry into the rhetoric of science was largely ignored until the 1970s. Currently, very little study has been done of rhetoric within the contemporary natural sciences--the rhetoric of "the communication of discoveries" and of "scientific digests and surveys." Instead, under the influence of the Weltanschauungen philosophy of science perspective, communication scholars primarily have focused on study of the apparent nonobjective and relativist nature of science by using the social/behavioral sciences or the relationship of natural science to public interest as exemplars.[1]

In contrast to the preponderance of speech communication studies in the rhetoric of science, I propose a problematic and methodology for the rhetoric of science which focuses on rhetoric internal to the natural sciences. I will (1) examine the rhetoric of science literature to illustrate the predominant focus and limitations of the problematic that emerged in the 1970s from the Weltanschauungen perspective (2) discuss a new emerging synthesis based on pragmatism and realism that reshapes the problematic and (3) sketch a possible outline of a new realist methodology specifically designed for the newly focused problematic and suggest an example of how it might be employed to arrive at improved insights into the rhetoric of science.

1

THE WELTANSCHAUUNGEN VIEW OF THE PROBLEMATIC RHETORIC/SCIENCE RELATIONSHIP

Prior to the 1970s study of the rhetoric of science was largely nonexistent. The logical positivist or received view that predominated philosophy of science in the early and middle twentieth century (Suppe, 1977, pp. 6-56; Polkinghorne, 1983, pp. 59-91) saw science as combining objectively described empirical data through the use of Whitehead and Russell's mathematical logic to form theories and make scientific progress in an accretive process that was totally logical and objective: rhetoric had no function unless it was to communicate findings to the public. Within speech communication, the predominant theories and methods of neo-Aristotelianism and factor-analytic experimentation also precluded a rhetoric of science. Neo-Aristotelian rhetorical criticism was focused on the individual speaker and speech, and conceived of rhetoric quite narrowly (Black, 1978, pp. 27-35; Scott & Brock, 1972, pp. 19-23). The factor-analytic experimental approach was modeled on logical positivism and often concepts for testing were borrowed from neo-Aristotelian theory (e.g., see Anderson & Clevenger, 1963).

In the 1960s a number of theoretical and methodological developments provided a basis for recognizing that the relationship between rhetoric and science is important. Philosophers of science developed devastating criticisms of logical positivism (see Popper, 1965; Kuhn, 1970; Suppe, 1977; & Polkinghorne, 1983, pp. 93-116) that were echoed by critics in speech communication in the 1970s (O'Keefe, 1975; Delia, 1976). The criticisms persuasively demonstrated the theory dependence of observations and a number of other weaknesses of logical positivism at the same time that the confidence in mathematics as a rigorous system for theory building,unification, and certainty (Whitehead, 1967,

pp. 19-37) was giving way to a fragmentation and crises of uncertainty in mathematics (Kline, 1980). Within speech communication the narrow theory and methodology of neo-Aristotelianism was severely criticized and alternate theories and methodologies were advanced (Black, 1978; Scott & Brock, 1972; Bitzer & Black, 1971) while the scope of rhetoric was broadened to include the perception of rhetoric as epistemic (Scott, 1967).

By the early 1970s all of these developments were coalescing into a recognition and interest in the rhetoric of science. The catalyst for this process may have been publication of Thomas Kuhn's The Structure of Scientific Revolutions (1962 & 1970) which became almost universally footnoted in 1970s articles on the rhetoric of science and on rhetoric as epistemic.

Kuhn provides an alternative to logical positivism by arguing that at best logic operates only in "normal science" where the nature of facts and theories are agreed on and science operates in a puzzle-solving mode. Major advances in science, Kuhn suggests, are through scientific revolutions in which there are paradigm shifts. Advocates of different paradigms lack common ground for agreement on facts and criteria for evaluation of theory. Thus when paradigms are in dispute rhetoric is a more important resource than logic for resolving what direction a scientific discipline will take. Furthermore, these paradigm shifts demonstrate that what constitutes fact and legitimate logical manipulation for the elaboration, testing, and evaluation of theories changes with the world outlooks (Weltanschauungen) of the different paradigms. Although Kuhn's position has been severely criticized by philosophers of science who have developed various alternative positions that also reject logical positivism (see Suppe, 1977, pp. 119-730; Polkinghorne, 1983, pp. 103-133), Kuhn's

position has clearly been the most widely accepted in speech communication, probably because of the important role it affords to rhetoric and its consistency with the view of rhetoric as epistemic.

The rejection of logical positivism, the popularity of Kuhn's position, the view of rhetoric as epistemic, the broadening scope and methodology of rhetorical theory and criticism all have interacted synergistically to create a literature in the rhetoric of science that has grown from virtual nonexistence prior to 1970 to a major subfield by the late 1970s. Many different directions have been pursued in the literature, but I would identify six general types of studies: (1) elaborations of Kuhn and of the nonobjective, relativist, and rhetorical nature of knowledge (2) studies of behavioral and social science (3) studies of pre-twentieth century physical and natural science (4) studies of twentieth century physical and natural science (5) criticisms of how rhetoric has been employed in the interaction of science and the public and (6) studies that resist the trend stimulated by Kuhn of seeing science as nonobjective and relativist.

A few studies may be cited as examples of the tendency to elaborate on Kuhn and on the nonobjective, relativist, and rhetorical nature of knowledge. Scott (1968) examines Arthur Larson's use of "scientific facts" to reveal epistemic assumptions underlying public address. Paul Campbell examines the relationship of poetic-rhetorical, philosophic, and scientific discourse and finds poetic to be prior to scientific discourse (1973) and the poetic concept of personae to be present in scientific discourse (1975). Weimer (1977) considers science as a particular type of rhetorical transaction. Brummett (1976) uses Kuhn to reject the objective, mechanistic view of reality and uses

Scott (1967) to expand on the epistemic function of rhetoric as constituting an intersubjective reality. Kelso (1980) uses Kuhn and Feyerabend to argue that since science is nonobjective and rhetorical it poses a potential danger as "an absolutistic ideology of knowledge" (p. 28).

The large number of studies of behavioral and social science may exist because those sciences are of more intrinsic interest to communication scholars and are more clearly nonobjective, relativist, and rhetorical. Examples are Ackerman-Ross' study (1976) of the epistemic rhetorical nature of speech communication and psychology, Czubaroff's studies of the rhetorical problem of intellectual responsibility (1974) and of academic controversy (1975), Ruben and Wiemann's study (1979) of information diffusion in communication, and Siebold's excellent analysis (1979) of the crucial function of criticism in communication theory and research.

There have been several carefully developed studies of pre-twentieth century physical and natural sciences. These have been very helpful in understanding how rhetoric has been employed by science in the past, providing a sense of continuity in the rhetorical practices in science, and in providing case studies of theory development and change. For example, John Campbell's series of studies of Darwin (1970; 1974; 1975; 1986) are among the most carefully researched and detailed in the literature, and his 1986 study is used to analyze the relative merits of Kuhn's revolutionary and Toulmin's evolutionary views of theory change. Wenzel (1974) also provides an important contribution in noting the importance of scientific institutions in influencing and reflecting rhetoric in early America. It may be dangerous to assume, however, that twentieth century developments have not produced important changes in the rhetoric of contemporary science.

Study of twentieth century physical and natural science has been very limited. Almost all studies attempted have actually focused primarily on the relationship between scientific and public argumentation rather than on argumentation within science. A recent and important exception is Lyne and Howe (1986) who focus on rhetoric initially internal to paleontology which shifts to inclusion of audiences in other scientific disciplines and eventually to the public. There are two fairly obvious reasons for the lack of studies of contemporary "hard" sciences. First, it may be difficult to grasp the scientific discourse of the contemporary "hard" sciences. It is much easier to understand and employ rhetorical concepts for the less technical social sciences or dated and understood versions of pre-twentieth century "hard" sciences. Second, considerations of the public appear to be more intrinsically involved with social science research (Babbie, 1986, pp. xviii-xxii), and therefore of more interest to many researchers. Although these two reasons help to account for why researchers have not examined rhetoric within contemporary "hard" science, they are not well-founded reasons. If public argumentation is indeed more intrinsically involved with the social sciences, then the contemporary "hard" sciences provide a clearer set of exemplars of rhetoric within science. Much study of the physical and natural sciences is needed to more clearly test and determine the scope, nature, and limits of rhetoric in scientific discourse that is most clearly "scientific."

More subtle reasons for the deficiency in studying rhetoric within the contemporary "hard" sciences are revealed by examining studies focusing on the relationship between the scientific and public "realms." Criticisms of how rhetoric has been employed in the interaction between the scientific and public "realms" have become increasingly common, often using Burkean, Marxist,

phenomenological, or ideological criticism to expose the narrow perceptions, limited ethics, and danger of scientists and technologists. These perspectives have been used to criticize scientific and technical rhetoric concerning disarmament (Anderson, 1970), ecology (Brown & Crable, 1973), the SST controversy (Bytwerk, 1979), sugar (Mechling & Mechling, 1983), the cosmos (Lessl, 1985), Three Mile Island (Farrell & Goodnight, 1981), and the recombinant DNA controversy (Gross, 1984). The clearest theoretical development of the approach is offered by Goodnight (1982) who distinguishes between the personal, technical, and public "spheres" of argument to suggest that expansion of the technical "sphere" has been in opposition to the needs of the public "sphere." The limitations, dangers, and narrow-sightedness of scientific and technological rhetoric for public policy concerns and the importance of public involvement in scientific and technological issues which may affect society has been voiced with a frequency and vigour that has made this perspective a conventional wisdom in the literature.

Underlying this conventional wisdom are some subtle assumptions which also help to account for the dearth of studies concerning rhetoric within the contemporary physical and natural sciences. Past influence within speech communication of Weltanschauungen assumptions fosters a view of science as nonobjective, relativistic, and largely ideological. This view of science engenders treatment of science as largely just another ideology, but one with dangerous truth claims that are deleterious to public argumentation. Theoretical perspectives are chosen which view science as nonobjective, relativist, ideological, and "scientistic" prior to actually examining discourse within clear cases of science. Rather than examining the clearest and "purest" cases

of scientific discourse, the contemporary hard sciences, researchers operating from Weltanschauungen assumptions examine the gray areas of discourse involving applied science, social science, technology, and their relation to the public realm. Consequently, although a number of studies have been done of rhetoric within the social sciences or pre-twentieth century hard science, almost all of the research on discourse involving contemporary hard science has focused on the gray area of the relationship between the scientific and public "spheres" of argument without providing detailed analysis of rhetoric within science to examine whether the clearest exemplars of science are indeed nonobjective, relativist, and ideological.

An additional subtle reason for the failure to carefully examine rhetoric within contemporary hard science is that the conceptual metaphor underlying the "sphere" metaphoric expression induces researchers to think of the relationship between science and the public in terms of physical or geopolitical space (Jones, 1987; Lakoff & Johnson, 1980).[2] Seeing science as "eroding" or invading the public "sphere" (Goodnight, 1982, p. 223), for example, greatly oversimplifies the interrelationship between scientific and public argumentation and engenders the view that argumentation within science is primarily something to be studied in order to defend against it, rather than as being something that is of intrinsic interest. One could claim alternatively that the public "sphere" is invading the scientific to annex scientific theory and fact for public purposes. For example, Hofstadter's (1959) analysis of social Darwinism suggests that first conservatives and then liberals appropriated Darwin's theory and findings for political and social purposes. Both claims, however, are too simplistic. The complexity and nature of the interrelation between scientific

and public argumentation is not likely to become clear until some basic understanding of scientific argumentation is developed that does not make a priori assumptions that science is inherently ideological. If close examination of rhetoric within the contemporary hard sciences reveals that these exemplars are indeed ideological, nonobjective, and relativistic, then so be it, but first exemplary cases of "pure" or "basic" science need to be investigated.

In summary, the preponderance of the literature on the rhetoric of science views science as nonobjective and relativist, carrying implicit and dangerous ideological assumptions, and in need of corrective by exposure to the public realm. The preponderance of studies of specific scientific discourse within science have focused on either the social and behavioral sciences or on pre-twentieth century physical and natural sciences, finding further evidence of the nonobjective and ideological nature of science. The problems investigated by this literature seem to be (1) in what ways is science nonobjective, relativist, and ideological? (2) how extensive is the role of rhetoric in science? (3) to what extent does rhetoric serve to provide an epistemic base for science? (4) what are the underlying ideological assumptions of science? and (5) how can science and technology be made to serve the public? Support for the Kuhnian perspective has been derived from (1) the nature and direction of the questions posed (2) the assumptions of the Kuhnian perspective itself (3) the use and nature of rhetorical criticism perspectives and methods originally developed to analyze public discourse (4)the limitation in practice of studies on rhetoric internal to science to the social/behavioral sciences and pre-twentieth century hard sciences and (5) the limitation in practice to use of contemporary hard sciences to examine difficulties in the link between public and technical

"realms." As a result, most of the literature on the rhetoric of science has focused on apparent ideological aspects of science, assuming that rejection of logical positivism necessarily entails rejecting any sense of scientific objectivity by which scientists arrive at consensus on the relative merits of competing theories.

A TRANSFORMED PROBLEMATIC EVOLVING FROM REALISM AND PRAGMATISM

A limited number of rhetoric of science articles suggest a different direction than most of the literature has taken. Wander (1976) notes the importance of science in public policy deliberations, but argues for two types of problematics: how the rhetoric of science is used in public policy deliberations and how it is used within science. As noted above, the literature has generally chosen to focus on the first or to examine poor exemplars of the second in which both problematics may be complexly interlinked.

Especially noteworthy is Overington (1977) who insightfully notes that the scientific community as audience is a key concept in the work of Kuhn, Popper (and other critical rationalists), Polanyi (1964), and Ziman (1968). Overington uses Polanyi's work on the special training of scientists with Ziman's work on science as a uniquely effective method of consensus formation to develop an analysis of four stages of the rhetorical process within science.

Gross (1983) carefully distinguishes how the discursive genres of oratory, scholarship, and science use analogy and intersubjectivity, noting that scientific reports not only place value "on the heuristic function of analogy and the rules of inference and evidence" for analogy generation, but are distinguished from scholarly argument by their use of "a complex of quantitative methodologies shared by scientists and central to their verification procedures"

(p. 44). Additional studies on use of rhetoric in scientific reports have included Halloran (1978) on the need and use of eloquence, Lyne and Howe (1986) on rhetoric within paleontology and larger scientific audiences, Wenzel (1974) on early American scientific societies, the Johns Hopkins studies of scientific communication (Nelson & Pollock, 1970), and various articles in IEEE Transactions on Professional Communications.

Schneider (1979) applies Perelman's concept of the universal audience (1969, pp. 31-35) to scientific argumentation to maintain that scientific discourse is rational argumentation that fits neither the logical positivist ("extreme objectivist") nor the Kuhnian ("extreme subjectivist") positions. John Campbell (1986) finds that the rapid acceptance of Darwin's thesis was due to rational argumentation that employed the existing paradigm and suggests that Toulmin's (1972) evolutionary conception of scientific theory change generally fits the facts better than Kuhn's revolutionary conception of scientific theory change.

Thus, there are a few studies which take a different direction than that suggested by the Kuhnian perspective. This direction is toward an emerging pragmatic, realistic view of the rhetoric of science that incorporates the principles of objectivity and rationality in science while also accepting that science experiences substantial changes in theoretical perspective in a nonaccretive manner. Albert North Whitehead observes that, "In formal logic, a contradiction is the signal of a defeat: but in the evolution of real knowledge it marks the first step in progress towards a victory" (1967, p. 187). The apparent contradiction of positions between Kuhnian perspectives and logical positivism hopefully leads us toward an evolutionary synthesis of the

two positions. That synthesis itself posits the (primarily) evolutionary growth of knowledge in the form of historical realist positions such as those of Stephen Toulmin and Dudley Shapere (Polkinghorne, 1983, pp. 116-133; Suppe, 1977, pp. 650-728). This synthesis was emerging and becoming accepted in the philosophy of science at the time that the Kuhnian position was being accepted in speech communication--only very recently have articles such as Campbell's (1986) begun to refer to the historical realist literature. Yet, Suppe (1979, pp. 633-634) reports that Kuhnian Weltanschauungen views are essentially obsolete in the philosophy of science:

> . . . The Weltanschauungen analyses are not widely viewed as serious contenders for a viable philosophy of science. Contemporary philosophy of science, although strongly influenced by these Weltanschauungen views, has gone beyond them and is heading in new directions. The Weltanschauungen views, in a word, are passe, although some of their authors continue to develop them and they continue to be much discussed in the philosophical literature.

In moving beyond the Weltanschauungen analysis the historical realist position has "a strong commitment to both a metaphysical realism and an epistemological realism" (Suppe, 1977, p. 652). This "virtually precludes 'sociological' views of knowledge such as are embraced by Kuhn and Feyerabend" because it makes "the basic assumption that science can and does yield knowledge descriptive of how the world really is, and that observational interaction between man and that world plays an important role in obtaining such knowledge" (Suppe, 1977, p. 652). This realism is coupled with a pragmatic focus on how science is actually conducted that accords an extremely important role for argumentation:

> Contemporary philosophy of science is rapidly becoming philosophy of science--a discipline concerned with science as actually practiced yet at the same time doing philosophy. Science, as practiced, involves

> an ongoing process of observation, experiment, recourse to prior theory, reliance on various metaphysical principles, and so on, exploited via reason and argument to suggest hypotheses, evaluate their promise for further development, debate their adequacy, develop them further, accept or reject them as true or false, and so on--the point of the enterprise being to obtain systematic knowledge that provides understanding of the world we live in. Whether or not its use of it is good, far more of science is concerned with reasoning, argument, and marshalling evidence than with manipulating nature in the laboratory. In short, a central and characteristic activity of science is the use of reason in the suggestion and development of hypotheses and theories and in evaluating the knowledge claims made by those who advance such hypotheses and theories. (Suppe, 1977, p. 650)

Thus rhetoric, in the form of rational argumentation, is seen as central to the understanding of science and theory development and change. From this perspective it is not necessary to assume that major scientific progress is nonobjective or relativist (see Suppe, 1977, pp. 677, 699-703) in order to accord a major role for rhetoric and argumentation, nor does historical realism assume that theory development and change is totally logical and accretive, thereby giving rhetoric little or no role in science. The position taken by historical realism is therefore consistent with Schneider (1979) and Campbell (1986) on science as rational argumentation. As Shapere indicates, "What is needed is closer examination of actual scientific development and practice" (Suppe, 1977, p. 651), and this means that study of argumentation and rhetoric within science is extremely important.

Consequently, although past study of the rhetoric of science has focused on the link between the public and scientific realms and on the alleged ideological nature of science there is much theoretical justification, both from what is now the most widely accepted position in the philosophy of science and from a small part of the literature in the rhetoric of science (Wander, Overington, Gross, Halloran, Lyne & Howe, Wenzel, Schneider, & J. Campbell),

to develop a methodology for the study of internal scientific rhetoric. The literature implicitly suggests several reasons why study of internal scientific rhetoric and development of a methodology for its study is important: (1) science serves as an exemplar of rational discourse concerning knowledge claims--understanding argumentation within science may lead to better understanding of the rational base of argumentation[3] (2) the definition and relationship of rhetoric, argumentation, and logic may become clearer with study of internal scientific rhetoric (3) since major scientific developments can change our understandings of reality and major applications of science can transform our world and life, an understanding of science is intrinsically important (4) an understanding of argumentation in science is central to an understanding of science (as indicated by Suppe) and (5) a focus on rational aspects of rhetoric as they pertain to the conduct of science may enable an assessment of whether science is indeed ideological based on careful analysis of how science is actually conducted. Clearly a methodology is needed to study something as important as rhetoric within science.

TOWARD A REALIST METHODOLOGY FOR RHETORIC WITHIN SCIENCE

Review of the literature in the rhetoric of science and the philosophy of science suggests the need for a methodology for study of the rhetoric of science which is able to examine the rational, argumentative nature of science and scientific discourse. Methodology may be considered to be "the examination of the possible plans to be carried out . . . so that an understanding of the phenomena can be obtained" (Polkinghorne, 1983, p. 5). In other words, it is "a system of methods" (Webster's, 1980, p. 1134), not a particular method, for

organizing pursuit of knowledge in a particular field or subfield in a manner that is informed by and consistent with theoretical developments in that field and related fields. A methodology thus does not merely consist of a set of methods, but also a set of theoretically informed criteria or regulative rules (Searle, 1969, pp. 33-42) for developing or choosing specific methods and for applying them in a consistent, systematic manner so as to generate a unified understanding of the field of investigation. Freely "borrowing" a method from another field or subfield without determining whether it is theoretically and pragmatically consistent with the overall methodology and theory results in a weakening and subversion of the methodology, so rules for choice and application of methods are important, whether the rules are explicit or implicit.

This interpretation of the systematic nature of methodology and the importance of consistency is not universally agreed upon. Indeed, Kuhnian Weltanschauungen views have contributed to the popularity of pluralist epistemologies and methodologies within speech communication (e.g., see Polkinghorne, 1983, pp. 250-251; Ford & Klumpp, 1985; Swanson, 1977a & 1977b). It must be noted, however, that historical realism directly rejects pluralist epistemology and metaphysics in favor of realist assumptions, as indicated above by Suppe. Consequently, if study of internal scientific rhetoric is to be informed by and consistent with historical realism, then the methodology for study must be realistic, systematic, and unified. Toward that end several general regulatory rules for method selection and application can be tentatively suggested which appear consistent with the concerns raised in the review of the literature on the rhetoric and philosophy of science.

Rule 1: methods chosen for study of internal science communication should be consistent with the most evolved understanding of the philosophy of science.[4] This rule initially commits method selection to consistency with historical realism, but as understanding of science evolves so too can and should the method for understanding the use of rhetoric in science. The immediate implication of this rule is that methods should not be borrowed from the rest of the field unless they are consistent with or modified to be consistent with historical realism. Application of methods designed for public address or social movements which begin by assuming that science is ideological, nonobjective and relativist would not fit the methodology. For example, the most popular method of rhetorical criticism is dramatism. Kenneth Burke defines dramatism as "a method of analysis and a corresponding critique of terminology" that focuses on "cycles or clusters of terms and their functions" of which "act" is the most important (Burke, 1968, p. 445). Many aspects of Burke's dramatism condemn "scientistic" terminology and perception, although they are primarily based on a reaction to logical positivism and on cursory examination of "scientism" that does not include the contemporary hard sciences. To carelessly employ different aspects of dramatism to analyze internal scientific rhetoric would therefore be inconsistent with historical realism and would produce a distorted understanding of science stemming from dubious a priori assumptions. Key elements of Burke's method, however, such as his emphasis on realism with "act" as the foremost term in the pentad (1969, pp. 227-274) and the obvious usefulness of the pentad for analyzing evolutionary transformations of forms, concepts, theories, and institutions make certain elements of

dramatism appropriate and consistent with historical realist methodology if care is taken to use the concepts in a manner consistent with the methodology.

Rule 2: at least some of the methods developed as part of the methodological system should serve to reveal perceptions and understandings of science and rhetoric that scientists have as individuals and that science has as a set of institutions. If we are seeking to understand scientists and science, our methods should not immediately discount scientific perceptions as narrow or inadequate--scientists are the primary sources and users of rhetoric in science and so constitute a valuable data base for understanding what science is and how rhetoric functions within it.

An example of a method that would conform to rule 2 is phenomenological rhetorical criticism. A number of rhetorical critics have noted that a critic may use the message to get at the underlying understandings and perceptions of the source of the message (Rosenfield, 1968, 1974; Gregg, 1966; Lanigan, 1969; Hyde & Smith, 1979). This is an excellent method for studying discourse to determine the perceptions and understandings of scientists, but one must also be careful not to violate rule 1 since many phenomenological critics and the philosophers upon whom they base their methods make assumptions inconsistent with those of historical realism. For example, the phenomenologist Gadamer appears to be inconsistent with historical realism (Gadamer, 1981, p. 160; Polkinghorne, 1983, pp. 225-228) while Hirsch and Ricoeur appear to be consistent with historical realism (Polkinghorne, 1983, pp. 230-237, 244-246). Another method that would be appropriate is empirical phenomenological study. The theory and method of the phenomenological psychologist Giorgi (1975, 1983), a former physicist, are particularly suggestive and appropriate.[5]

Rule 3: methods should be specifically appropriate to an understanding of internal scientific communication. Although the interaction of public and scientific argumentation is of substantial interest, a good understanding of internal scientific communication should aid in understanding that interaction. Methods should be sensitive to how internal scientific rhetoric is actually used. Methods should not impose a priori assumptions about science that are based on perspectives that have not closely examined appropriate exemplars of "pure" or "basic" science. Treating internal scientific rhetoric as something that it may not be is of limited use if one is attempting to understand it.

Rule 4: applications of methods should distinguish between the physical/natural sciences and the social/behavioral sciences. The literature reveals that the characteristics of the two types of science may not be the same. Distinctions should also be made between basic science and applied science since the clearest exemplars of how science is conducted are likely to be basic research in the physical and natural sciences. Study of applied science and social/behavioral science is also quite valuable since each discipline is likely to have important differences in how rhetoric is employed.

These rules are useful as tentative general guidelines for the selection and development of methods that fit a realistic methodology for studying rhetoric within science. Development of methods may also derive directly from historical realist philosophers such as Toulmin and Shapere as well as those such as Perelman who have stressed argumentation and rationality in rhetoric. Nor should the foresight of Peirce's realistic "pragmaticism" be forgotten as a potential source of method for understanding rhetoric within science (see Lyne, 1980).

The potential for this "realist" problematic and methodology for the rhetoric of science may be illustrated by comparing its application to that of dramatism. An interesting exemplar for application of concepts is the recombinant DNA controversy of the mid-1970s, which both Gross (1984) and Jones (1980) have analyzed from a dramatistic perspective. Gross, for example, has developed an intriquing analysis of the controversy using the dramatism of Victor Turner and Kenneth Burke to examine stages of it as a <u>public</u> controversy. Concepts about <u>social</u> drama are employed that assume from the beginning that the scientists' rhetoric was a matter of conflicting ideologies (p. 399) which ultimately resulted in a failed social drama as there was no public resolution of the controversy. Although the rhetoric of scientists is examined, the focus is on public aspects of the controversy and on the scientists' rhetoric as essentially an ideological clash that is contributing to the "rift" in the public sphere. Gross' analysis is thought provoking concerning the relationship between technical and public spheres and stands as an exemplar of the insight which dramatism can provide for understanding the rhetoric of science.

In contrast to a dramatistic focus on the rhetoric of science that begins with the public and ideological aspects of the controversy, a realist approach to understanding the rhetoric of science would focus on understanding rhetoric within science prior to analyzing its emergence into the public. An outline of some preliminary findings of research which I am conducting on the recombinant DNA controversy suggests the difference in insight generated by such an approach.[6]

The recombinant DNA controversy had four largely distinct phases: (1) argumentation within the subdiscipline of tumor virus research (2) argumentation

within the discipline of molecular biology (including tumor virus research) (3) argumentation between biological scientists (primarily molecular biologists, but also interested others such as microbiologists) informed by an awareness of some aspects of public issues and concern and (4) argumentation by biological scientists and others in public settings. Informal communication networks are important in scientists' communication in all four phases, but each phase is marked by one or more formally organized communication settings: (1) the first Asilomar conference (2) the drafting of a letter endorsed by the National Academy of Sciences and also the second Asilomar conference (3) proceedings under the auspices of the National Institutes of Health in which research guidelines were drafted and (4) hearings before Congress, city councils, and various other forums.

Discourse in the first three phases appears to be very important for understanding how the scientists themselves understood the world and interacted with it to define the problems posed by recombinant DNA research. In the first phase the problem was seen as a not particularly urgent question of fact to be determined by scientific investigation. The problem was construed narrowly as one involving one special type of experiment using a complex recombination technique employing cancer viruses. The general consensus was that no clear scientific evidence existed that such experimentation posed a threat, but that the matter warranted further investigation.

The second phase of the controversy in many respects is the most important in providing insight into the scientists' understanding of the problem, their rhetorical action in light of that understanding, and the nature of the final phase. During the second phase understanding of the problem broadened to

include other types of DNA. In large part this was due to the involvement of molecular biologists other than tumor virus researchers. The problem was still perceived primarily as one of scientifically determinable fact. Examination of the underlying conceptual metaphors (Lakoff & Johnson, 1980) in the molecular biologists' discourse in this and other phases suggests that they conceived of recombinant DNA experimentation as involving manipulation of objects. Thinking about DNA, viruses, plasmids, bacteria, etc. as objects provides metaphoric entailments that foster thinking about ways of "manipulating" and "controlling" the objects in determinable ways, while thinking of them in terms of life forces makes such thinking more difficult. An example is the important Berg committee letter (Berg, et al., 1974) which suggested temporary voluntary research guidelines and called for the second Asilomar conference. Some metaphoric expressions for the living organisms and genetic substance are objects conceptual metaphor are "construction," "rejoining," "incorporation," and "replication" of "molecules" so as to "exchange genetic information" and "amplify their number." Thus the molecular biologists' conceptualization of genetic "material" engendered the view that DNA, viruses, bacteria, enzymes, etc., were manipulable and controllable and so a safety risk was unlikely and if there was a risk, then scientific study would find ways of controlling it.

The Berg committee letter served to create a rhetorical situation in which failure to reach a consensus at the second Asilomar conference would (1) make implementation of effective guidelines virtually impossible (2) create widespread media attention and (3) indicate that guidelines, if they were to exist at all, would have to be imposed by the government (although this would represent a time delay during which much recombinant DNA research could take

place without guidelines). Overington (1977) stresses that the scientific community constitutes an audience which has received special training enabling it to rationally assess information and arrive at a consensus--science is a uniquely effective method of rational consensus formation. This seems to be the case especially when the scientists are all from one discipline such as molecular biology. For a variety of complex factors (and the simple factor of the limited time for the conference) the reaching of some sort of consensus at the conference was extremely difficult, yet it was achieved.

Realization that science operates through rational consensus formation (including common grounding in conceptual metaphors) leads to an analysis that shows that (1) the organizers of the second Asilomar conference set up the conference in a way that promoted optimum consensus formation through rational discussion, even though non-molecular biologists were extremely limited in their role or excluded (2) consensus formation did occur despite extreme time and situational demands (3) that consensus formed the basis for a program of scientific research that functioned rhetorically (a) by holding out promise to the scientists that new knowledge of potential dangers and ability to further control genetic materials through such things as "biological containment" would soon enable more adventurous research and (b) by providing "scientific evidence" to demonstrate to Congress and other public forums that experimentation was not risky and was controllable and containable (4) throwing the conference open to outsiders (the public realm) would have made rational discussion of the crucial issues impossible within the time demands and consensus would not have been formed (5) if no consensus had been formed there probably would not have been a program of scientific research to rationally resolve

factual questions central to the controversy--eventual policy decisions by the government would have been less informed and perhaps less rational and (6) exclusion of the public was actually the best, most ethical thing the scientists could have done--it was pragmatic and realistic, serving the interests of both the scientists and the public by providing immediate research guidelines and a program of research that enabled better decision-making by both scientists and the government. All of this is not to suggest that excluding the public from scientific communication is usually a necessary or a good policy. Rather, one must pragmatically and realistically examine the specifics of the situation, including the rhetorical situation within the scientific community, when judging the rhetoric of science.

Understanding what happened at Asilomar helps one understand what happened in phases three and four. Phase three is marked by the development of official guidelines based on the consensus reached as Asilomar. The question of risk from research is viewed more broadly as other biologists and the National Institutes of Health become involved. Some individual scientists and scientific interest groups tried to raise very broad questions about the meaning of the research and its impacts, but they were generally viewed as outside the mainstream of the scientific community and received only limited media attention during phase three.

Phase four is marked by the simultaneous publication of guidelines by the National Institutes of Health and the Cambridge, Massachusetts city council hearings on experimental safety which created widespread media, public, and governmental attention. The primary outcome of this phase was the Congressional decision not to impose restrictions beyond what was being required by the

National Institutes of Health. This outcome was welcomed by the scientists who had presented to Congress new scientific findings that sometimes had not even been published--findings which of course demonstrated the safety of the experimentation and the containability of the experimental "material."

In contrast to seeing the scientists as ideologically engaged in a failed social drama, this analysis suggests that the molecular biologists, and later other scientists, were engaged in rational consensus formation in which the criteria for determining the nature of the problem evolved as more heterogeneous audiences and situations were addressed. The evolutionary development of the definition of the problem promoted rational consensus formation and pragmatic decisions that benefited both the scientists and the public. Rational consensus formation probably would have been impossible if the public had been actively involved in the early and middle stages of the controversy.

Two aspects of the scientists' rhetoric stand out as particularly strong and noteworthy. First, the scientists' conceptual metaphor <u>living organisms and genetic substances are objects</u> not only enabled the scientists to think about the genetic "materials" as manipulable and controllable, but also provided a resource with which to persuade others that the safety problem was limited and controllable. Second, the scientists' program of research was itself (a) a product of rhetorical exigencies (b) a rhetorical appeal to scientists that refraining from the more potentially dangerous experimentation was palatable because it was only temporary, and (c) a rhetorical and scientific way of invention of evidence and a newly constituted reality in which recombinant "materials" could be "biologically contained."

Thus the realist methodology for studying the rhetoric of science leads to new insight and conclusions that old methods such as dramatism fail to reach. It may well be argued that analysis of the interaction between the scientific and public "realms" is needed, but such an analysis should be based on an understanding of science and scientific discourse. The realist methodology leads to observations and insights directed at how rhetoric actually functions within the scientific process, rather than to observations and insights filtered through a screen of a priori assumptions and judgements imposed on science.

The realist methodology also has potentially useful applications to related problematics such as the nature of argumentation fields and the epistemic nature of rhetoric. Science affords ideal exemplars of rational argumentation fields which have varying degrees of similarity to one another. By observing similarities and differences in institutions underlying argumentation the universals and variables of argumentation may be determined, as well as the merits of Perelman's concept of a "universal audience." Also, by phenomenologically or hermeneutically determining what scientists take to be starting points for the construction of their arguments we may be able to determine whether these starting points are themselves rhetorically constituted.

In summary, a review of the rhetoric of science literature reveals that most of the literature is based on Kuhnian Weltanshauungen assumptions which are inadequate in light of new understanding that science is neither highly logical nor highly illogical, but is instead highly rational with institutionalized methods for assuring a sense of objectivity and rational consensus formation. The broad outlines of a methodology for the study of rhetoric

within science has been sketched and an example of the potential power of the methodology has been posed. Much work remains to be done by adapting already existing methods to this realist methodology and by adapting new methods out of the newly-emergent literature of historical realism. Hopefully we will be able to fulfill Charles S. Peirce's dream of a developed methodology for the rhetoric of science.

NOTES

[1]See Suppe (1977, pp. 125-127, 135-151, 633-649) for a discussion of the Weltanschauungen position, its most popular advocate, Thomas Kuhn, and why this view of science as nonobjective and relativist has lost favor with contemporary philosophers of science. Contemporary philosophers of science such as Stephen Toulmin and Dudley Shapere now tend to accept the objectivity of scientific knowledge, although not in the sense that logical positivists did, and maintain that the relative merits of competing scientific theories can and are assessed by fully rational means (see Suppe, 1977, pp. 677, 699-703).

[2]"Sphere" and similar terms ("domain," "realm," "field," etc.) that are commonly employed to conceptualize differences in argumentative activity are metaphoric expressions of a conceptual metaphor that has misleading metaphoric entailments. (See Lakoff and Johnson (1980) and Lakoff (1986a & 1986b) for the theory of metaphor from which I derive my criticism, and Jones (1987) for development of this argument). Thinking about differences in argumentative activity (i.e., differences in audiences, criteria, procedures, etc.) in terms of different portions of physical space has become common, due partly to the extent to which our culture thinks of human activity in terms of space and partly due to the force of Goodnight's (1982) speculations on the personal, technical, and public spheres and the theoretical tradition from which his essay stems. Goodnight admits that the metaphor is not entirely felicitous since it entails unchanging arenas while the differences in activities "are subject to revision by argument" (p. 217). Examples of other misleading entailments which Goodnight does not acknowledge are that the metaphor conceives

of distinctions between activities as marked by clear boundaries which inhibit movement across them and entails a static total quantity of "space" such that as one sphere expands (such as the technical sphere) it is seen as "at the expense of the another" (Goodnight, 1982, p. 217). Lyne and Howe's (1986) study of punctuated equilibria and my currently developing study of the recombinant DNA controversy suggest that these assumptions are dubious and that the metaphor misdirects our thinking about distinctions and relations of types of argumentative activity. We need a more appropriate conceptual metaphor for thinking about and expressing the complexities of the inter-relation of scientific and public argumentation.

[3]As an example, much social cognition research is based on assumptions concerning the nature of science and its employment by communicators as naive scientists (Hewes & Planalp, 1982; Sillars, 1982). Better understanding of internal scientific argumentation is therefore likely to contribute to understanding of cognitive aspects of the communication process.

[4]This rule should not be interpreted as meaning that speech communication ought be subservient to philosophy. Rather, given the importance of argument to understanding the philosophy of science, speech communications scholars may help to determine the direction of more evolved understandings of the philosophy of science.

[5]I have developed an analysis of the usefulness and appropriateness of Giorgi's theory and method in a prospectus for an empirical phenomenological

study of the rhetoric of natural science research reports. Giorgi's theory and method not only are consistent with historical realism, but also implicitly support the importance of argument and audience in science.

[6]The analysis which follows is intended as a sketchy outline of preliminary research conducted for my planned dissertation. It consequently focuses on initial insights into the controversy without providing the detailed development that I will present in a later paper.

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