

4. TOPICAL PERSPECTIVE AND THE RHETORICAL GROUNDS OF PRACTICAL REASON IN ARGUMENTS ABOUT SCIENCE

1. INTRODUCTION

Only four decades ago, scholars across the disciplines assumed that science is unique among human activities in its rigorous conformity both to empirical criteria for evidential appraisal and to formal rules for testing logical inference. Science, at its best, sought answers to questions of inquiry with recourse to foundations which, purportedly, are impervious to the inquirer's own interests, values, and preferences. Accordingly, the discourses of science, with such firm foundations in nature and in logic, are the best vehicle for bringing forward claims to knowledge that approximated, as far as humanly possible, that which is true.

Today, scholars are more apt to assume that science is constructed within a dynamic complex of social processes permeated with human interests, values, and preferences. The actual practices of scientists consist of myriad layers of decision making and judgment down to its logical and empirical core. The discourses of science, then, are not privileged since they adduce claims to knowledge that lack the special legitimacy once afforded through appeal to purportedly indisputable foundations. Those claims, it turns out, are interested, value-laden, and opinionated, as are those adduced in less epistemologically exalted fields of human endeavor.

Scientific discourse brings forward claims that are far more contingent than heretofore believed and, thus, are open to deliberation, debate, and disagreement. The presence of contingency invites *rhetorical* studies. There is a growing literature on rhetorical dimensions of science that looks to expose the play of contingency behind claims to foundational truths and certainties. In a comprehensive review of that field, Campbell and Benson (1996, p.75) saw consensus in 'the recognition that scientific perception is not immaculate; that scientific method is diverse, social, argumentative, and suasive'. They contend further that 'radical' and 'moderate' projects within the field diverge over what one commentator (Pera and Shea, 1991, p.viii) described as the belief 'that science [does] not provide genuine knowledge and that its methods and its results [are] mere social conventions' (p.75).

Those who adhere to foundationalist positions and those who oppose them still share in common the assumption that 'knowledge' rests on indisputable foundations. Foundationalists assert that point, as they stand against what they perceive as the reduction of knowledge to epistemologically groundless power struggles. Many who hold anti-foundationalist stances also assume that knowledge rests on indisputable foundations, but they instead contend that there are no such foundations

in science and question the legitimacy of science's claim to special knowledge status.

There is a third position that does not assume that knowledge requires indisputable standards but instead redirects our efforts from what Dewey (1929) once called a 'quest for certainty' and toward explorations of situated, practical reason. Dewey's concern was how to arrive at 'concrete judgments about ends and means in the regulation of practical behavior.' The range of positions that together constitute this 'third way' do not all share Dewey's pragmatism, of course, but despite important differences they together return us to concerns about practical reason¹ (see notes at end of chapter).

In this essay, I propose to show that behind scientists' formal, published discourses operates a special logic of situated, practical reason. For guidance, I extract from rhetorical theory what I have called a 'topical' perspective for examining the informal features of this practical logic of situated argument in science. I shall first give a synopsis of that perspective. I then illustrate how to use that perspective to probe the operations of practical, rhetorical reason behind Watson and Crick's famous announcement of the DNA double helix. I conclude with a discussion of implications for this practical, rhetorical understanding of the 'logic' of argumentation in science, with attention to the problem of science literacy.

2. TOPICAL PERSPECTIVE AND RHETORICAL LOGIC

A topical perspective focuses on a special kind of situated, practical reason as an alternative to foundational approaches to argumentation. Toulmin (1983, p.398) raised questions relevant to that focus when he sought to redirect our thought about argumentation from foundational emphases on rules of universal validity to practical grounds of situated judgment:

Are these the *right* (or relevant) arguments to use when dealing with this kind of problem, in this situation? That is, are they of a kind appropriate to the substantive demands of the problem and situation?

Practical approaches to argumentation raise questions that reveal precisely what foundational approaches conceal: they involve 'particular people, in specific situations, dealing with concrete cases, with different things at stake'. It thus becomes relevant to ask '*Who* addressed this argument to *whom*, in what *forum*, and using what *examples*' (Toulmin, 1988, p. 339).

Toulmin's questions bring us squarely into contact with rhetorical considerations. Practical reasoning requires attention to the demands on argumentation before situated audiences confronted with specific problems. Thus, we must examine arguments for patterns of judgment that constrain specific instances of practical reasoning. Those patterns are relevant to particular situations, and are not universal; they are substantive, not formal; they are practical, not theoretical.

While the operations of demonstrative logic involve reasoning from within the premises of a particular theory or conceptual framework, arguments that "apply

theoretical ideas to practical situations, or which seek to criticise those theories, [must] look outside the theories and so become 'practical' or 'rhetorical' arguments" (Toulmin, 1988, p. 348). Toulmin's point can be generalised to any contested or contestible frame of reference, orientation, or conceptual viewpoint. Indeed, we could extend that point to the reportage of data, which also must evoke the right patterns of situated, audience judgment to warrant their acceptance. Put otherwise, even 'facts' never speak completely for themselves. 'External' rhetorical resources are always required.

Toulmin (1988, p. 347) directs our attention to 'trustworthy generalisations' as among the external resources that are available for adjudicating situated, practical relevance and, thus, brings us to the threshold of rhetorical theory of topical invention². Here, we find some guidance on the operations and standards of situated, practical reason. I have used that theory to frame a perspective for conducting analysis of situated argumentation and judgment about science (Prelli, 1989). Conducting a topical analysis of argumentation reveals how participants (1) frame the specific points at issue, and (2) draw upon often taken-for-granted values and other thematic premises as warrants for accepting particular responses to those issues. Those values and themes, those trustworthy generalisations or *topoi* of argumentation, constrain how audiences adjudicate the situated, practical 'reasonableness' (Prelli, 1989, pp. 113-118) or 'appropriateness' (Waddell, 1990, pp. 393-395) of proffered claims³.

Legitimizing grounds that scientists share *as* scientists comprise a fairly consistent set of principles, presumptions, and premises. For instance, a fundamental principle governing scientific argumentation is that reasonable claim making involves maintaining or extending comprehension of some part of the natural world that concerns a specific community of interest. Moreover, it is widely assumed that claims advanced have emerged from prescribed methods and procedures for solving the kinds of technical problems that otherwise would have obscured that community's fuller comprehension (Prelli, 1989, pp. 120-25). Potentially reasonable arguments about science, then, advance claims that identify or modify specific problems that scientists perceive as relevant to their better comprehension of the natural order and do so through accepted procedures and methods.

Though the specific problems chosen and their formulation vary considerably, we still can make generalisations about the *kinds* of problems scientists address whenever they make and evaluate arguments about science (Prelli, 1989, pp.144-158). Scientists identify and address ambiguities or defects in evidence and data, in prevailing theories and interpretations, in received methods and procedures, and in the significance of proffered claims for the research community. Respectively, these recurrent kinds of problems or ambiguities are *evidential*, *interpretive*, *methodological*, and *evaluative*. All are 'scientific' problems, in so far as they directly or indirectly impede the efforts of a research community to maintain or extend its comprehension of natural order.

Classical rhetorical theory asserted that problems or ambiguities giving rise to debate can be framed as distinctive kinds of issues. Stripped of circumstantial details, specific issues about any problem or ambiguity are finite and reducible in structure to four fundamental kinds. *Conjectural* issues turn on whether some thing does or does not exist. *Definitional* questions turn on what constitutes the meaning of admitted things. *Qualitative* issues involve questions of how admitted and defined things apply within a particular mix of circumstances. *Translative* issues revolve around which procedures or actions are best for resolving situated problems. These four kinds of issue specify the different ways that scientists frame evidential, interpretive, methodological, and evaluative ambiguities or problems.⁴

Toulmin's 'trustworthy generalisations' resemble what were called in classical rhetorical theory *topoi* or *loci*; they are 'topics', 'regions', or 'places' where one can turn to find premises for potentially relevant lines of argument. What are the *topoi* of argumentation about science?⁵ They are a veritable checklist of topics normally taken up when teaching the practical logic of scientific inquiry, if not the techniques and procedures usually glossed behind the simple rubric, 'scientific methods.' An inventory includes empirical accuracy, precision, and consistency with received knowledge. *Topoi* specially associated with theoretical claims include explanatory power, predictive power, scope or generalisability. Those and other themes and values are generally available and potentially relevant resources for argumentation that scientists can use to legitimate their specific claims as reasonable responses to specific points at issue.⁶

This partial summary of the general rhetorical grounds of practical reason shows that argument about science is neither illogical nor nonlogical; it is grounded in communally shared and conventionally understood standards of scientific reasonableness. Of course, the operations of that topical, rhetorical logic always are specific to situation; accordingly, any inspection of that logic requires attention to the practical demands and particular circumstances that generated the arguments under examination.

In the next section I illustrate the operation of topical, rhetorical logic through inspection of the practical reasoning behind Watson and Crick's classic DNA double helix announcement.

3. RHETORICAL LOGIC AND THE DNA DOUBLE HELIX

Watson and Crick's famous DNA double helix announcement (1953) initiated one of the greatest advances in twentieth century biology, furnishing what Kuhn would have defined as an exemplary problem-solution or paradigm for that field (1970). The full context of the path to DNA's three-dimensional structure is reconstructed in careful historical works about the event (Judson, 1979; Olby, 1974). Also available are autobiographical accounts from leading participants (Chargaff, 1978; Crick, 1988; Watson, 1968). Rhetoricians found the announcement irresistible as a test case for the claim that the discourses of science are indelibly

rhetorical (Bazerman, 1981; Fisher, 1994; Gross, 1990; Halloran, 1984; Miller, 1992; Prelli, 1989).

I contend that the significant rhetorical features of the announcement are displayed prominently through its situated adaptation of an informal, topical logic. The grounds of that logic constrain (1) how issues are framed to focus points for audience adjudication and, (2) how claims are warranted as 'reasonable' or 'appropriate' responses to those issues. The announcement works to constrain audience appraisal of its proffered claims through often implied evocation of technical values and other thematic premises that scientific communities evolved as grounds for assessing 'the scientifically reasonable' during situated, practical problem solving.⁷

Much was already known about the DNA molecule when Watson and Crick started working earnestly on the problem. Its chemical composition was known since the 1930s; it consisted of phosphate and sugar groups (with attached bases). Avery (with co-workers MacLeod and McCarthy) had intimated as early as 1944 that DNA was associated with genetic material. Hershey and Chase made that point more boldly in 1952. Watson and Crick also had data about the dimensions of the molecule from published and unpublished experimental work. The central ambiguity was how all this information could be integrated within a coherent structure for the molecule.

Crick and Watson worked to solve DNA's structure at the Cavendish Laboratory at Cambridge. They were not alone in this effort. Linus Pauling was working on the problem at the California Institute of Technology and, prior to Watson and Crick's announcement, had published (with Robert Corey) a proposed structure of his own. Maurice Wilkins and Rosalind Franklin were at work on the problem at King's College in London.

Watson and Crick's article frames the problem of DNA's structure primarily as an *interpretive* problem. They set out two major claims in the opening paragraph:

We wish to suggest a structure for the salt of Deoxyribose Nucleic Acid (D.N.A.). This structure has novel features which are of considerable biological interest' (1953a).⁸

The first claim is developed extensively through specific description and applications of their proposed model. As the piece unfolds, we see how the model integrates structural features and dimensions meaningfully within a single configuration. We also see that they did not approach the problem as primarily evidential and, thus, as requiring exacting experimental investigation before adducing their proposed solution. Experimental data were necessary but insufficient means to persuasion in this case.⁹ The second major claim turns out to be *evaluative*. Once the model is established, Watson and Crick suggest with considerable brevity precisely what makes the proposed structure 'of considerable biological interest' and, thereby, establish a claim for the theoretical solution's significance.

Watson and Crick's claim to possess an answer to the structural problem logically presupposes that no meaningful theoretical structure existed. They had to

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