

Figures of Argument

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Abstract: From the seventeenth through the nineteenth centuries, scientists such as Kekule, Mendel, Lavoisier and Harvey argued for insights that depended critically on antithetical expressions and reasoning. The heuristic and persuasive use of devices like the antithesis has roots in the in combined grammatical, rhetorical and dialectical training established during the early modern educational reforms of the humanists. While the entire array of figures includes devices which inscribe all the rhetorical appeals, the set of devices derived from parallel phrasing illustrates how certain figures of speech express lines of reasoning iconically. But the continued use of such devices invites a general rationale for their persuasiveness based on the importance of pattern completion in language processing.

Résumé: Dès le 17^{ième} et pendant le 19^{ième}, certains arguments de savants tels que Kekule, Mendel, Lavoisier et Harvey dépendaient sérieusement sur des expressions et des raisonnements antithétiques. L'usage éducatif et persuasif de stratagèmes comme l'antithèse trouve ses racines dans un entraînement grammatical, rhétorique et dialectique établi au début des réformes éducatives humanistes. Bien que la gamme entière de figures inclut toutes les approches rhétoriques, l'ensemble des expressions établies sur les tournures parallèles illustre comment certaines figures de rhétorique expriment des raisonnements iconiques. Mais la persuasion qui résulte de l'usage continu de telles figures invite une explication générale fondée sur l'importance de l'achèvement des structures linguistiques dans la compréhension d'un langage.

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In 1865 the chemist August Kekule published an article in French and German introducing the structure of benzene as a particular arrangement of carbon atoms, an arrangement that, many years later, Kekule claimed to have visualized while dozing on and off in his easy chair before a fire. But when Kekule made a case for this structure in the *Bulletin de la Société Chimique de France* and the *Annalen der Chemie*, he did not offer his daydream as support for his claim. But neither did he offer detailed experimental data and a chain of inferences leading up to his insight. Instead, he argued by gesturing to the obviousness of his claims and the ease of reaching them, and by using the semantic resources of a particular rhetorical device to make his claims plausible. Thus the actual text of Kekule's argument suggests a different version of his methods and perhaps even of his original inventive resources. And it provides evidence for how reasoning and composing practices characterized in the rhetorical tradition can appear in the sciences, though they are

not limited to scientific arguments.

Kekule introduces his views as based on a hypothesis that he says, constructing his audience, almost all chemists admit: the atomicité of elements, their ability to behave like discrete units. In *The Architecture of Matter*, Toulmin and Goodfield point out that Kekule never actually committed himself to more than a descriptive notion of the atom, though it is difficult to keep that reservation in mind while reading his text (264-265).

Calling the status of his argument “theorizing,” Kekule expresses the hope that he will “see this theory rapidly confirmed or refuted by numerous experiments [experiences]” (Kekule, 1865, 98)¹ He therefore offers only a plausible extrapolation, beginning from the assumption that substances with at least six carbon atoms must have something in common, some type of core. In accounting for this core, he assures his readers that his hypothesis is so simple, it will be unnecessary to insist on it at length. Proposing that carbon atoms can bind to each other, Kekule reaffirms, from his own earlier work, that this binding can produce chains when one carbon joins with either one or two neighbors. Concentrating on chains of just six atoms, he then proposes the existence of two kinds: *une chaine ouverte* and *une chaine fermée* (Kekule, 1865, 100). The former does not bind to itself; the latter does, closing into what could be called a circle, though the words *circle* or *ring* never appear in the article nor does any visualization of the benzene ring that is now so common. An open chain of six carbon atoms would contain eight “non-saturated” affinity units, he claims, and a closed chain six, leading to differences in the compounds that could be formed.² In short, Kekule’s plausible proposal in this paper, called one of the most successful predictions ever made in science, has at its core a pair of semantic opposites, open and closed, deployed in claims with contrasted corresponding properties.

If Kekule’s paper argues for a plausible pair of opposites that awaits confirmation, another famous argument delivered in the same year is characterized by its meticulous presentation of experimental results: namely Gregor Mendel’s paper on plant hybridization. Yet this argument too is driven by oppositions in both its data presentation and its reasoning. Deceptively chronological, Mendel’s single scientific publication offers a statistical accounting of seven characters of pea plants followed through several generations and interpreted in a way to reveal the laws of genetic combination that now go by his name. However the hallmark of Mendel’s work is not his careful empiricism; his many predecessors in plant hybridization did far more breeding experiments than he did. It is rather his imposition of antitheses in both constructing his categories of observation and in interpreting his results. Always somewhat confusing, even suspicious to later generations, was Mendel’s luck or cunning in selecting traits of pea plants that bred true and were not the products of linked genes or mosaic expression. But Mendel chose traits that he could, as he explains, separate easily; or, to put this constraint another way, he chose traits that he could describe separately: yellow versus green, wrinkled versus

smooth, tall versus short, a selection driven in part by the available terms (Mendel, 1866, 7-8). Mendel's conceptual leap was then his imposition of the terms *dominant* and *recessive* on these contrasted traits, defined by antitheses as follows: a dominant trait is the only one that appears in the first generation of hybrids from a cross and a recessive trait is the one that reappears in the first generation from the hybrids (Mendel, 1866, 10-11).³ The hybridizer cannot know ahead of time which is which. Having been a student of mathematics and physics at the University of Vienna, Mendel knew how to impose the combinatorial principles for two items randomly assorted in what in retrospect could be called a coin toss with genes.

Less well remembered about Mendel's work is that he named a second order of antitheses, two contrasted types of dominants, parental and hybrid (Stamm-Merkmal and Hybriden Merkmal, p 15). When he crossed plants that were dominant by phenotype, some of course yielded, and would continue to yield, only offspring expressing the dominant trait, while others yielded offspring showing the same statistical variation in traits as the first generation from the hybrids (3/4 dominant, 1/4 recessive). This difference would have been striking for Mendel given that he was looking at pea shape and color in pods on a single plant as expressions of traits in a subsequent generation, so he could, again invoking opposites, distinguish between plants that had phenotypically different peas in their pods, and those that did not. It was the imposition of this second antithesis that allowed Mendel to make predictions on the outcome of future crosses, and so claim that he had discovered the "laws" of hybridization. It is to this day doubtful that Mendel really had a conception of unitary material genes in gametes, but then he really did not need such a conception to manipulate the patterns of opposites that he had established.

Moving backward in time almost eighty years before Kekule and Mendel, Lavoisier delivered to the *Academie des Sciences* his only paper in geology, but it was one which made as stimulating a contribution as his work in chemistry. Lavoisier had been part of a project to map the mineralogical resources of France, and when he finally reported on this work, he began his paper by first reminding his audience that, given the evidence of marine bodies of all types in these strata, it was impossible to doubt that the sea had once covered a great part of the globe. But he became convinced of the following distinctions in his observations. His actual wording deserves quotation at some length, first, because it demonstrates the combination of providing the argument and gesturing toward it as in Kekule, second, because of the interpenetration of the language of description and that of the subsequent claim, as in Mendel, and, finally, simply because Lavoisier is such an elegant writer.

But if after the first view one follows with a more profound examination the arrangement of the banks and the materials which compose them, one is astonished to see there at one time all that characterizes order and tranquility, and at the same time all that announces disorder and movement. Here one finds a mass of shells thin and fragile; the majority are neither worn down nor abraded; they are precisely in the state in which the animal abandoned them in losing life; all those of an elongated figure are bedded horizontally; almost all are in the situation determined by the position of their

center of gravity: all the circumstances which surround them suggest a profound tranquility and, if not an absolute repose, at least of gentle movements depending on their will.

Some feet above or below the place this observation was made presents a spectacle entirely opposite: One no longer sees any trace of beings living or animated; one finds, in that place rounded pebbles of which the angles have been abraded by a rapid movement continued for a long time; it is the image [tableau] of a sea in anger, which comes to break against the shore, and which rolls with a crash the considerable mass of the shingle. How to reconcile these observations so opposite? How do effects so different appear from the same cause? How has the movement which has abraded quartz, rock crystal, the hardest stones, which has rounded their angles, respected light and fragile shells? (translated from Lavoisier, 1789, 186-187)⁴

This passage is a tour de force of rhetorical stylistics. It hinges on an antithesis which is then beautifully amplified, leading to a paradox expressed in repeated rhetorical questions.

It is, however, unlikely that Lavoisier's field observations were in fact presented to him in such stark contrast. No accusation is intended here that he falsified his perceptions, but when he expressed them, the structures available to him, no doubt from his considerable rhetorical training, led him to frame his observations in etched oppositions, order versus disorder, tranquility versus movement. (The term *tranquillité* has its sense as stillness emphasized when it is paired against movement, so a better English translation, sensitive to the underlying figure, would probably be *stillness versus movement*). Lavoisier claims that his opposed observations, "Ce contraste de tranquillité et de mouvement, d'arrangement et de désordre, de séparation et de mélange" (187) did not seem explicable at first until by dint of seeing and re-seeing, it seemed possible to explain in "une manière naturelle et simple," the "principle laws which nature has followed in the arrangement of horizontal beds" (187-188).

There must exist in the mineral realm two sorts of beds very distinct, the one formed in the full sea and at a great depth, and that I will name in imitation of M. Rouelle, pelagian beds, the other formed at the shore which I will name littoral beds; that these two species of beds must have distinctive characters which do not permit them to be confounded, that the first must present a mass of calcareous materials, of animal debris, of shells, of marine bodies accumulated slowly and peaceably, during an immense succession of years and centuries, that the other, on the contrary, must present above all image of movement, destruction and tumult (translated from Lavoisier, 1789, 189-190)⁵

Lavoisier's conclusion is the outcome of antithetical reasoning and phrasing; the two are indistinguishable. In Toulmin's terms, both data and claim have the same verbal signature. The passage presenting the two types of beds, pelagian and littoral, deep sea versus shore, has the force of a characterization by definition based on the description of their distinctive features. The plausibility of Lavoisier's argument, his characterization of it as "natural and simple," depends on the audience's willingness to accept the occurrence of opposites as plausible so that, in a very literal sense from

Aristotle's terms expressing the first of the twenty-eight lines of argument in the *Rhetoric*, opposite lies with opposite (Aristotle, 1991, 241; Freese, 1926, 296).

Another century before Lavoisier, in the early 1600s, William Harvey used the same figural logic to shape his observations, experiments and premises in arguments for the circulation of the blood, overturning the long-held belief that the body produced and absorbed its blood in a one-way flow. Again, the story is sometimes told that Harvey's breakthrough was shaped by his metaphorical insight that the heart is a pump, though this claim need not be labeled a metaphor to begin with because Harvey could have meant, literally, the heart *is* a pump. But such an image, metaphor or identification never appears in his published argument, *De Motu Cordis*. (It does appear on a separate page inserted in lecture notes, but the date of this notation is problematic [Whitteridge, 1971, 169-170].) What appears instead in Harvey's text is a very rich use of other figures of speech to express his arguments. A device called the antimetabole is critical in Harvey's expressed reasoning, but in subsidiary arguments Harvey uses antitheses supported in part by observations from his own dissections and those of his recent predecessors among the anatomists. Because of the distinctive syntactic and semantic profile of the antithesis, it is possible to use parallel phrasing and one set of opposing terms to predispose an audience toward seeing the other pair of terms in the phrases as opposites. In Harvey's case, the two terms being separated and pushed apart are "veins" and "arteries," terms which were sometimes used interchangeably by earlier anatomists. Arguing against traditional learning, here is how Harvey emphatically claimed their difference.

Though vein and artery were not unreasonably both styled veins (as Galen noted) by the ancients, one of them, namely the artery, is a vessel which carries blood from the heart to the component parts of the body, while the other is a vessel which carries blood from those component parts back to the heart. The one is a channel from, the other a channel to, the heart. The latter channel contains cruder, worn-out blood that has been returned unfit for nutrition; the former contains mature, perfected, nutritive blood (Harvey, 1990, 47; Harvey, 1628, 42).⁶

The antitheses in this passage that encourage the reader to accept the opposed or at least differentiated nature of the veins and arteries are based on the reciprocal relation of the heart versus the rest of the body, on motions to and from the heart, and on the opposite nature of the blood they carry, i.e. crude versus perfect, worn-out versus mature, non-nutritive versus nutritive. While Harvey was on sound anatomical ground with his arguments for the direction of flow, the veins having semi-lunar valves permitting only one-way movement, he was carried by the figure into less certain territory with his claims about the nature of the blood.

Harvey's arguments were written in Latin, and his antitheses are expressed more crisply in that language. Examples such as Harvey's can be multiplied in early modern texts from natural philosophy, but they persist even today in arguments across the sciences.

The Antithesis in Contemporary Scientific Arguments

The expectation that nature offers opposite entities with opposite properties has proved surprisingly durable and fruitful in scientific invention and in the subsequent arguing for that invention in texts. Take a recent example from molecular biology. In the field of gene regulation scientists had established that the DNA inside a cell's nucleus is wrapped around histones and they identified certain enzymes that could add methyl groups to these histones, contributing to the regulation of the encircling genes. But they also predicted that there had to be "enzymes that did the opposite" (Couzin, 2004, 2171); Why there would be this expectation is of course rooted in precedents in biological systems predicting a reversible mechanism in this case; the argument from precedents here is field specific. But there is also that same presumption of the likelihood of opposites tapped by Kekule, Mendel, Lavoisier and Harvey. For decades, molecular biologists had a name in waiting, histone demethylase, for an enzyme that eluded discovery until last year.

The ubiquity of such paired opposites as the core of scientific arguments is of course thanks to the importance of what Mill called the method of difference in research design (Mill, 1874, 280-281). A sampling of articles from one volume of *Science* in 2001 reveals research reports on predator naïve versus predator experienced moose, on contrasted molecular switches at the center versus the membrane periphery of cells, on bosons that clump together and fermions that avoid each other, and on Antarctic temperatures that show a long-term pattern of increasing while Greenland temperatures show a simultaneous pattern of decreasing (Fahnestock, 2004, 25-27). A very recent addition to this list, from the social sciences, is the case made by researchers at the University of Alberta reported in the *Science Times* a few weeks ago that parents observed in supermarkets prefer their pretty children to their ugly children (Bakalar, 2005, F7). Here perhaps the presumption of opposites has run amok with research that is "pretty ugly," but this example leads to another point. The cases offered so far of scientific arguments expressed in antitheses are cherry-picked successes. But nature need not cooperate with the use of antitheses as an invention device any more than an audience has to be captivated by it. There have probably been more failed than successful scientific arguments based on antitheses – phlogisticated versus dephlogisticated air, continuous versus discontinuous evolution, and others long forgotten. The antithesis is a linguistic prompt, an invention device for a potential line of argument. No more, and no less.

The recent examples of scientific arguments hinging on antithesis, and the unrolling lineage behind them – Kekule, Mendel, Lavoisier, Harvey – can be linked to the tradition of argument invention and expression as it was revived and revised in the fifteenth and sixteenth centuries. In what follows, the historical roots for these figure-based arguments in natural philosophy are traced to the new, rhetorically-inflected dialectical treatises of the 1500s. The interanimation of rhetoric and dialectic in this period has received considerable attention from historians (e.g., Gilbert, 1960; Howell, 1961; Vasoli, 1968; Jardine, 1974; Kristeller, 1979; Mack, 1993)

and it is the subject of a recent collection of essays edited by Van Eemeren and Houtlosser (2002). An historical argument about sources does not, however, entirely explain the persistence of these forms; their enduring appeal can instead be traced to the more general role of iconicity in persuasiveness, as illustrated by arguments epitomized by parallelism, the root of the figures antithesis and antimetabole. While a cognitive rationale for the persuasiveness of these devices is possible, such a rationale would not be possible for all the stylistic devices marked in the rhetorical tradition. An overview of the types of figures, using the categories of contemporary linguistics, suggests that they re-inscribe in isolated devices the variables of situated argument. Ignored today, the figures were prominent in early works of natural philosophy, thanks primarily to the very different attitude toward language in the early modern period which justified a stylistic approach to argument that we tend to find problematic.

Early Modern Dialectic

The invention and expression of lines of argument like the antithesis was the deliberate subject matter of the early modern arts curriculum. The revised dialectic that along with grammar and rhetoric took its place in the trivium under the humanist educational reforms of the sixteenth century is usually discounted in the history of logic. In actually trying to defend this period, E.J. Ashworth conceded that “historians of logic have regarded the early modern period with unremitting gloom,” seeing the fifteenth and sixteenth centuries as a “period of unchecked regression, during which [logic] became an insignificant preparatory study, diluted with extra-logical elements...” (Ashworth, 1968, 179).

But this sixteenth-century humanists’ dialectic, filled with “extra-logical” elements, was the system taught to many of the first generation of natural philosophers, to Harvey at Cambridge, to Kepler at Tübingen, to Gilbert, to Huygens, to Hooke, to Newton. Key texts in this tradition are Rudolph Agricola’s *De Inventione Dialectica*, written in 1479 but first published in 1515 (Cogan, 1984, 163), and Philip Melanchthon’s *Erroremata Dialectices*, which went through three expanding versions in 1521, 1527 and 1547 (Melanchthon, 1963a, 509-510; the earlier editions had different titles). Their “degenerate” version of dialectic persisted through the seventeenth century with many imitators including, for example, Robert Sanderson’s *Logicae Artis Compendium*, first published in 1615 and in print well into the eighteenth century (Howell, 1961, 299-307). It was the third edition of Sanderson that Newton’s uncle gave him when the family decided to send him to Cambridge and that Newton reportedly read during the summer before he matriculated. It was the first book he attended lectures on and discussed with his tutor, though he had already mastered it (Brewster, 1965, 21).

Early modern dialectic differs somewhat from its predecessors because its authors redefined its goals and changed its emphases. For Agricola and Melanchthon, dialectic is not primarily an art of disputation or questioning. It is a

general art of teaching, and to that end it provides guidelines for analyzing and inventing convincing arguments (McNally, 1967, 393-395). Furthermore, it concerns all subjects humans are to be taught. For Melanchthon, who quickly incorporated insights from Vesalius and Copernicus into the Wittenberg curriculum (Kusukawa, 1995, 114-120; 170-173), the things to be taught included not only “the recognition of God, the perception and duties of the virtues,” but also “the consideration of nature” (Melanchthon, 1963a, 513-514). This reconceived dialectic takes on then the first of the three Ciceronian offices of the orator — teaching, and its goal is to produce extended discourse, not short answers in an exchange. The texts that could be produced according to the revised art included texts in natural philosophy, of which Melanchthon himself wrote two (Kusukawa, 1995, 92-95; 145-148).

As a general art of teaching, including advice on how to construct good arguments on any subject, early modern dialectic emphasized invention. That emphasis is especially obvious in Agricola’s textbook which dispenses with the traditional parts of scholastic logic and features the topics as they were presented in rhetoric textbooks. Rhetoric’s inventional schema, however, were always particular to arguments in the three essentially civic speech genres, deliberative, forensic and epideictic. But dialectical treatises were completely general in their suggestions of the subject matter of arguments. The humanist treatises in particular display an indifference to subject matter, mixing examples we would now separate between ethics and the natural sciences. So, for example, to illustrate the distinction between simple and complex questions, Melanchthon offers the following: “Whether a heavenly object is a comet or a star” and “whether a Christian can become a soldier” (Melanchthon, 1963a, 517; these are complex questions because they involve two terms rather than one such as “What is virtue?” and they both concern “hot” issues at the time). The bottom line is a new integration in these treatises: the inventional emphasis of rhetoric is combined with the subject generality of dialectic. The natural philosophers of the sixteenth and seventeenth centuries, exposed to the application of the topics to issues in natural philosophy, did not need a separate theory of argumentation to handle subjects in physics or astronomy since the texts in which they studied the invention of probable argument moved seamlessly from one field to another.

Melanchthon’s texts also reveal another dimension of the mix between rhetoric and dialectic at the time because he wrote treatises for both arts, each taken through several versions and each version through several editions, and he explicitly connected the two claiming, “So great is the resemblance between Dialectics and Rhetoric that scarcely any distinction can be observed between them” (La Fontaine, 1968, 82). And in the section of the final version of his *Rhetoric* devoted to the figures of speech, where an emphasis on argument might be least expected, he adds, “The zealous reader will observe that all the figures, especially those that enhance a speech, have their origin in the *places of dialectic* (La Fontaine, 1968, 263; “*locis dialecticis*” is incorrectly translated “dialectical expressions” by La Fontaine). In his strongest

claim for the connection, Melanchthon goes on to observe that the same expressions are at one and the same time adornment and argument (264). Melanchthon delivered on this declaration by organizing the figures in the third edition of his rhetoric according to the topics (Melanchthon, 1963b, 479-480; 482-483ff).

Overall, the humanist's attention to language is the connecting matrix across the three related arts of the trivium. In their pedagogical alembic, the arts of grammar, rhetoric and dialectic overlapped considerably, so that the exercises in reading and parsing under the grammarian were reinforced by the compositional and analytical exercises under the teachers of rhetoric and dialectic. Students would continually encounter the same forms. They would mark a figure like antithesis in their reading, they would practice it as a syntactic scheme in their composing, and they would learn that predicating opposites was a way to distinguish species (the goal of the arguments by Kekule, Mendel, Lavoisier and Harvey). And it is important to remember that the language medium for all this tuition was Latin, a second language for everyone in the early modern period, whose study usually began at the age of seven. The role of stylistic formalism in a laboriously acquired and primarily written second language is easy to imagine (see Costello, 1958, 180).

Perceptual Rationale for the Appeal of the Figures

It is hardly surprising then that early modern natural philosophy texts feature figured arguments. But the figures originated in classical treatments and survive past any influence of rhetorical training. So some account seems necessary in terms of perception and cognition to explain the persistence of these forms. Professor Toulmin has again set the direction of this line of inquiry in the discussion of language universals that concludes *Human Understanding* (1972). Are we dealing with linguistic universals here, with concepts whose slow pace of change looks like stasis? And again following the direction of Toulmin's inquiry, can the effect of the figures be explained in terms of what is known, albeit fragmentary, about language processing from neuroscience?

One explanation for the effectiveness of the figures is offered briefly in Tindale's *Rhetorical Argumentation* (2004) where he describes them as either constituting or emphasizing arguments (81-82), and suggests that, for a figure like antimetabole, the audience is persuasively involved because of their "experiencing the rhythm of the discourse," and 'seeing' the reversal (83). Tindale concludes that there is "something distinct about the arguments drawn from the figures" (86), that they engage the audience "at a quite deep, often emotional level, before reason moves in as an organizing force" (86).

Though a dissociation of these devices from reasoning may be unnecessary, nevertheless locating the effect of at least some of the figures in the "rhythm," that is in the sound dimension of prose, provides a starting point for investigating their enduring persuasiveness. What are the sources of this rhythm? The antimetabole and the antithesis, for example, are built from parallel cola or clauses; the sound

similarities between the cola would indeed constitute a perceivable pattern and this pattern, along with certain semantic features, can have a certain force and memorability.⁷

For a perceptual rationale behind this memorability, we can find a starting point in the school of Gestalt psychology, whose “laws” have been absorbed as a set of commonplaces in current theories of perception: the laws of closure, similarity, proximity, symmetry, continuity, and finally, the law of *pragnanz* according to which human perception is seen as governed, overall, by an innate drive to make visual experiences regular, orderly, simple, and symmetrical (Boeree, 2000). Of course in the case of figures, the input is aural, not visual. But the point holds: humans prefer patterns in perceptions and work to complete them, and perhaps, from this perspective, reasoning and pattern completion are not all that far apart.

How would such a propensity for pattern detection and completion operate at the level of sentences or propositions? To explore how patterns depending on similar units or sounds are a feature of some of the figures of speech, we can go back to Aristotle, Book III of the *Rhetoric*, where, in his discussion of effective prose style, he first drew attention to *pariosis* or what we would call *parallelism* between cola or clauses (243).

Two consecutive clauses can be parallel in several ways: First they can be roughly the same length in number of syllables or have the same pattern of stressed syllables; hence they can present sound similarities to the ear. Such sound similarities are not trivial since there is substantial evidence from neurolinguistics, based on imaging and studies of brain damaged patients, that the prosodic contour of a phrase, which carries its affective dimension, is decoded separately in the brain from the syntax and semantics (Fahnestock, 2005, 164-68). Hence the prosodic contour of an utterance is a distinct feature. Rhetorical manuals marked out this kind of sound parallelism as *isocolon*, and they advised that in prose, as opposed to poetry, the adjacent cola (clauses) need only be approximately equal.

Next, two consecutive sentences can be parallel not in length but by virtue of having the same grammatical structure, that is, the same placement of subject, verb, object, etc., in relation to modifying phrases and dependent clauses. And within those same grammatical structures, the words used can reflect patterns of organization in the lexicon; that is, the chosen terms can come from the same semantic field or be paired as synonyms or matched as opposites. The sum of all these sources of parallelism would be clauses featuring exact repetition, since precisely repeated phrases necessarily have the same syllable length, grammatical form, and semantic features. Rhetorical manuals paid a great deal of attention to patterns of repetition, whether in the beginnings or endings or within or between clauses.

Taken in pairs, parallel clauses with the same grammatical structure and with repetition can produce an impression of coordination, leveling or similarity between statements. To begin with the obvious, they can effectively express a comparison, though of course two parallel clauses are by no means the only way to express a

comparison. A comparison can be sandwiched into a single sentence or developed across pages of text. But two adjacent clauses featuring the constraints just mentioned can be taken to epitomize a comparison (Fahnestock, 1999, 23-24). A verbal epitome is the most succinct and yet complete expression of a line of argument, as in the following fabricated example:

Clinton sent troops to intervene in Haiti

Reagan sent troops to intervene in Grenada.

These two sentences repeat all but their first and last words, and the words not repeated come from the same semantic categories: US presidents and Caribbean Islands. Whatever the factual nuances avoided here, the parallelism makes these statements comparable if not equal. One could back away from the repetition but retain the same grammatical structure and still preserve the sense of comparability: *Reagan sent troops to intervene in Grenada and Clinton used the military to control the Haitian situation*. Again, such parallelism epitomizes likeness. A real example occurs in Clinton's speech praising the Marines who defended their comrades in Mogadishu: "That's the kind of soldiers they are. That's the kind of people we are" (Clinton, 1993).

In a theory of figuration that is part of a theory of argument, figures are defined as apt or epitomizing iconic forms for the arguments they express (on iconicity see the excellent article by Leff and Sachs, 1990). Nothing of course stops us from going beyond two and piling up more parallel clauses as in the following passage from the second chapter of John Stuart Mill's *On Liberty*.

History teems with instances of truth put down by persecution. If not suppressed forever, it may be thrown back for centuries. To speak only of religious opinions: the Reformation broke out at least twenty times before Luther, and was put down. Arnold of Brescia was put down. Fra Dolcino was put down. Savonarola was put down. The Albigeois were put down. The Vaudois were put down. The Lollards were put down. The Hussites were put down. Even after the era of Luther, wherever persecution was persisted in, it was successful (27).

Here, one could say that Mill has constructed a comparison among seven items. But of course his persuasive purpose in this passage is to offer a summation supported by a series of examples, and these individual instances have been constructed into examples on the basis of parallel predication. So here is the next obvious use of parallelism (with in this case a heavy dose of epistrophe, i.e. repeated endings): parallelism, especially with repetition, is the epitomizing or iconic form for example sets that support a summation or generalization.

Appearing in a text published in England in 1859, Mill's passage builds on the assumptions, beliefs and even anxieties of its contemporary audience. But Mill's argument is also crafted stylistically for effectiveness with any reader of English. The passage uses formal or figural persuasiveness to induce adherence by pattern completion. To support his general claim about the usual success of persecution, each of the instances Mill cites must be immediately accepted as an uncomplicated

particular case supporting the overall point. Accepting the examples as support is encouraged in the first place by parallelism in their presentation. Seven sentences share the same grammatical structure and vary tightly between six to eight syllables, establishing and sustaining a relentless rhythm. By at least the second example, the repetition has set up a pattern and hence an expectation in the reader that the pattern will be continued, as gestalt psychologists noticed.

Furthermore, it is necessary to Mill's argument here that each instance of persecution be roughly equivalent to the others. As Perelman and Olbrechts-Tyteca (1969) point out, when arguers cite supporting examples for a generalization, they tend to reduce or skeletalize the specific instances so that only their common feature has rhetorical presence (358). What would detract from Mill's point here is any sophisticated second thinking about the individual examples that began to make distinctions among them – whether, for instance, the cases of Savanarola and the Albigeois were really equivalent. Instead, the homogeneity of the individual cases is constructed by the repetition so that they can be expressed as equal items in a minimal listing. The equivalence in the examples is also achieved by Mill's use of the passive construction (*were/ was put down*) minus an agent and their forcefulness is further enhanced by the phonetic brutality of the repeated “put down.” Consider the loss of force and clarity if Mill had ended each sentence with an attribution of agency in a “by” phrase (e.g., *Savanarola was put down by the Venetian Doge. The Albigeois were put down by a papal army.*) There would be a gain in historical accuracy, but as the tails of the sentences began to wag out of control, the focus on the point of commonality in the examples would diminish.

Example sets phrased as a sequence of parallel predications were used to illustrate induction in early modern dialectical treatises. Melancthon's example concerns three types of wine (1963a, 620): It was translated into English in Thomas Wilson's *The Rule of Reason*: “Rhenyshe wine heateth/ Malmesey heateth/ Frenchewine heateth, neither is there any wyne that doth the contrary: Ergo all wine heateth” (1970 [1551], n.p.). The same verbal epitome is used in early editions of the venerable Irving Copi, where induction is characterized as probable argument and no clause claiming the absence of contrary examples is offered: “All cows are mammals and have lungs/ All horses are mammals and have lungs/ All men are mammals and have lungs. /Therefore probably all mammals have lungs” (Copi, 1972, 25). A contemporary logic text like Groarke and Tindale's uses a somewhat different canonical instance of an inductive argument: “The group of microchips examined is a representative sample of the chips sent. All of the microchips examined are made to specification. All of the microchips sent are made to specification” (2004, 292). But every one of the “microchips examined” would have to sustain a parallel claim (e.g., “Microchip #234 was made to specification,” “Microchip #235 was made to specification,” etc.).

Rather than fit instances of parallelism with existing argument types, it might also be interesting to ask the bottom-up question, “Given a particular stylistic structure, what kind of argumentative work can it perform?” The set of potential

rhetorical arguments is perhaps larger than typically appreciated (see Tindale, 1999, 113, 200). Here, for instance, are sentences in sequence from Dr. Martin Luther King Jr.'s *I've Been to the Mountaintop*: "The nation is sick. Trouble is in the Land. Confusion all around" (King, 1968, 2). This series exhibits approximate isocolon (5, 6, and 6 syllables), and it seems likely that the final sentence was reduced to a fragment so that it would fit the pattern. Isocolon alone imposes only the constraint of sound parallelism by syllable length; it is a very minimal figure and probably rarely noticed. Yet here it underscores *restatement* as these three sentences essentially repeat the same point.

Another possibility epitomized by parallelism is the *replacement* relation, which is in effect a single antithesis, deploying both isocolon and grammatical parallelism. Here is an example from a Stephen Jay Gould essay in which the second proposition fills the place emptied by the first: "This is not an essay about optimism; it is an essay about tragedy" (1993, 282).

And finally here is the presentation of *alternatives* in parallel phrasing with repetition, again from Clinton's address to the nation on Somalia, "Do we leave when the job gets tough, or when the job is well done?" (1993). To present alternatives is to present roughly equivalent options; hence the epitomizing force of parallelism.

Antimetabole:

There are semantic constraints on all the arguments using parallelism cited above. In comparisons or example sets, the terms filling the grammatical slots should belong to the same semantic category, or at least the audience should believe or come to believe that that constraint has been fulfilled. Once the semantic constraints on parallel clauses are changed, a different set of arguments is epitomized.

Beginning with parallel clauses, instead of repeating terms in the same order we can switch their order. This manipulation creates the figure *antimetabole* which has given us everything from Jesus' revolutionary claim that "The Sabbath was made for man, not man for the Sabbath" (Mark 2:27) to Seven-Up's memorable ad line, "You like it; it likes you." The antimetabole can iconically express corrective inversions, identity claims and claims of reciprocal causality (Fahnestock 1999, 131-155).

And this particular figure had a special place in Aristotelian dialectic as the test phrasing for a statement about a unique property or a definition as opposed to a statement about a genus or an accident. Claims that fell into the former set were convertible; that is, they could sustain an antimetabole. Those in the latter presumably were not. Aristotle's example in the *Topics* shows the convertibility of a property of man: "For if he is a man, he is capable of learning grammar, and if he is capable of learning grammar, he is a man" (Barnes 1984, I, 170).

If we encounter an antimetabole in an early modern work in natural philosophy, from a mind trained in the stylistic identification of argument forms, we can almost

be certain that its author is testing a proposition of a certain kind by its convertibility. When Newton wrote his 1672 paper on the spectrum created by a prism, he used the following formulation as the second in a list of claims:

To the same degree of refrangibility [i.e. bending] belongs the same colour, and to the same colour ever belongs the same degree of refrangibility. The least refrangible rays are all disposed to exhibit a red colour, and contrarily those rays which are disposed to exhibit a red colour are all the least refrangible. So the most refrangible Rays are all disposed to exhibit a deep Violet Colour, and contrarily those which are apt to exhibit a violet colour, are all the most Refrangible (Newton, 1672, 3081).

This statement follows item #1 in which Newton claims, “Colours are not Qualifications of Light, ... but Original and connate properties” (3081). Readers as familiar with Sanderson’s *Logic* as Newton, where the requirement of convertibility is mentioned in the first few pages, would recognize item #2 as support for item #1 (Sanderson 1631, 6, 18). This scholastic formalism could be just an interesting side note but it is arguably much more; it can be seen as the inventional prompt for what Newton reports as his *experimentum crucis* (3078). Because Newton knew the kind of reciprocal claim he had to support, he designed his critical experiment to demonstrate the persistent degree of refrangibility associated with a particular color. In this experiment involving two prisms, the first separates by refrangibility into color and the second uses isolated color to show the same degree of refrangibility. It is otherwise somewhat confusing to see why Newton makes this experiment the crucial one, rather than the other antimetabolic demonstration that white light is split into colored light, and colored light recombined into white light, as reported toward the end of the paper (3086). But here he is testing a definition which should also be as convertible as a claim about properties.

Antithesis:

Still another permutation on a pair of grammatically parallel clauses is possible with another semantic variation. In the classical understanding of word families, great emphasis was placed on pairs of opposites. In Aristotelian semantics as given in the *Categories* and used in the *Topics*, there are four types: contraries, contradictories, correlatives, and privatives (Barnes 1984, I, 18, 189-190). In parallel clauses, key words in the subject and predicate can be matched as opposites, producing the figure of speech antithesis. With this new constraint, the syntactic frame of parallelism expresses not comparability but contrast. *The New Testament*, betraying its origins in Greek rhetorical practices, is filled with these: “For as by one man’s disobedient act many were made sinners, so by the obedient act of one shall many be made righteous (Romans 5.19). Aristotle pays special attention to parallelism that predicates opposite of opposite, giving it a special place in the *Rhetoric* both as the first of the twenty-eight lines of argument in Book II, chapter 23, and as an especially engaging phrase structure in Book III, chapters nine and ten. In Book II, Aristotle recommends trying out a predication where opposite lies

with opposite to see if one has a premise that would be acceptable to one's audience as in his example, Temperance is beneficial because excess is harmful. Constructing a memorable premise in a parallel statement deploying opposite wording works because it satisfies the widely held belief that opposite things should have opposite qualities.

The use of the antithesis to make distinctions by predicating opposite features is illustrated in the opening examples from Kekule, Mendel, Lavoisier and Harvey for whom, as for Newton in the case of the antimetabole, a figure of speech had heuristic power, dictating ahead of time the kind of claim that the evidence had to support. Hence figural epitomes prompt invention and suggest a direction for observations and experiments which may or may not be refuted later.

Other Figures in the Tradition

The figures attended to here that depend on parallel phrasing and certain semantic constraints (parallelism, antimetabole, antithesis) can be connected as epitomes, as "prefab" iconic forms, to certain durable lines of argument taught explicitly in dialectic and rhetoric. But the figure manuals offer many more than three figures of speech; the Roman *Rhetorica ad Herennium* specifies sixty-three and some Renaissance figure manuals offer over two hundred. Does each epitomize or prompt the invention of different lines of argument?

To even begin to address this question requires appreciating the systematics of the figures as it has been worked out over the centuries. Despite expansions and differences from manual to manual, three basic and very different categories of figures, first set up by Quintilian, persist: schemes, tropes and the lamentably labeled "figures of thought" [*figura sententiae*] (Quintilian 1986, III, 350-357). One way to understand these categories is to look back from the perspective of contemporary linguistics and use its subdisciplines of phonology, morphology, semantics, syntax, and pragmatics to help sort out the figures. There are in fact figures that can be placed in each of these divisions of contemporary language study. Some schemes concern sound patterns (e.g., *isocolon*, *alliteration*, *assonance*, *homeoteleuton*), and others specify word or more particularly morpheme construction (*paronomasia*, *agnominatio*). With a baffling desire for precision, figure manuals specify all the ways to alter words by adding, deleting, transposing or substituting letters or syllables. So the sound dimension and the inner construction of words, the territory of phonology and morphology, are amply covered in rhetorical stylistics. (For a dictionary of figures with definitions from classical and early modern rhetorical treatises, see Sonnino 1968.)

Under semantics, the category of the tropes needs no introduction since its most important member, metaphor, has come in some cases to displace not only all of rhetorical stylistics, but all of rhetoric. That metaphors, or more specifically what Aristotle calls in the *Poetics* "proportional metaphors," are arguments from analogy has been frequently illustrated (Corbett 1984, 251-252). The other figures

originally identified as tropes concern some type of displaced reference. These include not only metaphor, metonymy and synecdoche, as forms of renaming according to various principles of substitution, but also devices like antonomasia, antiphrasis, litotes and hyperbole which deliberately rename or misname to create a shared awareness between a speaker and listener on the intention for the substitution and hence the implicated value.

Schemes involve syntax by specifying the precise order of clausal constituents and the placement of phrases. Under this category are all the figures of repetition which are so notable in oratory in the grand style like Martin Luther King Jr's. And to this category also belong the three discussed above – parallelism, with or without isocolon, antimetabole and antithesis.

The final category, figures of thought, corresponds to pragmatics, the subdiscipline of linguistics that concerns features of language determined by context and use. Figures of speech in this third category constitute a very large group of devices that construct or manage the speaker/audience relationship in terms of parameters including their social distance, their group identities, their states of mind and emotion both initially and dynamically in the unfolding of an argument, and in terms especially of their state of agreement on the argument itself. So for example when Kekule said that his argument was obvious and needed little explanation, he was attempting to “preconstruct” his reader's attitude toward his argument. One of the durable devices in this category is *licentia* or “frank speech,” the device by which a speaker acknowledges the power or superior position of an addressee but nevertheless claims to boldly tell the addressee something that he or she would rather not hear, what we now call speaking truth to power ([Cicero] 1981, 349). All these devices either foreground, construct or attempt to manage an unfolding speaker/audience relationship. Some of the figures selected by Tindale in *Rhetorical Argumentation* fall into this pragmatic category (e.g., *praeteritio*, *prolepsis* [Tindale 2004, 78-85]), and it was this category that expanded greatly in early modern treatises which anatomized a very large set of possible speaker/audience interactions and speech acts the rhetor might perform. So for instance, the greatest of the early modern English style manuals, Henry Peacham's *Garden of Eloquence*, includes the figure *ara*, “a form of speech by which the orator detesteth and curseth some person or thing, for the evils which they bring with them, or for the wickedness which is in them” and in Peacham's specification of its use, “This figure is the fit instrument of speech to express the bitterness of the detestation within us against some evil person, or evil thing” (Peacham 1954 [1593], 64). *Ara* has its partner, mentioned next, in *eulogia*, “A forme of speech by which the orator pronounceth a blessing upon some person for the goodness that is in him or her” (65). The former is usually directed at a third party, the latter to the audience.

In the context of a fully rhetorical view of argument, all these devices may have persuasive force; they are all figures of argument from a rhetorical perspective of the three appeals. Knowing them ahead of time, as those trained in the rhetorical

tradition did, could certainly prompt their deployment in a specific situation. But only some of them epitomize the lines of argument used to make a case, to invent the logos.

Conclusion

The tradition of rhetorical stylistics and the analysis of actual arguments, as expressed, the suggestions of neuroscience and the principle of iconicity all elevate forms of expression as important elements in argument. This view of language could inspire again the centuries-old distrust of eloquence that is a hallmark of both the seventeenth-century reformers who wanted to abandon natural language in favor of a perfect symbol system, and the twentieth-century postmoderns who despair over language and the supposed indeterminacy of meaning. Professor Toulmin has reminded us of this destructive perspective in *Return to Reason* and of the concomitant idealization of a mathematical standard of reasoning. But to the sixteenth-century humanists, at the moment of fusion between rhetoric and dialectic, language was still an instrument of power that merited celebration not suspicion. Henry Peacham, author of perhaps the best treatise on style in English, calls figured language, in his highest terms of encomium, the most excellent gift of divine goodness making humans “next to the omnipotent God in the power of persuasion” (Peacham 1954, 3-4). With perhaps less than this pitch of enthusiasm, we can still appreciate the role of craftsmanship in using language and the role of some of the figures as prepared linguistic grooves of argument and ideation. We are in a position to teach our students not only an awareness but perhaps once again a mastery of these forms and their inventive possibilities.

Notes

¹ “Il me parait opportun maintenant de publier les principes fondamentaux d’une théorie que j’ai conçue, il y a assez longtemps déjà, sur la constitution des substances aromatiques, et qui se base uniquement sur des hypothèses que presque tous les chimistes admettent maintenant, à savoir: l’atomicité des éléments en général, et la tétratomicité du carbone en particulier.” (Kekule, 1865, 98); “... c’est ensuite l’espoir de voir cette théorie rapidement confirmée ou réfutée par les nombreuses expériences qui sont en voie d’exécution.” (98).

² “... une chaîne, lequel, considéré comme une chaîne ouverte, aura encore huit affinités non saturées. Si l’on admet, au contraire, que les deux atomes qui terminent cette chaîne se combinent entre eux, on aura une chaîne fermée possédant encore six affinités non saturées” (Kekule, 1865, 100): The pairs of terms to be taken as opposed (ouverte/fermée and huit/six) were italicized in the original. Kekule does continue in the article to explain families of substances in terms of these types of chains.

³ “In der weiteren Besprechung werden jene Merkmale, welche ganz oder fast unverändert in die Hybride-Verbindung übergehen, somit selbst die Hybriden-Merkmale repräsentieren, als dominierende, und jene, welche in der Verbindung latent werden, als recessive bezeichnet” (Mendel, 1866, 9-10; italics added). In the original printing, the words *dominierende* and *recessive* are printed with extra spacing between the letters, and so stand out distinctly in the text, but this effect may be an accidental byproduct of left and right margin justification. The most frequently

used English translation of Mendel's paper does not preserve the minimally parallel phrasing of the original.

⁴ "Mais si à ce premier coup d'oeil on fait suivre un examen plus approfondi de l'arrangement des bancs et des matières qui les composent, on est étonné d'y voir à la fois tout ce qui caractérise l'ordre, la tranquillité, et en même temps tout ce qui annonce le désordre et le mouvement.

Ici se trouvent des amas de coquilles parmi lesquelles on en voit de minces et de fragiles; la plupart ne sont ni usées, ni frottées; elles sont précisément dans l'état où l'animal les a laissées en perdant la vie: toutes celles qui sont de figure allongée sont couchées horizontalement; presque toutes sont dans la situation qui a été déterminée par la position du centre de gravité: toutes les circonstances qui les environnent attestent une tranquillité profonde et, sinon un repos absolu, du moins des mouvements doux et dépendants de leur volonté.

Quelques pieds au-dessus ou au-dessous du lieu où cette observation a été faite se présente un spectacle tout opposé; on n'y voit aucun trait d'êtres vivants ou animés; on trouve, à la place, des cailloux arrondis dont les angles ont été usés par un mouvement rapide et longtemps continué; c'est le tableau d'une mer en courroux, qui vient se briser contre le rivage, et qui roule avec fracas des amas considérables de galets. Comment concilier des observations si opposées? Comment des effets si différents peuvent-ils appartenir à une même cause? Comment le mouvement qui a usé le quartz, le crystal de roche, les pierres les plus dures, qui en a arrondi les angles, a-t-il respecté des coquilles fragiles et légères?" (Lavoisier, 1789, 186-187)

⁵ "Ces premières réflexions nous conduisent à une conséquence naturelle, c'est qu'il doit exister dans le règne minéral deux sortes de bancs très distincts, les uns formés en pleine mer, et à une grande profondeur, et que je nommerai à l'imitation de M. Rouelle, bancs *pélagiens*, les autres formés à la côte, et que je nommerai bancs littoraux; que ces deux espèces de bancs doivent avoir des caractères distinctifs, qui ne permettent pas de les confondre; que les premiers doivent présenter, les amas de matières calcaires, des débris d'animaux; de coquilles, de corps marins accumulés lentement et paisiblement, pendant une succession immense d'années et de siècles; que les autres, au contraire, doivent présenter partout l'image du mouvement, de la destruction et du tumulte" (Lavoisier, 1789, 189-190).

⁶ "Vena & arteria ambae à veteribus venae non immerito dictae, ut Galenus annotavit; eo quod haec, videlicet arteria, vas est differens sanguinem, è corde in habitum corporis; illa sanguinem ab habitu rursus in cor: haec via à corde; ad cor usque, illa: illa continet sanguinem crudiorum, effectum, nutritioni iam redditum idoneum; haec, coctum, perfectum, alimentativum" (Harvey, 1661 [1628], 60; this passage from a later revised edition places a colon between each complete antithesis and the semicolon between each half of an antithesis).

⁷ To briefly illustrate the potential of these figures to express arguments in a memorable manner, the many figured phrases quoted in *Return to Reason* (2001) can be cited: To note just antimetaboles: Toulmin observes that Euclidean models focus attention on "doing your sums right" and not on "doing the right sums" (66); he recalls the Kantian epigrams, "precepts without concepts and concepts with precepts," and "Idealism without Realism is naïve, Realism without Idealism is sterile" (146); he cites Raymond Greene's aphorism about people who put too much emphasis on their work: "Their work eats them up. Whereas they, of course, ought to eat up their work" (113); he quotes Imre Lakatos, "In theoretical arguments, truth flows downward from general statements to particular ones. Empirically the contrary holds good: Truth flows upward from particular examples to broader generalizations" (108).

References

- Aristotle. 1991. *On Rhetoric: A Theory of Civic Discourse*. Trans. G.A. Kennedy. New York: Oxford University Press.
- Ashworth, E. J. 1968. "Propositional Logic in the Sixteenth and Early Seventeenth Centuries." *Notre Dame Journal of Formal Logic* IX.2: 179-192.
- Bakalar, N. 2005. "Ugly Children May Get Parental Short Shrift." *The New York Times (Science Times)*. May 4: F7.
- Boeree, C. G. 2000. *Gestalt Psychology*. <http://www.ship.edu/~cgboeree/gestalt/html>. Accessed 1/15/2005.
- Barnes, J., ed. 1984. *The Complete Works of Aristotle*. The Revised Oxford Translation. Princeton, NJ: Princeton University Press.
- Brewster, D. 1965 [1855]. *Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton*. Vol. I. New York and London: Johnson Reprint Corporation.
- [Cicero]. 1981. *Rhetorica ad Herennium*. Cambridge, MA: Harvard University Press.
- Clinton, W. J. 1993. "U.S. Military Involvement in Somalia." Address to the Nation, Washington DC, 7 October 1993. <http://dosfan.lib.uic.edu/ERC/briefing/dispatch/1993/html/Distpatchv4no42.html>.
- Cogan, M. 1984. "Rodolphus Agricola and the Semantic Revolutions of the History of Invention." *Rhetorica* 2.2: 163-194.
- Copi, I. M. 1972. *An Introduction to Logic*. 4th ed. New York: Macmillan.
- Corbett, E.P.J., ed. *The Rhetoric and Poetics of Aristotle*. New York: Modern Library.
- Costello, W. T. 1958. *The Scholastic Curriculum at Early Seventeenth-Century Cambridge*. Cambridge, MA: Harvard University Press.
- Couzin, J. 2004. "Long-Sought Enzyme Found, Revealing New Gene Switch on Histones." *Science* 306.5705: 2171.
- Eemeren, F.H. van and P. Houtlosser, eds. 2002. *Dialectic and Rhetoric: the Warp and Woof of Argumentation Analysis*. Dordrecht: Kluwer.
- Fahnestock, J. 1999. *Rhetorical Figures in Science*. New York: Oxford.
- Fahnestock, J. 2003. "Verbal and Visual Parallelism." *Written Communication* 20.2: 123-152.
- Fahnestock, J. 2004. "Preserving the Figure: Consistency in the Presentation of Scientific Arguments." *Written Communication* 21.1: 6-31.
- Fahnestock, J. 2005. "Rhetoric in the Age of Cognitive Science." In R. Graff, A.E. Walzer, J.M. Atwill, eds. *The Viability of the Rhetorical Tradition*. Albany, NY: SUNY Press, pp. 159-179.
- Freese, J. H. Trans. 1926. *Aristotle: Art of Rhetoric*. Cambridge, MA: Harvard University Press.
- Gilbert, N. W. 1960. *Renaissance Concepts of Method*. New York: Columbia University Press.
- Groarke, L. A. and C. W. Tindale. 2004. *Good Reasoning Matters! A Constructive Approach to Critical Thinking*. Ontario: Oxford.
- Gould, S. J. 1993. *Eight Little Piggies: Reflections in Natural History*. New York: Norton.
- Harvey, W. 1661. *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus*. London: R. Daniels.

- Harvey, W. 1990. *The Circulation of the Blood and Other Writings*. Trans. K. J. Franklin. London: Everyman.
- Howell, W.S. 1961. *Logic and Rhetoric in England, 1500-1700*. New York: Russell and Russell.
- Jardine, L. 1974. *Francis Bacon: Discovery and the Art of Discourse*. Cambridge: Cambridge University Press.
- Kekule, A. 1865. "Sur la constitution des substances aromatiques." *Bulletin de la Société Chimique* 3:98-110.
- King, Jr, M. L. 1968. "I've Been to the Mountaintop." (<http://www.americanrhetoric.com/speeches/mlkivebeentothemountaintop.htm>)
- Kristeller, P.O. 1979. *Renaissance Thought and Its Sources*. Ed. Michael Mooney. New York: Columbia University Press.
- Kusukawa, S. 1995. *The Transformation of Natural Philosophy*. Cambridge: Cambridge University Press.
- La Fontaine, M. J. 1968. "A Critical Translation of Philip Melancthon's *Elementorum Rhetorices Libri Duo*." [Latin text with English translation and notes.] Unpublished thesis. University of Michigan.
- Lavoisier, A. L. 1789. "Observations Générales sur Les Couches Modernes Horizontales qui ont été deposees par la Mer et sur les Conséquences qu'on peut tirer de leurs Dispositions Relativement à L'Ancienneté du Globe Terrestre." *Memoires Academie des Sciences*, pp. 186-204.
- Leff, M. and A. Sachs. 1990. "Words the Most Like Things: Iconicity and the Rhetorical Text." *Western Journal of Speech Communication* 54 (Summer 1990): 252-273.
- Mack, P. 1993. *Renaissance Argument: Valla and Agricola in the Traditions of Rhetoric and Dialectic*. Leiden: Brill.
- McNally, J. R. 1967. "Rudolph Agricola's *De Inventione Dialectica Libri Tres*: A Translation of Selected Chapters." *Speech Monographs* 34.4:393-422.
- Melancthon, P. 1963a. *Erotemata Dialectices*. In C.G. Bretschneider, ed. *Opera quae supersunt omnia*. XIII: 509-752. New York: Johnson Reprint Corporation.
- Melancthon, P. 1963b. *Elementa Rhetorices*. In C.G. Bretschneider, ed. *Opera quae supersunt omnia*. XIII: 415-506.
- Mendel, G. 1866. "Versuche über Pflanzen-Hybriden." Separatabdruck aus dem IV. Bande der Verhandlungen des naturforschenden Vereines. Brünn: Gastl.
- Mill, J.S. 1978 [1859]. *On Liberty*. Indianapolis: Hackett.
- Mill, J.S. 1874. *A System of Logic, Ratiocinative and Inductive: Being a Connected View of the Principles of Evidence and the Methods of Scientific Investigation*. New York: Harper.
- Newton, I. 1672. "New Theory about Light and Colors [sic]." *Philosophical Transactions* 6: 3075-3087.
- Peacham, H. 1954 [1593]. *The Garden of Eloquence*. Gainesville, FL: Scholars' Facsimiles.
- Perelman, C. and L. Olbrechts-Tyteca. 1969. *The New Rhetoric: A Treatise on Argument*. Trans. J. Wilkinson and P. Weaver. Notre Dame, IN: University of Notre Dame Press.
- Quintilian. 1986. *Institutio Oratoria*. Vol. III. Trans. H. E. Butler. Cambridge MA: Harvard University Press.

- Sanderson, R. 1631. *Logicae Artis Compendium*. 3rd ed. Oxford: Lichfield.
- Sonnino, L. 1968. *A Handbook to Sixteenth-Century Rhetoric*. New York: Barnes and Noble.
- Tindale, C.W. 1999. *Acts of Arguing. A Rhetorical Model of Argument*. Albany: SUNY Press.
- Tindale, C. W. 2004. *Rhetorical Argumentation: Principles of Theory and Practice*. Thousand Oaks, CA: Sage Publications.
- Toulmin, S. and J. Goodfield. 1962. *The Architecture of Matter*. Chicago: University of Chicago Press.
- Toulmin, S. 1972. *Human Understanding: The Collective Use and Evolution of Concepts*. Princeton: Princeton University Press.
- Toulmin, S. 2001. *Return to Reason*. Cambridge, MA: Harvard University Press.
- Vasoli, C. 1968. *La dialettica e la retorica dell'Umanesimo*. Milano: Feltrinelli.
- Whitteridge, G. 1971. *William Harvey and the Circulation of the Blood*. London: MacDonal.
- Wilson, T. 1970 [1551]. *The Rule of Reason*. Amsterdam: Theatrum Orbis Terrarum.

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