

ISSA Proceedings 1998 - The Use Of Metaphor In Scientific Argument: The Case Of Edward Clarke's Sex In Education



Contemporary research on metaphor has demonstrated with some emphasis that metaphor plays a significant role in science. Indeed, the discovery and description of the various functions performed by metaphor in scientific discourse has become a major research focus in metaphor scholarship (see Ortony, 1993). This focus was initiated in 1955, when philosopher Max Black (1955) argued in a landmark essay that metaphor constitutes “a distinctive intellectual operation” (79). By attributing cognitive content to metaphor, Black promoted the construct from a mere stylistic trope to a central figure in the process of scientific discovery. Subsequent research, including inquiry into the process of scientific modeling conducted by Black (1962) himself, established a virtual consensus regarding the necessity of metaphoric thought and description in science. Acknowledgment of this necessity can be found not only in the work of “metaphor-friendly” philosophers of science such as Thomas Kuhn (1993), but also in the work of logical positivists such as Ernest Nagel (1961).

This should not be taken to say that metaphor has been roundly embraced as a positive influence in science. Even Black (1955) was quick to point out that there is “no doubt metaphors are dangerous” (79). While metaphor may be indispensable in the process of theorizing, it can also mislead. The same heuristic function that enables metaphors to help us grasp new ideas can also serve to misdirect or limit our perceptions. In particular, there is an ever-present danger that metaphors will become reified or literalized. By this process, a metaphor, construct, or model becomes for the researcher not just a representation of reality, but the reality itself (Black, 1962).

There is a second fashion by which metaphor poses a danger in science. Not only can metaphor mislead researchers by construing their perceptions, but it can also serve a powerful rhetorical function in the interpretation of scientific data and the

application of those data to social contexts. Metaphor can serve as a bridge from scientific data to personal or political interests, and in the process, the data itself is reconstituted according to the metaphorical entailments. This risk pertains not so much to the good-faith misapprehension of reality as to the intentional, persuasive uses made of the results of scientific investigation. Metaphor is particularly vital in such uses given its peculiar efficacy as an ideological tool. Although the ideological function of metaphor has been explored in traditional analyses of rhetorical artifacts, far less attention has been paid to this function in the discourse of science. In this essay, I wish to characterize the rhetorical potential of metaphor in the interpretation and application of scientific data by way of a case study. My progress will be made up of an initial exploration of the ideological functions of metaphor, followed by an examination of these functions in the work of nineteenth-century Harvard physician Edward Clarke.

1. The ideological function of metaphor

Edwin Black (1970) writes that any discourse asserts a model of what the author would have his or her real audience become. This model is almost never characterized directly, but is implied by way of stylistic tokens. By the choice of language, the fashion in which the argument is clothed, an author implies an outlook. Style in this context serves as perspective, and, Black notes, this perspective matters inasmuch as “auditors look to the discourse they are attending for cues that tell them how they are to view the world, even beyond the expressed concerns, the overt propositional sense, of the discourse” (165). In all, stylistic cues link discourse to an ideology, a “network of interconnected convictions that functions in a man epistemically and that shapes his identity” (164).

Metaphor is particularly suited to conveying ideology or perspective due to its characteristic function of joining seamlessly dissimilar contexts. Modern scholarship on the construct (for an overview, see Johnson 1981, 3-47) allows that metaphor inspires original thought by animating elements or ideas from discrete domains. This thought results from a unique interaction of diverse associations in a process of comparison and negation. Language as a system is built on a vast foundation or system of metaphors by which abstractions such as space, time, and movement are construed. The choice of particular types of metaphors conveys what Wayne Booth (1978) calls “a world” (61). This world is not presented as an invitation to join with a given perspective, but draws its audience in by way of the interpretive process: “To understand a metaphor is by its very nature to decide

whether to join the metaphorist or reject him, and that is simultaneously to decide either to be shaped in the shape his metaphor requires or to resist" (63). This "decision" is seldom recognized as such; most often, auditors overlook the rhetorical dimensions of metaphor entirely in their interpretive processes, and assent by default to the perspective of the rhetor.

As a consequence, conventional metaphoric function – as contrasted with the function of novel, isolated metaphors – tends to take place without the awareness of auditors. This creates a significant rhetorical potential that may be of strategic advantage to participants in the discourse of science. However, while considerable scholarly attention has been devoted to charting the importance of metaphors in propagating scientific theory (e.g., Boyd 1993), and to demonstrating the ideological function of metaphors in sustaining research perspectives or paradigms (e.g., Brown 1986), less attention has been focused on the tactical uses of metaphor within particular scientific and quasi-scientific discourses. Questions of particular strategies of metaphoric conveyance have largely been left unanswered in the pursuit of larger issues of metaphor in science. It is my assumption in this essay that attention to such tactical issues is appropriate within the framework provided by existing research.

Accordingly, I am concerned with such questions as how, specifically, do metaphors serve as an inventional resource in the construal of scientific data? What are the commonplace uses of antagonism between science and poetics, and the theoretical antithesis between figuration and the language of empiricism, one would their uses of metaphor. Where in scientific discourse do metaphors most often appear, and where are they less in evidence? What levels of metaphoric function – word, sentence, subject, or discourse – are significant? In order to explore these questions, I turn to a case study in scientific discourse.

2. Edward Clarke's Sex in Education

Although largely absent from contemporary historical texts, the issue of women's access to traditionally male-dominated domains of higher education was an enormously popular concern in the United States during the latter half of the nineteenth century, receiving attention comparable to the debate over slavery that preceded it. The inaugural edition of the *Woman's Journal* is a case in point: The *Journal* began publication in 1870 as the official organ of the American Woman Suffrage Association. However, the front page of the new periodical's first edition was dominated not by suffrage, but by the issue of co-education in

American universities. According to one writer in the *Journal*, co-education was considered by many to be “the great problem of the age” (Woman’s Place 1870: 266).

The problem was particularly newsworthy in 1870 inasmuch as it appeared to be on the verge of resolution. In the years since the Civil War, increasing numbers of colleges and universities opened their doors to women. Even the staunchest supporters of separate education of the sexes showed signs of compromise. Harvard’s annual catalogue announced for the first time the names of women pupils in a post-graduate course, and the newly inaugurated president of the University admitted that the primary reasons for excluding women as full-time students related to the problem of common residence of the sexes rather than any categorical mandate. It seemed, in short, as if the “experiment of thirty-five years standing” had “long since passed the epoch of experiment,” and that co-education stood at the very threshold of popular acceptance (Harvard 1870: 1).

However, over the course of the next three years, the evolving consensus underwent a profound rupture that suspended its development as a moral issue and redirected the slow accumulation of knowledge about women’s education into a different field, that of medicine. This process of displacement and transformation was constituted rhetorically in scientific discourse. One work in particular, Harvard physician Edward Clarke’s (1873) *Sex in Education, or, A Fair Chance for the Girls*, served as catalyst for this rupture in popular conceptions of co-education. Written for a popular audience, the book was nevertheless ostensibly a scientific work resulting from Clarke’s extended clinical practice and his experience as a member of the Harvard oversight board.

First published in 1873, Clarke’s book was comprised of five chapters, labeled as follows: (1). Introductory; (2). Chiefly Physiological; (3). Chiefly Clinical; (4). Co-Education; (5). The European Way. In it, Clarke admitted that women have the capacity to learn the same material as men, but argued that women lack the capacity to learn in the same manner as men: “Boys must study and work in a boy’s way, and girls in a girl’s way.” Clarke’s thesis rests on the notion that “the [human] system never does two things well at the same time” (18)” In this instance, “two things” refer to thinking and developing a uterus. Should women persevere in their education, a host of calamities await them, including but not limited to the following: low spirits, lifelong painful menstruation, irregular menstruation, no menstruation, underdeveloped breasts and inability to breast feed, bearded masculinity, hysteria, anemia, St. Vitus’ Dance, dyspepsia,

neuralgia, headaches, loss of mental power, sterility, insomnia, insanity, and death (22). In short, educating women in the same fashion as men results in overwhelming physical damage.

The solution outlined by Clarke is that women should study one third less than men, and not at all during menstruation. This realistically negates the possibility of coeducation, since such an approach would require either an incompatible combination or a compromise that would yield "an average result," giving a fair chance "neither to a boy nor a girl." According to Clarke, then, "the inherent difficulty in the experiment of special and appropriate coeducation is the difficulty of adjusting in the same institution the methods of instruction to the physiological needs of each sex" (128). Perhaps the most controversial work on the limits of women's physiology ever written, Clarke's text was enormously popular, undergoing twelve printings in its first year and seventeen all told.

Such distant outposts of higher education as the University of Michigan, a co-educational institution, reported that "everyone" was reading the book: over two hundred copies were sold there in a single day (Walsh 1977: 124). References to the work can be found in a variety of documents ranging from personal correspondence and diaries to deliberative public records. The case of a woman student of the period is illustrative: M. Carey Thomas recalled that she and her fellow female students were "haunted by the clanging chains of that gloomy little specter, Dr. Edward Clarke's *Sex in Education*." (quoted in Walsh 1977: 124).

Nor was the book's effect limited to students. The degree to which the thesis was assimilated by the academy is demonstrated by a report of the Regents of the University of Wisconsin three years after the book was published: "Every physiologist is well aware that at stated times, nature makes a great demand upon the energies of early womanhood and that at these times great caution must be exercised lest injury be done.... Education is greatly to be desired, but it is better that the future matrons of the state should be without a University training than it should be produced at the fearful expense of ruined health; better that the future mothers of the state should be robust, hearty, healthy women, than that, by over study, they entail upon their descendants the germs of disease" (quoted in Smith-Rosenberg & Rosenberg 1974: 341-2).

This should not be taken to imply that the book excited only positive response. A year after Clarke's publication, educator Anna C. Brackett (1874) wrote, "it is seldom that any book arouses so much criticism, and, withal, so much earnest opposition as this has provoked, and seldom the newspapers so generously open

their columns to discussions so extended on the merits and demerits of any publication"; "The criticisms and the criticisms on criticisms would make already quite a volume" (368, 390).

In fact, the criticisms eventually filled at least four volumes, including Brackett's own, *The Education of American Girls*. Julia Ward Howe (1874), editor of a second volume, *Sex and Education: A Reply to Dr. E. H. Clarke's Sex in Education*, summed the thesis shared by most of the responses: "Dr. Clarke's discord exists not in nature, but in his own thought" (6). In addition to these volumes, the debate spawned any number of articles and monographs. Prominent educators and women's advocates, including Mary Bascom, Abby May, and Thomas Wentworth Higginson, responded to the issue with anecdotal evidence and observations of their own designed to counter Clarke's grim pronouncement. Dr. Mary Putnam Jacobi's essay "The Question of Rest for Women During Menstruation," winner of Harvard's Boylston Prize in 1876, was one of many scholarly attempts to gain the same end.

The historical significance of Clarke's text as flashpoint for this debate may be enough to warrant its examination; however, there is much else to recommend it to rhetorical analysis. Clarke was by no means the first physician to assert the importance of women's "special" physical nature. References to the overriding dominance of women's reproductive organs compared to all other bodily functions are common in the medical literature well before mid-century. Still, Clarke's project captured the public mind like none before it. Further, many of his most resolute opponents struggled to refute his claims. Feminist Caroline Dall wrote in her critique of *Sex in Education*: "I expected to find premises from which I should dissent, but, with the exception of that upon which the book is based [that higher education would destroy female health] I did not find any." (quoted in Rosenberg 1982: 13). That Clarke's critics should experience such difficulty in responding to what appears in retrospect to be an untenable position seems nothing less than remarkable.

3. A Confluence of Metaphors

As I hope to demonstrate, part of the effect of Clarke's (1873) work may be due to his extended and strategic use of metaphor, explicit comparisons in which one concept is likened to another or described in terms of another. There is no doubt that the text makes extensive use of these explicit metaphors. In illustration of the dictum that the "system never does two things well at the same time," it offers the

analogy of one attempting to meditate on poetry and drive a saw simultaneously: "He may poetize fairly, and saw poorly; or he may saw fairly, and poetize poorly; or he may both saw and poetize indifferently" (40). The blood is compared to "the water flowing through the canals of Venice, that carries health and wealth to the portals of every house, and filth and disease from every doorway" (46). Education is like agriculture. Those who advocated coeducation ignored the differences among species: "Because a gardener has nursed an acorn till it grew into an oak, they would have him cradle a grape in the same soil and way, and make it a vine" (127-8).

In all, over seventy-five such explicit comparisons appear in the text. The metaphors deployed do not serve as reasoned support or formal proof; neither do they only function as ornamentation. Rather, they serve in a literal sense to animate particular relations among the terms of comparison, and in this manner effect a particular interpretation. I. A. Richards (1936) writes that "it is the peculiarity of meanings that they do so mind their company" (10). Metaphor achieves a semantic dynamism by way of tensions among meanings at various levels of interpretation. First, there is the tension among the constitutive terms of a particular metaphor. Consider, for example, the seemingly innocuous textual description of women's growth and development as a voyage: "the first few years that are necessary for the voyage from the first to the second period, and those from the second to the third, are justly called critical ones" (Clarke 1873: 34). "The first of these critical voyages is made during a girl's educational life, and extends over a very considerable portion of it" (35). Following Richards's description of the component parts of metaphor, we may say that "voyage" in this passage serves as a vehicle, a means for conveying an idea ancillary to the primary narrative. The tenor of the passage - the meaning provided by the combination of vehicle, "voyage" in this case, and the ostensive subject, female development - must be inferred by the reader. By a process of interanimation, the possible meanings of each of these components are configured; by virtue of their proximity, certain shades of meaning are mobilized and others are constrained, yielding a combination unique to the particular context. In this case, I infer the salient characteristics of "voyage" to be risk, movement from one point to another, change.

The application of these characteristics to female growth in a literal sense provides some insight: female growth is a risky process of change, a movement among stages of development. However, a deeper insight can be found by

considering the telos smuggled into female development by way of this comparison. A voyage is undertaken for the sake of the destination; the “point” is to arrive, and this is the definitive character lent to the process of female development. We travel to get to some place. In the context of the metaphor, women grow to become fecund. The “point” to women’s growth is becoming fertile, potential child-bearers. This metaphor lends women’s existence a particular functional explanation – the reproductive capacity – and, by so doing, decenters other functions and explanations. Girls, in this light, are immature child-bearers; post-menopausal women are old, dysfunctional child-bearers.

The use of this and similar metaphors performs an especially effective rhetorical function. Metaphors instruct by combining and extending meanings with which we are already familiar in new and different ways. This collusion with accepted ideas dissipates the “newness” of metaphoric tenor and links it to the orthodox, which protects it and the larger case from attack (Ricoeur, 1975: 29). In the instance of the example at hand, the premise that women are essentially creatures of reproduction needed little protection in nineteenth-century American culture. Nevertheless, this meaning is smuggled into the “voyage” metaphor, secreted away in a process of overdetermination of meaning by the text. In a similar fashion, each explicit metaphor in the text exerts a limited or local influence over that portion of the narrative that it inhabits.

Not all metaphors deployed in the text have equal significance. In some cases, the metaphors used in the text are clearly isolated, and so less likely to elicit extended attention or interpretation by a reader. For example, on page 15, the passing textual reference to the “chains of matrimony” is unlikely to perform an especially significant rhetorical function. The reference is quite brief, the metaphoric form is subtle, and the images elicited have been so well and often used as to fail entirely to provoke associations. Rather, the juxtaposition has achieved the status of “dead” metaphor or cliché, and so may fail to perform any metaphoric function at all. In contrast, consider the extended comparison of education to agriculture that occurs on page 126: “The gardener may plant, if he choose, the lily and the rose, the oak and the vine, within the same enclosure; let the same soil nourish them, the same air visit them, and the same sunshine warm and cheer them; still, he trains each of them with a separate art, warding from each its peculiar dangers, developing within each its peculiar powers, and teaching each to put forth to the utmost its divine and peculiar gifts of strength and beauty.”

From this comparison, we might well take it that boys and girls are as dissimilar as different species of plants, overlooking the fact of the matter that they are of the same species, only different sexes. The extended attention lent to this comparison, its detail and vividness, combined with the newness of the elements in combination, results in a vivid, telling metaphor. These characteristics make it more likely that the metaphor will receive interpretive consideration and result in rhetorical effect. The reader is likely to be persuaded to consider boys and girls more different than he or she might otherwise be inclined to think.

A second level of interpretive tension is achieved by patterns of metaphoric reference. Through metaphoric repetition, a force of relations is rhetorically inscribed. Metaphors in which educators are compared to farmers, and boys and girls compared to widely dissimilar plant species occur three times in the text, and are among the most detailed and extended of all the comparisons found there. Several related metaphors, such as less-detailed references to educated women as "loaded grain before a storm," or the "fruits borne" by identical coeducation, extend and strengthen the relations that obtain in the extended garden metaphors, forming a web or complex of associations, and thus strengthening the rhetorical effect of the comparison. This pattern of references also entrenches the associations elicited, linking and securing them in a theme. Such a theme lends the strategy a certain discursive momentum that enables each successive reference to fit neatly into the growing complex of associations, facilitates assimilation, amplifies the effect, and reduces the likelihood of discord or rejection.

Clarke's text demonstrates a second pattern of metaphoric reference, this time in the object of repeated comparisons. The most frequent object of textual metaphors is the female reproductive function. A cluster of metaphors surrounds the process or reproduction generally, and the female reproductive organs in particular. In addition to the local effects on interpretation noted above, this pattern of metaphoric reference "overloads" particular concepts such as the reproductive function with metaphoric associations, and so reduces the ease of singular interpretation. Moreover, this repeated metaphoric reference indicates to the reader that the function of reproduction is surrounded by a special mystery, an irresolvable complex of meanings, and aura of importance.

Repeated use of the same or similar vehicles in various metaphors is another type of pattern of rhetorical significance. Comparisons of the human body, and women's reproductive organs in particular, to machines and engines are

especially common (Clarke 1873: 37, 38, 39, 83, 94, 131). This repeated comparison inspires a vision of humans as creatures of production, and women as producers of babies. Furthermore, simple characteristics of machines may also seem to apply to women: machines do not function autonomously, they have no feelings, they break down, but may in some cases be repaired. Machines, and by extension, women's bodies, are objects, distinct from the minds that direct them. They are also the engines of society, mechanisms of technology and advancement. Machines, particularly in the rampant industrialization of the late nineteenth century, represented progress and the future of the nation.

Women's reproductive organs are also frequently referred to as "the cradle of the race," so frequently, in fact, that what might otherwise be considered a passing cliché becomes an embedded reference, a deep-seated association of women and the responsibility of continuing the complex of American cultural and genetic elements. This association downplays alternative visions of women, such as that of women as independent agents, actors whose primary responsibility is to themselves or their immediate families. Women in this light are objects whose sole function is to nurture and protect the progeny of the race.

The pattern described by the location and frequency of metaphors in the unfolding narrative is also instructive. The introductory chapter contained ten metaphors, at a frequency of .53 per page. The second chapter, in which physiological issues were dealt with, contained 30 metaphors at a frequency of 1.03 per page. The third chapter, "chiefly clinical," relied on 20 metaphors at a frequency of .36 per page. The fourth chapter, "coeducation," contained 14 metaphors at a frequency of .33 per page. The fifth and final chapter, in which the European alternative was described, made use of only 3 metaphors, at a frequency of .16 per page.

Deployment of metaphors begins in the first chapter with a relatively high frequency, peaks in the second chapter, then tapers off thereafter. To the degree that we take metaphors to perform a rhetorical function, we may say that their rhetorical effect in the text is concentrated in what appears to be a functional manner. In the first chapter, "Introductory," Clarke outlines his case. In the second, he describes the physiological basis of his findings, including the bodily mechanisms and functions that relate identical coeducation to women's illness. The third chapter, "Chiefly Clinical," describes a series of cases in some detail and illustrates the phenomenon to which the text bears witness. The fourth chapter, "Coeducation," distinguishes among various options for educating

women, identifies logistical and other practical barriers to the appropriate education of the sexes, and lays out Clarke's recommendations in this matter. The fifth and final chapter, "The European Way," describes in detail the pastoral vision of European education, in which Clarke's admonitions take form, and by which the evils of women's illness are avoided.

We should expect, by this topical division and by Clarke's own emphases, that the greatest burden of proof should fall to Chapter 2, in which Clarke's authority and the jurisdiction of physiology are extended into the realm of women's education. In fact, this is the chapter in which the greatest number and frequency of metaphors occur. The introductory overview in which he hopes to gain initial compliance from reader has the second highest frequency. The third and fourth chapters, detailing case studies and Clarke's prescriptions, each contain a moderate number and frequency, and use of metaphor drops off sharply in the final chapter describing European educational traditions.

In addition to correlating with the text's varying logical burden of proof, the metaphors deployed correlate with the changing tone taken by the authorial voice. In the first chapter, the text is generously welcoming and personally expansive. In the second chapter, the reader is initiated into the mysteries of physiological function. It is in this section that the loftiest, awestricken tone, and the highest notes are sounded. The third chapter is largely filled with details of the lives and ills of the women who are the subject of the case studies. The tone here is one of deep, somber regret, as might befit the scene of a tragedy. The fourth chapter takes on an admonitory tone, in which the authorial voice lectures the reader in appropriate rules and guidelines of education. Finally, the last chapter engages the objective reporting voice embodied in Chapter 3 before ascending once again to the lofty abstractions found in Chapter 2. The point to my observations of tone is not to explain the incidence of one construct, metaphor, with another, tone, but rather to show a concerted movement in the text. Metaphors, like tone, form part of an orchestration of individual elements in which various rhetorical tools are brought to bear for maximum effect as needed by the unfolding narrative. By deploying metaphors appropriate to the logic and tone of argument, the text achieves a type of rhetorical force.

Literal associations and patterns of reference do not exhaust the role of metaphor in the text. Metaphors inscribe a third level of interpretive tension. The experience of textual forms exceeds mimesis; language is not only literal, but figurative, affective. This affective impression need not rely on interpretation.

Metaphors need not be “about” anything other than themselves, in the strictly denotative sense. Reading metaphors may provide a sensual pleasure derived from the simple experience of juxtaposition of concepts. In this sense, the experience of metaphor is gratuitous, self-fulfilling. Consider, for example, the text’s description of the damage caused by women’s forms of dress: “Corsets that embrace the waist with a tighter and steadier grip than any lover’s arm, and skirts that weight the hips with heavier than maternal burdens, have often caused grievous maladies, and imposed a needless invalidism” (Clarke 1873: 25). This passage is part of a section in which the text appropriates a discursive momentum by association with the dress reform movement. The metaphor may be read literally as saying that the conventions of women’s dress put a greater burden on women than do normal actions in the regular course of their lives. But this literal translation misses the richness of the metaphoric relation, the vivid, poetic connotations elicited by the thought of a lover’s grasp, or the settling weight of pregnancy.

In another example, the text succinctly describes its purpose using a metaphor: “[The book’s] object is to call attention to the errors of physical training that have crept into, and twined themselves about, our ways of educating girls, both in public and private schools....” (24). This reference may be literally read to say that errors have slowly and stealthily become part of the institution of American education. However, this interpretation is only part of the meaning evoked by the terms of the metaphor. The language employed draws a connotation of feral evil, even of serpentine constriction, and faintly echoes the Edenic fall from grace. These images are by no means a literal extension of the metaphor, nor in any sense a reduction of the primary form. Rather, these meanings reside at the very surface of the original composition.

Together, these examples demonstrate the erotic dimension of metaphoric reference. Although isolating the literal and figurative functions for analytic reasons may be informative, these performances work in concert in the text to achieve metaphoric effect. Hence, the text’s extended use of metaphor performs a suasive function at both rational and affective levels.

4. Discussion

This case study suggests first that metaphor serves a complex role as a tactical resource for participants in scientific or quasi-scientific discourse. Three particular levels of function were identified. First, metaphors may be used locally to obtain particular conclusions. In this role, metaphor asserts conclusions by way

of familiar images, making the extension seem routine and logical. Second, repeated patterns of metaphoric tenors, vehicles, and objects may be used to create redundant “waves” of implication. This redundancy can serve to overdetermine impressions on the part of the reader, and so strengthen conclusions reached in the text. Third, the presence of metaphors may provide an inherent attraction for readers insofar as the experience of metaphor can result in a sense of satisfaction.

Science has long asserted a transcendence of language by way of direct correspondence with reality, a claim disputed by rhetoricians and students of the scientific idiom during the past forty years. This study adds to a growing consensus that holds that scientific legitimacy should be considered a rhetorical device, apart from whatever other functions it may perform. Scientific legitimacy applied to lay contexts changes the interpretation of language in important ways. Among the most important of these changes concerns evidence and burden of proof. In lay contexts, we might expect an effective argument to present evidence linked by logic to some conclusion. Scientific legitimacy removes understanding of argument from the layperson by drawing on technical knowledge and esoteric connections. Far from disarming metaphor and other rhetorical devices, the use of this strategy allows for greater rhetorical effect by removing the grounds of counterargument from the common person, leaving him or her rhetorically defenseless against scientific pronouncement.

Sex in Education demonstrates the efficacy of crossing argumentative domains. Taken as a whole, the text represents a rhetorical hybrid, in which scientific data that support its case are combined with the figurative and ideological function of metaphor. Neither resource alone would suffice as utilized in the text; the case lacks scientific rigor and persuasive virtuosity in the traditional sense. But the hybrid strategy makes each resource more effective by virtue of the other’s contribution. Case studies that should, by scientific standards, represent a population are transformed by way of figuration into pathos, a form of popular proof, and so escape the judgment and constraint of scientific criteria. Credibility that should ordinarily rely on the strength of pronouncement is amplified in the text by the idiom of science. By shuttling back and forth in this fashion between esoteric and public language domains, the text constructs a powerful argument that evades counterarguments grounded solely in either domain.

A defense to this strategy cannot be found in purging science of rhetoric, because the language that constitutes science has a rhetorical “intent” entirely apart from

the goals and desires of any particular author (even though, in some cases, these intentions may overlap). This rhetorical intention resides in the common language itself, and cannot be divorced from any particular articulation. Still less profit may be found in attempting to remove science from rhetoric. Technical fields of study encompass knowledge that for practical reasons is removed from the layperson, and any attempt to make every argument accessible to everyone invites certain failure. Instead, this study indicates greater comprehension of the rhetorical dimension of the interplay of science and the public domain. Simply, and not so simply, understanding the rhetorical operations that affect us, and how these operations change when conducted across discursive geography equips us with the skills needed to decipher confusion, dispel mystery, and disarm obfuscation. In this role of common denominator, rhetoric provides continuity, a link among discursive domains.

Like Darwin's *Origin of Species*, Clarke's work makes little pretense of following the hypothetico-deductive model. Rather, both texts are remarkable for their virtuosity in reframing what was previously considered "fact," and exploiting argumentative potentials of diverse discursive traditions. Both authors combined ostensive fact and the heuristic potential of literary resources, suggesting an inventional strategy common to the genre. If Clarke's work has proven far less influential than Darwin's, it may be due to the less ambitious scope of Clarke's vision, and the extended reframing of fact that followed the publication of *Sex in Education*.

This should not be taken to minimize the achievement of *Sex in Education*. The text formed an important part of an emerging bio-rhetoric, in which the discursive resources of physiology were applied in the field of women's education. This application initiated a new source of rhetorical invention, and may be said to have revolutionized the debate over women's educational access. In addition, the text serves as an illustration of both the rhetorical potential and danger represented by the ideological function of metaphor.

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