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Stasis Theory and Paleontology Discourse

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Stasis theory is a powerful tool for rhetorical analysis, recently under fresh consideration by rhetorical theorists (e.g. Gross) and scholars who identify its utility in the writing classroom (e.g. Carroll). In this study, I apply stasis theory to a paleontological argument involving a controversial fossil, *Protoavis texensis.* Discourse related to the controversy is examined under the lens of the *staseis,* and the application of stasis theory to visual components of argumentative texts associated with scientific communication is explored. This paper applies stasis theory to science discourse based on the work of Lawrence Prelli; Frans van Eemeren, Rob Grootendorst, and Francisca Snoeck Henkemans; Mark Turner; Jeanne Fahnestock and Marie Secor; and others.

Stasis theory illuminates the issues facing a spectrum of audiences, from expert to public, who witnessed the paleontology controversy of *Protoavis texensis* as it simmered between 1986 and the very recent past. Numerous discursive artifacts provide the corpus for applying stasis theory in order to parse the issues at stake in the *Protoavis* case: peer-reviewed journal articles; explanations in popular magazines like *Discover;* personal communications; and illustrations from Chatterjee's publications, most especially his 1997 book, *The Rise of Birds: 225 Million Years of Evolution.*

Introduction

In historical sciences like paleontology and archaeology, claims tend to be hypotheses, and arguments are rarely resolved with absolute certainty; the challenge of understanding scientific articles with a critical, rhetorically-aware eye is left to the audience. Popularizations of arguments in historical disciplines are especially rhetorically complex because of the difficulty in communicating and interpreting elements such as facticity, the degree of confidence scientists have in their claims. The general public is subjected to contradictory information, or *seeming* contradictions, because of the complex ways in which scientists create and transform data, information, and knowledge. Identifying the basic claim in an argument can be a challenge.

From a researcher/theorist perspective, some speculation is often required to assess the standpoints and motivations of the scientist/rhetors when we embark on rhetorical analysis. Classical rhetorical theory and modern developments including argument theory provide tools for analysis, some more effective than others. The tools themselves

are laden with assumptions, and particular argument theories require that certain conditions of felicity or form or context be met before those theories can be applied (van Eemeren, Grootendorst, and Henkemans). A strict interpretation of pragma-dialectical theory, for example, requires that the interlocutors enter the argument with the intention of "resolving differences of opinion" (van Eemeren, et al. 274). Yet in a study about archaeological controversy, rhetorician Jeanne Fahnestock strongly suggests that resolution may not be the goal of scientists, and that "part of the real work of any discipline is its own perpetuation" which may *require* unresolved controversy (65). In rhetoric of science studies, definitions of key terms like "rhetoric," "argument," and many others are handled inconsistently, and are continually questioned and reconsidered. To increase the usefulness of such research, studies of scientific controversies must concern themselves with the terms in the analysis, the context of the disagreement, the motives of speakers, and both expressed and unexpressed values and assumptions operating within the discipline.

As with other historical (and less obviously, experimental) sciences, paleontology knowledge relies on interpretation, and truth is a construct built and continually validated by members of the community. The community typically includes academic scientists, museum personnel, illustrators, photographers, and field workers—those most familiar with the data and its interpretation, and the rhetorical situation in which the arguments emerge and evolve and become displaced during Kuhnian paradigmatic adjustments. Arguments in paleontology are complicated by technical language, sophisticated methodology, and collaborative writing processes. For members of the public witnessing arguments about the origin of bird flight or the lineage of ancient birds, the arguments may seem, or effectively be, impenetrable.

Originally a means for determining the precise legal questions under review in courtroom disputation, stasis theory has been presented in varying ways since the Classical period, though an understanding of stasis as "what constitutes an argument" is generally appropriate (Turner 101). Romans, Medieval scholars, and contemporary rhetoricians all use stasis theory in similar but not identical ways to help describe how issues take shape. Although stasis theory may be seen as primarily a tool for unraveling the value of evidence in the courtroom (forensic rhetoric), it is frequently applied to situations other than the courtroom, as it is considered to be "usable elsewhere, with modification" (Hauser, 133). Scholars have mapped stasis theory onto all discursive realms, expanding it from oral legal argument to multi-modal scientific and technical arguments.

The classical categories of stasis are still useful, and these form the foundations used by various twentieth century rhetoricians. For this reason, I will review classical stasis in a discourse analysis of Chatterjee's writing to exemplify how he initiates arguments by making assertions which lead to stasis of the various types. The responses by Chatterjee's opposition, which establish how argumentation is enjoined, are also offered, though not in elaborate detail.

Next, I complicate stasis theory by using a more modern version adapted for use in scientific controversy by Lawrence Prelli, who offers a two-dimensional model for stasis which plots the traditional categories of Aristotle against field-specific categories representing the way scientists work.

Finally, a dynamic, humanistic model offered by Mark Turner is used to show how stasis may fluctuate as assertions are supported or countered in the discourse resulting from paleontology controversy. This presentation of three ways to apply stasis theory to the paleontology controversy about avian evolution demonstrates the utility of stasis theory for rhetoricians who attempt to unravel and communicate the intricacies of scientific

disputation for a non-technical audience. Its utility hinges on the motivation of the rhetorician and the importance to the public of the subject under dispute.

Stasis is often subsumed under the rubric of the invention stage of forensic rhetoric. Scientific discourse is typically assumed to be forensic in nature, and while rich arguments can and should be made for epideictic and deliberative aspects of such discourse, the connections between forensic discourse, the temporal past, and historical sciences provide a tidy justification for investigations of stasis in scientific texts. The typical definition of stasis, from the Greek “placing or position” and meaning “issue,” suggests a spatial metaphor, that interlocutors must locate themselves within the vicinity of each other’s positions in order for an argument to commence (Lanham).

The concept of field-specificity is also important in discourse analysis. Arguments in different fields (discourse communities or disciplines) operate under field-specific constraints of convention, values, and expectations, identifiable as *topoi* or commonplaces. While some theorists use stasis as a universal or field-invariant method, Stephen Toulmin and others suggest that universal norms are likely nonexistent. Perhaps stasis works best when modified to fit the discourse norms of specialized fields.

The multi-modal nature of argumentative text becomes apparent during the application of stasis theory to discourse. While, typically, transcripts of spoken discourse and published writings are indicated by the term “text,” an expanded concept of text includes non-linguistic elements as potentially rhetorical, and more specifically, potential means of argumentation. Steven Mailloux offers a salient definition of texts: “[O]bjects of interpretive attention, whether speech, writing, nonlinguistic practices, or human artifacts of any kind” (98). Though this definition obviously broadens the site for argumentation beyond spoken or written discourse to other means of persuasion, other theorists consider the intangible processes of text production and navigation as texts capable of rhetorical effect (Wysocki). Images are considered as texts and as high functioning discursive artifacts under the rubric of stasis theory here, as are the hypothesized workings of the texts as readers interact with them.

Most importantly, this study invites further research and theory refinements, and future studies should certainly examine construction of texts as they happen in collaborative situations, where arguments are less likely to be reducible to discrete objects. Stasis theory has the potential to be increasingly useful in those pursuits. This case study, based in part on field research, seeks to provide a model for scientific communicators and rhetoricians who help their students and the public make sense of the complicated controversies in specialized fields.

Background of the *Protoavis texensis* Study

Professor and museum curator Sankar Chatterjee of Texas Tech University, the discoverer of *Protoavis texensis,* a 225-million-year-old birdlike fossil, is a key disputant who primarily publicizes his claims to a specialized audience of his peers using the forum of the peer-reviewed journal article. Some of those peers, most notably Yale Paleontologist John Ostrom, then present their opposing claims in similar ways. Ostrom, for example, asserted in a 1976 paper that *Archaeopteryx lithographica* is the first bird, and the one from which modern birds descended. About ten years later, Chatterjee claimed that *Protoavis texensis* predates *Archaeopteryx,* yet is more closely related to modern birds than *Archaeopteryx.* Both cannot be correct. If we assume for purposes of analysis that the scientists involved are seeking truth, and both have an interest in finding the best explanation of avian origins, then argumentative analysis can commence using any number of tools. In this particular case, stasis theory provides a

structure to unravel, graph, and analyze the arguments of Ostrom, Chatterjee, and others. Identifying particular points of stoppage, where a conflict must be resolved in order for further discussion to be relevant, is one payoff of stasis theory, especially when the issues are technical enough to be initially impenetrable to nonspecialist audiences or analysts.

A dramatic moment precipitating stasis in paleontology occurred in 1986 when Chatterjee re-examined fossils excavated by his team several years earlier. He determined that the fossils were avian in origin, but their date placed them almost impossibly early in the evolutionary timeline; could these 225-million-year-old fossils actually represent ancient birds? As his investigation developed, Chatterjee faced the challenge of unseating the fossil (*Archaeopteryx lithographica*) considered the basal species of avian evolution. The difficulty stemmed from several reasons having to do with the nature of the *Archaeopteryx* fossils:

- Several *Archaeopteryx* fossils exist, from several sites;
- The *Archaeopteryx* fossils are remarkably intact, including feather imprints adorning outstretched wings (soft tissue fossilization is not common, especially in birds); and
- *Archaeopteryx* fossils had cemented a place in both literature and lore of paleontology, having been discovered over a century earlier.

At the same time, the fossils discovered by Chatterjee had some deficits of their own aside from any competition posed by *Archaeopteryx:*

- The fossils did not constitute any complete specimens;
- The fossilized tissues were found disarticulated (jumbled) rather than intact; and
- Feather imprints were absent.

Chatterjee announced his interpretation of the fossils and was subsequently challenged on several fronts, each a site of stasis.

Introduction and History of Stasis Theory

Cicero wrote that stasis theory helps categorize and classify parts of controversies to be resolved by discourse (Matsen, Rollinson, and Sousa). If stasis is a point of departure for argument, then some agreement must have already been reached by the interlocutors. The remaining points of disagreement, perhaps irresolvable, and often shifting rapidly, are illuminated by stasis theory. Within stasis theory, the particulars of evidence and interpretation are exposed and shown to be sites for further contention.

In rhetorical studies and argumentation theory, stasis is often defined to be the point at which colliding points of view meet. Their intersection invites support for the standpoints, forming an issue (Hauser). Stasis occurs during the invention stage of rhetoric (Kennedy), though stasis theory is productively used to identify sites of conflict in discourse wherever arguments are located. The concept of stasis is at least as old as Aristotle, whose words eventually culminated in four key questions for defining key issues:

1. Did something happen?

2. If so, was harm done?

3. If so, was it great harm?

4. If so, was the great harm justified?

Hermagoras is credited with reworking these into another scheme, appending propriety to the list (Kennedy):

5. Is the trial for the crime being conducted properly?

These questions led to corresponding categories for stasis theory which are reflected in these shorthand terms:

- Conjecture
- Definition
- Quality
- Translation
- Method

Cicero's *De Inventione* begins by providing the groundwork for his understanding of stasis theory, known as *constitutio* in the Latin: "Every subject which contains in itself a controversy to be resolved by speech and debate involves a question about a fact, or about a definition, or about the nature of an act, or about legal processes" (Reprinted translation in Matsen et al. 180).

To illustrate the usefulness of stasis theory for understanding controversies in paleontology, some of Chatterjee's claims are presented here and subdivided based on the ancient scheme: conjectural, definitional, qualitative, and translative. For simplicity, the question of method is subsumed into translative (for an important consideration of jurisdiction, see Gross).

Conjectural Issues Surrounding *Protoavis texensis*

The question of fact in a law case is typically in the form:

What happened?

or

Did a crime occur?

Conjectural issues, then, focus on fact. In a courtroom case, interlocutors establish the facts of the crime. In the *Protoavis* case, several factual questions emerge. Few if any scientists dispute that Chatterjee located fossils; thus, the existence of the fossils, and to some degree their authenticity, remains unchallenged. Research of the literature unearthed no claims that Chatterjee had dated the fossils incorrectly; his primary method of dating the fossils based on the strata (layers of rock) in which they were located was acceptable to the audience of paleontologists and ornithologists who responded to the interpretations.

In the *Protoavis* case, the question of conjecture requires only minor modifications from the classical legal form:

What was found?

The simplest answer to this question is *not* a point of argument: "Chatterjee found 225-million-year-old fossils in the Dockum formation in west Texas." It was in the

definition and description of the fossils' significance that stasis erupts. The conjectural question would be easy to over-answer; that is, if "What is it?" were answered, "It's an ancient bird," then stasis moves from conjecture into another subcategory.

Definitional Issues Surrounding *Protoavis texensis*

In forensic discourse, definitions center on questions of this type:

Should x be called a crime?

or

What kind of crime was x?

Definition is easy to translate to paleontology, a science of classification. The definitional and naming issues that *Protoavis* elicited include the following:

- What kind of animal do these bones represent?
- How might the fossil best be described?
- What should the fossil be named?

Chatterjee could have identified the bones in a non-contentious way. Rather than claiming that they were birds, he might have avoided the argument altogether. Science orthodoxy requires, among other conventions, that a paper be published that introduces the new fossil to the academic community. The original describer, in this case, Chatterjee, names the fossil. The discoverer is in somewhat of a quandary; if other scientists are brought in to examine the bones, they might identify, name, and publish on the fossil before the person who discovered them. Thus, the scientist may rush to publish, running the risk of mistaking characteristics or interpretations of those characteristics because of the exigency to publish. Chatterjee worked systematically, as he determined that the characteristics of the bones warranted their classification as "birdlike," he verified his interpretation, and he published. Here, the arguments began to take shape in the scientific discourse, as evidence for the claims is examined.

Paleontologists look at features preserved in the fossil record to classify animals and build theories about how they looked and interacted in their environments. Proto-birds would certainly not have all the characteristics of modern birds. For example, both *Archaeopteryx* and *Protoavis* have teeth, unlike modern birds. Distinctions between birds and non-birds are problematic with respect to bird ancestors. A question about these particular animals is whether they flew. Flight is considered a characteristic of birds, though it is neither necessary nor sufficient (penguins don't fly; bats do). Some flying creatures in the Triassic are neither birds nor dinosaurs, but members of their own distinct class. Classification of *Protoavis* is complicated by the lack of data about its morphology, or form, and locomotion, though Chatterjee has developed mechanical models that do suggest the animal flew.

Feathers are a characteristic of birds not shared by any other modern animals. The feather may be an adaptation of a scale, in which case a link between scaled creatures and birds might be found (and searched for) in the fossil record, but soft tissues are only rarely preserved and thus available for discovery. *Archaeopteryx's* undisputed possession of feathers is a characteristic that made scientists comfortable classifying it as an ancestor to modern birds. *Protoavis* fossils have not to date been associated with fossilized feathers, but Chatterjee claims that quill knobs are evident on the fossils. Thus, Chatterjee logically concluded that *Protoavis* had feathers. Ornithologist Luis Chiappe disputes this and writes, " . . . [T]he wing quill knobs are probably anything but that" (797).

Thus, stasis exists within the association of feathers and protobirds. A syllogistic form may be possible in this case. It is presented here just as an example of formal logical structure within a largely nonsyllogistic argument of probability rather than certainty:

1. Premise: *Protobirds* are theropods with feathers and other avian features.
2. Premise: *Protoavis* is a theropod with feathers and other avian features.
3. Conclusion: *Protoavis* is a protobird

Among paleontologists, feathers are no longer accepted as a distinction between birds and non-birds, especially with respect to ancient creatures. Conceivably, a non-flying, heavy, reptilian animal with feathers could have evolved (as did non-birdlike, feathered Chinese specimens).

The cranial anatomy, aerodynamic potential, and other aspects of *Protoavis* emerge in the literature as issues resulting from the stasis of definition, initiated by Chatterjee when he described the fossil in 1986 as avian in origin and named it *Protoavis* (first bird) *texensis* (from Texas). The naming of the fossil alone became controversial. Some scientists suggested that Chatterjee could have noted the similarity between *Protoavis* and hypothesized proto-birds (called "proavian") without proclaiming it to be a bird. Ornithologist Chiappe writes of Chatterjee's arguments, "[T]he avian nature of *Protoavis* is far from certain" (798).

Qualitative Issues Surrounding *Protoavis texensis*

Qualitative issues classically comprised these kinds of questions:

How important is this, and what are the implications?

or

Is this profitable or unprofitable?

Translating qualitative stasis is more complex than the previous cases of conjecture and definition. The significance of the *Protoavis* discovery is no small matter because of its displacement of *Archaeopteryx* as a direct modern bird ancestor. However, one of the *topoi,* or commonplaces of scientific orthodoxy, is to resist being woven into a convenient story of cause and effect. To claim that scientists would accept or reject a hypothesis based on the impact that hypothesis has on their field contrasts with several expected values of scientists as individuals: disinterestedness, skepticism, objectivity, and perhaps others (Prelli 1989). Suppose that the imminence of a profound discovery about *Protoavis,ala* a Kuhnian paradigm shift, were apparent. Inconvenience to scientists does not justify rejecting evidence of the demise of the old paradigm. Because the primary goal of science is to observe and describe the world, interpreting observations based on disciplinary convenience constitutes a violation of the orthodoxy.

On the other hand, Chatterjee, like all other scientists with a fresh and interesting discovery in hand, stands to benefit should *Protoavis* be accepted into the body of knowledge constituting paleornithology. This is another, separate, site of the quality stasis. In this particular case, it is impossible to recreate in the absence of evidence in the form of discursive artifacts to help identify, isolate, and characterize Chatterjee's motivations and their effects on his discourse.

Chatterjee's fossils remain, to many experts, indeterminate in quantity and quality; parts of bones which may or may not be *Protoavis,* and may or may not be parts of

already-identified individuals, exist (Chiappe). The eminent Yale Peabody Museum Curator John Ostrom, who examined the bones and proclaimed them to be birdlike prior to Chatterjee's first publication, later changed his mind (Zimmer 48–50). In vertebrate paleontology, a fossil fragment often suffices to establish a species as a fact of the fossil record and to be accepted in the scientific community. In one notable example, scientific illustrators found themselves painting out the horn on *Iguanodon's* head and putting the horn on the animal's thumbs after the first articulated (intact) skeleton of the species was identified. The commercial appeal of dinosaurs motivates scientists and popularizers to publicize incomplete evidence, with all the concomitant misinformation that may be made public. *Copia,* quantity of evidence, of course, serves well to reduce misinformation when the number of fossils solidifies understanding of particular specimens. The fact that several complete *Archaeopteryx* fossils exist minimizes the evidentiary power of partial skeletons of *Protoavis,* especially considering *Protoavis'* poorer quality, when they are compared.

The quality of *Protoavis* fossils is not surprising given their age, dating to the very dawn of the dinosaur age, and the soft, degradable tissues birds are largely composed of. Thus, perhaps quality with respect to the data should be a negligible point of stasis. Birds are also able to escape from some of the events that lead to optimum fossilization: burial in slow moving mud flows, suffocation by volcanic ash, and drowning. After any animal dies, its chances of becoming fossilized are remote. Once the bones are fossilized, courtesy of favorable depositional environment and recrystallization processes, they stand every chance of being destroyed by the same heat and pressure responsible for metamorphic rock. Fossils that do end up in sediments are then subject to movements of the earth's crust—folding, faulting, and various other upheavals. Even if a fossil remains intact, its chance of being observed by humans is infinitesimal. Thus, the poor condition of the *Protoavis* fossils should be less important, given the mitigating circumstances, than the fact of their existence and nature as established through the conjectural and definitional *staseis.* Paleornithologist Larry Witmer argues, in the preface to Chatterjee's book, "[T]he more important issue is whether *any* of the bones are avian, because even if only *one* of the dozens of bones are (sic) actually avian, then there really is a Triassic bird" (viii).

Though Witmer's comment suggests putting an end to the arguments focusing on quality and quantity of the bones, claims about quantity and quality arise in the literature, demonstrating a challenge to Witmer's assertion. Chatterjee himself argues for several individuals among his fossils. Chiappe clearly identifies a site of qualitative stasis in the *Protoavis* controversy. First, he directly contradicts Witmer and claims that an avian characteristic does not make a bone avian. Then, he claims that the combination of bones is unconvincing because they were not found close enough together to be considered a single specimen or related species. Finally, he claims that a cladistic analysis is necessary to determine avian characteristics, and no single bone is sufficient for this type of analysis. In the final analysis, both the quality and quantity of fossils provide qualitative stasis in the *Protoavis* controversy.

Translative Issues Surrounding *Protoavis texensis*

The translative (a.k.a. procedural, objection) stasis also provides some interesting complexity. Among the questions that Cicero suggested Hermagoras might have recommended are these:

Who ought to bring action?

or

What is the appropriate place to discuss this issue?

or

What is the proper form of procedure?

In the *Protoavis* controversy, the most potent of Chatterjee's critics is John Ostrom, who personally observed and verified the fossils, and who later changed his opinion about their nature. Hermagoras predicted such interaction, in which, as Cicero suggests, the desire to disparage a rival may itself cause the existence of translative *staseis* in general to be contentious. Perhaps no scientist's claims resulted from personal feelings or motivations, but the possibility of factors beyond data influencing the arguments about the scientific issue cannot be overlooked, and has not been since ancient times.

The translative issues in the *Protoavis* controversy are many and varied. They begin with the field methods Chatterjee employed and continue to the ways that he expresses his ideas in the peer-reviewed academic literature.

The way that Chatterjee publicized his find was mildly or wildly unconventional, depending on whom one asks. He reported the birdlike status of *Protoavis* to his funding agency, the National Geographic Foundation, out of a sense of obligation to them. National Geographic determined that a press release would be appropriate. The press release was considered by some scientists to violate scientific protocol, but Chatterjee insists that he was not personally responsible for what National Geographic did with the information he provided to them. He fulfilled his obligation to the scientific community by publishing on the fossils in the Proceedings of the Royal Society but endured accusations of publishing too little, too late, and in the wrong journal. Ostrom claimed that "The announcement provoked a huge amount of interest, but when it was not followed up promptly with any formal documentation, interest turned to puzzlement" (212). Chatterjee claimed that he made the fossils available for inspection, but others replied that he didn't make them all available enough. For example, Chiappe stated that some "additional material" was "never . . . described or illustrated, and there are no data indicating that it can be undoubtedly referred to *Protoavis*" (797). In a commentary in *Nature,* Ostrom made a particularly strong request that "[O]thers should now be able properly to evaluate [Chatterjee's] claims" and complained that Chatterjee denied scientists "reasonable access" (212). Procedures for establishing probability, Ostrom's words suggest, are at issue in the *Protoavis* controversy, and the discussion in the literature shows procedure to be a site of stasis.

Finally, Chatterjee's credibility as a scientist was challenged by Ostrom who likened Chatterjee's claims about *Protoavis* to the famous cold fusion case–an assault referring to the first publication of the news about cold fusion occurring in popular, not peer-reviewed, forums, and perhaps an allusion to the rapid and fatal challenges against the cold-fusion claims put forth by Pons and Fleischmann. This time Chatterjee challenged the propriety of the disputation, suggesting that his hypotheses were available for criticism but perhaps his person shouldn't be, claiming that he felt personally attacked. Here, a scientific controversy clearly transgresses bounds of scientific thinking and enters into the realm of the interpersonal, demonstrating the fallacy of neat divisions between discursive spheres and hinting at some of the complexity inherent in scientific arguments.

While issues of jurisdiction may seem relatively innocuous, in the *Protoavis* case, they reverberate among paleornithologists. Even the academic field to which a controversy belongs can be a point of contention. The definition of a species is problematic, with geneticists considering the possibility of interbreeding as a way to group species, and

paleontologists necessarily using morphological characteristics (body forms) as a way to identify and separate species. Chatterjee's work influences ornithologists, paleontologists, and biologists in different ways. Scientists in these fields and in their various subfields use exactly the same methods to make different arguments. For example, cladistics, which groups species based on morphology and not chronology, supports a claim that species living in vastly different time periods may be more closely related than contemporaries; cladistics becomes a major tool for Chatterjee's arguments about *Protoavis.* The difference in scientists' applications of theoretical apparatus means that their conclusions may differ. Chatterjee's publication record reflects how he gravitates toward the subgroups whose members have articulated agreement with him; this gravitation is difficult for lay audiences to understand, and the argumentative moves entailed by discursive association may be invisible.

Summary of Classical Stasis Theory and Paleontology Controversy

The previous discussion clarifies traditional characterizations of *staseis* and connects stasis theory to the ongoing debate about *Protoavis.* The scope of the argument allows each of four subcategories of stasis—conjectural, definitional, qualitative, and translative—to be discussed with some specificity. A contemporary and specialized application of stasis theory operates in a different modality: the visual.

Stasis Theory and Paleontological Visuals

In his 1990 examination of biology discourse, Greg Myers makes the point that the imagery in scientific articles may speak louder, and to a broader, audience, than the words on the page. Scientific illustrations provide examples of how debatable claims are set forth by scientists in order to engage an argument. The classification of those claims and argument type requires some complexity beyond Aristotle's pared-down Classical model.

Rheorician Lawrence Prelli expands stasis theory to account for what he observes in scientific discourse. Providing a two-dimensional list of stasis types, Prelli offers *superiorstaseis,* that is, those that are field-specific to science: evidential, interpretive, evaluative, and methodological. These, he claims, correspond to the "four grand functions of doing science" (145). Prelli suggests that Aristotle's *staseis* are *subordinate,* loosely corresponding to the notion of general, referred to by Stephen Toulmin as field-invariant. Prelli combines translation and method into "translative" for rhetorical analysis of scientific discourse. Table 1 summarizes Prelli's taxonomy for categorizing discourse, used to identify *staseis* in illustrations.

Table 1. Prelli's Stasis Categories

Superior *Staseis*

	Evidential	**Interpretive**	**Evaluative**	**Methodological**
Subordinate S*taseis*				

Conjectural	Is there scientific evidence for claim x?	Is there a scientifically meaningful construct for interpreting evidence?	Is claim x scientifically significant?	Is procedure x a viable scientific procedure in this case?
Definitional	What does the evidence mean?	What does construct y mean?	What does value z mean?	What does it mean to apply procedure x correctly?
Qualitative	Which empirical judgments are warranted by available evidence?	Which interpretive applications of construct y are more meaningful?	Which claims are more significant, given value z?	Which investigations exemplify appropriate applications of procedure x?
Translative	Which evidence more reliably grounds claims about what does and does not exist?	Which scientific constructs are more meaningful?	Which scientific values are more significant?	Which procedures more usefully guide scientific actions?

One difficulty of moving beyond stasis as used generally into field specific arguments in science is the question of method. In legal discourse, method can clearly be identified as the method of arguing. In science, however, method is loaded with disciplinary significance. Prelli's superior stasis, "methodological" specifically focuses on the procedures used by the scientists when doing science, not when arguing about their interpretations. Yet both events—the scientific methods and the ways interpretations are argued—might be sites of stasis. Again, further refinements to the theory may be useful in helping determine which types of questions to use in various situations, and until consensus is reached, the arguments themselves are often easily classified as communication issues or science issues. Both arise in scientific arguments and neither need be privileged or ignored.

Staseis **of Illustrations**

Illustrations of fossils, ranging from anatomical skeleton reconstructions to panoramic depictions of habitats, are expected and useful accompaniments to scientific literature in various contexts. Drawings that reconstruct *Protoavis texensis* pose interesting foci for dissecting arguments about the interpretation of the fossil. While the photographs provided in the peer-reviewed journal articles inspired objections, the reconstructions of

the anatomical parts of *Protoavis* in the popular book raised even more opposition, evidenced in part by challenges to nature and interpretations of the fossil data (e.g. Chiappe). I consider here the different audiences Chatterjee addressed: expert paleontologists like Chiappe, and, in the book, a range extending from expert to novice. Technically literate graduate students or experts in fields other than paleornithology comprise the "expert" end of an audience spectrum, and the interested but less technically literate public are at the "novice" end of the spectrum. Here, technical literacy simply refers to degree to which the audience member is an insider, comfortable with the specialized languages of paleontology or the more specialized paleornithology. Assumptions about the audience emerge when the selection of graphics is analyzed.

Classifying Visuals

Drawings in paleontology texts span a range of types, and a vocabulary for describing them facilitates conversations about the illustrations. While any number of conventions might be used as a way to talk about illustrations, Myers provides a range of categories that allows discussing photos and different types of scientific drawings. Myers suggests that based on the amount of "gratuitous detail," illustrations reside somewhere along this spectrum (Figure 1).

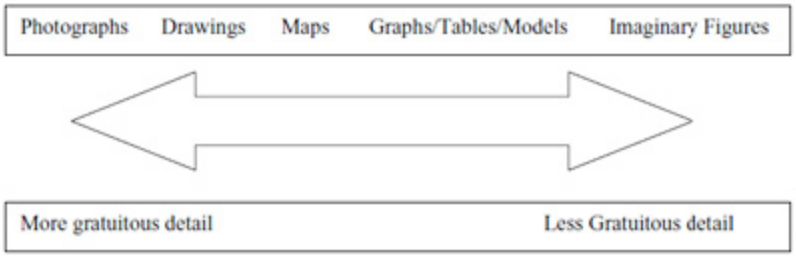

Figure 1. Myers' range of detail.

Photographs typically include the greatest amount of gratuitous detail. However, in the case of paleontology, illustrations incorporate more detail (gratuitous or not) than photos. Gratuitous detail, according to Myers, makes illustrations seem "contiguous" with the real world. If we define "gratuitous" as Myers does, "squiggles and splotches that do not seem relevant to the claim the picture illustrates" (235), then *Rise of Birds* illustrator Michael Nickell can certainly be said to have added details that, despite seeming irrelevant, would help the drawings be more persuasive, if only because of the realism in the illustrations. The photographs, in contrast, show fossils against a blank (white) background, with none of the detail of context and setting that we typically associate with a photographic representation of life.

Gratuitous detail is a fascinating rhetorical device if in fact a sense of contiguity with reality is persuasive for a nonexpert reader, but that hypothesis has not been seriously studied. It is however probable that lay readers are likely to be unskilled in identifying and challenging the interpretive components in Nickell's work and would probably interpret the work as established or accepted scientific fact rather than as a hypothesis. Expert readers quickly point out conjectural features of such illustrations and incorporate them into various arguments about the plausibility of concomitant interpretations.

Illustrations in Chatterjee's publications of interest here include photographs of the fossils, relatively simple skeletal reconstructions, more detailed restorations of dinosaurs as complete animals, and cladograms. For examples of reconstructions and restorations, see Czerkas's images, available online [1].

Other images that comprise or support arguments include panoramas that place *Protoavis* in a habitat, diagrams showing *Protoavis* as a link in the food chain, cladograms, and maps identifying where *Protoavis* lived.

Photographs as Evidential Conjectural

Photographs of the fossils offer the most direct evidence of the existence of *Protoavis.* Though the fossils themselves are the best available evidence, their delicate nature and obvious value is cause for their being closely guarded and preserved. These photographs might account not for a site of stasis, but for the avoidance of stasis: if Chatterjee can assert a fact that will not or cannot be challenged, resulting in absence of stasis (cf. Turner), he can move to other points of argument. In "Cranial Anatomy," Chatterjee's article that introduced the academic community to *Protoavis,* extensive photographic plates of individual fossilized bones are included as appendices. Ostrom criticized these photos, writing that "What we have are photographs of miniscule size and marginal quality, arranged in a confusing format" (212).

Subsequent publications omit such photographs altogether. Chatterjee's popular text, *The Rise of Birds: 225 Million Years of Evolution,* contains photographs, but only of the dig site, not the fossils. Instead, illustrations by Michael Nickell provide the book's best representations of Chatterjee's data. Chatterjee was criticized for not giving the audience for his book enough evidence to make a determination as to whether *Protoavis* should be considered the Ur-vogel. Chiappe claimed in an *American Zoologist* review that "Even though a complete skull and postcranial bones are illustrated in a way that appear to be uncontroversial in their anatomical details, the actual data on *Protoavis* is indeed poor and controversial" (797). The criticisms of the fossils identify the evidential/conjectural site of stasis, given the relative inaccessibility of the bones to experts and public audiences.

Photographs as Evidential Definitional

An important photograph that was published first in 1999 shows *Protoavis texensis* fossils arranged in such as way as to show what the fossils may have looked like had they been found in an articulated skeleton. The fossils were found disarticulated, jumbled, when they were discovered in the field, and the process of removing them from the field, and then from the matrix of debris surrounding them, hindered reassembling the puzzle. The articulated skeleton makes a strong claim visually that the animal had a particular morphology or form. In the photograph, the claim is not that the animal existed, but that the animal looked the way it is laid out in the photograph.

The stasis represented by the photograph is best identified as evidential definitional because the evidence is now interpreted and used to indicate something more than mere existence. The absence of such a photograph became a point of argument, and a site of stasis in Kevin Padian's *BioScience* book review of Chatterjee's *The Rise of Birds.* Padian forces the argument to stall based on the presentation of the available evidence: "Regrettably, no photographs of the original material are included, only reconstructions" (2). An argument can be made that such a complaint fits more neatly into another of the subordinate categories. However, the criticism of the method in which the evidence was provided to the various audiences in visual form is obviously a matter worthy of careful consideration; examinations of stasis offer the best ways to parse such arguments.

Enhanced Restoration As Methodological Conjectural

An enhanced restoration illustrated by Michael Nickell fills in missing bones and missing parts of existing bones, along with the placement of those bones in a drawing that suggests a typical position for the animal. An intermediate illustration exemplified by enhanced bone restoration intersects definition and method and thus fits the stasis category of methodological conjectural, when constituting the basis of argument, based on Prelli's classification. Decisions made about exactly how to fill in missing pieces of the fossil puzzle must reflect the scientists' and artists' sense of scientific viability. Typically, in the scientific illustration process, sketches move back and forth between scientists and artists as the best possible representation of the image is produced. An artistic rendering constitutes a form of scientific procedure, under this interpretation. The problem with the use of the term method becomes clear here: the method might be the way the argument is enjoined, the method the scientist used in collecting or analyzing data, or the method of visual presentation.

Detailed Restoration As Evidential Qualitative

A major point of contention among paleornithologists considering *Protoavistexensis* involves the question of whether it had feathers. Although feathers are no longer considered to be unique to birds, feathers influence how experts would categorize and describe the species. In the *Rise* depiction of *Protoavis* in the detailed restoration, the silhouette suggests feathers. In stark and perhaps unfortunate contrast to the lavishly feathered and fabulously preserved *Archaeopteryx* fossils, *Protoavis* left no feather impressions among its scattered bones. Chatterjee claims he has identified quill knobs in the fossils, but Ostrom challenges this as speculative (Zimmer 50). The goal in science is to yield an empirically warranted judgment; whether available evidence allows that judgment to be that *Protoavis* had feathers is a matter of interpretation and not data. The evidential/qualitative stasis is clearly the resting point of the argument because until the scientists agree about whether *Protoavis* did or did not have feathers, the argument is unlikely to advance.

Cladograms as Visual Arguments

Cladistics may or may not be a valid construct for interpreting *Protoavis,* depending on whom one asks. Chatterjee was challenged by cladistics experts who claimed that fossils missing as much substance as the *Protoavis* fossils could not possibly provide enough material for a valid cladistic analysis. Cladistics requires the input of an animal's physical characteristics into a computer program which then suggest the most likely phylogenetic relationships between the subject species and other known species (Shipman 32). The output is a visual map of phylogeny called a cladogram, a diagonal line with straight "branches" depicting related species.

Cladograms may exemplify what Myers sees as "optimization models which can be seen as curves looking for data points" (244). This is as good an explanation of the cladogram, and as good an argument for the cladogram being a rhetorical construct reflecting the necessity of addressing stasis, as we find, given the available models for rhetorical categorization of illustrations.

Cladograms as Interpretive Qualitative

Chatterjee uses a cladogram to place *Protoavis* in the lineage of Mesozoic birds. Chatterjee's inclusion of particular cladograms and the exclusion of other possible cladograms asserts that these, and only these, cladograms are necessary for the reader to judge the likelihood that *Protoavis* is morphologically related to birds. Padian claims

that “[A] full phylogenetic analysis needs to be done incorporating all available taxa and characters, based on previous work as well as on Chatterjee’s new interpretations” (206). Thus, the offering of cladograms by Chatterjee, and the critique of them by Padian, shows them to be a site of stasis; the cladogram or cladistic method is a construct through which interpretations of *Protoavis* features may be deemed meaningful. When questions about the utility of cladistics are raised, the superior stasis is still interpretive, but determining the appropriate subordinate stasis requires more investigation.

Summary: *Staseis* and Paleontological Illustrations

Clearly illustrations are sites of stasis. Their presence, accuracy, and entailed claims are all subject to published attack by interlocutors in the *Protoavis* debate. Stasis theory and illustrations intersect in meaningful ways. The stasis of text, applied to verbal and visual elements, is relevant for rhetoricians and argument theorists studying scientific controversies, and more importantly, provides a tool that could also be useful for scientists and lay readers attempting to unravel the strands of argument that exist in any complicated controversy. As for visual stasis, if illustrations functionally offer sites of stasis in arguments under any of the models of stasis which exist, then the study of argumentation in nonverbal forms is warranted.

Turner’s Dynamic Stasis in Paleontological Discourse

Mark Turner gives stasis theory new light by describing it as a dynamic system resonating with human reality. His view of language as metaphoric, imaginative, and perhaps poetic at its root informs his interpretation of stasis theory. Among other arguments, Turner claims that human understanding of force dynamics comes from the physics of human motion, and that metaphors of stasis can accommodate a human way of knowing and arguing, making it almost a natural way to conceive of argumentation. Turner’s metaphoric “force-dynamic image-schema” is used to map a simplified version of the first-bird controversy.

Turner credits his argument in part to a 1950 publication by Otto Alvin Loeb Dieter and also to Cicero (103). Bilateral opposition is critical for the identification of stasis, and the importance of symmetry is examined by Turner. Argumentative symmetry exists when a movement (e.g. a claim) is met by a countermovement, and the one ends where the other begins. Dieter, quoted by Turner, explains, “the middle stasis is the point of reversal” (102). The middle point in this case is not spatial, as it would appear in a drawing, but temporal and conceptual (consecutive): the counterclaim starts at the point in time when the claim ends.

Turner identifies a second model of stasis in which two points of view collide head-on, a simultaneous model of stasis, as opposed to the consecutive model. Hultzen’s vivid explanation of stasis as a “static impasse” is borrowed by Turner, who claims that this model is the most common view of stasis (105). Cicero’s term (in translation), “clash,” Dieter explicates as “originative agonistic standing.” Dieter argues that the original meeting of positions, not the subsequent movements away from the site of the clash, is the point of stasis, the point at where the argument is enjoined. Turner claims that Dieter conflates this model with the consecutive model. Turner claims that Dieter fails to recognize the difference between the consecutive movements model and the simultaneous model, but that this difference is important because like objects, the claims of the disputants possess more energy *at the point of* stasis under the simultaneous model.

Turner’s third model of stasis is the culmination of the force-dynamic image schema

metaphor he develops. It relies on metaphoric concepts of physical momentum as properties of propositions and builds on both previous models of stasis, the consecutive and the simultaneous. Turner builds a metaphor with imagery: common ground, a landscape, a location (movable) for the point of contention, and forces that pull and push. Turner's model of stasis, when applied to his concept of argument, provides a working definition: "[I]f there is no common ground for physical forces to meet upon, then the two contrary assertions cannot meet; they therefore cannot achieve stasis; they therefore by definition cannot constitute an argument" (109). The model, if constructed correctly, justifies the claim that a dispute is an argument, while simultaneously mapping it.

Such definitions call into question differing fundamental assumptions behind what constitutes an argument. Turner's contrasts with definitions provided by other scholars, such as van Eemeren, Grootendorst, and Henkemans, in explanations of argument theories such as pragma-dialectics. Turner's definition identifies argument as disputation within a common set of understandings, not simply any two conflicting assertions brought together, if the goal is to resolve the dispute. In van Eemeren's definition, desire for resolution must be present for an argument to be constituted under the pragma-dialectical model. In this way, Turner's model is both more limiting and more liberating than van Eemeren's. Common ground is not specifically referred to by van Eemeren, allowing more disputes to fit into their definition of argument. Though the desire for resolution of a dispute is not a necessary condition for the constitution of an argument and thus for the application of stasis theory under Turner's model, common ground is a necessary condition. It is not a sufficient condition, because at least two other conditions must be met: sufficiency of claims or context and sufficient knowledge. Overall, the Turner model of force-dynamic image-schema stasis is descriptive, while the pragma-dialectical model is inherently normative. The Turner model is thus more interesting to use for critical analysis of arguments that have already occurred, rather than for suggesting how arguments should ideally be structured. Most models of argumentation, it should be noted, presuppose factors of a rhetorical context including the existence of rational interlocutors acting with intentionality.

In order to apply the force-dynamic image-schema model to controversies in paleontology, the establishment of common ground on which interlocutors act is a first, necessary step. Secondly, the sufficiency of knowledge on the part of the interlocutors should be shown. Finally, the claims and the context must be understood by the interlocutors in similar enough ways that they stay on common ground rather than stray into areas which exclude the opposing speakers or claims.

I will only treat these conditions in a cursory manner, beginning with common ground. Research into the discourse of paleornithology convinces me that Ostrom, Chatterjee, Padian, Chiappe, Witmer, and other actors in the bird wars concur on more points than they dispute. Their training in biological sciences, specifically in geology and paleontology, and to varying degrees in ornithology and cladistics, involved enculturation into the academic orthodoxy of their fields. The nature of the academy and its conservative means of validation and knowledge production (refereed publications) forced these scientists to work within the same paradigm for most of their careers. These men are all well-established in their fields, having met what science rhetorician Dale Sullivan calls "stringent requirements" of disciplinary mastery and having forged appropriate alliances. Both Ostrom and Chatterjee hold positions of great respect as both professors and museum curators; Ostrom is at Yale and Chatterjee is at Texas Tech. The journals they read, conferences they attend, and textbooks they use in their classes are constructed from agreed-upon basal knowledge. Such claims about the similarities between the interlocutors are supported by scholarship investigating forum control of the scientific orthodoxy (Sullivan).

Given the common ground on which the controversy can be said to lie, and sufficient knowledge with which to make opposing claims, the force-dynamic image-schema analysis of stasis can be visualized for the paleontological debates. The static images in the figures are suboptimal but provide the start of a model which may better be achieved with video than still imagery, and for this reason, as I drew various sites of stasis, I began conceiving of them as frames, imagining what a video of the argument might look like.

I diverge from Turner's model only in allowing temporal discontinuity. If the application of the model is successful, it will clarify the nature of the argument (and whether it is constituted as such), identify the sort of argument, and if necessary, show how the argument fails to be constituted, in that eventuality (Turner 111). Turner lists four classical types of arguments: conjecture, definition, quality, and objection (110).

In 1976, Ostrom published an article beginning with the line, "The question of the origin of birds can be equated with the origin of *Archaeopteryx,* the oldest known bird" (91). Subsequent authors moved this argument forward by citing Ostrom, referring to *Archaeopteryx* as the oldest bird, or by building on his claims as they placed other fossils into a possible evolutionary scheme. A 1986 press release issued by National Geographic claimed that the *Protoavis texensis* fossils Chatterjee discovered in Triassic strata in Texas represented the oldest known bird (Padian 1998). Such claims directly contradict Ostrom's claim for *Archaeopteryx* and provide an opportunity for seeing stasis as a phenomenon of motion rather than a static model. As the debate raged, various scientists weighed in, each shifting slightly the momentum of the arguments from various positions. Padian in fact stated that "Protoavis is not accepted as a bird by most paleoavian workers, and it may never be . . ." (206), suggesting perpetual movement of the argument.

In mapping the argument, Turner suggests the following approach:

- Place propositions on a plane resembling a topographic map (with features such as sites with benefits for one or another position);
- Identify simultaneous oppositional claims; and
- Identify the type of claim at the point of stasis, the midpoint in the clash.

Here, Turner and I diverge. While he tackles an analysis of situations and metaphors that take the concept of argumentation to new levels, I restrict the approach to examination of the claims in the arguments of paleontology, resisting the complexity Turner invites through remaking the model to better fit deliberative discourse, and completely avoiding Turner's discussions of overarching metaphors he hopes will propel similar studies. I reduce Turner's thesis and present the final step:

- Track the argument as it evolves when it is conducted, evaluating the effect on the positions of evidence, *loci/topoi,* and considering the effective end of the argument: for example, whether winning results in one side's defeat or mutual compromise.

Figure 2 depicts a possible frame in this visualization of the theory of stasis and the process outlined above, using the bird origins argument as a case. In 1976, Ostrom presented an interpretation of *Archaeopteryx* as avian that went without high-profile challenge until Chatterjee's 1986 identification and interpretation of *Protoavistexensis.* At that time, *Archaeopteryx* had a position of advantage in arguments about bird origins. After 1986, when Chatterjee's interpretations of *Protoavis* displaced *Archaeopteryx* as the closest and oldest ancestor of birds, Chatterjee initiated definitional stasis coinciding with the movement of positions as Ostrom's original claim lost ground.

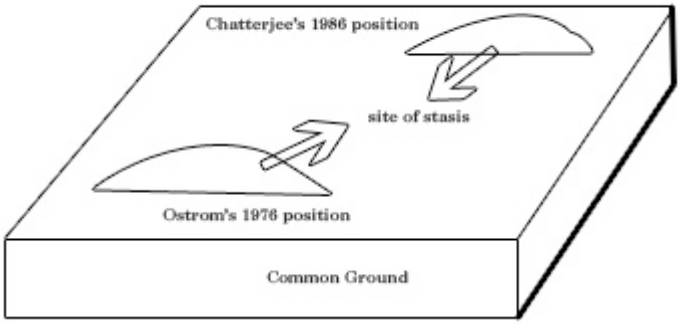

Figure 2. Oppositional claims by Sankar Chatterjee and John Ostrom, located on common ground of paleontological expertise.

Definitional Stasis under Turner's model

Turner's model can account for positions articulated at different times, as long as the criteria of common ground, common knowledge, and shared contexts exist. The model provides a way to visualize not only the positions as they are articulated, but also the type of stasis that is achieved when the argument is constituted. A dispute between John Ostrom and Larry Martin is depicted in Figure 3.

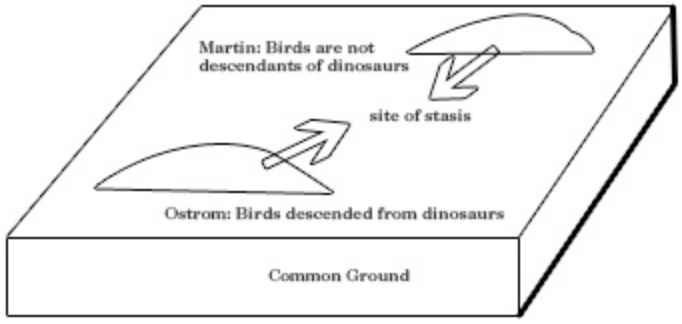

Figure 3. Oppositional claims by John Ostrom and Larry Martin, located on common ground of paleontological expertise.

In 1973, Ostrom published a paper stating his interpretation that dinosaurs are avian ancestors. In the mid 1990s, Martin reviewed several different texts on avian origins, and referred to Ostrom's theory, stating that the argument could be traced to Huxley; however, birds did not descend from dinosaurs, they descended from reptiles that predated dinosaurs. In 1998, Ostrom countered, "No nondinosaurian reptile has been identified as even a possible bird ancestor" (3). The dialog suggests that a consecutive model appears to apply to this case better than simultaneous model; of course, Turner's dynamic model can account for either. Figure 2 shows a possible pattern of positions of both interlocutors, relying on the reader to imagine movement from Ostrom, to Martin, and back again to Ostrom, and the swaying of the tide of opinion about bird origins as swelling of the landscape, rising in Ostrom's favor as he makes claims, and in Martin's favor when his claims dominate.

Conclusion

Stasis theory offers not only a framework for argumentative analysis, but also a series of alternatives, any of which may prove useful to technical or scientific communication theorists and rhetoricians wishing to promote the understanding of scientific controversy across various audiences. The cases I have studied, involving the debates over avian origins, provide a site for applying and examining versions of stasis theory. The bird-origins argument remains vital, with continual new discoveries and subtle movements to the Archaeopteryx-as-protobird paradigm, perhaps building up to a major paradigm shift. Although *Protoavis* has made its way into textbooks, the repository of received knowledge in paleontology, many scientists still dispute its standing as a protobird. Chatterjee's claims may also be evolving in the direction of arguing for *Protoavis* as a feathered theropod, not a bird.

Stasis in science exists in different forms between different interlocutors, sparking arguments within and across disciplines, discourse communities, and audiences. The temporal element of long-running arguments forces us to adopt a model that accounts for its recursive nature and varied forms, in which stasis spawns stasis, and stasis entails stasis (Fahnestock and Secor). Thus, analysis may never be completed because of the dynamic nature of arguments themselves, yet the lack of finality does not negate the usefulness of stasis theory to rhetoricians, despite the necessity of viewing snapshots or frames rather than complete linear sequences. In practical terms, an understanding of stasis theory may be used to clarify the reasons behind *Protoavis'* exclusion from some scientists' theories of avian evolution; one direction of further analysis is clearly Turner's detailed examinations of how *a*stasis, the lack of stasis, can prevent the commencement of argument.

The absorption of a controversial interpretation into the world of legitimated, orthodox scientific knowledge is a complex rhetorical process in which argumentation plays a vital part. Using some version of stasis theory, some of the conflicts between the spheres of the technical, the public, and the personal may be illuminated. The degree of modern technological knowledge required to make sense of discourse within academic, professional, and political subcommunities disenfranchises the public, to the detriment of participatory democracy. The singularity of "the public" is aptly, by Hauser, labeled irrelevant and is replaced by the more robust concept of multiple, dynamic "publics." To the communication instructor, who may be in the position of translating technical knowledge into information useful to general publics, visual rhetoric may become especially important, and thus the intersection between visuals and stasis theory is a good site for further research. If the nature and meanings of the illustrations designed by experts can be clarified for nonexpert audiences, those illustrations may bring the publics and the experts closer together through shared understandings. In order for this undertaking to be considered seriously, current assumptions about what constitutes "text" and "argument" may need to be revised.

The utility of stasis analysis remains largely untapped; stasis theory could provide rhetoricians, communication theorists, and other scholars a vehicle through which we might enhance the ability of widely varied audiences to interact fully with a broad range of technical arguments over a spectrum of modalities. My hope is that our fields will rediscover stasis in all sites of argumentative discourse, whether the arguments are constituted through words, images, links and nodes, or any other rhetorical elements. Then, we may again see stasis theory as being as useful and significant as it was in the courtrooms of Cicero's Rome.

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