

## ABSTRACT

Title: SCIENCE IN THE PUBLIC EYE:  
COMMUNICATING AND SELLING  
SCIENCE THROUGH IMAGES

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Scientific visuals designed to capture the attention of nonscientist audiences appear everywhere—from magazine covers to Internet blogs, from billboards to the Discovery Channel—and yet they have not received the critical attention they deserve. Situated at the crossroads of the rhetoric of science, communication studies, visual design theory, and the still emerging field of visual rhetoric, this dissertation seeks to shed light on the persuasive function of visuals in communicating science to non-experts. Occupying a grey area between scientific visualizations and “art,” the visuals used to communicate science to nonscientists should be classified, I argue, as scientific advertisements. Their purpose is to sell a positive and supportive attitude toward science, and since this need for support has existed since the scientific revolution, scientific advertisements have existed in different guises at least since the seventeenth century. Their form, however, differs, depending on the available technology and modes of representation. In this dissertation I explore how such images as frontispieces, portraits, magazine covers, and aestheticized visualizations

have contributed to the legitimization of science across temporal and cultural boundaries by influencing public attitudes towards scientists and their research. This project addresses the concern surrounding the public's current disengagement from science by considering whether science can be "sold" visually in a more responsible way.

SCIENCE IN THE PUBLIC EYE: COMMUNICATING AND SELLING SCIENCE  
THROUGH IMAGES

By

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## Chapter 1: Introduction

“In a world where science literacy is dismayingly rare, *illustrations provide the most immediate and influential connection between scientists and other citizens*, and the best hope for nurturing popular interest. Indeed, they are now *a necessity for public understanding of research developments.*”

--The National Science Foundation (emphasis added)

For the past nine years, *Science*, a weekly publication by the American Association for the Advancement of Science (AAAS), and the U.S. National Science Foundation (NSF) have co-sponsored an International Science and Engineering Visualization Challenge. The competition solicits eye-catching scientific visuals in different categories and presents awards for each (e.g., photography, illustration, informational graphics). An expert panel of judges selects award-winning images that contribute to the Challenge goals of promoting, as the quotation above clearly states, “public understanding of research developments.” Towards that end, a new addition to the Challenge in 2011 now allows *visitors* to the NSF website to vote for

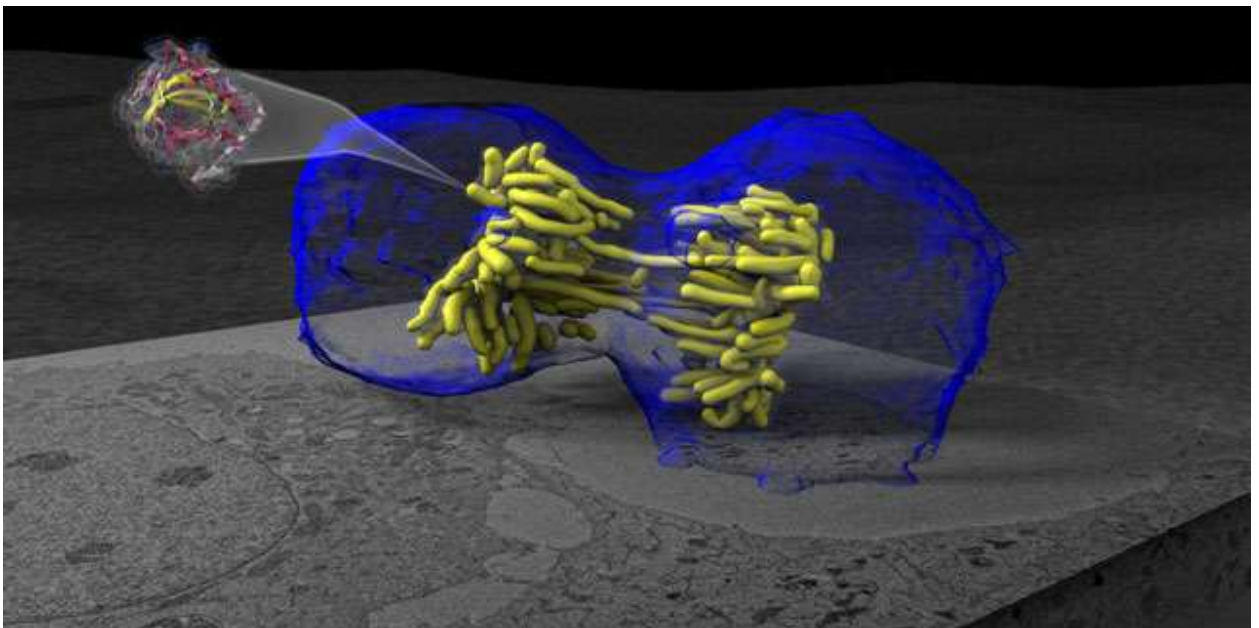


Fig. 1: “Separation of a Cell.” *Science*. 3 Feb. 2012.



their favorite images in each category, and the winning images are given a “People’s Choice” award.

Figure 1, titled “Separation of a Cell,” is the 2011 winner of the People’s Choice award in the category of Illustration. There were 3200 votes from visitors to the NSF’s website that were tabulated into the People’s Choice awards, according to the Special Feature article in *Science* that reports on the competition. What the article does not say, and perhaps what cannot be determined from the voting mechanism, is who these voters are. What audience, in other words, visits the NSF website frequently enough to be aware of the Visualization Challenge? What “people” does this audience comprise?

Although the Challenge has as one of its primary goals to foster communication “between scientists and the general public”—two diverse, stratified entities that have been characterized problematically as homogenous and opposed to each other— it is not likely that anyone other than people interested in science voted for their favorite images in the competition. To reach the target audience of “the general public,” the images would need to be displayed in a venue frequented by broad audiences, not the National Science Foundation website. Even if the image did travel on the Internet to more democratic venues, a phenomenon that I will focus on later in this chapter, what would this image communicate to nonscientists?

I have provided the title: “Separation of a Cell.” But is the title enough to assist viewers in comprehending everything going on in this image? Is it possible to explain what all of the different components represent—for instance, the yellow

objects, and the small gray and pink orb? There is no key or legend included with the image to help viewers identify these different components.

There is, however, a caption for the image provided on the NSF's website:

This new and tactile view of a cell undergoing division comes thanks to a specialized protein called MiniSOG. This illustration shows the molecule zipping toward the reader, fluorescent and standing out crisply from an electron microscope image. With some tweaking, MiniSOG binds tightly to a second protein closely associated with DNA, giving scientists the ability to target and view chromosomes in detail as they peel apart during mitosis (Strain "Caption").

Unless viewers are familiar with biology or have recently taken a class in it, then the caption probably does not help with identifying the various components in the image. That is because there are some terms in the caption that would need to be defined for viewers who have not recently been in a biology class. For instance, the terms "MiniSOG,"<sup>1</sup> and "protein" the way that it is used in this context, and maybe even "mitosis" could use definition. Beyond unfamiliar terminology, there is also a lack of context for general audiences. In other words, what is the significance of scientists being able to "target and view chromosomes as they peel apart"? What exciting things can happen now because of that new ability?

I begin with this example because it illustrates some of the issues surrounding current science communication efforts. A part of the problem is the perceived scientific "illiteracy" of the public, alluded to in the quotation by the NSF that opens this chapter. The notion of *scientific illiteracy* is highly contested. Is it possible to measure something as vague as scientific literacy? Representing one attempt is the 2009 Pew Research Center Poll, which consists of a multiple choice test (see "Pew

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<sup>1</sup> MiniSOG stands for mini singlet oxygen generator.

Research”). This project does not attempt to join the discourse on scientific literacy, but rather suggests that visual communication can assist in public outreach attempts. By *public outreach* I mean a process of engaging non-expert audiences—a process that has not yet achieved a balance between the notions of *public education* and *public appreciation* of Science, two concepts elaborated on in the section below on science communication.

The NSF’s Visualization Challenge draws attention to the *potential* of visual discourse to improve public outreach, and it also exhibits some of the challenges associated with visual communication that must be addressed. One of these challenges pertains to audience conceptualization. When the intended and actual audiences for an image are different, there are bound to be communicative problems, as the above example demonstrates, because different audiences require different amounts of contextualization. But another major challenge with visual communication—one that does not have an easy solution—is the widespread misconception that images are more accessible than verbal or written discourse.

There is a pervasive assumption that because images are immediate and readily available to be taken in that they are somehow easier to understand than spoken words or text.<sup>2</sup> This assumption is still apparent in many college composition programs, which reflect a fear of teaching visual communication because it might be

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<sup>2</sup> E.g. Bizony: . In a recent article in the magazine *Engineering & Technology*, science writer Piers Bizony celebrates the merger of art and science, arguing that “pictures speak to all of us”—even, he says, “people who aren’t so fluent in that [scientific] language” (43). Bizony’s attitude is similar to the one expressed in the NSF’s Visualization Challenge manifesto; there is this notion that visuals are a great equalizer, that everyone can comprehend visual “language.”

seen as a baser form of communication.<sup>3</sup> Anybody can look at images and understand them. The visual example that opens this chapter has already shown that that is not the case. Images—especially science images—need to be accommodated for different audiences.

Jeanne Fahnestock describes the process of “accommodating” scientific information for non-expert audiences. She demonstrates that when scientific reports are “accommodated” for non-expert audiences they undergo changes in form and function, actually shifting rhetorical genres from forensic to epideictic. In other words, accommodations appeal to an audience of non-experts not by reporting facts but by celebrating scientific discoveries and taking into consideration the audience’s already held values and assumptions (278-279). Despite the rhetorical repackaging, however, scientific information is communicated in accommodations; it is communicated in such a way as to facilitate understanding for a new audience beyond the scientific community. I argue in this dissertation that Fahnestock’s concept of accommodating scientific information can be extended fruitfully to visual communication.

The techniques for successful visual communication between scientific communities and non-expert publics have not yet been put to the best possible use. This project seeks to make strides in that area by showing what persuasive work visuals have been able to do in the past—and what they can do now, in a digital age—to improve science communication. I argue that, under certain conditions, images have the capacity to communicate and to orient nonscientist viewers to forthcoming

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<sup>3</sup> See e.g. Diana George’s article and Ann Marie Seward Barry’s *Visual Intelligence*. There has been a push to include visual discourse in the composition classroom. See e.g. Selfe et al.; Wysocki and Lynch; and George.

information. Images that function in this way—as portals into scientific discourse—are not new or rare; they simply are not studied. This project focuses on examples of *portal* images, ones that have the potential to serve informative and introductory functions, and that have operated at science/public interfaces since the early-seventeenth century.

At the core of this project is the contention that historical models of visual science communication are readily available for adaptation to our digital culture. In other words, it is a matter of uncovering, rather than *discovering*, effective practices for current visual science communication; attending to past practices will provide insight into visual persuasion. That being said, the remaining chapters take a historical trajectory, sampling past trends in visual science communication from frontispieces in the early seventeenth century (Chapter 2) to photographed portraits of scientists (Chapter 3) to popular science magazine covers (Chapter 4), all of which lead into a survey of science images on the Web (Chapter 5). As the chapters progress through extensive changes in the sciences, literacy, advances in publication technology, and historical events, they highlight for present purposes the accompanying changes in the types of images used and the rhetorical appeals they make to broad audiences to culminate in a discussion of how current communication efforts can be improved.

What these images have in common across time and place is significant: they all share that introductory function to unfamiliar scientific content—that is, they serve to introduce uninitiated audiences to science as a preface to, and sometimes in place of, text. In the past, such images have contributed to the legitimization of science by

visually constructing scientists and their research for broad audiences. Attending to visuals positioned between the sciences and publics across different time periods, this dissertation marks the first attempt to catalog best practices for visual science communication in various historical and rhetorical contexts.

The cases that I have selected, from frontispieces to images on the Internet, are meant to begin a genealogy of scientific visuals designed to garner public support, but this study is far from exhaustive; rather, I intend to sketch the outlines of a new field of study that will require a great deal more research in visual design theory and communication studies to fill in. Some central questions regarding this larger project are, *What constitutes effective visual communication?* and *What does it mean to communicate science?*

The nature of this project makes it necessary to rely on an interdisciplinary approach to analyzing images; therefore it is situated at a complex intersection of rhetorical studies in science, visual studies, science communication theory, and, as I will explain, advertising theory.

A dual focus on historical trends and practical applications makes this project relevant to rhetoricians interested in popular science images and also to science communication theorists and practitioners devoted to improving the perceived relevance of the sciences in society. Those interested in the possibilities of visual rhetoric in general might also find this project helpful, as a compilation of various approaches to analyzing images is presented at the end of this chapter.

In this introductory chapter, I propose that the insights of rhetoricians studying scientific discourse can inform the field of science communication. This improved

perspective on science communication is then complicated by the incorporation of visual design and persuasion. I combine visual and rhetorical theories to analyze the scientific images in this project. Finally, to illustrate the utility of this approach to visual analysis, I apply it to the “Separation of a Cell” image. At the end of this chapter, the cases of visual science communication that form the rest of the chapters are described in more detail.

### **Rhetoric of Science and Science Communication**

Rhetoricians over the past thirty years have shed light on the history and epistemology of science to investigate how scientific persuasion has evolved. Early introductions to the field, such as those by Bazerman (1988) and Gross (1990; 2006), and Prelli (1991) rhetorically analyze scientific discourse by drawing from classical frameworks. Most include case studies focusing on key figures in science, such as Darwin, and how their work changed beliefs about nature. Harris’s collection of *Landmark Essays in the Rhetoric of Science* (1997) contains several case studies that demonstrate the rhetorical nature of scientific discourse. Later work in the field looks at how rhetorical figures function in scientific discourse, such as Ceccarelli’s work with metaphor (2001). Going well beyond metaphor, in *Rhetorical Figures in Science* (1999) Fahnestock makes the case that figures such as parallelism, antithesis, incrementum, gradatio, and ploche, used in scientific argument epitomize lines of argument found in ancient rhetorical topics. Fahnestock’s piece in the Sage Handbook of Rhetorical Studies on “The Rhetoric of the Natural Sciences” provides a thorough overview of the field and suggests areas for further research, one of them being the

importance of visual persuasion in science. Rhetoricians have demystified scientific authority to show that scientific discourse is not exempt from rhetorical analysis because it is ultimately a human-designed endeavor to persuade audiences to hold certain beliefs about the natural world.

Rhetoricians have also studied communicating science to non-expert audiences. To refer to the transfer of scientific information between scientific communities and nonscientist audiences, social and historical studies often use the term “popularization.” However, the nature of the scientific community, the public, and the modification of original information are all points of dispute among scholars. For example, there is a tendency to describe popularized information as distorted or “dumbed down.” Hilgartner takes issue with this description because it implies that there is such a thing as “pure” or true scientific knowledge that is inaccessible to the public (519-520; 530). In the same vein, Whitley argues that knowledge is not distorted in translation but rather “redescribed” and “subtly altered” (7). Both theorists argue for a broader view of popularization that takes into account the changeability and diversity of both the scientific community and the “general public,” for neither is a stable, monolithic entity (Hilgartner 534; Whitley 11).<sup>4</sup>

An accurate way of understanding the transfer of information between the scientific community and nonscientists can be found in Fahnestock’s essay,

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<sup>4</sup> Going a step further, Secord argues for abandoning the label “popular science” altogether because it suggests that the information labeled as such is “not science” or “even a kind of pseudoscience parading as the real thing” (670). Resisting Secord’s call to abandon the term, Broks argues in *Understanding Popular Science* that we view popularization as “encompassing a set of problematics,” allowing us to pay attention to a wide range of communicative formations, agents, and audiences (1-2). Broks’ description of the term as expressing a plurality of rhetorical situations is useful, and although I will refer to a “scientific community” and “non-experts,” I acknowledge the stratification of both groups and the complexities of the communicative process.



“Accommodating Science,” which, as described above, presents an in-depth look at the specific changes in form and function that occur when scientific reports are recast for non-expert audiences. The concept of *accommodation* refers to a more complex rhetorical process than the term *popularization*. The notion of adjusting information according to an audience’s already held values and assumptions has unwittingly been adopted by a new community of scholars and practitioners in the field of Science Communication Studies. Their attempts at accommodating science, however, are generally uninformed by the rhetorical canon, and so while some pieces are in place, others are missing from the very challenging puzzle of communicating science to broad, non-expert audiences.

### **Science Communication: A Growing Discipline**

Science Communication as a field of study developed in the late 1970s when the journalism community recognized the need to bridge the “gap” between the scientific community and the public.<sup>5</sup> The field is now populated mainly by journalists, public information officers, and communication scholars. The overarching objective of the field of Science Communication is to fill the gap between the scientific community and non-expert publics with intermediaries equipped with both scientific knowledge and communicative finesse.<sup>6</sup> Researchers in this field study public perceptions of scientific scholarship and devise theoretical

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<sup>5</sup> Sharon Dunwoody’s introduction to Kahlor and Stout’s anthology, *Communicating Science* (2010), provides a useful history of this field’s development.

<sup>6</sup> An interdisciplinary field in its own right, science communication requires knowledge of science and technology, journalism, and visual persuasion in order to publicize the work of scientists in a way that is both relevant and accessible to non-experts (Christensen 3-4).

models for the transfer of information between scientists and non-experts.<sup>7</sup> Since the 1970s several models of science communication have been created only to be discarded to make way for new and potentially more effective methods of informing diverse audiences about scientific research. For example, the “Public Understanding of Science” model (abbreviated as PUS or POS) was discarded because of its one-way flow of information from the scientific community to the public. POS was replaced by PES, Public Engagement with Science, which depicts a two-way flow of information—the idea here is that the scientific community also benefits from learning about the public’s concerns and values.<sup>8</sup> In the *Hands-On Guide for Science Communicators*, Christensen describes PAS, *Public Appreciation of Science*, which seems to be the new trend (see Chapter 5). With PAS, transferring information is abandoned and replaced by the idea of transferring certain beliefs or values about science (4).

Furthermore, while appreciation is a necessary precursor to gaining support for scientific research, it marks only a first step towards that goal. An example of a public appreciation model can be found in a 2009 article in *The American Journal of Botany* entitled “What’s Next for Science Communication,” which explores the perceived lack of interest in scientific research on the one hand, and scientists’ lack of desire and ability to reach out to non-expert audiences on the other hand.<sup>9</sup> The authors of this article, Nisbet and Scheufele point to the fact that, despite the

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<sup>7</sup> Science communication researcher Sharon Dunwoody provides a brief history of the field in her Foreword to *Communicating Science* (2010), an anthology edited by Kahlor and Stout (ix-xi).

<sup>8</sup> For overviews of these models, see e.g. Brossard and Lewenstein; Leach, Yates, and Scanlon ; and Russell (69-115).

<sup>9</sup> The former is explicitly stated whereas latter is implied in Nisbet and Scheufele’s analysis. See also Borchelt and Hudson, and Russell for characterizations of the scientific community (91-6). Nisbet and Scheufele outline and chart several “frames” that are designed to make scientific issues relevant to the public by cloaking them in various non-scientific guises.

development of new theories of communication, these central problems on both sides of science communication remain unchanged. Securing public interest in scientific issues is a challenge, Nisbet and Scheufele argue, because the general public is “miserly” when it comes to actively pursuing knowledge (1769). It is true that without efficient communication, non-experts remain uninformed about scientific progress, and scientists are at risk of losing funding for important research projects.<sup>10</sup> But the solution that Nisbet and Scheufele propose, which involves using generic framing devices to make scientific policies more palatable to non-scientist audiences,<sup>11</sup> gives the impression that there is not much depth to the information transmitted in the communication process. Not to mention, the authors ignore the possibility of using images to communicate. Whereas a frame is flat and two-dimensional, a portal—in the form of an appealing image—can potentially lead viewers into scientific discourse more effectively, I maintain, than text alone.

Finding a middle ground between the lofty and unrealistic idea of public understanding and the superficiality of public appreciation will require using all of the available means of persuasion in an increasingly complicated web of technology. Bringing out the rhetorical undertones of science communication, and demystifying

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<sup>10</sup> With that financial pressure in mind, the National Science Foundation (NSF) and American Association for the Advancement of Science (AAAS) have recently begun a competition for scientists to create aesthetically pleasing visualizations that would appeal to a general audience (“Visualization Challenge”). See also Christensen (Part I: “Setting the Scene”).

<sup>11</sup> Their frames are generic enough to be applied to most scientific issues and used on most non-expert audiences. Thus, many rely on “buzzwords” that correspond to “hot button issues” in U.S. culture and politics, as these terms would be most likely to capture the attention of a broad audience; the titles of some of the frames are “social progress; economic development; morality/ethics; scientific uncertainty; Pandora’s box; and public accountability” (1772). The frames, according to their own definition, are “interpretative storylines that communicate what is at stake in a societal debate and why the issue matters” (1770).

the persuasive process, can only improve communicative efforts. What is especially needed is more attention to visual communication.

Because of its dominance in all areas of communication, visual persuasion, discussed in greater detail later in this chapter, has become an increasingly important factor in information exchange. Research in science communication has only begun to scratch the surface of visual persuasion (see e.g., Barry, “Science and Visual”; Trumbo). Without adequate critical attention, images cannot be used to their fullest potential. A better understanding of the communicative potential of images can lead to more effective science communication than textual information alone, and it can improve the flow of information between scientific and nonscientific communities. Visual science communication will depend on a willingness to engage in rhetorical analysis, to evaluate images in their proper contexts with attention to producers, media, and audiences. Moreover, understanding how images communicate requires a vocabulary for assessing visual composition and elements of design. To return to the opening example, Figure 1, it is fairly safe to say that the cell separating image is visually pleasing. But describing what it is about the image that makes it so pleasing to the eye may not be intuitive to those who are not trained in art history or visual theory. After a discussion of scientific visualizations (below), I return to the subject of visual persuasion and methods of critically analyzing relationships among elements in images to interpret the whole, or the visual message.

### **A Visual Rhetoric of Science Communication**

An important distinction must be made between scientific visualizations in research reports and scientific images that are circulated outside of the scientific community and seen by non-expert audiences. The latter are the subject of this project. Rhetoricians have studied scientific “visualizations”—images in research reports intended to illustrate phenomena and provide evidence for scientists’ arguments—for their contribution to knowledge formation in the sciences.<sup>12</sup> Their studies have paved the way for this project and they will inform the discussion that follows concerning science images in the public sphere.

Scientific argument is often dependent on visual evidence, and rhetoricians along with historians and sociologists of science have turned their attention to how visualizations have contributed to the making of scientific knowledge. Technological advancements have led to changing practices over time, but regardless of whether it’s a simple line drawing or an electron micrograph, visualizations have played an essential role in the arguing of facts into being since the discipline began. A well-known historical study of scientific imaging practices is Daston and Galison’s *Objectivity* (2010). The authors take visualizations appearing in scientific encyclopedias as exemplary of changing technical practices and attitudes towards epistemological concerns.

Rhetorical approaches to studying scientific visualizations in research reports consider all of the agents involved in the creation process, the media or apparatus used, the process by which images are created, and the audience, intended or otherwise. Fahnestock’s “Verbal and Visual Parallelism” and sections of each chapter in *Rhetorical Figures in Science* focus on the contribution of visualizations to

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<sup>12</sup> See e.g. Fahnestock (1999; 2003; 2004) and Gross, Harmon, and Reidy.

scientific arguments. Her extension of the figures to visual representations deserves more attention by rhetoricians. Gross, Harmon, and Reidy's *Communicating Science* devotes a brief section to classifying different types of scientific visualizations and their indispensability to argumentation. They explain how different modes of representation can either amplify features or eliminate extraneous details (200-7), and they make the case that "assertions tied to visual evidence have become a routine part of scientific argument" (200).

Non-rhetoricians who take a rhetorical approach to visuals include Martin Rudwick, whose much cited article on the development of a geological "visual language" (1976) takes into consideration the technologies available for creating geological visualizations in the late nineteenth century. Rudwick focuses on the persuasiveness of these scientific visuals and their role in solidifying geology's disciplinary status. Likewise, Greg Myers's study of images in E.O. Wilson's *Sociobiology* outlines the choices available to scientists for visual representations of concepts and evidence. A practitioner who has taken a rhetorical approach to discussing scientific images is Edward Tufte, who explores the choices scientists must make in representing different phenomena and data and also offers advice for both constructing and analyzing scientific visuals. In *Beautiful Evidence* (2006), Tufte unmask the selection processes as data are transformed into information-packed, yet efficient, graphs, charts, and diagrams.

A very thorough overview of visualizations in contemporary scientific reports is Luc Pauwels's "Theoretical Framework for Assessing Visual Representational Practices" in *Visual Cultures of Science* (2006). In the first of a series of detailed

charts, Pauwels breaks down scientific representation into its constituent parts beginning with the type of referent, be it visible, invisible, non-visual, postulated, or conceptual. He explains that it is important to identify the type of referent first because it determines the medium for representation, and representational devices impose various constraints on the end product.<sup>13</sup> Even more difficult to evaluate are referents that are conceptual or “non-visual,” and both present a unique set of concerns.

Non-visual referents have created anxiety over which phenomena actually exist in “objective reality” and which are “constructed” by the machine. Studies coming from a sociological perspective express concern that machine-generated structures are being given status as “ontological entities.”<sup>14</sup> Pauwels responds to these anxieties by explaining that, even if data are constructed out of observations, “they are based at least in part on quantitative or qualitative aspects of an observed *reality* of some kind and thus are not purely invented or products of the imagination” (3). Visualizations that “transfer authority to the ‘machine’” do present problems in interpreting data, specifically because the representation is of “artifacts of the instrumentation,” but, according to Pauwels that does not warrant an epistemological crisis (9). For the last fifty years, the majority of scientific representations are reliant on machines, so it is worthwhile to become familiar with the constraints imposed by specific representational devices and learn to be critical of the representation. As Pauwels advises, researchers should first understand the nature of the referent and

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<sup>13</sup> Some examples that Pauwels gives of “invisible referents” are internal organs and bones, microscopic organisms, and stellar constellations because they cannot be seen by the naked eye without some type of intervention (2).

<sup>14</sup> See essays in Lynch and Woolgar’s *Representation in Scientific Practice*. See also Merch’s article in Huppauf and Weingart (192).

then the process through which it became visualized. Although Pauwels takes a decidedly rhetorical approach to the evaluation of visualizations, he is not a rhetorician and does not place his focus on how images persuade.

Another popular area of study has been the intersection between science and art. Collections like Allen Ellenius's *The Natural Sciences and the Arts: Aspects of Interaction from the Renaissance to the 20<sup>th</sup> Century* (1985) and Brian Baigrie's *Picturing Knowledge: Historical and Philosophical Problems Concerning the Use of Art in Science* (1996) begin their studies by defending a focus on the visuals in science, emerging from the entrenched belief that visuals are merely supplemental to text and incapable of doing epistemological work. Many of the essays in Ellenius's and Baigrie's collections are concerned with locating the places where the two cultures of art and science intersect.<sup>15</sup> Visualizations from Dürer's realistic etchings of animals to theory-laden diagrams of conceptual phenomena are discussed in these collections.<sup>16</sup>

It is clear that a great deal of work has been done on scientific visualizations and on the intersections between art and science, especially from a historical perspective. But there are few studies on scientific images intended for the public eye, which can include visualizations that have traveled outside of their original research reports, images that were created by scientists specifically for public

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<sup>15</sup> See e.g. Ackerman and Broberg in Ellenius's *The Natural Sciences and the Arts* and Topper and Baigrie in *Picturing Knowledge*.

<sup>16</sup> See also Kemp's *The Science of Art* (1990). For perspectives on science influencing art, see Strosberg's *Art and Science* (2001), and Caulfield and Caulfield's *Imagining Science: Art, Science, and Social Change* (2008).



consumption, and even images created outside of the scientific community but adopted for public circulation.<sup>17</sup>

### **The Rhetoric of Scientific Advertisements**

Studies on science images in the public are largely concerned with how images might be used to humanize science and make scientific discourse more “accessible” for non-scientist audiences.<sup>18</sup> One of the few studies is Huppauf and Weingart’s collection of essays, *Science Images and Popular Images of the Sciences* (2007), which is concerned with popularized scientific images as a means for scientists to shape public perceptions of their work.<sup>19</sup> Similarly, Kathryn Northcut’s article, “Images as Facilitators of Public Participation in Science” (2006), characterizes popular science images as a means of humanizing and making scientific discourse more “accessible” for non-scientist audiences (6). Although I agree that popular science images have the potential to be as complex and hardworking as these theorists suggest, I argue that critical attention must also be paid to the potentially negative consequences of popular science images. For example, Pauwels briefly reflects on the tendency of popular science images to be superficial:

A visual representation may perform the function of an eye catcher, a means to arouse and maintain attention and interest, or even to entertain the reader/spectator (and thus bring them into the right mood for acceptance.) Some aspects of a visual representation in science may even perform no other function than to appeal to the aesthetic feelings of the receivers or just be an expression of the personal aesthetic preferences of the maker (19).

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<sup>17</sup> Huppauf and Weingart developed a brief taxonomy of “popular” science images that I will elaborate on in a later section. See also chapters by Nikolow & Bluma and Schummer & Spector

<sup>18</sup> See Huppauf and Weingart’s introduction and Northcut’s article, “Images as Facilitators of Public Participation.”

<sup>19</sup> See especially their introduction and the chapters by Nikolow & Bluma and Schummer & Spector.

Visuals circulated for public consumption no longer serve the purpose of providing evidence for a study. Therefore, accuracy and precision are not privileged as they are in the creation of scientific visualizations; instead, stylistic features and compositional layout are of utmost importance for popular science images because these are the elements that can be manipulated for maximum visual effect.

There are obvious changes in audience and important changes in function when visuals are circulated outside of the scientific community. The possibility that elements will be manipulated for visual effect as opposed to clarity and accuracy is perhaps the most important distinction that can be made between scientific visualizations and visuals circulated for public consumption. As opposed to visuals that support scientific claims, which belong to the forensic genre, visuals that are primarily aesthetically pleasing advertise a positive attitude towards science serve an epideictic or celebratory function.

However, describing images as celebratory or as advertising science might wrongly give the impression that they are not capable of doing heavier work. That is precisely what I intend to disprove in this project. What I am calling attention to is the idea that images, like written or oral discourse, can be “accommodated” for different audiences. I am applying Fahnestock’s model of accommodation to the visual realm. In that regard, images can both advertise science *and* lead viewers to further engage with scientific discourse if they are treated as portals; the chapters that follow will provide examples to substantiate this claim.

The notion of advertising or selling science has been discussed already by some science journalists and science communication theorists, who describe science

as though it were a marketable commodity. That is, science has become a product, packaged in palatable ways to be sold to non-expert publics. Journalist Dorothy Nelkin's *Selling Science* (1995) encapsulates this idea in book-length form. She describes how science news has had to compete with political and social issues in the mainstream, and because people want short bursts of entertainment, science writers often oversimplify to keep peoples' attention (113-114). A more recent collection of essays by journalists edited by Bauer and Bucchi (2007) also focuses on the need to package and sell science like a product to consumers who are inclined not to pay attention (see e.g., Radford, Franklin, and Dunwoody in this collection).<sup>20</sup>

To distinguish the aims of this project from these particular views on advertising science, I would like to point out that, although advertisements are not uncommonly assumed to have one purpose only, to sell *products*, another purpose, often forgotten but as important as selling products, is selling *attitudes*. It is the case that decontextualized scientific images are often in a position to sell Science as a product, but the portal images in this project are capable of selling more than the vague idea of "Science": they have the capacity to increase viewer engagement and sell positive attitudes towards the scientific community. Visuals do not have to cease being significant for science after the visual appeal has been made. To move beyond the visual appeal, it is necessary to pinpoint and elaborate on the persuasive qualities of visuals, which requires some knowledge of visual persuasion in general, the subject of the next section. The studies of popular science images mentioned above do not describe *how* they can achieve the status of democratizing agents—rather they

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<sup>20</sup> Nelkin and Tietge also discuss how "science" has been co-opted by advertisers trying to portray their products as having proven results.

assume that images are always already democratizing agents. One of the goals of this project is to determine how accommodated scientific visuals persuade, and how they can become more persuasive.

What I am calling visual scientific advertisements have existed in different guises at least since the seventeenth century because garnering public support has always been a key concern. The form that these advertisements take differs depending on the available technology and modes of representation. Today, for example, micrographs can be aesthetically altered using programs like Photoshop, whereas three hundred years ago scientific phenomena were generally represented in drawings reproduced through the process of engraving.

Not all popular science images have been expert images subjected to aesthetic manipulation; some were created for the express purpose of being circulated widely outside of the scientific community. Frontispieces and photographed portraits, the topics of the next two chapters, meet the latter criteria. Chapter 4 on magazine covers straddles the two categories, and my last chapter on the Internet takes up the issue of visualization manipulation in greater depth. In all cases, despite their different origins, the images in this project have the potential to initiate non-expert audiences into scientific discourse. These images occupy a space—often literally, as with magazine covers—between viewers and the scientific enterprise, and are thus in a position to persuade viewers to formulate positive attitudes towards science, and to link them to scientific discourse.

## **Visual Persuasion**

Visual persuasion has not yet received the attention it clearly deserves in science communication. The neglect of visual persuasion may stem from a deep-rooted cultural conviction that images must be compared to linguistic communication, and that they are inherently inferior. The notion that it is easy to look at pictures because they are less intellectual than texts unfortunately remains valid in many circles, as mentioned earlier. It is easy to ignore the persuasive features of images that are delivered rapidly to the eye rather than through a series of elaborate premises and conclusions. But taking the time to consider an image's composition—the elements that make up its structure—and its purpose(s) in a particular context can lead not only to a better understanding of how images communicate, but to the more effective use of images to communicate.

There has been much debate over the possibility of visual argumentation, and correspondingly, the possibility of a visual rhetoric. An entire issue of *Argumentation & Advocacy* was devoted to the possibility of visual argument in 1996, and the ideas expressed in these articles continue to circulate in discussions of visuals today. The general consensus of this issue is that images cannot make arguments on their own; they cannot put forth premises, support them with evidence, and make claims like words can (see e.g., Birdsell & Groarke; Blair; Flemming). Scholars who believe in a strict definition of *argument*, like that espoused by Toulmin's model, still contend that images are incapable of making arguments (see e.g., Gross, 2009). Despite this faction of theorists, the possibility of visual argumentation is alive and well in other disciplines, most notably in advertising. Before elaborating on the views promoted in

this field, I will review the differences between visual and textual communication that have been the subject of much debate.

Visual communication has been studied from a variety of perspectives, each with an interpretation of the potentiality of images and how they should be theorized. One theory is that, because visual communication preceded written communication, humans are hardwired to process visuals more rapidly and effectively (see e.g., Stephens). Exploring the cognitive processing of images, Anne Marie Seward Barry explains in *Visual Intelligence* (1997) that we do indeed process images differently than words. She argues that images affect us mentally before linear logic can be imposed on the viewing process, which explains in part why images are capable of provoking immediate emotional responses (116).

Another perspective suggests that there is an ideological struggle manifested in tensions between visual and textual communication, and which one is privileged over the other depends on the historical context (see e.g. Mitchell; Lessing). Nicholas Mirzoeff describes visual culture as the representation of reality through images, subject to processes of selection, interpretation, and omission, and thus linked to ideology (37). Regarding tensions between words and images, Hariman and Lucaites argue that some images are so culturally significant that “no caption is needed” to contextualize them. Furthermore, images have been studied for their capacity to incite social and political change, challenge dominant cultures, and advance new perspectives (see Olson, Finnegan, and Hope). The power of images to influence beliefs, values, and attitudes is seemingly agreed upon across the board, but there is no agreed upon theory for analyzing images.

One important approach to visual analysis was propagated by semiotician Roland Barthes in the 1970s and predicated on the belief that images can be “read” like texts. More recently, Kress and van Leeuwen have expanded on the semiotic approach to visual analysis in their comprehensive handbook, *Reading Images* (1996). This approach has sparked controversy largely because research in human cognition shows that images and words are processed through different systems (see e.g., Barry). There is also the argument against “reading” images that parses out the extreme differences between the linguistic analysis of syntax, for instance, and the lack of an equivalent structure in visual compositions (see e.g., Gross 2009). Although these criticisms of the semiotic approach to visual analysis are valid, they do not nullify the utility of many of the concepts elaborated by Kress and van Leeuwen, derived from studies in the psychology of vision by Rudolph Arnheim and others.<sup>21</sup>

Just as there is no unified “visual grammar,” there is no unified “visual rhetoric” to speak of. There is no Aristotle for images. Perhaps for this reason, rhetoricians are uncertain about the multidisciplinary nature of visual studies and about housing such a fragmented discipline under the umbrella of rhetoric. This uncertainty is best described by Hill and Helmers in *Defining Visual Rhetorics* (2002), wherein *visual rhetoric* is left undefined. Beyond the multidisciplinary nature of visual studies, there is also the issue of the rhetorical “toolkit” being unsuited to visual analysis, and this issue is best described by Sonja Foss. She identifies two camps involved in this debate: one that makes do with the classical toolkit as is, and another that sees a need for expanding and supplementing classical concepts to analyze visuals. The

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<sup>21</sup> Their approach is discussed in depth below and put into conversation with advertising techniques.

framework below, compiled from various sources, will make it clear that expanding the rhetorical toolkit to include tactics from other disciplines is not outside the realm of possibility, nor does it make the resulting analysis any less rhetorical.

### **Visual Rhetoric in Advertising Theory & Practice**

At the same time that rhetoricians are still struggling with the concept, advertising theorists have already established that a visual rhetoric exists. Researchers in the field of advertising theory have focused on rhetorical tropes and schemes in visual advertisements, arguing that knowledge of classical rhetoric can assist in more effective advertising. Even more significant to the aims of my project is that they have provided insight into how different visual configurations are generally received by broad audiences. The field of advertising has an inherent interest in reception theory; that is, gauging audience reception to visual stimuli.

In fact, studies in this field provide a glimpse into both the production and reception stages of visual argumentation. Linking the rhetorical canons of invention, arrangement, and delivery to the deployment of visual elements, Scott (1994) is frequently cited as one of the first to advance a theory of visual rhetoric specifically for advertising images. Scott explains that “The rhetorical intention behind a visual message would be communicated by the implicit selection of one view over another, a certain style of illustration versus another style, this layout but not that layout” (253). Her claims are important for the development of a theory of visual rhetoric because she challenges the arguments of theorists like Fleming (1996), Blair (1996),



and Birdsell & Groarke (1996) that visuals are incapable of argumentation.<sup>22</sup> It is important, however, to acknowledge the distinction between visual *argumentation* and visual *persuasion*. While advertisements undeniably accomplish the latter, their achievement of the former depends upon one's definition of an argument.<sup>23</sup>

One significant aspect of visual persuasion that Scott does not address is the role of composition design, and without attention to composition there can be no thorough framework for analysis. Other advertising theorists have produced frameworks and taxonomies based in the rhetorical tradition. For example, a taxonomy of visual tropes and schemes was developed by Jacques Durand (1987), who studied under Barthes in the 1960s. Durand's table of rhetorical figures in advertisements classifies the figures according to the criteria of "rhetorical operation" (e.g., addition, substitution, exchange) and the relation between variable elements within a composition (e.g., identity, similarity, opposition), and he provides numerous advertisements to depict the figures at work. McQuarrie & Mick (1996), inspired by Durand's work, go a step further to explain how each of the figures in advertisements can work persuasively to impact audience reception. Their taxonomy is slightly different from Durand's, but no more elaborate. Instead, their focus is on consumer responses to advertisements that employ visual figures (e.g., metaphor, repetition, antithesis, pun), as opposed to the same advertisements without the figuration (1999; 2003). One example from their study is an advertisement for carsickness medication; in the ad with the figure, a box of medication is shown in a car seat, figured as the

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<sup>22</sup> In her article with Kenney from *Persuasive Imagery* (2003), she refutes the arguments of these theorists in more detail.

<sup>23</sup> For example, Fleming, Birdsell and Groarke, and Blair have a strict definition of argument and its composite parts, whereas a looser definition of an argument as any form of persuasive discourse would easily encompass a theory of visual argumentation (see e.g. Wysocki and Lynch).

buckle of the seat belt. In the ad without the figuration, the box is not the seat belt buckle, but rather just sitting on the car seat with the seat belt aside. Importantly, McQuarrie & Mick's studies have an empirical component to prove that advertisements with rhetorical figures are more effective at capturing the attention of audiences; specifically, rhetorical figures expressed visually in ads, such as the carsickness ad, are more likely to cause "elaboration," or greater viewer engagement with a text (1999; 39).

Although their work on visual figuration is significant, the one aspect of the advertisement that can be considered a figure is not the only persuasive element; rather, all of the principles of visual design and analysis, elaborated on below, merit consideration in a thorough rhetorical analysis. McQuarrie and Mick's examples of visual figuration do not show consideration of all of the principles of visual design and analysis, and most advertising studies do not perform this process.

Advertising handbooks, as opposed to theory-driven analyses, focus more on actual methods for creating persuasive visuals. These practical handbooks rely on the principles of visual design, which are essentially elements that are universal to visual discourse, or, one might say, the *topoi* of visual persuasion. The principles of visual design are described in *Advertising Principles and Practice* (2003) as follows:<sup>24</sup>

**Direction:** Usually, designers create a visual path for the eye as it scans the elements. In Western countries most readers scan from top to bottom and from left to right. Most layouts work with these natural eye movements, although a layout can manipulate directional cues to cause the eye to follow an unexpected path.

**Dominance:** The most emphasized element in an ad is the dominant element. Normally the dominant element is a visual, but it can be a headline if the type

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<sup>24</sup> See Wells et al. 373-375. I have reproduced their text almost exactly here, only leaving out their references to specific examples in their book.

is big and bold enough to dominate other elements. By definition there can be only one dominant element, one focal point; everything else must be subordinate. Dominant elements are larger, more colorful, bolder, or positioned in a more prominent spot, such as at the top of the page.

**Unity:** With unity, all the elements in an ad fuse into one coherent image and the pieces become a whole. Neighboring elements that touch and align add unity and help with direction. An old axiom states the importance of grouping things: “Keep things together that go together.”<sup>25</sup>

**White Space:** Areas of the layout that aren’t covered by art or type are called white space or negative space. White space can be a design element in itself—either to frame an element or to separate elements that don’t belong together.

**Contrast:** Contrast makes one element stand out from another and indicates importance.

**Balance:** When an artist decides where to place an element, he is manipulating balance. There are two types of balance: formal and informal. Formal balance is symmetrical, centered left to right. Formal balance is conservative, it suggests stability, and it’s used in more upscale product ads. Informal balance is asymmetrical and creates a visually exciting and dynamic layout, counterbalancing visual weights around an imaginary optical center.

**Proportion:** Equal proportions of elements in a print ad are visually uninteresting because they are monotonous. Two visuals of the same size fight with one another for attention, and neither provides a point of visual dominance. Copy [e.g., text] and art should be proportionately different. Usually the art dominates and covers two-thirds to three-fifths of the page area (if the ad is not meant to be text-heavy).

**Simplify:** Most art directors realize that less is more. Generally, the more elements that are crowded into a layout, the more impact is fragmented. The fewer the elements, the stronger the impact. Clutter is the opposite of simplicity. It comes from having too many elements and too little unity. However, like all rules, this one is made to be broken. Art directors know that to create the effect they want [...] in a nonlinear layout, they have to sacrifice simplicity (373-375).

The authors not only explain what is meant by each principle, but also suggest what the persuasive effect of each might be, depending on how the designer manipulates

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<sup>25</sup> Their reliance on Gestalt psychology is especially evident here, although the authors do not mention it.

them. All visual discourse can be created and evaluated according to the above principles in different combinations and variations.

Advertising theory borrows from visual theory, which provides even more insight into the utility of these principles by further breaking down visual compositions into their disparate elements. Dondis's *Primer of Visual Literacy* (1973), for example, begins by explaining the significance of such elements as the dot and the line—elements that a non-initiated viewer might not stop to consider—before moving into larger concepts, which she discusses in terms of opposing pairs: for instance, consistency and variation, understatement and exaggeration, and symmetry and asymmetry (112-121). Dondis's approach to visual analysis will be applied in later chapters, in combination with other approaches.

The advertising principles of design listed above only represent a part of the larger project of advertising. Sean Brierley's *The Advertising Handbook* (2002) provides a series of starting points for visual persuasion, specific techniques that can be applied in any situation.<sup>26</sup> Brierley also describes the behind-the-scenes research involved in creating persuasive advertisements tailored to specific audiences. Practitioners, called “creatives,” who construct advertisements, are tasked with balancing research findings on eye movement, attention, memorability, comprehension, and psychological responses in addition to finding out as much as possible about the attitudes and lifestyle of their target audience (Brierley 141-142). Brierley outlines advertising strategies that are contingent on knowledge of the target audience's beliefs, and that also presume a certain level of cultural awareness on the

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<sup>26</sup> Brierley does not recognize (or at least acknowledge) the rhetorical foundations of these starting points for visual persuasion.

part of the viewer. Some examples of the strategies Brierley lists as starting points for persuasion are mode of address (direct or indirect); metaphors and stereotypes; exaggerating reality; omission of important details (to involve viewer); and narrative structure.<sup>27</sup> Presumably, all of these starting points can be expressed through different media, since advertising takes on written, visual, aural, and combinations of all three modes, but in the visual realm, they are applied through the principles of visual design (listed above). Advertising practitioners are unwittingly rediscovering the classical rhetorical cannon.

### **The Basics of Visual Analysis**

Scientific images functioning as advertisements are not always as straightforward as typical product advertisements, which generally operate by appealing to their target audience's attitudes and lifestyles (see Brierley above). While some of the scientific advertisements discussed in this project do successfully appeal to their target audience's attitudes and lifestyles, others—especially more current examples, such as the one that opens this chapter—seem to have lost sight of their audiences. The indeterminacy of scientific images invites misinterpretation, especially if the images are not accommodated for their intended audiences.

Regarding the interpretation of images in general (not just science images), some would argue, despite all of the evidence to the contrary, that viewer subjectivity bars the development of a unified system of visual analysis: it seems impossible to

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<sup>27</sup> Other examples of his advertising *topoi* are prominence and proximity; co-option (of a major event, another genre, a popular song, etc.); controversial themes; challenges or contests; entertaining storytelling, humor, flattery, or parody; distraction; criticizing other brands; playing on consumer anxieties; fantasy/escape/nostalgia; consistency and authority; directive/ call to action (Brierley 143-169).

impose a structure on a viewing process that is unique for each person. Put a different way, there is much more room for subjective interpretation in the analysis of images than in the analysis of text. Viewers' previously held beliefs, values, and experiences all contribute to what might be described as a process of freer association that occurs with visual stimuli. The resulting chain of associations to other ideas and images would be impossible to follow, let alone standardize under a single rubric.

However, despite the element of subjectivity in visual analysis, there are some qualities of visual design and composition that are consistent, and these are the principles of visual design. The principles of visual design have been recast in advertising theory, composition theory, and, handbooks of visual analysis (such as Kress and van Leeuwen's *Reading Images*) with different emphases on producing and analyzing images. Also significant is the lack of a consistent vocabulary for describing images among the different approaches. Developing a consistent vocabulary and a unified framework is a grand undertaking that is not feasible in this project. Rather, in this section I review current approaches to visual analysis and suggest how aspects of each can come together to form a more complete framework.

Kress and van Leeuwen have devised perhaps the most comprehensive approach to analyzing visuals that takes into consideration the effects of image design and composition on audiences or viewers in *Reading Images*. Their approach will be used most often in the chapters that follow. Not only do Kress and van Leeuwen elaborate on most of the visual design principles used in advertising theory, they apply them to a wide variety of images—not just advertisements or aesthetic visuals. Their account of the way that people view images—such as the direction the eye

takes across a composition, the reaction to people depicted in images, the understanding of certain patterns and symbols—is rhetorical, as they describe the viewing process as determined by culture, context, and the qualities inherent in each image. Below are some qualities that can be considered common to most images.<sup>28</sup>

These are essentially expansions of the design principles.

**Navigational Cues:** Vectors are strong lines formed by depicted elements in the image, usually diagonal, that indicate direction (44; 57). They are dynamic forces that illustrate “narrative processes” insofar as they guide the viewer’s gaze through the image elements in a particular sequence (57). Vectors emanate from “actors,” which are the most salient elements in composition due to size, placement, contrast against background, color saturation, or psychological salience (human figure/face) (61). From a designerly perspective, by creating vectors in a visual composition, image designers can control, to a certain extent, the order in which viewers attend to elements in the composition (see e.g., Dake; Dondis; Wysocki & Lynch; Wells et al.).

**Viewer Positioning:** Images involve two kinds of participants: represented participants (people, places, and things in the image) and interactive participants (people who communicate with each other through images, the producers and viewers of images) (119). The angle from which a viewer looks into an image is related to power relationships between the viewer and represented participants in the image: a horizontal angle indicates involvement and an equal relationship; a high vertical angle gives power to the viewer; and a low vertical angle gives power to the represented participant (140-6). Other factors such as the gaze of represented participants (demand-direct address;

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<sup>28</sup> The categories described are extremely condensed and paraphrased from Kress and van Leeuwen’s *Reading Images*, as each category spans an entire chapter in their book. The categories here also draw from Dondis and Wysocki and Lynch. While considering the framework laid out in the following pages, it may be helpful to look at Figure 1 again to have a concrete visual to map concepts onto. In the next section, I provide an analysis of Figure 1 using the concepts described here.

offer-object of contemplation) (121-24); the size of the frame and social distance between represented and interactive participants (130); and the viewer's perspective (135) determine the nature of the interaction between viewer and image.

**Level of Realism:** Kress and van Leeuwen use the linguistic term *modality* to refer to the level of reality depicted by an image (160). Social groups define reality differently—for example, from a scientific perspective, reality does not stop with what can be seen with the naked eye (163). But for the public, the standard of measuring realism is naturalism or “photorealism” (163). Photographs have a reputation for being more “true” than other types of visual representations because they appear to be unbiased representations of “what is” (see e.g., Finnegan). Markers of realism include color saturation, differentiation and modulation; contextualization (e.g., absence of setting); representation (pictorial detail); depth (perspective); illumination (play of light); brightness (Kress and van Leeuwen 165-7). One thing that is absent from Kress and van Leeuwen's analysis is the producer's perspective: the creator of the image has a personal way of dealing with and representing an aspect of “reality” not necessarily aligned with “naturalism.”

**Tensions, Unity, & Arrangement of elements:** This category refers to the ways that elements in an image are positioned in the composition and how they interact with each other and work as a whole (181). The placement of elements (top, bottom, left, right, center, or perimeter) is linked to their “information value” (193-206). The weight or salience of elements (that is, what elements draw the eye first) depends on factors like their size, placement in the composition, color, shape, or psychological import (212). Elements can be framed or grouped in meaningful ways by other elements in the composition, by empty space, by discontinuities of color or shape, or by repetition of elements, shapes, or colors (214-217). Again, absent from Kress and van Leeuwen's system is the producer's perspective: the creator of the



image can devise a visual hierarchy, an implicit set of instructions that imposes structure on the viewing process in terms of the direction the eye takes throughout the image (see Wysocki and Lynch 287-294). Kress and van Leeuwen attend to this concept from a viewer-oriented perspective instead, referring to it as a “reading path.”

The features of images described above can work in various combinations to carry out persuasive functions in visuals. An example analysis below will integrate the various components described in this section.

### **“The Separation of a Cell”: Applying the Basics of Visual Analysis**

To demonstrate a rhetorical analysis of a scientific visual intended for nonscientist audiences, I will turn once again to the opening Visualization Challenge illustration of a cell separating (see fig. 1). Why, from an aesthetic perspective, did this image win the People’s Choice Award? What elements of its visual composition make it visually appealing? There is an article in *Science* magazine that provides some insight into why the image may have won, although non-expert audiences would *not* be likely to stumble upon it.<sup>29</sup>

It is possible that the description of the image in the *Science* magazine article has synthesized viewers’ comments from when they voted for the image, but the writer of the article does not specifically say so.<sup>30</sup> Still, his published speculations are helpful to understanding the image’s visual appeal:

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<sup>29</sup> I suggested in the introduction to this chapter that the caption on the website, which everyone can see, is likely ineffective at describing what the image actually represents because of its specialized vocabulary and lack of context for general audiences.

<sup>30</sup> I was not able to find any viewers’ comments on the image.

From films like *Avatar* to hand-held video games, 3D is all the rage. Textbook graphics are not catching on. In this illustration, Andrew Noske of the National Center for Microscopy and Imaging Research at the University of California, San Diego, and colleagues create a visualization of mitosis that hops off the page.

The new and tactile view of a cell undergoing division comes thanks to a specialized protein called MiniSOG. This molecule, which Noske's team shows zipping toward the reader, is fluorescent and stands out crisply under an electron microscope. With some tweaking, it also binds tightly to a second protein closely associated with DNA. That gives scientists the ability to target and view in detail chromosomes as they peel apart during mitosis. The result is a far cry from the standard, flat images popular in biology textbooks, the team writes. And unlike the 3D glasses that accompany screenings of sci-fi films, this new visualization approach may be more than a gimmick, giving students a deeper look at a familiar phenomenon (Strain "People's Choice").

First, what this article description provides that the caption does not is a broader significance and an audience for the People's Choice illustration. The statement near the beginning, "Textbook graphics are not catching on [to 3D]," and later, "The result is a far cry from the standard, flat images in popular biology textbooks" both indicate that this illustration is meant to be a new-and-improved textbook graphic. The audience is implied by its purpose, but the last sentence makes it clear that students are the intended audience for this separating cell image. Second, in addition to the new contextualization of the illustration, the writer of the article highlights certain details in the image, providing an effective starting point for a visual analysis.

One important point of emphasis is the comparison made between the cell separating image and other 3D media: the author of the article writes that the visualization "hops off the page" and compares it to the 3D film *Avatar* and video games, which are "all the rage" (Strain "People's Choice"). His estimation is that 3D media are appealing to everyone (it is "all the rage"), and because this textbook graphic has 3D features, this textbook graphic would succeed at appealing to a broad

audience. That being said, the author only specifies one aspect of the image's composition that gives the appealing illusion of three-dimensionality: the MiniSOG "zipping towards the reader."

Based on that description, we know that the MiniSOG is the grey and pink orb coming out of the larger cell structure. As the author indicates, there can be the illusion of movement in a static composition. In this case, movement is achieved by the diagonal vector formed by the grey swatch between the two structures. We know from the basics of visual analysis that diagonal lines are more dynamic than horizontal or vertical lines, and this composition is dominated by diagonals. These diagonals are dynamic because they work to direct or "move" the viewer's gaze across the composition, as with the example of the eye moving from the chromosomes in the separating cell to the MiniSOG. Beyond that vector, the entire cell is situated on a diagonal with the MiniSOG being its highest point. Imagine if the cell had been depicted so that it was not on an angle but rather forming a horizontal line with the MiniSOG. The illusion of three-dimensionality would have been less forceful. Other diagonal lines are formed by the grey background surface that frames the cell—these extend from the bottom-left to the top-right, which contrasts with the angle that the cell is on and thus draws more attention to it, not to mention it contributes to that three-dimensionality that the author of the article emphasizes.

The vectors formed by diagonal lines represent one layer of the visual's persuasive qualities—the base layer. On top of that, there are factors like form, color, and the subtle shading of shapes that contribute to the three-dimensionality and

appeal of the image. For example, the focal point of the image (the part of the composition that attracts the eye first) is centered on the yellow chromosomes, which are visually salient for many reasons, including their central location; their vibrant color against the grey background; the fact that they are framed by the neon blue of the cell structure; and last but not least, their form. By form I mean the curvature of the yellow shapes and their irregularity—they are standing out in different directions, and some of them are seemingly stretched out, while others are contracted. These details are significant because they give the impression that the chromosomes are in motion, thus heightening the movement already created by the foundational vectors in the composition.

To sum up, the illustration of a cell separating is appealing predominantly because of its features that create the semblance of movement. If we were watching an animation, our eye would be drawn to whatever elements were most dynamic, and the same goes for implied movement in a still composition. The qualities of the image that create this effect are not elaborated on by the author of the article. By identifying these qualities, however, science communicators could hone in on the strategies used by designers to make appealing images and reuse these strategies in the creation of images specifically intended for public outreach.

Soliciting the creation of scientific visuals that are appealing and attention-grabbing is therefore a worthwhile endeavor under certain conditions. Returning to the caption and *Science* article, however, recall that the information provided about this image was not accommodated for general audiences. That being said, if the illustration of a cell separating were to travel to more popular websites, it would not

do more than visually appeal to public, nonscientist audiences; its significance would cease at the surface level because the text provided by the NSF and *Science* is not fodder for a thorough accommodation. Images on the Internet have great potential to be picked up (digitally speaking) by whoever sees them and dispersed widely—so widely that it would be impossible to trace the full extent of their influence and reach. Supposing the separating cell traveled on the Internet to a more democratic venue, such as a popular news website where it would be seen by nonscientists, that image would take on an entirely new role. Suddenly, an image entered into a science competition that was lauded by people in the scientific community for its breakthroughs in digital visualization becomes, quite simply, a visual representation of Science (with a capital ‘S’). A publicly circulating scientific image, in that regard, can be a synecdoche for Science.

I maintain that visual synecdoches for Science have the potential to be carriers of meaning beyond their visual appeal, but as of yet they have not been used to their full potential. Today, any “scientific” image (having some relation, even tenuous, to science) circulating on the Internet can potentially mediate an asynchronous exchange between audiences who see it and the creators of the image. That does not mean, however, that these exchanges are fruitful—that is, that they lead to an increased awareness about whatever scientific content the image depicts (see Chapter 5). What I will argue in this project is that the significance of visually appealing scientific images does not *have* to cease at the surface level, if only there were sufficient context provided by the image source that could be accommodated for a nonscientist audience.

## Chapter Overview

The chapters that follow focus on scientific “advertisements,” or portal images, from different points in history to uncover the persuasive qualities inherent in each. Much like the rhetorical analysis above, the case studies in each chapter involve the context, agency, and visual composition. Many of them rely more heavily on Kress and van Leeuwen’s approach to visual analysis than the others mentioned in the section above, although in future projects I hope to more thoroughly fuse the different approaches. As explained in the introduction to this chapter, the purpose of this project is to study the ways that images can serve as portals with the ultimate goal of improving visual communication in current efforts to engage non-expert publics with scientific issues.

The historical journey begins in Chapter 2 with the study of frontispieces, one of the earliest forms of visual science communication. Appearing in books before or with title pages, frontispieces, I argue, served as visual introductions to the forthcoming “scientific” discourse. Seventeenth- and eighteenth-century audiences for the new natural philosophical discourse were general by default, but frontispieces often appealed to readers’ already-held knowledge of emblems and symbols to serve as one of the most obvious types of “portal” images into unfamiliar empirical texts. In this way, the aesthetically pleasing and allegorical images could function to advertize and legitimize new scientific knowledge before the field was socially, politically, and culturally accepted. I examine the complex relationship between a

select group of frontispieces and the empirical texts that they preceded, ranging from the early seventeenth century to the early nineteenth century.

By the late-nineteenth century frontispieces had disappeared from scientific texts, but the invention of the camera led to new forms of visual advertisements. Accordingly, Chapter 3 focuses on photographic portraits of scientists circulated in popular media that I argue participated in shaping public impressions of scientists and science. In particular, I look at the first photographs of scientists at work taken and circulated for public consumption—a new trend made possible by the invention of the portable camera in the 1920s, which afforded photographers significant artistic license. Departing from formal portraiture, scientists were often portrayed in a laboratory, working with impressive-looking equipment, creating the precedent for what we now know as stereotypical images of scientists. Although photography may have contributed in part to the concept of “scientific objectivity,” as Daston and Galison among others have argued, I show how this new technology also served to humanize science by revealing the person behind the experiment for wider audiences. This chapter explores the import of the photograph of the scientist in shaping early-twentieth century public conceptions of science.

The persuasive design strategies used for popular science magazine covers form the subject of Chapter 4. I begin by tracing the changes in design on the covers of *Scientific American*—once a publication respected by experts who sought to gain a wider audience for their research, but now considered a popularization on the same level as, for example, *Discover*. I use what many have called the “downfall” of *Scientific American* to illustrate that visual design changes are directly related to

changes in target audience. Then, I analyze a select group of covers from *New Scientist* and *Science Illustrated*, one well established and one very new popular science magazine, to show recurring cover design choices—designs repeated ostensibly because they are most effective at engaging the broadest audiences with science. Ultimately, I argue that the techniques employed in these contemporary “frontispieces” constitute successful visual communication—it is the magazine cover, after all, that does the work at the newsstand of persuading passers-by to open the magazine and engage with the interior scientific contents.

My final chapter tackles science images on the Internet. Specifically, I follow award-winning science images from visualization competitions that are notorious for travelling on the Internet without context, especially to blogs, and I explain the repercussions of disseminating images without their original contextualization. One of the obvious consequences of images traveling without textual grounding is that they are open to misinterpretation, especially by non-expert audiences. As Tufte and others in the field of information design have indicated, visuals without clear explanations are deceptive and even dangerous in the long run, if the aim is indeed to inform rather than merely impress. The visualization competitions that I investigate in this chapter are run by well-respected scientific organizations like the National Science Foundation and the Association for the Advancement of Science, with the aim of reaching out to non-expert audiences. I investigate their competition guidelines and mission statements to uncover the sources of the problem, and I use the foundation laid in this chapter regarding science communication and visual analysis to discuss possible solutions.



In a coda, I discuss how this project evolved and how it will continue to expand on the possibilities brought to light in the chapter examples. For the different types of visuals (e.g., portraits, magazine covers), I share my ideas for an updated, contemporary analog. I conclude with a word about collaborative efforts between the sciences and humanities.

Scientific visuals designed to capture the attention of nonscientist audiences appear everywhere—from magazine covers to Internet blogs, from billboards to the Discovery Channel—and yet their persuasive power has not been appreciated. Popular science images, in the instances that they are given attention in science communication studies, are touted as democratizing knowledge, since images are said to be naturally more “accessible” than scientific text. My dissertation complicates the notion that popular science images are more accessible by focusing on the rhetorical situations surrounding different types of visual popularizations—that is, on the agents involved in producing the images, the contexts in which they are produced, the place of publication and media used, and the intended and actual audiences. My project addresses the concern surrounding the public’s current disengagement from science by considering how science can be “sold” visually in a more responsible way.

## Chapter 2: The Visual Exordium: Contextualizing Frontispieces in Early “Scientific” Texts

“[The Royal Society] have therefore been most rigorous in putting in execution, the only Remedy, that can be found for this *extravagance*: and that has been, a constant Resolution, to reject all the amplifications, digressions, and swellings of style: to return back to the primitive purity, and shortness, when men deliver'd so many *things*, almost in an equal number of *words*. [The Royal Society] have exacted from all their members, a close, naked, natural way of speaking; positive expressions; clear senses; a native easiness: bringing all things as near the Mathematical plainness, as they can”

– Thomas Sprat, *History of the Royal Society* (1667)

Founded in 1660, The Royal Society of London was one of the first and most influential scientific organizations. The society, still in existence, provided a venue for proponents of a new Natural Philosophy, now called “Science,” to discuss their ideas about changing the way that knowledge was formed about the natural world. Specifically, Natural Philosophers argued that the only way to properly learn about the natural world was through observation and experimentation, and that classical models of gaining and relaying knowledge had to be abandoned. Thomas Sprat’s *History of the Royal Society* (excerpted above) exemplifies the aims of the organization. Published just two years after the first issue of the society’s journal, *The Philosophical Transactions of the Royal Society* (1665), Sprat’s *History* places emphasis on the stylistic changes promoted by the society, namely their rejection of “amplifications, digressions, and swellings of style” to champion instead a “naked, natural way of speaking” that approaches “Mathematical plainness” (Sprat).

At the same time that natural philosophers were actively striking out embellishment in their discourse, they were also subscribing to a tradition that was

ostensibly subversive to their aims. An illustration will make that point clear.

Figure 1 is the frontispiece to Carl Linnaeus's *Hortus Cliffortianus* (1737).

Linnaeus is best known for his system of binary classification for species, and he has been credited for developing the field of botany. The frontispiece shows a congregation of mythological figures, each with symbolic import derived from the classical allegorical tradition. The background is a beautiful depiction of a garden owned by George Clifford that Linnaeus studied for several years. The fruits of his labors are published in the *Hortus Cliffortianus* following this beautiful



Figure 1: Frontispiece to Linnaeus's *Hortus Cliffortianus* (1737). By Jan Wandelaar.

frontispiece and a preface, and they are delivered in the plain,

mathematical style praised by Thomas Sprat. Why did Linnaeus choose to commission an artist/engraver to design this frontispiece for his “scientific” work that strove to banish stylistic embellishment?

In the introduction to this book, I make the argument that visuals have been used to garner public support for the scientific enterprise at least since the early-

seventeenth century. Frontispieces are the most obvious examples of images functioning as portals into scientific discourse, and the fact is that many books in natural philosophy include them before the empirical studies, despite natural philosophers' concerted efforts to move away from aesthetics. In the instances when natural philosophers chose to include frontispieces, it is possible that they deemed it acceptable to subscribe to an aesthetic tradition because they were otherwise initiating sweeping epistemological changes.<sup>31</sup>

Providing more insight into what might be termed the “acculturation” practices of natural philosophers, Adrian Johns writes in *The Nature of the Book* (1998) about the social and literary practices employed by experimental philosophers to establish their place in society.<sup>32</sup> For instance, early natural philosophers used organizations like The Royal Society of London as a “strength in numbers” tactic and kept their doors open to society in an effort to foster conversation and ultimately acceptance for their experimental practices (Johns 470). Additionally, they developed a system of recording their work to include the most minute details both to escape issues of piracy and to provide readers with the sense that they were “virtually witnessing” the experiments as they took place, lending credibility to the practice (474). Johns correlates the gradual authorization of experimental philosophy to the history of reading practices and the ability to overcome the limitations of print. I argue that another important method of inserting controversial work into the cultural mainstream concerns not only textual but *visual* persuasion: the inclusion of the

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<sup>31</sup> It is also possible that authors had little say on the final assembly of a book, which is when the frontispiece would have been inserted. Both possibilities (authorial agency and lack thereof) will be considered in this chapter.

<sup>32</sup>See especially Chapter 7, “Piracy and Usurpation: Natural Philosophy in the Restoration,” 444-542. See also 6; 41.

frontispiece.

But the decision to include a frontispiece is not as simple as it may seem. Frontispieces are complex visual documents not only because of their symbolic content, but also because of the nature of their production and the many hands involved. Natural philosophers did not make their own frontispieces—they (or book publishers) commissioned artists and engravers to create them, many of whom are not identifiable; for that reason, in current scholarship, little attention has been paid to the relationships between natural philosophers and the artists or engravers of the illustrations preceding their texts. In contrast to studies that ignore issues of agency, this chapter will take into consideration the complex rhetorical situations surrounding five frontispieces by five different natural philosophers spanning the early-seventeenth century to the early-nineteenth century: Sir Francis Bacon, Carl Linnaeus, Denis Diderot and Jean d’Alembert, and Alexander von Humboldt.<sup>33</sup>

These frontispieces are from different time periods and countries of origin, and they bring to light different rhetorical issues pertaining to agency and contextualization. However, they all share in common an introductory function to forthcoming scientific discourse. Art historians have discussed the significance of frontispieces from economic and symbolic perspectives, and they have argued that these illustrated title-pages were responsible for promoting the work of natural philosophers, which are all valid points that I will elaborate on in the following

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<sup>33</sup>The frontispieces in this study were selected specifically because they were taken out of context to varying degrees in other studies. Regarding Sir Francis Bacon’s texts, see for example Corbett and Lightbown, *The Comely Frontispiece*; regarding the *Encyclopédie*, see for example Londa Shiebinger, “Feminine Icons: The Face of Early Modern Science,” *Critical Inquiry* 14.4 (1988): 661-691; and regarding Humboldt’s works, see for example Joan Steigerwald, “Figuring Nature/Figuring the (Fe)male: The Frontispiece to Humboldt’s *Ideas Towards a Geography of Plants*,” in *Figuring it Out: Science, Gender, and Visual Culture*, eds. Ann B. Shteir and Bernard Lightman (Hanover, NH: Dartmouth College Press, 2006).

section. What scholars have failed to acknowledge is the significance of the connection between frontispieces and authors' prefaces to their empirical texts. I argue that, because readers were offered the frontispiece illustration before reading the book, frontispieces can be considered visual *exordia*, imbued with all of the rhetorical potential of traditional verbal or written exordia.

In classical rhetoric, the exordium is the introduction to a speech, the aim of which is to make the hearer attentive and well-disposed to the upcoming subject matter. The *Rhetorica ad Herennium* provides a thorough overview of “best practices” for constructing an exordium tailored to different situations and types of audiences.<sup>34</sup> In this chapter I extend the concept of the exordium to encompass a visual genre, suggesting that the aims remain the same in the visual realm—to prepare the audience for the upcoming subject matter and make them well-disposed to it. Frontispieces are thus persuasive visual documents that—physically bound into the text itself—become a part of the author's prefatory material, and as such, they should be analyzed in conjunction with the prefaces written by natural philosophers. When viewed in this way, we will see that frontispieces deserve much more credit for their role in the validation of the early scientific enterprise.

### **Literature on Frontispieces**

Beginning in the mid-sixteenth century, it was common for texts in all subjects to include engraved full-page illustrations prior to the text—that's what

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<sup>34</sup>For example, in “difficult” cases that often alienate the audience, the rhetor has to gain their sympathy before deploying the main arguments; in “obscure” cases, the audience is typically uninformed or the subject matter is beyond their grasp, and the rhetor's task is to explain the essence of the case briefly and in simple language before delving into the subject matter. See [Marcus Tullius Cicero], *Rhetorica ad Herennium*, trans. Harry Caplan (Cambridge, MA: Harvard University Press, 1954). The *Rhetorica ad Herennium* is the earliest Roman treatise on rhetoric, composed in the first century, BCE. Its true author is unknown, but the text was long attributed to Cicero.

frontispieces are—and thick catalogues have been compiled to account for them.<sup>35</sup> These often classically-themed allegorical illustrations were bound into the front of books in the final stages of book assembly on higher quality paper, appearing before any textual information. Some engravings were copied from already existing illustrations executed by a different artist, and some were engraved by the same artist who designed them.<sup>36</sup> Like paintings, many frontispieces were aesthetically pleasing, and it is easy to dismiss them as mere decorations, but their privileged position in the front of books makes them much more rhetorically charged than mere embellishments.

From an economic perspective, frontispieces were a marker of prestige, both for the author and for the buyer of the book. As William Ivins explains in *Prints and Visual Communication* (1969), “Etchings and engravings have always been expensive to make and to use as book illustrations. The books that were fully illustrated with them were, with few exceptions, intended for the consumption of the rich and the traditionally educated classes”(18). Earlier frontispieces, often called title-pages because of the ability to include text with the images, were “woodcuts”; they were made by carving designs in relief into woodblocks, and then inking the lines that stood up from the surface. The technique of engraving progressed so that lines were carved into metal or wood, and ink was poured into the grooves, yielding a cleaner impression.<sup>37</sup> Frontispieces, bound in separately, could be engraved even when other images within the text were woodcuts. Authors who chose to include them were

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<sup>35</sup>See e.g. Alfred Forbes Johnson, *Catalogue of Engraved and Etched English Title-Pages to 1691* (Great Britain: Oxford University Press, 1934), vii.

<sup>36</sup>The engraving process made it possible to reproduce these visualizations in every copy of the book. For more information about the engraving process, see for example Adhémar; Ivins; and Zigrosser.

<sup>37</sup>For a more detailed explanation of the process, see Ivins, *Prints and Visual Communication*, 49.

likely trying to appeal to elite readers.

In addition to being markers of prestige, historians have attested to the significance of frontispieces as promoters of books and their authors, and art historians have attested to their capacity to convey concepts through symbols.<sup>38</sup> Both of these functions of frontispieces will factor into my analyses below. However, in addition to their economic and symbolic attributes, the physical placement of frontispieces gives them a persuasive value that exceeds the credit they are given in current scholarship. Because frontispieces occupy such a prominent space in the books of natural philosophers and should be seen as a part of their prefatory material, the question of why they chose to participate in the allegorical, aesthetically pleasing tradition becomes all the more pressing. Beyond book promotion and economic concerns, these visual documents had as much potential to corroborate the author's intentions as they had to subvert them. It is especially important to acknowledge artists and/or engravers in the instances in which the thematic content of the frontispiece seems to resist the intentions of the author or authors, as laid out in their introductions and prefaces, precisely because frontispieces came first and signaled to readers how to view the texts that followed.

Still, most scholarship on frontispieces removes them from their original contexts to categorize and discuss them thematically. Existing scholarship on frontispieces can be broken into two broad categories: 1.) catalogues that exhibit great breadth, in the number of frontispieces compiled, but little depth in terms of the

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<sup>38</sup>. See for example Corbett and Lightbown (esp. 46-7); Johnson (viii); and Remmert (257-267).



contextualization of each visual,<sup>39</sup> and 2.) case studies that focus on a specific theme and pack as many frontispieces as possible underneath a thematic umbrella. The former are helpful for locating rare frontispieces in the vast genre that spans countries and centuries. The latter are always informative about the selected theme and provide a great deal of cultural context; however, in removing frontispieces from their respective texts, the authors frequently remove a significant aspect of their contextualization and even, I would argue, divest them of their genre. A frontispiece dissociated from the text it precedes is a frontispiece no longer. What follows is an overview of the scholarship in the second category.

Some of the most recent essays on frontispieces are featured in *Figuring it Out: Science, Gender, and Visual Culture* (2006), edited by Shteir and Lightman. Shteir's "Iconographies of Flora" focuses on frontispieces that portray or are otherwise associated with the aforementioned goddess to discuss her role as the "face" of Botany in its early stages. Another example from this collection is Steigerwald's "Figuring Nature/Figuring the (Fe)male: The Frontispiece to Humboldt's *Ideas Towards a Geography of Plants*," which limits itself to a single author's oeuvre (that of German naturalist Alexander von Humboldt). However, Steigerwald uses the frontispieces in Humboldt's revolutionary work to make claims about his sexual orientation and personal life rather than to show their persuasive function, specifically regarding the texts they precede, for his potential audience.

In the same vein as the studies from Shteir and Lightman's collection is

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<sup>39</sup>. The most thorough catalogues were compiled by Arthur Hind, keeper of the prints at the British Museum in the mid-twentieth century, and finished by his apprentices after his death. See Arthur Hind, *A History of Engraving and Etching from the 15th Century to the Year 1914* (1963). See also Corbett and Lightbown.

Schiebinger's "Feminine Icons: The Face of Early Modern Science" (1988). Schiebinger demonstrates the pervasiveness of the female form in early scientific iconography, including frontispieces, to make claims about gender in scientific culture. To an even greater extent than the other authors mentioned above, Schiebinger is quick to translate the visual contents of each frontispiece into an ideological message and to attribute that message to the author of the scientific text. One of the major issues with this method, aside from the removal of the frontispiece from its original context, lies in the fact that the natural philosophers did not make their own frontispieces, and the extent to which they participated in their designs differs in each case. Moreover, many frontispieces featured classical symbols and allegories—stock types, like the goddess Isis representing Nature—and were not necessarily reflective of an author's "ideology."

A model study of an artist/author relationship is art historian Mary Sheriff's "Decorating Knowledge: The Ornamental Book, The Philosophic Image and The Naked Truth" (2005). Sheriff provides an excellent close reading of the frontispiece in Diderot and d'Alembert's *Encyclopédie* (1775) that I will return to in a later section, and she explains the artist's important role in designing the image.

Also braving the complicated topic of artist/engraver/author relationships are Kaoukji and Jardine in "A Frontispiece in Any Sense They Please" (2010). They acknowledge that the artist and the engraver were often different people, that their names are not always on the frontispieces, and that finding information about their careers involves scouring through catalogues of the sort mentioned above. Significantly, Kaoukji and Jardine "read" the frontispiece alongside the author's text,

as I will do in the following case studies, moving through the separate components of the image to link their significance to sentiments expressed in the text (440-444). However, the authors seemingly reject the whole interpretive process at the end of their study to say that “we may freely speculate on the multiple possible meanings” of all of the figures in the frontispiece: “of the bird, on the possible implications of Kepler’s and Galileo’s body language, on the adventures opened up by the sea, etc.” (447). While my study will emulate Kaoukji and Jardine’s methodology in many ways, I hope to demonstrate that “free speculation” can be limited by rhetorically analyzing frontispieces in conjunction with the authors’ prefaces, which in many cases indicate that they *are* designed to be read in a certain way.<sup>40</sup>

Remmert also offers important insights into the nature of the frontispiece in his chapter in *Transmitting Knowledge* (2006). In contrast to studies like Schiebinger’s, Shteir’s, and Steigerwald’s that focus on thematic elements of frontispieces, Remmert’s chapter does explore the persuasive functions of frontispieces and takes the audience, intended and otherwise, into consideration. Importantly, Remmert makes the argument that frontispieces convey information about a text faster and to a broader audience than the printed word (256), and that these complex visuals participated in constructing the public persona of the author and the contents of his text (270). After these significant insights, however, Remmert goes on to characterize frontispieces as detachable from their texts, worthy of analysis when separated from natural philosophers’ books.

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<sup>40</sup>. Some frontispieces are equipped with explanatory poems or captions, usually written by the author of the text. Kaoukji and Jardine focus their analysis around such an explanatory text only to conclude that the author intends “free speculation” on the part of the viewer. While their conclusion may be valid in that particular case, there are many instances in which the explanatory text does not promote free speculation, as I will show in a later section.

In contrast to studies that fail to acknowledge the rhetorical context regarding authorial intent and the explication of images, this chapter evaluates frontispieces on a case by case basis, taking into account the unique rhetorical situation for each visual exordium. Any analysis of a decontextualized frontispiece—viewing it as an autonomous work of art—would result in limitless speculation about its visual composition that is not only unnecessary, but fruitless, considering that it is bound into an entire book that grounds its implications. Even if, as in some cases, the illustrations diverged from the authors’ intended specifications, the fact remains that authors chose to include them, and they frequently supplemented the visuals with explanatory captions or poems to guide viewers’ interpretations.

The case studies will proceed chronologically, beginning with a discussion of the frontispieces in two of Sir Francis Bacon’s texts (1620), then examining the one in Linnaeus’s *Hortus Cliffortianus* (1737), proceeding with an evaluation of the famous frontispiece to the 1775 edition of the *Encyclopédie*, and finally concluding with the frontispiece corresponding to Alexander von Humboldt’s early contributions to biogeography (1807). These frontispieces represent different eras in scientific history and thus represent authors who faced different challenges in gaining acceptance for their work, who had access to different technologies, and who hail from different countries. The rhetorical analysis of frontispieces that follows discourages the impulse to study them out of their proper context; sheds light on the complicated notion of agency in the creation process; and evaluates frontispieces as portals into unfamiliar discourse, as *visual* equivalents to the authors’ prefaces.

## Sir Francis Bacon's *Instauratio Magna* (1620) and *Sylva Sylvarum* (1627)

In this first case, two of Sir Francis Bacon's texts share a very similar frontispiece design, despite being done by different engravers. Bacon commissioned the frontispiece for the *Instauratio*

*Magna*<sup>41</sup> (fig. 2), but what is especially interesting is that he was not alive to commission the second frontispiece for the *Sylva Sylvarum* (fig. 3). Bacon's editor, William Rawley was responsible for both publishing the *Sylva* and overseeing the frontispiece design after his death.<sup>42</sup>

Here is a case in which two frontispieces are clearly linked but not by the author's choice. What are the implications of a visual exordium that was not endorsed by the author?

Furthermore, what persuasive purpose, if any, does the linkage between the two frontispieces serve?

Before examining Rawley's side of the story and the "copycat" frontispiece,



Figure 2: Frontispiece to Bacon's *Instauratio Magna* (1620). By Simon van de Passe.

<sup>41</sup>. The *Instauratio* was supposed to have six parts, but only the first two were completed, the first part being an extended version of Bacon's earlier *Proficiency and Advancement of Learning* (1605), and the second part being the *Novum Organum*, which comprises several aphorisms concerning the interpretation of nature. See David Simpson, "Francis Bacon," *Stanford Internet Encyclopedia of Philosophy*.

<sup>42</sup>. Rawley was entrusted with Bacon's work after his death. For more information on Rawley, see Graham Rees, ed, "Introduction" to *The Oxford Francis Bacon XIII* (Oxford UP 2000), esp. lxxiii-lxxxiii.

however, the original frontispiece commissioned by Sir Francis Bacon for the *Instauratio Magna* merits a closer look (fig. 2). The engraver of the frontispiece, Simon van de Passe, came from a family of engravers, and his work was prolific in England. According to Arthur Hind in *A History of Engraving and Etching*, van de Passe was “ready to supply, in [his] modest but sound manner, any demands the publishers might make” (138). Thus, it can be inferred that Bacon conveyed his vision for the frontispiece to the publishers who then instructed van de Passe.

Whether or not author and artist communicated directly cannot be determined in this particular case. Suffice it to say that the themes represented by the symbols in the frontispiece can also be found in Bacon’s preface, which is the appropriate place to look for textual anchorage for the image.

This preface may be viewed as the textual counterpart of the visual exordium and can aid in decoding the meaning of the visual composition. Although Bacon does not comment on the frontispiece explicitly in his preface, there are clear instances in which he invokes the images represented in it. For example, consider the most prominent elements of this frontispiece: the Pillars of Hercules, also called the pillars of fate, with the ship “sailing” through them. In the preface, the first image that Bacon evokes in a series of vivid metaphors are the pillars. He constructs an analogy using the image of the pillars to describe the failure of men to expand their intellectual horizons: “These [failings] are like pillars of fate in the path of the sciences, since men have neither desire nor hope to encourage them to explore beyond.”<sup>43</sup> For Bacon’s contemporaries, the pillars represented not only the

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<sup>43</sup>. Francis Bacon, *Novum Organum, With Other Parts of The Great Instauration*, trans. and ed. Peter Urbach and John Gibson (Chicago: Open Court Publishing Company, 1994), 7.

boundaries of the known world, but also the notion of limitless ambition, a symbolic tradition accredited to Emperor Charles V.<sup>44</sup> Bacon adopted the columnar device as well as the emperor's motto, "Plus Ultra," a retaliation against the Greek myth in which the Pillars of Hercules read "Non plus ultra," or "Nothing further beyond."<sup>45</sup> One might say that the frontispiece visualizes Bacon's case against the stagnant learning in his time.

There are many layers of significance in the collage of symbols represented in this frontispiece, and one pertains to cultural and religious acceptance. Although Sir Francis Bacon has an excellent reputation in today's rendition of the history of science, when he first proposed his overhaul of human knowledge and learning, his ideas were not immediately palatable to supporters of the status quo. Bacon had to conjure a spirit of intellectual reform using whatever means necessary. The frontispiece, capturing readers' attention before they encountered the arguments contained within the text, contributed to this effort. For example, from an art historical perspective, the pillars, because they are not supporting a building but are free-standing, are symbolically said to be supporting the sky or the heavens. Likewise, the symmetrical construction of the columns brings order to the frontispiece's composition and reinforces the stability of Bacon's ideas, however revolutionary they may be.

Significantly, the pillars most obviously link the *Instauratio* frontispiece to the

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<sup>44</sup>. See Marie Tanner, "Charles V and the Order of the Golden Fleece" in *The Last Descendent of Aeneas* (Yale UP, 1993), 155-7.; Corbett and Lighthown, 186-7; and Earl Rosenthal, "Plus Ultra, Non plus Ultra, and the Columnar Device of Emperor Charles V," 217.

<sup>45</sup>. Rosenthal sheds light on the origin of Charles V's motto and also offers commentary on its usage after him. He writes, "It would seem that Charles' motto had become a universal symbol for limitless ambition..." See Rosenthal "Plus Ultra," 217.

one in the *Sylva* (fig. 3). The same symmetrical, stable foundation that supports the ships' journey to unknown territory in the *Instauratio* frontispiece supports the entire world of human knowledge—the *globo intellectualis*—in the *Sylva* frontispiece, engraved by Thomas Cecill. In fact, the only significant differences between the two images is the large globe sitting between the pillars in place of the ship in the earlier frontispiece, and the heavenly/solar entity descending on the globe in the *Sylva* frontispiece. Margery Corbett and Ronald Lightbown provide a close reading of this frontispiece in their compilation of emblematic English title-pages (1979), stressing its similarities to that of the *Instauratio*. They



Figure 3: Frontispiece to Bacon's *Sylva Sylvarum* or *A Natural History* (1627). By Thomas Cecill.

discuss Charles V and the adaptation of his emblem on the frontispiece, and they go as far as to mention the inventor of the emblem, the humanist Marliano, who intended it to symbolize Charles's rule as it extended from Spain to the territories in the New World (186). It is strange that they entirely omit the engraver of the frontispiece, who



adapted the image to suit Bacon's text, but find it necessary to mention Marliano.<sup>46</sup> In other words, Corbett and Lightbown provide historical context for the frontispiece without sufficiently contextualizing its actual construction. Likewise, their interpretation of Cecill's frontispiece is a collage of references to Bacon's other works—specifically the (much earlier) 1605 version of the *Proficiency and Advancement of Learning*, the *New Atlantis* (1626), and a tract written in 1612 that was published posthumously in 1653 entitled *Descriptio Globi Intellectualis*—rather than focusing on the text that the frontispiece actually precedes.

There are a few points that need to be made concerning this odd mixture of evidence. First, an extended version of the *Proficiency and Advancement of Learning* is the first part of the *Instauratio Magna*, so it is curious that Corbett and Lightbown choose to reference the much earlier version of the text, especially since they do make the connection between the two frontispieces. And secondly, the *New Atlantis* may be considered a fictional narrative and makes for strange evidence, considering that Bacon's other philosophical works are readily available for supporting their claims. Corbett and Lightbown's reference to the *Descriptio Globi Intellectualis* seems relevant, if that is indeed where Rawley found the idea to name the globe, but they do not offer insight into how the image should be read in light of that text.

There are merits to the sort of miscellaneous analysis put forth by Corbett and Lightbown. Their choice of evidence and diverse combination of sources is certainly

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<sup>46</sup> Marliano's emblem for Charles V bears little compositional similarity to van de Passe's frontispiece; in fact, the only resemblance is that they both depict the Pillars of Hercules, which represented the boundaries of the known world in antiquity. See Tanner, "Charles V," 155. That a connection exists at all between the frontispiece and Charles V's emblem is perhaps explained by the fact that Bacon adopted his motto "Plus Ultra" for his intellectual pursuits. For a discussion of this motto, see Corbett and Lightbown, 186-7.

intriguing and serves the purpose of contextualizing the emblematic frontispiece within Bacon's oeuvre. However, collecting and piecing together ideas from Bacon's other works, almost as if to say that Bacon somehow presaged the frontispiece design, does not put forth an accurate representation of the situation. In actuality, Bacon did not intend to publish the *Sylva* at all, let alone commission the frontispiece, and this significant information can be found simply by turning to the preface of the work in question—Rawley's letter to the reader at the beginning of the *Sylva*.

Rawley writes, "I have heard his Lordship [Bacon] often say, That if he should have served the glory of his own Name, he had been better not to have published this Natural History, for it may seem an indigested heap of Particulars..."<sup>47</sup> Rawley justifies going against Bacon's wishes, taking it upon himself to publish the work, by claiming it to be a part of the larger body of Bacon's work represented in the *Instauratio Magna*, even though the experiments recorded are less than satisfactory:<sup>48</sup>

And as for the baseness of many of the Experiments, as long as they be God's works, they are honourable enough: And for the vulgarnesse of them true Axioms must be drawn from plain experience, and not from doubtful, and his Lordship's course is to make Wonders plain, and not plain things wonders....(Rawley "To the Reader").

Rawley as editor must in fact argue in his preface for the connection between these two very disparate works in Bacon's oeuvre. The two texts do not share a clear connection or structure—the *Sylva* is a series of experiments that read like an instruction manual,<sup>49</sup> and the *Instauratio* is a philosophical discourse. In any case, if

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<sup>47</sup> Rawley, "To the Reader." in *Sylva Sylvarum*.

<sup>48</sup> Some might argue that Bacon's statement about not wanting to publish the *Sylva* was typical and meant to be an expression of humility. But the fact remains that the *Sylva* was an unfinished manuscript. Moreover, since Rawley was responsible for having it published, his preface—the text immediately following the frontispiece—is more appropriate for contextualizing the image than the independent semiotic system for images employed by Corbett and Lightbown.

<sup>49</sup> For example, the first experiment in Century I begins, "Dig a Pit upon the sea-shore, somewhat above the High-water mark, and sink it as deep as the Low-water mark..." and the second experiment

Rawley's intention was to link the *Sylva* to the *Instauratio*, commissioning a frontispiece with an immediately recognizable composition is one readily apparent way to solidify the link between the texts.

Further evidence for the deliberateness of Rawley's frontispiece selection is the fact that it was done by a different engraver. Thomas Cecill, an English engraver, was responsible for this one, not the previous Dutch engraver, Simon van de Passe, which means that the design was not simply recast by the same craftsman but deliberately copied by another. The globe is labeled "mundus intellectualis," or the world of human understanding; it might be inferred that the replacement of the ship with the globe is indicative of the progress that has been made since the intellectual ship left the land of Greek-dominated philosophy in the earlier frontispiece. In order to assure religious authorities who were skeptical of the new system of human understanding that it was not intended to threaten established values, Cecill's globe is basking in the light of God (inscribed in Hebrew letters on the light source). Though there is little doubt that the sphere represents a globe, the shadowed part of the "mundus intellectualis" is etched with curved lines that give it an iridescent quality, like a pearl. The pearl is a symbol of perfection, so perhaps it is no coincidence that this globe looks like a pearl displayed on a dish, as it would give the impression that Bacon's *Instauratio Magna*, with the final addition of the *Sylva Sylvarum*, has reached completion and perfection.

In sum, Rawley's letter to the reader and choice of frontispiece are the only

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begins, "Take a glass and put water into it, and wet your finger, and draw it round about the lip of the Glass..." and the text continues on like this for "ten centuries." See Francis Bacon, *Sylva Sylvarum or A Natural History in Ten Centuries, 11th ed.*, 1685, ed. William Rawley (London: B. Griffin (1980): Reel 1029:21), Microfilm, 1-2.

material connections between the two texts. Viewed in this light, it may be argued that the frontispiece to the *Sylva Sylvarum* is meant to serve a greater purpose than simply indicating the book's prestige and drawing a specific audience—it makes a visual argument, supporting Rawley's introduction, for integrating the *Sylva Sylvarum* into the earlier *Instauratio Magna*. Corbett and Lightbown's miscellaneous compilation of evidence to explain the frontispiece is incongruous to a reading of the frontispiece that actually links it with the text that it prefaces (the *Sylva Sylvarum*) and the larger work to which Rawley has appended it (the *Instauratio Magna*). To view the frontispiece as a visual exordium, one should *first* reference the author's written preface to find context for its imagery before turning to various other sources.<sup>50</sup> A rhetorical reading of the second frontispiece reveals it as a ploy on the part of the editor to expand Bacon's project for a new natural philosophy. A reading of the frontispiece out of the context of its book, without Rawley's preface and without consideration of the earlier frontispiece, would not uncover its full potential as a persuasive visual document that can participate in the process of situating a text, endorsing a project, and orienting readers to said project.

### **Linnaeus's *Hortus Cliffortianus* (1737)**

Just as the frontispiece to the *Instauratio Magna* can be read in accordance with Sir Francis Bacon's preface, the frontispiece to Linnaeus's *Hortus Cliffortianus* (see fig. 1) visually corresponds to his introduction and dedication sections.

However, the rhetorical situation changes a great deal between these two cases primarily because Linnaeus, unlike Bacon, worked closely with his artist, Jan

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<sup>50</sup> In this case, the author is Rawley, although Bacon's preface to the *Instauratio* could provide context for Cecill's frontispiece, too, because Rawley intends to link the *Sylva* to the *Instauratio*.

Wandelaar. Not only did Wandelaar create the allegorical frontispiece illustration, he also worked with Linnaeus on all of the scientific illustrations of plants inside the *Hortus Cliffortianus*. Given that Wandelaar worked under Linnaeus's guidance for the botanical illustrations to ensure that the depictions were accurate,<sup>51</sup> it would not be out of line to assume that Wandelaar designed the frontispiece under Linnaeus's guidance as well.

As mentioned in the introduction to this chapter, Linnaeus is most often recognized today not for the *Hortus*, but for his later *Systema Naturae* (1758) in which he describes his famous system of binomial nomenclature to classify natural species. The *Hortus* marks the beginnings of that classification system, as it is a highly detailed catalogue of plants that Linnaeus compiled while employed by George Clifford—hence *Hortus Cliffortianus*—in his magnificent gardens. Linnaeus spent two years classifying the plants in Clifford's gardens to create the extensive list that composes the body of the text (Stafleu 11). Because the body of the text is a catalogue of plants, readers must rely on Linnaeus's introduction and dedication sections to learn how the text should be read. These prefatory sections contrast sharply with the main text because they are not only instructive but also celebratory. It is clear from the prefatory material that Linnaeus sought to convince readers of the importance of studying plants, and the frontispiece most certainly participates in this botanical celebration.

Still, readers today should not assume that Linnaeus was solely responsible for designing the scene depicted in the frontispiece because the fact remains that he did

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<sup>51</sup>. Biographer F.A. Stafleu writes that Linnaeus himself had considerable artistic talent and therefore required that his "descriptive scientists" be able to draw well (22).

not make it, regardless of his input in the inventional stage. Evidence for the artist's autonomy appears in the form of a poem accompanying the frontispiece with

Wandelaar's name on it (fig.

4). Wandelaar's poem both describes the visual content of the frontispiece and celebrates Linnaeus's overall project.

That Wandelaar wrote a poem

to provide context for the

visual indicates that all of his artistic choices in creating the

frontispiece were carefully

calculated and thus deserve

critical attention. It is

important to note that although

the artist could have chosen to

design a frontispiece more in

line with his in-text scientific

illustrations of plants, he

instead designed a frontispiece

that deliberately subscribes to the classical tradition of employing emblems or

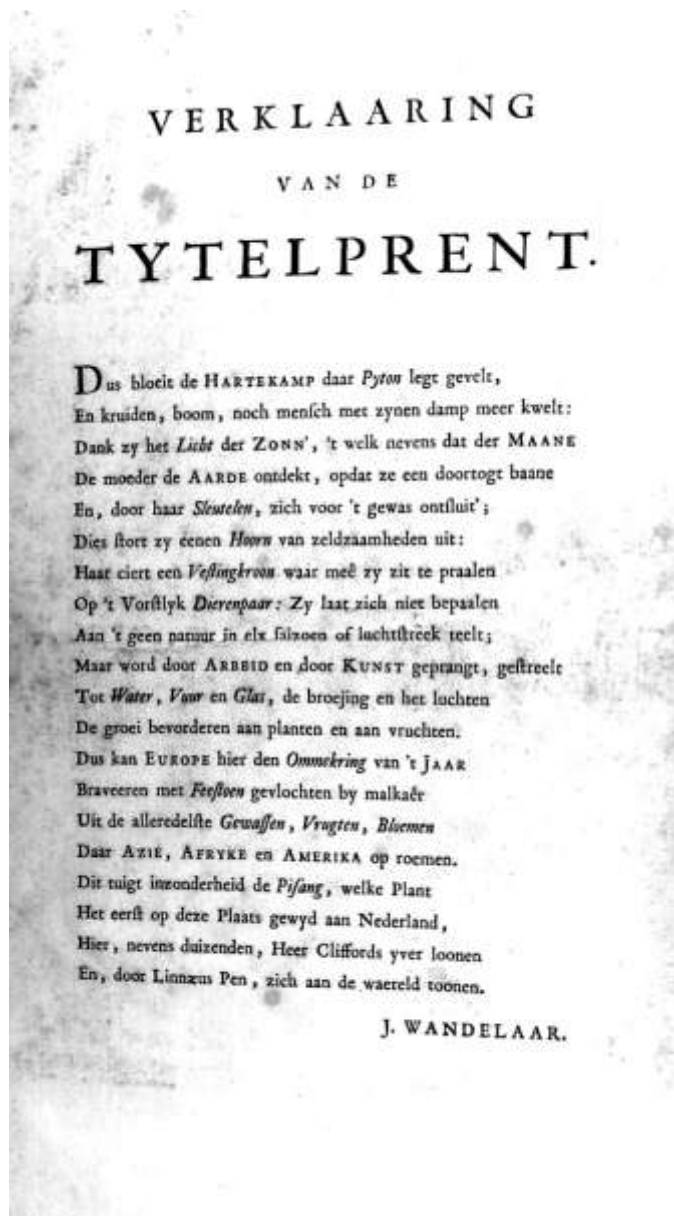


Figure 4: Poem to accompany frontispiece for Linnaeus's *Hortus Cliffortianus*. By Jan Wandelaar.

allegories to convey a message.<sup>52</sup> To be clear, Wandelaar and Linnaeus intended for readers to first encounter this mythological scene—as opposed to the anatomy of a flower or plant, for instance—before they read anything, including Linnaeus’s introduction. There are always rhetorical implications when such a decision is made.

It was fairly typical for frontispieces in natural philosophical texts of the seventeenth and eighteenth centuries to subscribe to an allegorical style; Linnaeus’s and Bacon’s texts are in good company. At least part of the reason for this stylistic choice is that readers would have been familiar with the language of emblems<sup>53</sup> and they would have been engaged by such a vivid, detailed scene. But Wandelaar’s poem also provides some guidance for the identification of symbols and characters. As already mentioned, Wandelaar’s beautiful frontispiece is a portrayal of George Clifford’s garden, called Hartecamp. Clifford himself appears as a statue near the upper left corner of the piece, presiding over the scene below. A diverse group of allegorical figures, cherubs, plants, animals, and scientific instruments crowds the foreground.<sup>54</sup> The artist’s poem opens by describing the scene as follows:

So Hartecamp flourishes, where the Dragon lies put to death  
not any longer harming herbs, trees and men with its breath.  
Thanks to sunlight, also to the moon, Mother Earth is revealed  
and opens her bosom through her keys.<sup>55</sup>

The dead dragon is laid out on the right side of the composition, its face seemingly

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<sup>52</sup>For detailed explications of the frontispiece, see for example Gunnar Broberg, “The Dragonslayer,” *Tijdschrift voor Skandinavistiek* 29 (2008): 29-43 and Victoria Dickinson, *Drawn From Life* (1998).

<sup>53</sup>See e.g. Broberg and Tibell.

<sup>54</sup>Linnaeus had been experimenting with the centigrade thermometer, which is depicted in the foreground. See John L. Heller, Introduction to Linnaeus’s *Hortus Cliffortianus* in *Taxon: Journal of the International Association for Plant Taxonomy* 17 (1968): 667.

<sup>55</sup>This is Broberg’s translation of Wandelaar’s poem, which is originally in Dutch. Broberg only translates the first few lines in his article, “The Dragonslayer.” The only other available English translation is by Willem Klooster, “Explanation of the Frontispiece,” in Jorge Cañizares-Esguerra, *Puritan conquistadors: Iberianizing the Atlantic, 1550-1700* (Stanford: Stanford University Press, 2006), 279.

under the foot of the god Apollo. Undoubtedly a plethora of interpretations exist for the dragon's significance. A dead dragon in a flourishing garden takes on for contemporary audiences religious connotations—the scene becomes almost edenic with the man and woman as the focal point, surrounded by all of God's creation. The twist to the biblical narrative, of course, is that the reptilian creature is slain, and the garden is permitted to thrive. The most telling part of this particular visual narrative is that the god Apollo, who is stepping on the dragon's head, has the face of a young Linnaeus.<sup>56</sup>

The religious narrative played out in the frontispiece is significant. It illegitimizes arguments against natural philosophers being able to understand the workings of nature by suggesting that Linnaeus, a natural philosopher, is capable of bringing order and peace to God's creations through knowledge of them. Not only do humans have access to knowledge of the natural world, but they also are able to use it in a way that promotes harmony between humanity and nature. Linnaeus opens his dedication in a way that corroborates this notion; he shows deference to the Christian God by providing a narrative of God's creation of the world, and he argues that because God created plants before he created people, it is most natural for people to study plants.<sup>57</sup> Thus, Linnaeus takes the arguments of religious proponents and shifts

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<sup>56</sup>See Broberg, who explains in "The Dragonsayer" that the scene in the frontispiece is "possible to interpret (with the help of the explanation connected to it) as Flora being unveiled by Apollo, putting his foot on the dragon's head" (37). In his caption of the frontispiece, Broberg writes, "In centre Natura, Flora, Cybele or Mother Earth, standing on the dragon or hydra of Hamburg is Apollo, Perseu or Linnaeus surrounded by representatives of the different continents" (38). For the same interpretation, see also Gunnar Tibell: "Linnaeus grows bananas and comes up with a 'modern' thermometer." (2008). In these accounts, the authors indicate that readers would have recognized the figure as the god Apollo from Wandelaar's explanatory poem and their knowledge of classical symbols.

<sup>57</sup>Carl Linnaeus, *Hortus Cliffortianus*, ed. and trans. John L. Heller: "When Man had been so marvelously created, endowed with senses and the judgment to reason about his surroundings, was it



them to support his studies.

Other elements of the frontispiece can be read in accordance with Linnaeus's appeals to his audience in the prefatory text. To begin with, the other people in the composition all represent different continents—Asia, Africa, and America—who are presenting their botanical offerings to Europe, the woman seated on the lion in the center of the illustration. This scene is conveyed textually as well; Wandelaar's poem reads:

Thus Europe can defy the Year's circle  
With a Festoon Braided  
From the most noble Crops, Fruit, Flowers  
That Asia, Africa, and America can boast of.<sup>58</sup>

The scene of Europe accepting the botanical offerings of the other continents also corresponds to the part of Linnaeus's dedication in which he describes the contents of the different "houses" in Clifford's gardens; these houses are categorized by the places of origin of the plants they contain, and the text lists plants from all of the continents represented by the allegorical figures (Linnaeus 673). By featuring Europe as the recipient of the other continents' offerings, the frontispiece is able to corroborate the message that Linnaeus has brought knowledge of the rest of the world to Europe through his studies of plants, an argument for the legitimacy of botanical

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for any other purpose that the Creator placed him in the marvelous world, where nothing came to the notice of his senses but natural objects, especially the wonderful plant-machines, than that in awe before the lovely work he should marvel at the Master, worship him?" (669). For the Latin, see Carl von Linné, *Hortus Cliffortianus* (1737), arranged by Kurt Stueber: "Creatum tam mirifice Hominem, sensibus & iudicio instructum, quo ratiocinaretur de adstantibus, collocavit Creator in mirifico orbe, ubi nihil in sensus incurreret praeter naturalia, praefertim planatarum mirae machinae, an ob aliam causam, quam ut ex opere pulcherrimo ductus Magistrum admiraretur? Veneraretur?" (Linné).<sup>58</sup> This is Klooster's translation. In other places, there are gaps where the Dutch is not translated, and the translation overall is not idiomatic. An alternative and equally rough translation might be: "So can Europe host to the circle of the year, with good honor when woven by the noblest of all crops, fruits, flowers have Asia, Africa and America to boast." For the Dutch, see Jan Wandelaar, "Verklaaring van de Tytelprint": "Dus kan Europe hier den Ommekring van 't jaar/ Braveeren met Feestoen gevelochten by malkaer/ Uit de alleredelste Gewassen, Vrugten, Bloemen/ Daar Azie, Afryke en Amerika op roemen."

studies.

It is worth emphasizing that Linnaeus, like other natural philosophers at this time, did have to legitimate his studies to skeptical or disinterested audiences. Here is how Linnaeus characterizes his audience in his preface:

To-day men are slaves to various pleasures...Some are in love with paintings and sculptured works of art, others with antique and outworn arms and armour...they busy themselves with a false reflection of beauty, while the fleeting hour passes; every man is rapt after his enjoyment. But for my part I would judge no pleasure to be more innocent than that which the first created man embraced, than that which supports the life which is so kind to mortals. Therefore let my pleasure be in plants!<sup>59</sup>

More important than the pleasure that plants can offer, Linnaeus then explains, is their necessity to the study of medicine. “Nowhere are there more errors, more deficiencies,” he writes, “than in this one branch! Nothing else is to blame but the neglect of medicinal plants, the neglect of botany.”<sup>60</sup> The frontispiece, which of course precedes this argument, works to put the reader in a sympathetic state of mind by portraying Clifford’s beautiful garden, perhaps persuading readers into sharing Linnaeus’ sentiment that plants can indeed be a source of pleasure before he explains their necessity to the neglected study of medicine. Despite Linnaeus’s judgment against men who are “in love with paintings and sculptured works of art,” he commissioned Wandelaar to create an aesthetically pleasing frontispiece to be the portal into his text.

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<sup>59</sup> Linnaeus, 669. This is Heller’s translation. For the original Latin, see Linné, *Hortus Cliffortianus*: “Homines hodie variae tenent deliciae; alii poculis generosis & cibis opiparis; alii palatorum splendore & vestimentorum fulgentibus crustis; alii picturis & dedalaeis operibus, armis antiquis & obsoletis alii, chinensibus testis & cochlearum mille modis variegates cucullis vero alii mentem fallant, falsaque occupant pulchritudinis imagine, dum brevis avolat hora; trahit sua quemque voluptas. Nullam tamen Ego innocentiorum judicarem ea qua potius est creatus primus homo ea quae amicissimam mortalibus vitam sustentat. Sit hinc in plantis mea voluptas!”

<sup>60</sup> Linnaeus, 670. For the Latin, see Linné, *Hortus Cliffortianus*: “Nulla pars medicinae, obstupesco dum dico verissimum, minus est exulta quam medicamentorum cognitio; nullibi plures errores, pluresque defectus quam in hac sola! caussa alia nulla quam neglectus simplicium, neglectus botanices.”

All in all, this visually complex frontispiece serves an equally complex purpose. First, in portraying a harmonious scene of all of God's creations, the frontispiece aids in making readers predisposed to the coming argument in support of the neglected field of botany. Secondly, in portraying Linnaeus as Apollo overseeing the botanical scene, the frontispiece also garners respect for Linnaeus and his studies. The choice to portray Linnaeus as a god would be considered quite hubristic had Linnaeus made the frontispiece himself. But the depiction of him as a god presiding over all of botanical creation is possible precisely because he did not create the frontispiece. Wandelaar's illustration thus adds an element to Linnaeus's argument in the dedication that Linnaeus himself could not have carried out successfully—especially not in written discourse (i.e. I, Linnaeus, am like a god). His visual identification with Apollo in the frontispiece might have helped predispose readers to Linnaeus's arguments that appear later in the dedication. Finally, the allegorical scene likely provided a more engaging frontispiece than a "scientific" illustration would have. While readers would have been familiar with the complex symbols represented in the frontispiece, and thus would have been able to pick up on the visual message being conveyed, they would not necessarily have recognized its purpose to get them in the right frame of mind to read a potentially controversial scientific text. The frontispiece genre allowed for the delivery of implicit messages before authors addressed their readers in the text.

### **Diderot's and d'Alembert's *Encyclopédie* (1751; 1775)**

As with the other texts studied here, the *Encyclopédie* has a preface that can

be assessed in conjunction with the frontispiece, and it is in this *Preliminary Discourse* that d'Alembert lays out the aims and goals of the monumental project begun by Diderot. However unlike the other situations discussed so far, this frontispiece was not published at the same time as the preface; in fact, it was not added to the text until 1775—nearly twenty-five years after the *Preliminary Discourse* was published with the first edition of the encyclopedia.<sup>61</sup>

One might expect that, with twenty-five years to carefully select a frontispiece for the project, Diderot and d'Alembert would have chosen one that reflected the values expressed in the *Preliminary Discourse*. In actuality, however, Diderot selected an image at the 1765 *Salon*<sup>62</sup> that seemingly destabilizes d'Alembert's prefatory message (fig. 5). In this particular case, the double-author



Figure 5: Frontispiece to d'Alembert's and Diderot's *Encyclopédie* (1751; 1775). By Charles Nicholas Cochin the Younger.

arrangement complicates the frontispiece-text connection, and the plot thickens when the author-artist relationship is also considered. Following consideration of these

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<sup>61</sup> The encyclopedia was published in several volumes (including volumes of plates) between 1751 and 1772. Later, more supplemental volumes were added.

<sup>62</sup> The *Salons* were biennial art exhibitions in the Louvre.

complexities, I explicate the frontispiece in conjunction with a detailed prefatory poem that was published along with it.

A product of the French Enlightenment, Diderot's and d'Alembert's *Encyclopédie* places a great deal of emphasis on the mechanical arts and touts the empirical methodology of natural philosophers not just in France, but across Europe. Already well-known for his contributions to science and mathematics, d'Alembert was primarily responsible for writing the *Preliminary Discourse* in 1751 to systematically outline the general principles and characteristics of disciplines from the liberal arts to the mechanical sciences, showing the inter-relations among the disciplines and how they came to be (x; 4). In line with the intellectual spirit of his age, d'Alembert privileges facts and recognized truths over hypotheses and speculation, writing, "let us conclude that the single true method of philosophizing as physical scientists consists either in the application of mathematical analysis to experiments, or in observation alone...rigidly dissociated from any arbitrary hypotheses."<sup>63</sup> Bearing in mind d'Alembert's quest for truth and knowledge through direct observation and analysis, one might expect the *visual* preface, or frontispiece, to the *Encyclopédie* to reflect similar values.

Eighteenth-century artist Charles Nicholas Cochin the Younger displayed his drawing of the frontispiece-to-be at the 1765 *Salon*, the biennial art exhibition at the Louvre, which Diderot not only attended but wrote about in publications called *Salons*. In his *Salons*, Diderot provided ekphrastic descriptions of the artwork on

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<sup>63</sup>Alembert 25. This is Schwab's translation. For the original French, see Alembert, *Discours Préliminaire de L'Encyclopédie*: "et concluons que la seule et vraie manière de philosopher en physique consiste ou dans l'application de l'analyse mathématique aux expériences, ou dans l'observation seule, éclairée par l'esprit de méthode, aidée quelquefois par des conjectures lorsqu'elles peuvent fournir des vues, mais sévèrement dégagée de toute hypothèse arbitraire" (42-3).

display to those who could not attend the show; he has been called “a one-man substitute for the fascinating but inaccessible chorus of voices that constituted the Salon public” (Crow xiii). It was at the 1765 *Salon* that Diderot identified Cochin’s drawing as the future frontispiece of the *Encyclopédie*, although it is unclear whether he commissioned it specifically or he selected it on a whim. He was friends with the well-known artist, which may have also played a role in its selection. Diderot’s opinions of Cochin’s artwork are plainly stated in his *Salons* of 1765 and 1767. He even takes note of Cochin’s opinions of others’ paintings quite often in his 1765 *Salon*, alternately agreeing and disagreeing with his friend’s assessments.<sup>64</sup> For instance, regarding one of Baudouin’s paintings, Cochin believes that the more crowded an illustration is, the more engaged the viewer will be (Diderot “On Art” 90). Diderot then offers his own opinion on how the painting *should be* composed, and he concludes by saying, “So? So Cochin doesn’t know what he’s talking about” (91).<sup>65</sup> The point to be taken here is that even if the author and frontispiece artist are on good terms, they are not necessarily going to agree about the artwork. Still, the fact remains that Diderot chose Cochin’s piece for the encyclopedia. The image now merits a closer look. Diderot’s brief description of Cochin’s drawing in his 1765 *Salon* will also provide some insight into his decision.

In Cochin’s elaborate drawing, a crowd of allegorical figures is gathered in a massive cloud, from which emerges a veiled woman emanating light. Two of the

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<sup>64</sup>Diderot writes in the 1765 *Salon* that he communicated with different artists during the exhibition at the Louvre, and only after considering their opinions did he offer his own reflections. See Diderot (“on Art” 3). Generally speaking, he seems to value Cochin’s opinions, even if he often disagrees with him. The editor of the *Salon*, John Goodman, explains that Diderot first learned art criticism by studying Cochin’s art criticism, specifically his *Voyage d’Italie* (182).

<sup>65</sup>This is Goodman’s translation. For the original French, see Denis Diderot, *Salon de 1765*: “Donc Cochin ne sait ce qu’il dit. S’il défend son confrère contre la lumière de sa conscience et de son propre goût, à la bonne heure”(169).

robed figures beside the radiant woman are trying to pull off her veil, and she is leaning away from them, resisting their efforts, while another woman sails up from the left-hand side with a garland to adorn her. Diderot provides an interpretation of this scene in his 1765 *Salon*, maintaining that the radiant woman represents Truth, the two trying to unveil her are Reason and Philosophy, and the one with the garland is Imagination.<sup>66</sup> The unveiling of Truth is a common theme in traditional allegory, and in this case it might signify the encyclopedia's aim to reveal Truth by employing reason, as described in d'Alembert's *Preliminary Discourse*. However, viewers cannot overlook the figure of Imagination on the other side; by portraying Imagination *decorating* Truth, the artist is complicating the visual message. Regarding Imagination's role, art historian Mary Sheriff explains that "every description of Cochin's allegory published in the eighteenth century affirmed imagination's role as decorator [of Truth]" (Sheriff 160). Thus, although Truth is being revealed by Reason and Philosophy, Truth is also being subjected to the faculty of Imagination, which decorates, embellishes, or simply interferes with the naked Truth.

There are hints in d'Alembert's *Preliminary Discourse* that the role of Imagination in this scene is incongruous with the project's larger values. Despite d'Alembert's ideas on the nature and role of imagination, Diderot selected a frontispiece that privileges imagination as the focal point of the image. First, in the *Preliminary Discourse*, d'Alembert gives his definition of "imagination": "We take imagination in the more noble and precise sense, as the talent of creating by

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<sup>66</sup>See Diderot "On Art" (182); For original French see Diderot *Salon* (319).

imitating” (51).<sup>67</sup> The frontispiece depicts a personified Imagination decorating Truth, which is perhaps the less noble sense of the term—Imagination is not a creator or imitator but an embellisher or manipulator. Secondly, d’Alembert situates imagination “last in the arrangement of our faculties” because it “deals only with purely material beings” (52).<sup>68</sup> The frontispiece portrays Imagination “dealing with” Truth, which is certainly not a material being and which belongs to the province of philosophy or reason. This is not to say that d’Alembert undervalues the faculty of Imagination; he simply does not privilege it (by any means) over the faculty of reason in his hierarchy. For this reason, the fact that personified Imagination usurps so much of the spotlight as the focal point of the composition seems problematic, and if anything, it should be personified Reason in place of Imagination.

Diderot happens to call attention to the distribution of elements and points of emphasis in the frontispiece composition in his 1765 *Salon* review. Although Diderot opens his review of the future *Encyclopédie* frontispiece by saying, “This is very ingeniously composed,”<sup>69</sup> he also spends half of the paragraph outlining its faults: “Certainly this composition boasts a considerable variety of character and expression, but the levels of depth don’t advance and recede enough; the upper area should fade into the background, the next move forward somewhat, and the third be the most forward of all.”<sup>70</sup> If one were to apply Diderot’s criticisms to the composition—if,

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<sup>67</sup>For the French see Alembert, *Discours Préliminaire*: “Nous prenons l’imagination dans un sens plus noble et plus précis, pour le talent de créer en imitant” (70).

<sup>68</sup>For the French see Alembert, *Discours Préliminaire*: “...et l’imagination ne travaille que d’après les êtres purement matériels: nouvelle raison pour la placer la dernière dans l’ordre de nos faculties” (73).

<sup>69</sup>Diderot “on Art” (182); Diderot, *Salon de 1765*: “C’est un morceau très ingénieusement composé.” (319).

<sup>70</sup>Ibid. “Il y a certainement dans cette composition une grande variété de caractères et d’expressions, mais les plans n’avancent ne reculent pas assez; le plus élevé devrait se perdre dans l’enfoncement; le suivant venir un peu sur le devant, le troisième y être tout à fait.”



that is, the upper area did indeed fade into the background more than the middle and lower sections—the embellishment of Truth by Imagination would receive much less emphasis in the image. In exchange, the other figures representing various academic disciplines would receive more emphasis.

Perhaps to impose this alternative emphasis, and to smooth over the contradictions between imagination's role in d'Alembert's *Preliminary Discourse* and its role in the image, Diderot provides a poetic description of the frontispiece to be published alongside it in the 1775 edition of the *Encyclopédie*. Although viewers would have been able to interpret the symbols in the frontispiece, Diderot's text serves as a "key" and guides viewers' interpretation of the image, to a certain extent controlling its meaning by highlighting certain aspects of the illustration while suppressing others. More specifically, Truth, Reason, and Philosophy are invoked first, followed by all of the personified academic disciplines (consuming the majority of the description) while Imagination is detained until the end of the poem:

Beneath a temple of Ionic architecture, sanctuary of Truth, we see Truth wrapped in a veil, radiant with a light which parts the clouds and disperses them.

*On the right of Truth, Reason and Philosophy are engaged, the one in lifting the veil from Truth, the other in pulling it away.*

At her feet Theology, on her knees, receives her light from on high.

Following the line of figures, we see grouped on the same side Memory, and Ancient and Modern History; History is writing the annals, and Time serves as a support for her.

Grouped below are Geometry, Astronomy, and Physics.

The figures below this group show Optics, Botany, Chemistry, and Agriculture.

At the bottom are several Arts and Professions that proceed from the sciences.

*On the left of Truth we see Imagination, who is preparing to adorn and crown Truth.*

Beneath Imagination, *the Artist* has placed the different genres of Poetry—Epic, Dramatic, Satiric, and Pastoral.

Next come the other Arts of Imitation—Music, Painting, Sculpture, and Architecture<sup>71</sup>

It is worth noting, too, that when Imagination is finally mentioned, directly afterwards Diderot references “the Artist” for the first—and only—time, as if to remind readers that neither he nor d’Alembert were responsible for this placement. Diderot’s phrasing of Imagination’s role is also significant, as he describes Imagination as “preparing” to adorn Truth. His phrasing gives the impression that Imagination is waiting for Truth to first be revealed completely by Reason and Philosophy, which yields a very different message than if Imagination had hastily decorated Truth before Reason and Philosophy had the opportunity to reveal it fully. Here is an excellent example of how text can be carefully used to direct viewers’ understanding of an image—Diderot essentially gives step-by-step instructions encapsulated in a poetic form.

One could say that Cochin’s illustration reflects his own vision of the hierarchy of human faculties, a vision that may not coalesce with that put forth in the *Preliminary Discourse to the Encyclopédie*.<sup>72</sup> According to Caroline Van Eck, the artist’s use of perspective to guide the viewer’s gaze is “equivalent to the orator’s task to choose a disposition that is most conducive to persuasion” (26). Even Kress and van Leeuwen’s handbook for “reading images,” which leaves artistic intent out of the equation, also explains that the viewing process is directed by implicit visual cues in

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<sup>71</sup>The poem appears in Alembert, *Preliminary Discourse* (vi, emphasis mine).

<sup>72</sup>In spite of this fact, some authors will still attribute the artwork solely to the authors, making claims that the visual in some way reflects Diderot’s and d’Alembert’s perspectives. For example, Shiebinger, in “Feminine Icons: The Face of Early Modern Science,” attributes the frontispiece to the authors to make an argument about “feminine hegemony in science,” while Cochin is relegated to a footnote (661).

the composition. One of the most important cues, denoting salience, is the focal point of an image—where the eye goes first. The focal point in this image, as already stated, is the brightest area surrounding Truth, which highlights the diagonal vector formed by Imagination reaching out with the garland to adorn Truth. Imagination also occupies the top-left portion of the composition, which automatically receives visual prominence because of our typical “reading path” (see Kress and van Leeuwen). Thus, Imagination is in a more prominent place in the composition than those doing the unveiling, Reason and Philosophy.

In placing visual emphasis on Imagination embellishing Truth, Cochin’s artistic argument complicates the notion that we can reveal Truth and uncover the mysteries of the world by simply employing our faculties of reason. Although Cochin’s frontispiece might not entirely conform to Diderot’s aesthetic values or d’Alembert’s guidelines in the *Preliminary Discourse*, it likely would have served the purpose of assuring skeptical readers that the project was worthy of attention as a compendium of human knowledge represented by the cloud of figures in the image. The *Encyclopédie* project was not readily accepted by authorities—Diderot struggled with issues of censorship because the project was deemed contrary to the morals held up by the state.<sup>73</sup> That said, the traditional imagery and visual message of this frontispiece might have helped to gain more public support for a project that was opposed by religious authorities and condemned for its departure from established values.

### **Humboldt’s *Ideas for a Geography of Plants* (1807)**

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<sup>73</sup>See Crow, Introduction to *Diderot on Art*, who explains Diderot’s struggles with the *Encyclopédie* project.

**and *Ideas for a Physiognomy of Plants* (1806)**

The last frontispiece to be discussed in this paper requires more contextualization than the others discussed so far because I argue that it does the work of linking two texts in the author's oeuvre. In some ways, this situation is reminiscent of the case of Sir Francis Bacon's two texts, linked together by their frontispieces, but the differences between the two cases are also significant. For one, the author, German naturalist Alexander von Humboldt (1769-1859) was well-acquainted with his engraver, and moreover, Humboldt was not dead when the second of the two texts in question was published.

He was responsible for selecting the frontispiece (fig. 6), but he does not say outright in his prefaces that he intended to link the two texts with it; that is my contention, based on a reading of image, text, and rhetorical situation.



**Figure 6: Frontispiece to Humboldt's *Ideas for a Geography of Plants* (1807). Designed by Bertel Thorvaldsen to be engraved by Raphael Urbain Massard.**

Humboldt contributed significantly

to what is now the field of biogeography, and his two works discussed here reflect a

tension between Enlightenment ideals and a more Romantic view of nature propounded by Goethe, his longtime friend and mentor. Regarding this tension, the styles in which the two texts in question are written are completely different—even though the titles only differ by one word. *Ideas for a Physiognomy of Plants* (henceforth *Physiognomy*) is characterized by elaborate, expository prose, and *Ideas for a Geography of Plants* (henceforth *Geography*) is a rather dry, empirical text.<sup>74</sup> Only one of these texts has a frontispiece, and it is surprisingly the empirical text. Furthermore, this empirical text, the *Geography*, lacks a substantial introduction to read alongside the frontispiece. My contention is that the previously published *Physiognomy*, in its entirety, fulfills the function of an introduction or exordium to the *Geography* and corresponds to the frontispiece illustration. In other words, the *Physiognomy* features rhetorical tactics that would have left readers attentive, receptive, and well-disposed to the type of empirical study put forth by Humboldt in the *Geography* a year later—tactics that the *Geography* itself is lacking.

From the outset, the preface to the *Geography* reads like a report of Humboldt's work to date and does not point to the frontispiece at all, let alone offer insight into its significance. In the preface, Humboldt explains how the text originated in his observations of plant life during his travels through the tropics.<sup>75</sup> This “report” could have very easily been delivered in the style of a travel narrative, especially considering his aesthetic sensibility in the *Physiognomy*, which I will

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<sup>74</sup>In German, these are *Ideen zu einer Physiognomik der Gewächse* and *Ideen zu einer Geographie der Pflanzen*, respectively. There are a few variations to the title of this work. “Ideas for a Geography...” and “Essay on the Geography...” are more popular than “Ideas Towards a Geography...” but all of these translations correspond to the same work. I am using Lomolino et. al.’s translation (see Humboldt, “From *Essay on the Geography of Plants*,” in *Foundations of Biogeography*).

<sup>75</sup>Humboldt, “From *Essay on the Geography of Plants*” (49-50).

attempt to capture in what follows.<sup>76</sup> The *Physiognomy*, published a year earlier and previously delivered as a lecture at the Royal Academy of Science in Berlin,<sup>77</sup> is seemingly the more artistic, poetic counterpart to the *Geography*. That it was first delivered as a lecture indicates that the *Physiognomy* was conceived for a broad audience and thus served as an advertisement for Humboldt's empirical project—the *Geography*—prior to its publication. The *Physiognomy* can be read successfully as a detached exordium to the longer, empirical text, its contents corresponding more naturally to the frontispiece.<sup>78</sup>

The frontispiece portrays Apollo unveiling a statue of the goddess of nature, known variously as Diana, Artemis, or Isis,<sup>79</sup> and it was designed by Danish neoclassical sculptor Bertel Thorvaldsen to be engraved by Raphael Urbain Massard.<sup>80</sup> In this case, as mentioned earlier, the author and artist were acquainted: Humboldt met Thorvaldsen when visiting his brother in Rome in the summer of 1805.<sup>81</sup> Thorvaldsen is known for his sculptures, not for drawings, and this could account for the image's lack of background detail or embellishment—it is essentially a drawing of two sculptures. Else Bukdahl, who studies his sculptures, makes the case that Thorvaldsen was concerned with coordinating the associations between “nature and the ideal” and “outer and inner nature” among other relations (227). It

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<sup>76</sup>For a detailed account of his travels, see De Terra, especially Chapter 10, “Famous in Paris” (190–210).

<sup>77</sup>See A. von Humboldt, “*Ideen zu einer Physiognomik der Gewächse*,” and also A. von Humboldt, “*Ideen zu einer Physiognomik der Gewächse*.”

<sup>78</sup>According to De Terra, the *Ideas for a Physiognomy of Plants* became a part of Humboldt's more comprehensive *Views of Nature (Ansichten der Natur)* in 1807—his most popular work, published in three different editions and translated into several different languages (208).

<sup>79</sup>For more information about the goddess with a veil, see Pierre Hadot, “Isis Has no Veils.”

<sup>80</sup>See Steigerwald, “Figuring Nature,” 54; 79 n. 1.

<sup>81</sup>*Ibid.*, 79. This was after the French version of the *Geography* was published, but before he delivered his lecture on the *Physiognomy* and published the German *Geography*, which explains why only the German version has the frontispiece.

seems that the tensions Bukdahl speaks of in Thorvalden's sculptures are represented in this frontispiece by the sculpture of Apollo, which closely resembles the *Apollo Belvedere*,<sup>82</sup> a symbol of ideal beauty, and the landscape on which he uncovers the goddess of nature. The ancient Greek statue of *Apollo Belvedere*, which now stands in the Cortile del Belvedere in the Vatican, was admired by Thorvaldsen's contemporaries as a representation of ideal beauty, and Thorvaldsen studied the statue closely (Bukdahl 229). In contrast to this ideal is the nature goddess, a deformed figure with multiple breasts and inscriptions of natural phenomena on her body. What might be the implications of this unveiling of nature by the ideal?

This frontispiece shares the theme of unveiling with the *Encyclopédie* frontispiece, but here the goddess of nature's veil is completely removed by Apollo, which suggests a different connotation than the partial unveiling of Truth in Cochin's illustration. That the veil is completely removed from Nature in Thorvaldsen's drawing could suggest that more progress has been made towards understanding or knowing Nature and "her" powerful influences on humanity, or that there is more confidence in natural philosophy to do the unveiling. According to Hadot in *The Veil of Isis*, Humboldt sent the frontispiece as a gift to Goethe, who called it "a flattering illustration that implies that Poetry, too, might lift the veil of Nature" (viii). Goethe's reading of the frontispiece would not have surprised or confused his contemporaries as it would confuse readers today—Hadot explains that "The allegory was perfectly clear to educated people of this time" (viii). Indeed Humboldt creates a link between the natural and metaphysical world in the *Physiognomy* that seemingly corresponds to

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<sup>82</sup>For the image and a more detailed account of the statue's history, see Karl Galinsky, "The Apollo Belvedere."

the frontispiece's connotations; he explains to his readers, "This influence of the physical on the moral world—this mysterious reaction of the sensuous on the ideal, gives to the study of nature, when considered from a higher point of view, a peculiar charm which has not hitherto been sufficiently recognized."<sup>83</sup> In other words, Humboldt makes the argument that the study of the physical environment is not only an empirical endeavor, but metaphysical as well. By associating natural philosophy with the moral sensibilities of his contemporaries, when their tendency was to dissociate the two, Humboldt could appeal to a broader audience.

The stone tablet at the goddess of nature's feet displays the title of Goethe's "scientific" yet aesthetic work, *Die Metamorphosen der Pflanzen* (*The Metamorphosis of Plants* [1789]). Humboldt commissioned the frontispiece as a dedication to Goethe, as the two frequently corresponded about their mutual "philosophic and scientific interest in nature" (De Terra 58). According to Joan Steigerwald (2006), Humboldt's *Geography* builds on Goethe's *Metamorphosis of Plants* by adding "instrumental investigation" to the latter's emphasis on "aesthetic appraisal," and this explains the inscription on the stone tablet in the frontispiece (66). Steigerwald's point is that Humboldt's portrayal of nature is informed by both an aesthetic and a scientific reading of it. She furthers this claim by making the connection between the figuring of nature in the frontispiece and the figuring of nature in Humboldt's maps and diagrams (a compelling point that is unfortunately not

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<sup>83</sup>Humboldt, "Ideas for a Physiognomy" (219). This is Otte and Bohn's translation. For the original German, see Humboldt, *Ideen zu einer Physiognomik der Gewächse*, Project Gutenberg EBook: "Der Einfluss der physischen Welt auf die moralische, dies geheimnisvolle Ineinander-Wirken des Sinnlichen und Aussersinnlichen, giebt dem Naturstudium, wenn man es zu höheren Gesichtspunkten erhebt, einen eigenen, noch zu wenig gekannten Reiz" (14).



pursued in her essay).<sup>84</sup> Steigerwald's essay does revivify Humboldt's personal character and reconstructs his contemporaries' societal interests in a way that is certainly enlightening, but it likewise removes the frontispiece from its proper context—that is, the book in which it appears, and other texts in Humboldt's oeuvre with which it is associated, particularly the *Physiognomy*. The important point to take away from Steigerwald's analysis is that the frontispiece concretizes the link between Humboldt's scientific oeuvre and the more aesthetic model with which Goethe studied nature.

According to Humboldt's biographer, Helmut De Terra, Humboldt sent a copy of the *Physiognomy of Plants* to Goethe with a letter, explaining, "While in the lonely forests of the Amazon, I often relished the thought that I might dedicate the first fruits of my travels to you. It is a crude attempt to treat physical and botanical subjects aesthetically" (De Terra 208). This aesthetic treatment of the natural world, as mentioned earlier, is *not* present in the *Geography*; in fact, the aesthetically pleasing frontispiece is the only element of the *Geography* reminiscent of the aesthetic sensibility of the *Physiognomy*. The lyrical prose in the *Physiognomy of Plants*, at least in Otte and Bonn's translation,<sup>85</sup> is reminiscent of Linnaeus's Dedication to the

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<sup>84</sup>Instead, she writes about the cultural significance of the imagery depicted in the frontispiece, asserting that, "It should be read through the context of a fascination with ancient Egypt and cosmotheism, through the understanding of deities such as Diana as specific figurations of an indefinite cosmic divine power..." (65). Ultimately, Steigerwald inserts Thorvaldsen's frontispiece into a catalogue of other similarly themed frontispieces to construct an argument about Humboldt's personal convictions as they coincide with the cultural milieu of his time. Moreover, Steigerwald uses the gendered portrayal of the unveiling of nature as a springboard for discussing fictional works like Goethe's *Wilhelm Meister's Apprenticeship* (1795) and Schlegel's *Lucinde* (1799), and brings Humboldt's sexuality into her argument about how the frontispiece should be read (74-77).

<sup>85</sup>The preface to their translation states: "Great pains have been taken with the present translation, as well in regard to fidelity and style, as in what may be termed the accessories." E.C. Otte and Henry G. Bohn, Introduction to von Humboldt's *Views of Nature*: Microfiche v. Bohn also describes "the highly wrought and, it may be said, poetical descriptions, written in the Author's earlier years..." (viii).

*Hortus Cliffortianus*, and like Linnaeus, it becomes clear that Humboldt is trying to reach a broad audience, specifically “those who have never quitted our own hemisphere, or who have neglected the study of physical geography.”<sup>86</sup> In an effort to be both instructive and engaging, perhaps to multiple audiences with varying knowledge of his field, Humboldt juxtaposes phrases that are over-run by current specialist terms, not widely known (e.g., “microscopic infusorial animalicules”<sup>87</sup> to flowing, vivid descriptions of nature, as when he writes:

Indelible is the impression left on my mind by those calm tropical nights of the Pacific, where the constellation of Argo in its Zenith, and the setting Southern Cross, pour their mild planetary light through the ethereal azure of the sky, while dolphins mark the foaming waves with their luminous furrows.<sup>88</sup>

Most of the *Physiognomy* follows the latter trend (i.e. aesthetic descriptions), whereas even the preface to his *Ideas for a Geography of Plants* is lackluster. Because the aesthetic consciousness from the *Physiognomy* is absent in the *Geography*, it seems that Thorvaldsen’s frontispiece illustration is intended to import this aesthetic awareness by proxy. It is understandable that Humboldt would have wanted to preserve—for the audience of the *Physiognomy* in general and for Goethe in particular—some semblance of his aesthetic appreciation for nature. Thus, in reading the frontispiece of the *Geography* alongside the preface of the former, more aesthetically attuned text, readers can better appreciate its function as a visual exordium.

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<sup>86</sup>Humboldt, “Ideas for a Physiognomy,” 215. For the German see Humboldt, “Ideen zu einer Physiognomik”: “Diese Zunahme kann leicht von denen bezweifelt werden, welche nie unsern Welttheil verlassen, oder das Studium der allgemeinen Erdkunde vernachlässigt haben” (9).

<sup>87</sup>Ibid., 212.

<sup>88</sup>Ibid., 213. For the German see Humboldt, “Ideen zu einer Physiognomik”: “Unauslöschlich wird mir der Eindruck jener stillen Tropen-Nachte der Südsee bleiben, wo aus der duftigen Himmelsbläue das hohe Sternbild des Schiffes und das gesenkt untergehende Kreuz ihr mildes planetarisches Licht ausgossen, und wo zugleich in der schäumenden Meeresfluth die Delphine ihre leuchtenden Furchen zogen” (5).

## Conclusion

In this chapter, I have analyzed five frontispieces from various time periods and countries of origin to argue that frontispieces should be viewed as visual exordia and read in conjunction with the authors' prefaces or explanatory poems. Contrary to common practice, frontispieces should not be taken out of their rhetorical contexts to be categorized into groups according to a specific theme or according to the genre of science to which they belong. Typically, the process of grouping frontispieces in this way leads to their conflation under a single theoretical analysis, which causes their complex agency and rhetorical function in specific works to be overlooked.

In some cases the artists do work closely with the authors—Linnaeus and Wandelaar and Humboldt and Thorvaldsen exemplify this type of cooperative relationship (especially in Wandelaar's case, considering that he also responsible for the scientific illustrations within the body of the text itself). However, the artist's vision does not always cohere with the aims of the authors, as in the example of the *Encyclopédie*. The case of Sir Francis Bacon presents an altogether different scenario from any of the others, because his untimely death required his editor to make publication decisions for him—decisions that he likely would not have made—and these factors in turn determined the frontispiece selection.

Considering frontispieces from a rhetorical perspective as visual exordia orienting audiences to particular texts allows for a clearer understanding of their specific persuasive potential in each author's project. Without the textual grounding provided by both prefaces and poems accompanying the frontispieces, the messages conveyed by these complex visuals would not be as readily apparent. More

importantly, the visual messages would not have had the same salience for the enterprise of experimental philosophy if they had been viewed as autonomous works of art. Frontispieces were purposefully bound into the front of books so that readers would encounter them first—their meaning is derived from that special context. Removed from that context, the illustrations are not frontispieces, but merely engravings. I have argued in this essay that situating the frontispiece in its rhetorical context is necessary for a thorough and accurate analysis of its implications for and relationship to the author's oeuvre. Only at that point can further claims be made regarding the cultural or ideological implications of these visual exordia.

Perhaps because they have become an archaic mode of visualization, frontispieces to Early Modern scientific texts are rarely given the same amount of attention in contemporary scholarship as the visualizations that accurately represent natural phenomena in historical scientific discourse. Such realistic illustrations clearly function as heuristic representations when paired with natural philosophers' empirical research, while frontispieces appear to be merely decorative indicators of a book's prestige. I have attempted to prove otherwise by depicting these emblematic title-pages as compelling visual arguments corresponding to the written prefaces in natural philosophical works, persuasively orienting readers to the coming content. While the juxtaposition of mythological and scientific figures might be disconcerting to a scientist today, frontispieces are just as much a part of the history of science as visualizations of scientific experiments.

Twentieth-century equivalents to the frontispiece—images that would do this same work of orienting readers to scientific discourse and encouraging engagement

with unfamiliar intellectual territory—are the subject of Chapter 4. The next chapter takes a closer look at the scientists behind the science to see how their portraits can serve as portals into the scientific enterprise.

### Chapter 3: The Face of Science: Life Magazine’s Advertisement of Science Through Portraits

Thinking back to the natural philosophers from Chapter 2, there are no images of Carl Linnaeus studying plants at George Clifford’s garden, nor are there any images of Alexander von Humboldt exploring “the lonely forests of the Amazon.”<sup>89</sup> Of course, this may seem obvious because cameras did not exist to capture these events. Drawing and painting were still the primary means of creating likenesses of natural phenomena. So, instead of portraits of natural philosophers “in action,” there are portraits of them posing with objects that pertain to their interests. For example, Figure 1 is a painting of Linnaeus holding the plant that was named after him, the *Linnaea borealis*; this portrait was painted at Clifford’s garden (“Biography”).

How does a static portrait like the one of Linnaeus differ from photographed portraits of scientists that are typically seen on the Internet today, such as Figure 2. The image of a scientist in a laboratory or busy working with complex scientific paraphernalia is commonplace now.



Figure 1: Portrait of Linnaeus at Hartecamp.

This photograph is one of many that can be found through a Google Image search of

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<sup>89</sup> This is from a letter to Goethe, quoted in De Terra (208).

“scientist at work” in quotation marks. The image comes from a website called *Science Daily*,<sup>90</sup> and it shows research scientist Madhu Singh from the University of Iowa “at work in his lab” (“New Role”). In these types of portraits, the scientist generally appears in a laboratory setting in the midst of working with scientific paraphernalia. The scientific objects surrounding him, which have been called “symbolic attributes” or “accoutrements,” are a way of defining his identity as a scientist (see e.g., Kress and van

Leeuwen 108-9; Jordanova 80). According to studies of portraiture, the objects surrounding a person in a portrait or photograph are typically intended and understood as symbols of that person’s interests or occupation. Thus, in scientific



Figure 2: Madhu Singh, University of Iowa. From *Science Daily*.

portraits, scientific objects can work as metonyms to import the authority of the scientific enterprise into a photograph.<sup>91</sup> That being said, this chapter is concerned with how different types of portraits, such as “the scientist at work,” advertise science to nonscientists

Photographs of scientists posing with their projects (as opposed to busily working on them) still exist, too, of course. Other types of portraits include scientists

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<sup>90</sup> *Science Daily* bills itself as “Your source for the latest research news,” and is set up like a news website with headlines hyperlinked to articles on a wide range of scientific subjects. Tabs across the top of the main page link to articles on the following subjects: Health & Medicine; Mind & Brain; Plants & Animals; Earth & Climate; Space & Time; Matter & Energy; Computers & Math; Fossils & Ruins.

<sup>91</sup> Jordanova actually posits four functional possibilities for what she calls “accoutrements”: “They either provide visual interest, or follow established conventions, or convey information thought valuable to viewers, or act as symbols” (80).

teaching a class or instructing a lab, or scientists collecting data or analyzing specimens outdoors. And there is also the occasional portrait of a scientist doing “everyday” activities.<sup>92</sup> The invention of portable cameras in the early-twentieth century opened up all of these different options for photographers and subjects—to pose, or not pose; to be in a lab or outside; to be doing work, or to be looking at the camera. Those are just a few of the many choices involved in staging a portrait.

Each distinct type of portrait—e.g., the scientist teaching, the scientist busily working—conveys a different visual message. The relationships that are created between represented participants, to use Kress and van Leeuwen’s terminology, and viewers are entirely different when, say, the scientist is looking at the camera versus looking into a microscope. In this chapter, I explore how these distinct portrait types construct scientists and, by association, the scientific enterprise, for non-expert publics.

I am particularly interested in analyzing the earliest iterations of these photographed scientific portraits to reveal how our current conceptions of the scientific portrait may have originated. An appropriate site of analysis, then, is *Life* magazine, the first U.S. photojournalism magazine, launched by Henry Luce in 1936. With an estimated readership of twenty million by the 1950s and its coverage of all subject areas, *Life* was the primary dispenser of the news visually on a national scale before the invention of television (Kozol 5-6). The ways that *Life* modified its visual rhetorical appeals to a national audience, by showcasing different types of scientific portraits in different contexts, are strategies still relevant to today’s climate of

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<sup>92</sup> Jacobi and Schiele study some of these “archetypes,” which I will return to and discuss in greater depth.



ambivalence towards the scientific enterprise.

Adding another layer of depth to this study, I analyze portraits of individual scientists who have been acknowledged for their personal contributions to science in addition to portraits of scientists in *Life* stories covering AAAS Conventions (American Association for the Advancement of Science), who are thus depicted in association to their larger scientific community. The portraits attest to the fact that depictions of scientists in *Life* differ when they are portrayed individually and when they are associated with the larger scientific enterprise. Person/group relationships are dynamic, such that when one constituent is viewed negatively in society, the whole group suffers, and conversely, when the group is viewed negatively in society, its associated individuals are stigmatized. Authorities on argumentation in oral and textual discourse, Perelman and Olbrechts-Tyteca argue that “Individuals influence our impression of the group to which they belong, and, conversely, what we think of the group predisposes us to a particular impression of those who form it” (322). To demonstrate how these person/group dynamics described by Perelman and Olbrechts-Tyteca in *The New Rhetoric* are manifested *visually* in *Life*, I will present two case studies: the first will determine the style of scientific portrait most often represented in *Life*, and the second will explore the extent to which these typical scientific portraits may be rhetorically altered in photo-essays concerning political crises facing the larger scientific community.

The goal of this chapter is to distinguish and analyze many of the types of photographed portraits of scientists to first reach a national audience and to determine how these portraits constructed scientists and the scientific enterprise as a whole. By

considering the basics of visual persuasion, detailed in Chapter 1, I will show how scientific portraits have the capacity to project different attitudes towards science. Kress and van Leeuwen's approach to visual analysis will be paramount in this chapter, as they focus a great deal on narrative elements in photographs, such as the scientist's gaze, positioning of elements within the composition, size of elements relative to each other, angle from which the photograph was taken, and other rhetorical conventions of photography. In connection with the larger themes of this project, some types of portraits may be more effective than others at serving as portals into scientific discourse. In the conclusion, I suggest ways of using the results of this study to inform the portrayal of scientists in the media today.

### **Science and Photography: The Nineteenth Century**

Over the course of the nineteenth century and into the twentieth, "science" increasingly became a professionalized and specialized group of disciplines. Prior to professionalization, it was thought that anyone who made science an avocation was a "scientist," but most fields eventually became exclusive to "experts" who had received institutional training (Barton 5; Gross et. al 118). Additionally, as scientific disciplines grew even more specialized into distinct subfields, more specialized journals appeared that were only accessible to experts in a given field.<sup>93</sup> Both of these factors contributed to the "gap" between scientists and nonscientists that is so

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<sup>93</sup> On the subject of popular science journals, see also the historical studies of Barton and Sheets-Pyenson, who both describe popular science periodicals as undergoing a shift in purpose around the 1860s from encouraging amateur participation in scientific activities to de-emphasizing participation in favor of simply garnering support for professional science (Barton 3; Sheets-Pyenson 555). See also Whalen and Tobin's account of this change, which they claim is the result of changes in editorship from small, self-appointed parties to larger corporate entities (198-199).

prominent today.<sup>94</sup> But another factor to consider besides specialization and professionalization is the expansion of literacy education and the birth of a mass market, which led to a more stratified audience for scientific discourse and a need for “popular” publications (Lightman 652).<sup>95</sup> By the early twentieth century it was possible to make a clear distinction between “professional” and “popular” publications and “scientific” and “nonscientific” audiences (Kronick 65; Gross et. al 120-121). Science earned a respected place in society due to all of the changes mentioned here in the same era the camera came into prominence.

The advent of photography in the mid-nineteenth century transformed the sources of evidence and therefore of persuasion in many sciences, lending credibility to research by allowing for “accurate,” “true-to-life” visualizations of natural phenomena, both visible and invisible to the naked eye. As soon as cameras became attachable to microscopes, not long after Daguerre’s 1839 invention, scientists claimed that photographs of microorganisms served as unquestionable evidence in their research.<sup>96</sup> Most viewers and scientists thought that cameras could record evidence without the intrusion of human subjectivity. Changing visualization practices in the field of science and the notion that photography could lend

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<sup>94</sup> Bensaude-Vincent’s article on the “genealogy of the gap” presents an interesting perspective on this topic. She does not argue that it is the media’s fault for causing the gap, but she does point to “science mediators” as being responsible for spreading the idea that there was a rupture between science and the public. She also holds them accountable for giving the public the sense that they had been disenfranchised regarding science research policy decisions by equating all science with nuclear physics during the cold war. For other current characterizations of the “gap” between the scientific community and the public, see e.g. Christensen, Nisbet and Scheufele, and Russell.

<sup>95</sup> Popular periodicals were not the only form of science popularization in the nineteenth century; much has been written on the subject of scientific spectacles, cabinets of curiosity, and public lectures that incorporated drawings. Besides Lightman, who has written prolifically on this subject, see e.g. Kuritz, O’Connor.

<sup>96</sup> See e.g. Huppauf and Weingart (9). Robert Koch is one of the most frequently cited example of scientists who used the “objectivity” of photography to substantiate his projects in the mid-nineteenth century.

“objectivity” to scientific research have been studied most notably by Daston and Galison in *Objectivity* (2007). These authors take visualizations appearing in scientific encyclopedias as exemplary of changing visualization practices and attitudes towards epistemological concerns.<sup>97</sup> They argue that the notion of objectivity replaced “truth-to-nature” in the nineteenth century as the predominant epistemology, characterized by “accurate” visual representations of natural phenomena that portrayed anomalies and flaws, as opposed to the idealized, standardized representations that filled the pages of earlier encyclopedias.

The obsession with objectivity eventually gave way to what Daston and Galison term “trained judgment” around the turn of the twentieth century, a shift that returned authority to the expert scientist to select what gets representation and what does not—an unambiguously rhetorical process that applies to all visualizations, contrary to popular belief.<sup>98</sup> In addition to these epistemological changes, however, photography also transformed the public face of science in a quite literal way, making significant contributions to the advertisement of science through images of scientists. What I explore in this chapter is how photography changed the face of science in a human-centered way, through its connection to portraiture—a counterpoint to the supposed objective affordances of photography.

### **Science and Photography: The Twentieth Century**

Portraits of scientists have been in circulation since the process of engraving

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<sup>97</sup> For more on the role of visualizations in scientific arguments, see e.g. Fahnestock, Gross et. al, and Myers.

<sup>98</sup> For more on the subjectivity of scientific visualization, see e.g. Rossner and Yamada’s article on image manipulation and, for a completely different perspective, Frankel’s monograph on the construction of aesthetically pleasing scientific images.

allowed for such circulation, but the portraits of scientists that we see everywhere today are a product of sweeping changes in image reproduction, publishing trends, literacy, and even changes in scientific disciplines. To understand and appreciate the persuasive power of scientific portraits that persist into the twenty-first century, we can look back to the origins of the photographed scientific portrait.

Although the camera replaced the paintbrush in the realm of portraiture, it took several decades before photography could eclipse painting and engraving in terms of its flexibility and cultural prestige in representing subjects. Due to the limitations of early photography—namely, the requirement that subjects stand still for a substantial amount of time—it can be surmised that the *formal* portrait of the scientist was privileged in the late-nineteenth century, as opposed to medieval images of scientists portrayed holding up flasks. The latter type of image, which persists as a stereotypical image of the scientist to this day, actually stems from the medieval image of the alchemist holding up a flask of urine to the light (fig. 3).<sup>99</sup> These drawings of scientists *in situ*—or as I will describe them, “at work”—could not be realized in photographs until technological advancements in photography took place in the early-twentieth century. That is, scientists could not be photographed in the middle of working on research projects until cameras were invented that could be transported easily without bulky equipment and had fast enough shutter speeds to capture “candid” portraits.<sup>100</sup>

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<sup>99</sup> See e.g. Ball; Schummer and Spector.

<sup>100</sup> Portable cameras with faster shutter speeds that replaced heavy equipment came into existence in the late 1920s with the German invention of the 35 mm Leica. The Graflex camera was another commonly used portable camera in the 1920s and 1930s. See Cookman pp. 94-97.

Candid portraits of scientists in the twentieth century could reach a national audience when magazines and newspapers gradually adopted photomechanical reproduction, which facilitated image publication and dissemination.<sup>101</sup> Thus, a magazine like *Life*, due to its national circulation and its exemplary status in photojournalism, had the capacity to shape scientists and science through portraiture for a national audience. The photographs circulated in *Life* magazine specifically have been



Figure 3: *The Physician* (1519).

studied as conveyors of ideology, creators of social norms, and shapers of public belief (see e.g., Kozol; Cookman; Hariman and Lucaites). As the leading visual news source in the 1940s and 1950s, *Life* was at the forefront of constructing public perceptions on multiple subjects (Kozol 5-6). At a time when science was a subject of public fascination and respect, the photographs in *Life* magazine provided a glimpse into the discipline, allowing a broad audience to see what science “really” looked like.

Although images are now understood to be powerful, persuasive communicative objects, at the time that *Life* was at its height of popularity in the 1940s and 50s, photographs were still thought to be unbiased, unmediated representations of truth (see e.g., Kozol 7-11, 23-25; Cookman 5-7; Finnegan 135-

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<sup>101</sup> Also called the “halftone process,” photomechanical reproduction was invented by Stephen Horgan in the late-nineteenth century but was not incorporated into mass media publication until decades after its invention. Photomechanical reproduction allowed photographs to be published on the same page as text. Prior to adopting the halftone process, newspapers and magazines had to hire engravers to make woodcuts or steel engravings based on photographs (Cookman 64).

136). Cara Finnegan calls the believed facticity of photographs the “naturalistic enthymeme,” a “profoundly influential but often unrecognized argumentative resource: their perceived relationship to nature” (“Naturalistic” 135). In other words, she argues, there was an overwhelming inclination to assume that photographs are “real” or “true” until proven otherwise (135).

Postmodern theorists have advanced the argument that photographs are not objective, that all photographs are mediated, and that they are not directly associated with “reality” (Cookman 6-9). Semiotician Roland Barthes also debunked some of the myths associated with supposed photographic reality in “The Photographic Message” (1977) and *Camera Lucida* (1980). Increasing attention has been paid to images (such as documentary photography) as persuasive tools for social reform and as having the capacity to construct ideology (see e.g., Mitchell’s *Iconology* (1986); Stephens’ *The Rise of the Image the Fall of the Word* (1998); Mirzoeff’s *Introduction to Visual Culture* (2000); Hariman and Lucaites’ *No Caption Needed* (2007); Olson, Finnegan, and Hope’s *Visual Rhetoric* (2008); Rancière’s *The Future of the Image* (2009)).<sup>102</sup>

In the same way that scientists select what visualizations receive representation and advance scientific knowledge, magazine editors select what images of scientists get circulated to mass audiences to shape public perceptions of the scientific enterprise. Scholars agree that, due to editor Henry Luce’s vision for

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<sup>102</sup> Many photographs taken during the “golden age” of photojournalism, generally agreed to be between 1925 and 1950, are now considered iconic, such as Dorothea Lange’s “Migrant Mother” (1936) or Alfred Eisenstaedt’s “Times Square Kiss” (1945). *Life* was building on the tradition of documentary photography that began in the nineteenth century with notable figures like Jacob Riis, and that continued into the twentieth century with the “iconic” photographs of Dorothea Lange and others. In *No Caption Needed*, Hariman and Lucaites argue that iconic photographs, such as the ones just mentioned, reproduce ideology, communicate social knowledge, shape collective memory, model citizenship, and provide figural resources for communicative action (9).

the magazine, reproduced below, and conservative political standpoint, *Life* tended towards presenting an idealized picture of American culture,<sup>103</sup> striving to form the broadest consensus possible through photographs (see e.g., Doss; Littman; Cookman; and Kozol). Here is an excerpt from Luce's proposal to advertisers, which appeared in the magazine's first issue, resembling a mission statement (November 1936):

To see life; to see the world; to eyewitness great events; to watch the faces of the poor and the gestures of the proud; to see strange things machines, armies, multitudes, shadows in the jungle and on the moon; to see man's work—his paintings, towers, and discoveries; to see things thousands of miles away, things hidden behind walls and within rooms, things dangerous to come to; [...] Thus to see, and be shown, is now the will and new expectancy of half mankind. To see, and show, is the mission now undertaken by a new kind of publication (Luce 3).<sup>104</sup>

Luce's mission promised to unite readers under a collective viewing experience of the fascinating and unknown, and as we will see, science is subsumed into this vision.<sup>105</sup>

Underscoring the tendency towards consensus and consistency is the fact that *Life* operated on the "strong-editor principle," which, according to photojournalism expert Claude Cookman, means that the editor of *Life* was in control of choosing the stories, the images, the space allotted to them, and the layout (156). *Life*'s managing editors were handpicked by Luce and had complete control over the staff and the magazine's contents; in combination with Luce's directives, the managing editor's

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<sup>103</sup> Cookman contends that *Life*'s downfall in the 1970s was in part due to Luce's staunch conservatism and stubborn commitment to an ideology that was no longer supported on a national scale (175-176).

<sup>104</sup> Henry Luce made use of the most up-to-date technology to ensure the highest quality images, and to earn wide circulation, he successfully wooed advertisers to his project (Kozol 29-30).

<sup>105</sup> One example of *Life*'s calculated portrayal of science in this light pertains to the 1955 reconstitution of the poliovirus, a breakthrough that received a great deal of media attention. According to Angela Creager in *The Life of a Virus* (2002), *Life* wanted a part of the publicity and made a photo-essay with several images from the Virus Laboratory. Creager writes, "Among the shots they hoped to capture for the public eye were..."—and here she quotes the *Life* science editor—"... 'examples of huge, complex, or expensive equipment which typify the newest look in virus tools'" (283).



personal preferences shaped the magazine and the attitudes that it advertised (Cookman 156). Accordingly, photographers had no say in the selection of their images or the writing of accompanying stories (Cookman 158). In *Life's America*, Wendy Kozol explains the hierarchical process: "Editors often provided photographers an assignment with detailed shooting scripts based on extensive research. These scripts included editors' objectives for the story and requests for certain types of shots" (39).<sup>106</sup> Photographers took several more photographs than would appear in the magazine so that editors could choose from a large pool to construct their photo-essays (Kozol 39-40). A photo-essay, as defined by *Life* editor Maitland Edey, is "a collection of pictures on a single theme, arranged to convey a mood, deliver information, tell a story, in a way that one picture alone cannot" (1). As mentioned earlier, of particular interest is the way that *Life* portrayed scientists in photo-essays devoted to their specific research projects versus the way that the magazine portrayed scientists in photo-essays devoted to the scientific community as a whole, and in relation to the changing political landscape of science (e.g., pre-WWII and post-Sputnik eras).

Before comparing depictions of scientists individually and in association with the scientific community, however, the different types and conventions of photographed scientific portraits appearing in *Life* require elucidation. And before an analysis of *Life's* photographs can take place, we turn to the conventions of scientific portraiture in general and the scholarship that has broken ground on that subject.

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<sup>106</sup> Writers, and even photographers in some cases, were generally not given credit for their work—most of the articles do not give an author's name—which indicates that the text is much less significant than the images even from an editorial standpoint (Cookman 158).

## Studies of Scientific Portraits

Much of the scholarship on scientific portraits is concerned with early, painted portraits of natural philosophers as opposed to more current, supposedly candid photographed portraits, although there are some important exceptions, and my work expands on their arguments. Whereas other studies have focused on how portraits can be used to garner public support for the discipline or shape attitudes towards science—two concepts that are indeed central in my project—I go a step beyond that in this chapter to also consider how portraits of scientists change compositionally when situated in different social contexts in the same publication, a concept that has been (to my knowledge) unexplored in the literature on scientific portraiture. By social context I mean the social climate conveyed by the article in which the photograph appears, and also any relevant cultural and/or political events concurrent with the publication of the article.

My argument is predicated on some very important points that have already been argued into place by other scholars. The first point, made by Ludmilla Jordanova in *Defining Features* (2000), a study of scientific and medical portraiture over a 340-year time span, is that portraiture is responsible for creating public identities. Jordanova argues that portraiture “constructs not just the identity of the artist and the sitter, but that of institutions with which they are associated. Portraiture is just one highly artificial means by which, in some societies, individual and collective identities are forged” (18, 20). The power of portraiture in shaping public identities for the viewing audience is also considered by historian Patricia Fara in a study of several portraits of botanist/explorer Joseph Banks (1743-1820). Fara

concludes that Banks was not only able to “restyle his own image,” but, *through his portraits*, he contributed to “transforming the stereotype of the English male traveler from the foppish aristocrat [...] into the masculine hero risking his life for the sake of England and of science” (42). In other words, Banks attempted to project to the public conceptions of scientists in general through his own, carefully-styled personal presentation. For example, in his 1772 portrait commissioned from Joshua Reynolds, Banks appears at work in his study, posed with papers, a pen, and a globe next to him. Fara argues that the accoutrements in this portrait, which follows the style of medical practitioners’ and architects’ portraits, identify Banks as an intellectual man of science (46).

Accoutrements, or objects surrounding the scientist, are inextricable to analyses of portraits because, as Jordanova points out, they are what identify scientists as scientists (80). In this connection, the authority of science is conferred on the individuals via the scientific accoutrements that represent their scientific area of specialization (e.g., a botanist would be shown studying plants). Kress and van Leeuwen call these accoutrements “symbolic attributes,” which can “establish a relation of identity through ‘pointing’” (108). A study that exemplifies the importance of accoutrements is de Chadarevian’s analysis of portraits of Watson and Crick. She demonstrates how objects or accoutrements function to both shape scientific identities and even to construct scientific discovery accounts. Explaining that the famous photograph of Watson and Crick with a model of DNA is one of *eight* taken by Barrington Brown in 1953, and that some of the non-famous versions of the photograph do *not* show the double helix, de Chadarevian argues that “for Brown’s

photograph to take on the significance it did, it was important that it represented both the model and its makers” (97). She points out that it is just as likely that the model made Watson and Crick famous as it is that Watson and Crick made the model famous (97). Even today the double helix is a symbol of genetics and the two scientists who discovered the structure of DNA.

Another important point, most notably made by Jacobi and Schiele in a study of two French science magazines, is that portraiture reflects certain attitudes about science and thus shapes viewers attitudes, depending on how scientists are depicted. As in the other studies mentioned, Jacobi and Schiele discuss the ways that photographed portraits “socialize newly-acquired knowledge” through stereotypes and ultimately “authenticate” the scientists producing that knowledge (737). Studying portraits in *La Recherche* and *Science et Vie*, Jacobi and Schiele identify three archetypal images of the scientist, arguing that “each corresponds to a distinct set of attitudes towards the popularization of science” (749).<sup>107</sup> The first archetypal figure is that of the “mad scientist,” who reconstructs the world by “delving into the realm of the forbidden, or at least the dangerous” (749). The second is the scientist as “teacher of humanity,” portrayed as authoritatively “dispensing knowledge” (749). The third and last archetypal figure that Jacobi and Schiele identify is one that I am going to explore in more detail; that is, the scientist as “the ordinary mortal,” which is unlike the other two types in that “it is rooted in a certain sensitivity to the anti-science current” (750). In other words, the goal of images portraying scientists as

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<sup>107</sup> It is worth noting that Jacobi and Schiele’s study is limited to the types of photographs appearing in popular scientific discourse, as opposed to publications with a more diverse readership, like *Life* magazine, which is the focus of my case study. Of the two magazines that Jacobi and Schiele use for their case study, one is described as “semi-professional” and the other, “popular” (734-5). Both would have audiences limited to people interested in science.

everyday people is to suggest that science is like any other activity, created by humans, and therefore not mysterious or unreachable.

Jacobi and Schiele only mention “the ordinary mortal” archetype in passing; generally, their focus is on how science has been mythologized in the public sphere, stressing the “epic tone” of some captions accompanying portraits (740). I delve deeper into both of these concepts—the notion of a mythologized science, and the notion that scientists can be depicted as “ordinary mortals”<sup>108</sup>—to arrive at some preliminary conclusions about portraiture’s utility in communicating science to non-expert audiences.

## **Methodology**

In the remainder of this chapter, I first sample and analyze depictions of scientists in *Life*’s “Science” section to determine what *types* of portraits—e.g., scientists posing, scientists busily working—are featured most frequently. Then I analyze depictions of scientists in articles covering annual conventions of the American Association for the Advancement of Science (AAAS) to demonstrate how portraits change compositionally and thematically when scientists are associated with the larger scientific community. The fact that depictions of scientists change dramatically when the focus of the article is on the whole scientific community indicates that, as other studies have shown, portraits can reflect different attitudes about science. My study reinforces the claim that portraits have the capacity to construct science for public audiences, and it does this by using a magazine that paved the way in constructing different aspects of “Life” visually for a national

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<sup>108</sup> They phrase it as, “The scientist gets down from a pedestal and mixes with the rest of us” (748). For another perspective on the notion of “hero worship” see e.g. Nikolow and Bluma.

audience (see e.g., Kozol; Cookman). My overarching aim, to situate this study in the context of my larger project, is to discover what types of portraits function more or less effectively as “portals” into unfamiliar territory for non-scientist audiences.

In order to determine the types of representations of scientists in *Life*, I sampled *Life*'s “Science” section from the magazine's inception in November 1936 until 1960 at five year intervals, looking at a whole year's issues for 1936, 1940, 1945, 1950, 1955, and 1960.<sup>109</sup> In the years sampled, there were a total of 68 “Science” stories containing one or more images of scientists.<sup>110</sup> In line with my initial prediction, the most common type of scientific portrait in the sample is that of the scientist busily working, as opposed to, for instance, posing with a project, or doing tasks unrelated to science. Out of the 68 stories, an overwhelming 54 contained at least one image of scientists in the middle of working on their projects.<sup>111</sup>

Because some of those stories have multiple images of scientists, I further narrowed my sample to stories that contained only one image of a scientist; there are 32 stories with one image of a scientist. By narrowing the sample in this way, I was able to focus on stories in which the editor made a clear choice to depict a scientist in one way only.<sup>112</sup>

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<sup>109</sup> Every issue of *Life* has been made available online by Google books. “Science” stories are not featured in every publication, but in several—enough to make “science” a category in the table of contents in issues where it does appear.

<sup>110</sup> Not all “science” stories contain images of scientists; the 68 stories that do contain images of scientists make up my sample. Of the 68 stories, 36 contained multiple images of scientists (either the same scientist portrayed more than once or multiple scientists pictured), and 32 stories contained a single image of a scientist or scientists.

<sup>111</sup> Less common portrayals feature scientists posed with objects of invention or discovery (16 stories out of 68); shown in a traditional portrait without scientific accoutrements (5 stories); teaching (3 stories); or in meetings (3 stories).

<sup>112</sup> The other 36 stories contained multiple images of scientists, and there are often different types of portraits of scientists contained in the same story. For instance, in the March 21, 1955 science story, there are three traditional portraits, two pictures of scientists at work, two pictures of scientists posed with objects of study, and one picture of a group discussion. And in many cases, there is more than

Out of the 32 stories in my sample, the majority—22 images—again depict scientists busily at work. The other stories show scientists posed with objects of invention or discovery (7 out of 32 images) and scientists in traditional portraits with no paraphernalia (3 out of 32 images). Significantly, none of the scientists is shown in a non-academic light, even though *Life* had a reputation for humanizing celebrities, politicians, and otherwise “special” members of society to show them as “normal” people. The fact that scientists are, as a rule, shown at work is important to the argument that I make in the section on portrayals of scientists in relation to their group, or scientific community; communal images differ drastically from what I am deeming the standard depiction of scientists in *Life*, based on my sample—that is, the “scientist at work.”

My second case study focuses on *Life*'s coverage of the American Association for the Advancement of Science (AAAS) conventions. In contrast to stories about specific scientific research projects, stories about the scientific community as a whole tend to focus on larger issues impacting the scientific enterprise in general, such as government funding, changing public attitudes, and science education. Thus, *Life* provides a snapshot of public attitudes towards the scientific enterprise in the articles corresponding to photo-essays on the AAAS conventions. Granted, *Life*'s characterization of public attitudes is a rhetorical construction, just like its photo-essays, but it has been argued that *Life*'s characterizations of “life” also helped to shape the public attitudes it purports to represent (see e.g., Kozol). In other words, the public attitudes expressed in *Life*, which represented the editors' version of the

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one type of depiction of the same scientist, as in the April 16, 1945 story with one picture of the scientist at work, and one picture of him posing with his invention.

status quo, likely served a norming function. I will analyze the photographs in the context of their accompanying articles.

There are four photo-essays depicting AAAS conventions over *Life's* forty-year run (1936-1972) ranging from 1939 to 1958.<sup>113</sup> In each case, I attend to the ways that the scientific enterprise is contextualized in the social climate of the time. As detailed below, the visual appeals of the photo-essays differ depending on the specific concerns or attitudes revealed by the articles. In line with the methodology proposed in the introduction to this project, I examine photo-essays through analysis of image composition—i.e. subject matter, arrangement of elements, presence or absence of scientific objects, framing—and corresponding textual information. Even though photographs are seemingly natural and “unstaged,” the fact remains that scientists cooperated with photographers, and photographers engaged in complicated processes of selection and rejection regarding angles, surrounding objects, and poses. Likewise, analyzing the editor’s layout of the images in the photo-essays reveals the narrative drive behind the editorial choices. Locating these photo-essays within their rhetorical contexts, I demonstrate the shifts in visual appeals that occur between advertising the scientific enterprise through its community members and advertising scientists through the lens of the larger scientific community.

Although this is a historical study, its relevance does not end in the mid-twentieth century. By taking stock of past photojournalistic practices and learning how portraits can reflect different attitudes, we can modify the current portrayal of scientists in the mass media. I will show how the content and composition of a photograph can influence the visual rhetorical appeal being made, and how images

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<sup>113</sup> For the AAAS case study, I chose the search term “AAAS.”



have the capacity to create either distance between or identification with public audiences. In the conclusion, I discuss how the *Life* editors' strategic shifts in their selection of visual rhetorical appeals remain relevant to science communication efforts today.

## ***Life's* Depictions of Individual Scientists**

### *The Scientist At Work*

The type of scientific portrait that occurs most frequently in *Life's* science stories is of a scientist busily working. To be clear, out of the 68 "Science" stories in the random sample, only 14 did not show an image of a scientist at work. Nearly 80% of all the stories feature images of the scientist at work, and nearly 70% of single-portrait stories feature the scientist at work. Therefore the word "typical" is appropriate for describing scientist-at-work portraits. Much less common is the scientist posed with objects of study or discovery, and the least common type of portrait is the scientist posed for a traditional portrait without scientific paraphernalia.<sup>114</sup> In this section, I briefly review the defining characteristics of my sample, address differences in image compositions, and analyze representative portraits in different categories.<sup>115</sup>

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<sup>114</sup> The photographs of scientists at work in this section are obtained from a random sample of *Life's* images of scientists appearing in "Science" stories between 1936 and 1960. As discussed in the methodology section, I have narrowed my focus to stories with a single image of scientists as opposed to stories with multiple images of scientists. Focusing on single-portrait stories ensures that the type of portrait represented in the story was selected by the editors over all of the other types. Out of 32 stories in my sample, 22 feature a "scientist at work" portrait, 7 feature a scientist posing with accoutrements, and 3 feature a traditional portrait.

<sup>115</sup> Because of its infrequency, I did not find it necessary to provide an analysis of a traditional portrait with no accoutrements. There are only three traditional portraits of scientists in the single-image category: one is a physicist, one is an "old age specialist," and one is a mousetrap inventor. In the multiple-image category, the traditional portraits represent scientists from still other specializations

Out of the 22 typical portraits of the scientist at work, only one is of a female. Perhaps surprisingly, only 5 portraits show scientists in lab coats; most often, they wear a dress shirt and tie (9 portraits), and sometimes even a suit (3 portraits) while they work. In the other cases it is either difficult to tell what the scientists are wearing or they are dressed in attire appropriate to their work environment (e.g., protective garb or outdoor jackets).

One of the most significant properties of typical portraits is the ratio of the composition allotted to the scientists versus the instrumentation or paraphernalia with which they work. In half of the portraits of scientists at work, the instrumentation receives visual salience, and in the other half, the scientist is given prominence in the composition. I have selected a representative example of each case: one in which the instrumentation receives prominence in the composition, and one in which the scientist receives prominence in the composition. Then, to contrast typical portraits with posed portraits, I have selected a representative example of a scientist posed with his object of study. To contextualize the photographs, I will briefly describe their accompanying articles, and in cases where it is relevant, the surrounding images of scientific phenomena.<sup>116</sup>

A representative example of a typical portrait showing the scientist as prominently as the scientific project pictured with him is from the September 26, 1955 “Science” story (fig. 4). In this portrait, a chemical engineering professor works on a study of gaseous bubbles that has implications for the oil industry, as the brief

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(e.g. veterinary science, virology). In other words, my research suggests that the area of specialization does not matter to the depiction of a scientist with no accoutrements.

<sup>116</sup> Although I have focused on science stories with only one image of a scientist, these stories often contain other images—not of scientists, but of a laboratory setting, for instance, or of scientific equipment.

story explains. It is titled “Blowing Bubbles for Business.” Just one page in length, the story’s photographs illustrate the experiment in progress, and the four paragraphs of text are concerned with the uses of “bubble data” for more efficiently producing gasoline and other products from oil. The scientist perches beside his experiment and measures the size of the bubbles, the caption explains. Because he is sitting on a ladder, the scientist is taller than the scientific apparatus in this composition, and the focal point appears to be his white shirt. Both his face and the light reflecting off of the tubes match his shirt in this black and white photograph, drawing the eye in a sweeping diagonal from top-left to bottom-



Figure 4: "Bubble blowing for business." *Life* 39.21 (November 21, 1955).

right—the typical reading path, according to Kress and van Leeuwen. Likewise, the darker areas of the composition visually “rhyme” with each other: the area surrounding his hands, and the entire bottom-left corner. This contrast of dark and light areas gives the composition balance despite its asymmetrical layout. That the scientist is on the left side of the composition puts him in the position of agent, by Kress and van Leeuwen’s estimation, and his hands reaching to the test tubes form a vector that conveys motion and power over the object he reaches for.

Because there is a person on the left side of the composition, slightly higher and larger than the slender tubes on the right side of the composition, and because of

the lighting and the angle from which the photograph was taken, the scientist seems to have more visual salience than the scientific accoutrements. In contrast to this relationship between scientist and scientific accoutrements is one in which the accoutrements overwhelm the scientist in the composition. How does the relationship between scientist and accoutrements in an image influence the attitudes reflected about science and scientists?

Figure 5 depicts scientific paraphernalia of such great magnitude that it towers over the scientist in the composition—a different dynamic from the previous portrait where scientist and paraphernalia are visually balanced in the composition. The portrait depicts a physicist “adjusting a microwave reflector at M.I.T.” and it comes from a November 19, 1945 story titled “Microwaves: exploration of smallest radio waves, which make up radio’s biggest wave band, opens up a vast territory for the future” (93). The first microwave radars were developed by physicists in 1940 to detect enemy bombers and submarines during World War II (Bowler and Morus 470). In the immediate aftermath of WWII, when this story was published, scientists were still being recruited for operations research to ensure national security (Bowler and Morus 471). Scientists benefitted from operations research by receiving government funding, and thus science became more and more entwined with military and industrial operations in the postwar era, shifting the thrust of science from theoretical or “pure” research to applied research (Bowler and Morus “Science and War”). The article accompanying this scientific portrait describes the microwave technology developed during the war and its applications for radar, but its attempts at generating interest in the technology revolve around future implications—specifically, the

replacement of radio waves by microwaves, and their uses for television broadcasting (“Microwaves” 93). In sum, the story describes how research geared towards war operations has led to further innovations that have great potential for improving daily communications.

In the scientific portrait included in this story, the physicist at work

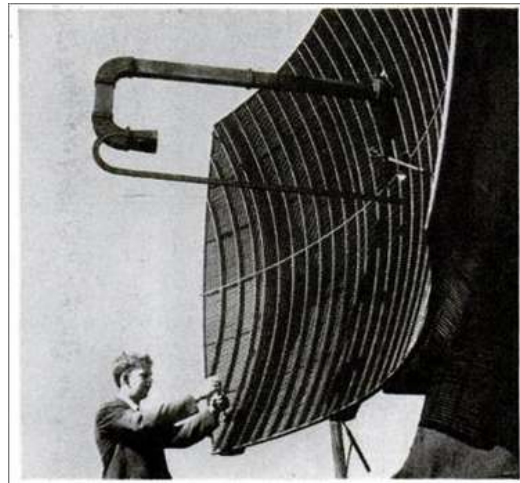


Figure 5: Physicist adjusting a microwave reflector at M.I.T." *Life* 19.21 (November 19, 1945): 98.

occupies a tiny portion of the composition in the bottom-left corner, whereas the microwave reflector fills the center of the image from the right side, taking up at least half of the composition.<sup>117</sup> Highlighting the contrast in size between the physicist and the reflector is the empty space in the composition, which is strategically (in terms of the angle from which the photograph was taken) above the physicist’s head. From this angle, viewers not only get a clear indication of the shape of the reflector and its three-dimensionality, but they also see it against an expanse of sky, to suggest a certain limitlessness of scientific research. Moreover, this angle allows viewers to see the scientist working on the reflector, to see his arms and hands making the necessary adjustments. Thus, the photograph advertises science through its scientists as a *dynamic* discipline that involves creating and operating complex equipment—equipment that “opens up a vast territory for the future.”

Had the physicist been posed with the microwave reflector, perhaps in front of

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<sup>117</sup> The photograph was taken for *Life* by F.W. Goro (“Microwaves” 93).

it and looking at the camera, the dynamic nature of science would not have come across visually, and neither would the scientist's direct role in shaping its results—his arms and hands form a vector leading to the reflector. Alternatively, had the scientist been shown in a closer shot, the magnitude of the reflector would have been sacrificed, in addition to the impressiveness and limitlessness of scientific research that it signifies. This example demonstrates the purposeful balancing of elements in a photographic composition to achieve a specific effect or message. According to Kress and van Leeuwen, if the scientists are positioned on the left of the apparatus, they are the source and origin of the apparatus. But in this case, because of the scientific object's colossal size and the fact that it towers over the scientist, the message that “big science is out of control” might also be a potential reading of the image. The two contradictory readings—scientist in control, scientist out of control—are balanced by the nature of the elements in the composition, described above.

Recalling the first example of the scientist on a ladder next to the tall test tubes, quite a different reflection of science is conveyed by the positioning of the scientist and other elements in the composition. When the scientist is the focal point of the image, as opposed to the accoutrements, he is undeniably in a more prominent role physically and, in this connection, he is given more *saliency* (to use Kress and van Leeuwen's term). Viewers are thus inclined to pay most attention to the scientist in the image and his impositions on the paraphernalia pictured with him, as opposed to paying most attention to the scientific objects and the relationship of that object—representative of Science—to the person pictured with it. In sum, portraits that feature the scientific objects give saliency to Science, imported as whatever non-

human object appears in the image, and portraits that feature the scientist reflect the human-centric aspect of the discipline. All of this is to say that the minutiae of portraiture can be charted and manipulated to create a wide range of depictions of scientists, each with distinct definitional power: this is a scientist, and this is his role.<sup>118</sup>

There is, however, a significant similarity among “scientist at work” portraits across the board, despite the compositional differences and accompanying variations in the construction and definition of scientists. That is, in my sample of “scientist at work” portraits, not a single scientist looks at the camera. According to Kress and van Leeuwen, who borrow from film studies, there is “a fundamental difference between pictures in which represented participants look directly at the viewer’s eyes, and pictures in which this is not the case...” (122). When represented participants do not look at the viewer, Kress and van Leeuwen call this an “offer” picture— this type of image “offers’ the represented participants to the viewer as items of information, objects of contemplation, impersonally, as though they were specimens in a display case” (124). The authors make an important caveat here for “scientific illustrations,” which they argue prefer the “offer” configuration because “a real or imaginary barrier is erected between the represented participants and the viewers, a sense of disengagement” (126). There must be the illusion, they argue, that the scientist does not know he is being watched, and the viewer “must have the illusion that the represented participants do not know they are being looked at” (126). Surprisingly, Kress and van Leeuwen do not comment on the power dynamic of such illustrations.

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<sup>118</sup> Recall Jordanova’s impressive study of scientific portraits over a 340-year time span, titled *Defining Features*.

It is significant, however, that they mention an *imaginary barrier* and the *sense of disengagement* reflected by these images of scientists.

Although “scientist at work” portraits might seem to serve as effective portals into the scientific enterprise, I argue that the scientists’ disengagement from viewers in this type of portrait actually work against any semblance of inclusivity, which is the ultimate goal of the portal image. Rather, portraits of scientists busily working give the impression that science is a mysterious and privileged enterprise, inaccessible to viewers except through the vehicle of a photograph. Because the scientists are shown in the middle of working on projects requiring specialist training and knowledge, and because the scientists do not engage viewers—with what Kress and van Leeuwen refer to as a “demand gaze”—these photographs participate in a culture of exclusion. There are still other types of portraits featured in *Life* magazine that construct science differently.

### *The Scientist Posing*

In contrast to the two portraits of scientists at work that were just analyzed is a type of portrait in which the scientist is clearly posing with his work. All of the 7 single-portrait stories featuring a scientist posed with scientific paraphernalia foreground the object of study in the image. A clear and obvious distinction can be made between scientists-at-work portraits and posed portraits when the scientist is looking at the camera.



I will analyze a representative example of a posed portrait in order to show what other qualities set a posed portrait apart from a scientist-at-work portrait. The scientist in Figure 6 from the July 18, 1955 issue is sitting in a field with rows of birds' eggs laid out in front of him. The story is titled "Which Egg Will She Sit On: Gull's Birdbrained Endeavor," and the image is captioned, "Egg arsenal, spread before [the scientist], includes glass egg (left, on paper) invisible to the gull, but which it will try to hatch when it feels egg with its body" (73).

Other images in the story show a herring gull interacting with the different sized and shaped eggs; for example, in one photograph the gull is flopped awkwardly on top of an egg that is twenty times the size of a normal gull's egg.

In the story, it is explained that the scientist, Gerard Baerends, a



Figure 6: Zoologist with "egg arsenal." *Life* 39.3 (July 18, 1955): 73.

zoologist and professor in Holland,<sup>119</sup> made the fake eggs out of wood and glass (pictured in figure 6) and placed them on the edge of the gull's nest to find out which ones she would try to bring in. The gull preferred speckled eggs to plain ones and even tried to hatch a square one. According to the brief article, all that can be gleaned from his experiment is that birds are stupid, although presumably Baerends

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<sup>119</sup> Baerends was a student of nobel-prize winner Niko Tinbergen, and a founder of ethology, the study of animal behavior (see "Baerends Lecture").

was able to draw more specific conclusions.<sup>120</sup>

Given that context, what can be said of the portrait? While the gull is shown in several different poses with the eggs, the zoologist is only pictured once, and he does not interact with the eggs at all. He does not point to different eggs, or hold them, or even look at them. Rather, he sits behind the eggs, cross-legged, shoulders hunched, and he looks up at the camera. The eggs are neatly and purposefully arranged. Baerends could have been portrayed placing the eggs on the edge of the gull's nest, or in the process of observing the gull's behavior, but instead the editor chose to portray him posing with accoutrements—in this case, the eggs he constructed.

In contrast to the scientist-at-work portraits, which seem candid and give viewers the illusion that the scientist does not know he is being watched, this is the epitome of a posed portrait: every aspect of the photograph seems planned, and the scientist looks at viewers. Kress and van Leeuwen call this the “demand gaze,” which they explain “creates a visual form of direct address. It acknowledges the viewers explicitly, addressing them with a visual ‘you’” (122). They argue that the gaze “demands that the viewer enter into some kind of imaginary relation with him or her” (122). Moreover, the photograph was taken from an angle that allows viewers to look down at the scientist, which places viewers in a position of power (146). These two qualities—the demand gaze and the angle from which the photo was taken—give this photograph potential to be an effective portal image because it promotes the inclusion of viewers rather than exclusion.

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<sup>120</sup> The article explains, “Ignoring the normal-sized wooden egg, the bird gamely struggled aboard the monster egg. This incident was illuminating to Gerard Baerends, professor of zoology...because it proved that an object needs to have only faint resemblance to a real egg for a herring gull to do its unintelligent best to hatch it, even in preference to an egg of proper size.” (73).

Arguably, the “scientist at work” portrait conveys the visual message that science is inaccessible to the average citizen. In showing expertly trained scientists actually engaging with their research projects and not looking at the viewer, scientist-at-work portraits provide visual evidence of scientists’ special knowledge and abilities. This style of portrait supports the message that science is inaccessible, mysterious, and important (viz: worth funding).

Because it promotes the exclusivity of the scientific enterprise, the scientist-at-work portrait might only be effective at advertising science positively in a social climate of appreciation for the enterprise. Dissociating expert scientists from nonscientists, scientist-at-work portraits likely would not be a positive advertisement for science in times of public distrust and fear of science. On the contrary, portraits of this type might exacerbate public distrust and fear by depicting scientists conducting research that is mysterious and unknown. In other words, that which is mysterious and unknown is much more likely to be seen as positive in a stable or optimistic social climate.

### ***Life’s Depictions of Scientists in Association to the Scientific Community***

#### *AAAS Conventions*

With only one exception, *Life’s* managing editors changed their visual rhetorical appeals in their coverage of American Association for the Advancement of Science (AAAS) conventions. As we will see, only one of four AAAS stories shows images of scientists at work, despite the prevalence of this particular type of portrait in depictions of individual scientists. Close analyses of the portraits in these stories in

conjunction with textual analyses will aim at answering the question, *How do portrayals of scientists change when they become associated with the burdens of their representative group, especially in times of political difficulties?*

Four stories covering AAAS conventions between 1936 and 1972 (*Life's* “life” as a weekly publication) will be analyzed in the following section to compare the depiction of scientists when they are associated with the scientific enterprise as a whole to individual scientists in “Science” stories generally. As I will explain in each case, the stories accompanying the images generally describe science fighting for respect, funding, or attention from the government and society—a marked change from the typical “Science” stories sampled in the previous section, which tend to focus positively on specific research projects rather than on the scientific enterprise. The study below will proceed chronologically and will be aimed towards showing the distinct differences in scientific portraiture when the focus is on the larger scientific enterprise. The visual appeals crafted by *Life's* managing editors in these cases are, it will be shown, very different from the appeals used in stories where scientific research projects are positively portrayed. The typical portrait of the “scientist at work” suddenly becomes atypical in these cases, and I will suggest how alternative types of visual appeals are strategically used by editors to promote a completely different attitude towards science through its scientists.

**“America’s Top Scientists Grow Gloomy at ‘Apemen’s’ Abuse of World’s Brains”**  
***Life*: Jan. 9, 1939**

There are some interesting visual juxtapositions set up in this brief, two-page

spread on the 1939 AAAS convention. Upon close inspection, the article text, captions, and images do not appear to be telling the same story. Even when only considering the images, different visual messages are conveyed by three different classes of portraits encased in this single photo-essay. Specifically, as seen in the screen capture in Figure 7, there are very close up images of scientists' faces and gesturing hands; an image of a scientist seen from a low angle in a dictating pose; and then at the bottom, a triptych of scientists in everyday settings. Each of these types of portraits sends a different visual message that, regardless of textual anchorage, might stir up certain stereotypes of scientists or promote new attitudes. But before considering how the images work, it is necessary to provide some context by looking at the article itself.

The title of the article alone packs a punch: "America's Top Scientists Grow



Figure 7: "America's Scientists Grow Gloomy." *Life* 6.2 (January 9, 1939): 16-17.

Gloomy At ‘Apemen’s’ Abuse of World’s Brains.” The further comparison between “supermen” and “apemen” provided by the article is designed to dissociate scientists from the negative effects of their research projects, namely the creation of weapons of mass destruction. It is worth taking stock of the description of this situation provided by the anonymous author of the article:

For the last 300 years, scientists of all nations have co-operated in developing discoveries though separated by thousands of miles. In recent years, however, their colleagues in Germany, Russia and Austria have either committed suicide, “disappeared,” or been told to concentrate on the manufacture of better oleomargarine or gunpowder. That this might soon be the fate of all scientists was the chief worry of A.A.A.S.

Because these ‘supermen’ fashion the tools with which the ‘apemen’ seek to destroy 5,000 years of civilization, the scientists decided at the meeting to abandon in part their traditional role as researchers in order to analyze scientifically the ills of the world and suggest remedies (“America’s Top” 17).

The article presents quite a bleak perspective if scientists claim they will abandon their research to attend to the international mess to which it supposedly contributed.

One of the main points of the article is to warn against the abuses of science in Germany, Russia, and Australia, which were increasingly seen as enemies.

What is surprising, then, given the article’s take on the situation, is that the caption of the speaker scientist (top-right) states, “Sir Richard Arman Gregory, British apostle of international scientific co-operation and unity, warned the scientists that it was time to act forcefully. ‘Scientific workers,’ he declared, ‘should not shirk their responsibility for upholding the freedom of thought where this principle is still honored, and of guarding against the abuse of that freedom’” (“America’s Top” 17). “Acting forcefully” and “Upholding the freedom of thought” both seem to indicate that scientists should continue doing their research, which is the opposite of what is

described in the article.

Moreover, matching the defiance expressed in the caption, Gregory is shown in a position of power— from a low angle, with one hand raised, and his shadow looming larger than his body in the background. He is visually scripted as a dictator, which does not at all accord with the article’s description of abandoning research “in order to analyze scientifically the ills of the world and suggest remedies” (17). On the contrary, such a passive description would require an equally passive visual depiction of scientists, which does appear in this photo-essay, albeit much smaller and at the bottom of the right page.

Viewers would likely not see the smaller triptych until after looking at the four close-up images of scientists taking up the entire left page. Like the portrait of Gregory, these four scientists, labeled by their various disciplines (e.g., entomologist and psychologist), are portrayed in an unflattering light. The captions for each of these close-ups are similar to the one for Gregory’s portrait in that they contradict the article and support free scientific research. For example, the caption for the economist and president of the AAAS, Dr. Wesley Mitchell, quotes him saying, “As citizens, scientists should do what they can to prevent the misuse of scientific discoveries. As scientists, they must not be hampered by world conditions” (“America’s Top” 16). Likewise, the psychologist, James McKeen Cattell “is opposed to the control of scientific discoveries and believes that ‘the true scientist works unselfishly and gives his results freely’” (16). All of them are portrayed as if emerging from the shadows, and their facial expressions and gestures are severe. To be sure, these scientists are not in their element; they are seemingly struggling to be

understood.

Finally, there is the small triptych, bottom-right, receiving less visual salience than the other portraits in the spread and differing markedly in terms of the visual



Figure 8: Triptych of “gloomy scientists.” *Life* 6.2 (Jan. 9, 1939): 17.

message conveyed (fig 8). Right away we can see that the poses of the scientists in the first two photographs reflect the “feeling of gloom” described by the article. But there is much more to be said of the portraits and their strategic depiction of scientists. The first photo is captioned: “Dr. Henry Baldwin Ward, most famous U.S. zoologist, was one of the many pessimistic scientists at the meeting. An expert on parasites, he teaches at the University of Illinois” (“America’s Top” 17). Dr. Ward looks pensive sitting slumped in a chair with his chin propped in his hand. The only other prominent element in the image is the sign next to him, which reads, “Scientists...Make yourselves at home! Glad you have come.” The second photo is similar to the first, the main difference being that *two* scientists are portrayed slumped in chairs, hands on chins. The repetition of the same pose strongly reinforces the gloomy mood mentioned in the article. However, the caption for this image, unlike



the first one, is not gloomy: “Dr. Axel L. Melander, biologist, and Dr. Brues are the Damon and Pythias of science. Childhood friends, they went to the same college, collaborated on research and on books.” In this case, the purpose of the caption is to provide personal information about the scientists pictured, as if to suggest “scientists are people too.” This message is already conveyed by the setting in which the scientists are portrayed—obviously, they are not shown in their laboratories or with scientific paraphernalia surrounding them; instead, they are shown relaxing in everyday settings.

The notion of the “everyday” or ordinary is taken to an extreme by the third photograph, which breaks the visual repetition set up in the first two photographs. For this triptych, the *Life* editors have selected photographs that are the ultimate representation of Jacobi and Schiele’s archetype of “the scientist as ordinary mortal,” which they say is the typical portrait used to counteract “anti-science” attitudes, and yet it is juxtaposed to an image of a scientist dictating and of frightening close-ups of other scientists (750). The photographs in the triptych seem almost out of place surrounded by the larger images of scientists gesturing in the shadows. However, the caption of the third photo aligns with the captions of the larger images in terms of the quotation it provides from the scientist pictured, Dr. J.J. Davis: “Said he: ‘Only free science can preserve our high standards of living.’” Like the other quotes provided in captions, Davis’s quote presents a strong argument in opposition to the one relayed in the article—that scientists in Germany and the Soviet Union are planning to “abandon in part their role as researchers...” (“America’s Top” 17). A major difference between Davis and the other scientists quoted, however, is in his visual

representation. He is shown sitting on the edge of his bed wearing pajamas, perhaps the farthest possible depiction from the “scientist at work” portrait. The images in this triptych suggest that scientists are working and discussing urgent matters—the looming war—even when they should be going to bed.

Scientists are not shown working with unfamiliar scientific instruments on unknown, mysterious projects in this story. Instead, the scientists in this case look concerned or are engaged in urgent discussions, and the captions for the images throughout the photo-story do not always seem to describe what the images depict. Perhaps *Life*'s images of “scientists as ordinary mortals” (with the exception of Gregory's portrait) are projecting an attitude that scientists are visibly concerned for the nation's future, but the captions almost seem to align them with the German and Soviet scientists described negatively in the article. Certainly this first AAAS study departs from the depictions of individual scientists described in the section above.

**“U.S. Science Holds Its Biggest Powwow”**  
***Life*: Jan. 9, 1950**

*Life*'s coverage of the 116<sup>th</sup> AAAS meeting is the exception to the rule in this study of AAAS images because it is celebratory and returns to the style of portraiture typical to the portrayal of individual scientists. The anonymous author of the introductory article to the photo-essay states: “It was a great week for scientists to look up old friends or better jobs and to get filled in on the news from the extended frontiers of knowledge [...]” (“U.S.” 17). Not only was it a great week for science, but a great era—the post-WWII era brought increased government funding to scientists who were willing to slant their research towards military projects (Bowler

and Morus 471-484). It is significant that this *Life* article was published just months before the Rosenbergs were prosecuted for espionage, and just before the height of the red scare.<sup>121</sup> Had the article been published later in 1950, the tone of the article would have likely been much different.

In an effort to revive the notion of “pure,” disinterested science in this post-war era of applied science, Vannevar Bush’s 1945 report, “Science: The Endless Frontier,” maintained that pure research would necessarily lead to technological advancements that would be applicable to government projects (Bowler and Morus 484). The 1950 *Life* photo-essay on the AAAS convention seems to operate on this principle, as it shows the research of scientists from a variety of fields and the positive implications of their research, as opposed to focusing on operations research.

The opening of the article celebrates the growth of the AAAS since its humble beginnings in 1848, when there were only 64 papers delivered in a few different subfields; by contrast, this 1950 convention “heard 2,150 papers on everything from evolution to parasitology” (“U.S.” 17). Perhaps most significantly, the writer makes some strategic rhetorical choices at the end of the article that automatically place readers on one side of the debate over the dangers of science—the side that does *not* believe that science is dangerous: “For those who argued that in coming thus far and bringing on the atomic age science had outdistanced man’s spirit, President Elvin Stakman had a terse answer: ‘Science cannot stop while ethics catches up...and nobody should expect scientists to do all the thinking for the country’” (“U.S.” 17). First, the article gives Stakman the last word, suggesting that *Life* supports his

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<sup>121</sup> Julius and Ethel Rosenberg were arrested in July 1950 for passing information about the atomic bomb to the Soviet Union. The federal government passed a new Internal Security Act (the McCarran Act) in September 1950 in response to Senator Joseph McCarthy’s accusations.

statement. Second, using the past tense—"those who argued"—makes it seem as though the issue is no longer relevant. Lastly, keeping the statement vague and impersonal—"For those who argued" versus "For those of *you* who argued" or some other form of direct address—distances readers from that mistaken argument. Readers of this article are thus implicitly directed towards a supportive view of science. The next page displays the photo-essay.

Before zeroing in on the images and captions, I will discuss the overall layout

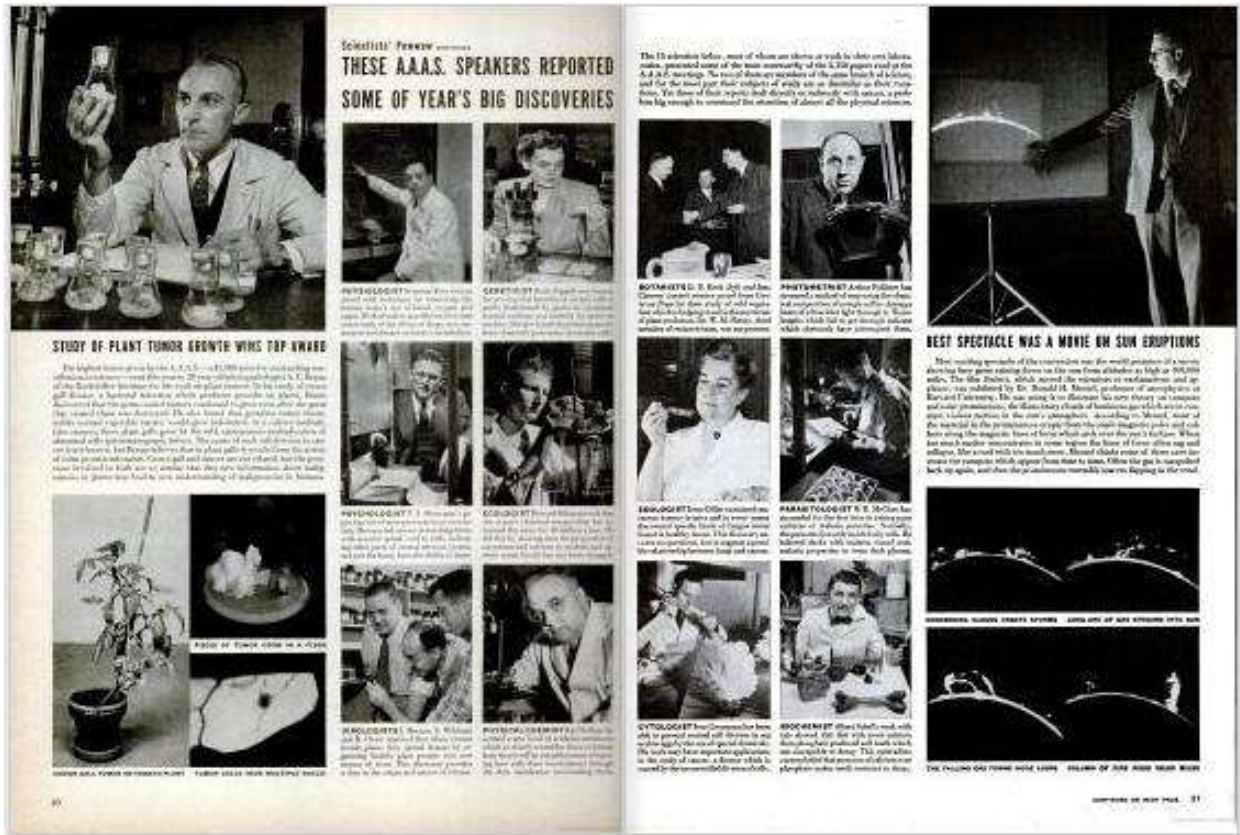


Figure 9: A.A.S. Speakers. *Life* 28.2 (Jan. 9, 1950): 20-21.

of the photo-essay, which can be seen in its entirety in Figure 9. Appeals are made to the audience through repetition and variety. Repetition of photographs that are the same size and shape—four forming a frame around the twelve in the center—is

appealing because of its symmetry and order. Moreover, Kress and van Leeuwen would say that such repetition of size and shape indicates classification, or the message that the people in the photographs are alike or members of the same group (83). What makes this use of repetition appealing is the variation of visual content within the repeated frames, which stimulates curiosity: viewers are prompted to look at each of the same sized photographs to find out how each one differs from the next.

Demanding attention as well are the two larger portraits in the top corners that frame the smaller ones, representing “Best Spectacle” and “Top Award” (figs. 10 &

11). The “Best Spectacle,” a movie on sun eruptions, was delivered by astrophysics professor Dr. Donald H. Menzel, who is depicted next to the movie screen, gesturing in a teacherly way. Scientist and screen are equally balanced in this left/right visual composition, with Menzel’s arm acting as a vector representing his ownership over the content of the movie.



Figure 10: "Best Spectacle." *Life* 28.2 (Jan. 9, 1950): 20-21

Presumably, this photograph was taken at the AAAS convention while Menzel lectured about the movie. In contrast, the scientist winning “Top Award” for his work on plant tumors, phytopathologist A.C. Braun (fig. 11), is decidedly *not* pictured at the convention. Rather, the photograph shows him in his laboratory,

holding up one of several Erlenmeyer flasks that are lined up neatly in front of him.<sup>122</sup>

The portraits of Menzel and Braun fit seamlessly into the archetypes described earlier: Menzel is what Jacobi and Schiele term “the teacher of humanity,” and Braun is the “typical” portrait of “the scientist at work,” holding up his object of discovery.

The editorial choice to include portraits of all of their subjects in the middle of working on the “year’s biggest discoveries” is significant because it is an exception to the rule in the sampled photo-essays on AAAS conventions. The scientists could

have been shown instead at the convention, as in the 1939 story.

Images of the scientist at work purport to show nonscientist audiences scientific “discoveries” that they would not be able experience firsthand. For nonscientist audiences

to appreciate images of scientists at



Figure 11: "Top Award." *Life* 28.2 (Jan. 9, 1950): 20-21

work, they would have to be in support of that work. If audiences were leery of science because of its role in “bringing on the atomic age,” as suggested by the introductory article, the depiction of scientists in a lab—working on unknown, potentially harmful projects—would only strengthen audiences’ convictions that science is mysterious and therefore dangerous. Thus, in order for the “scientist at work” appeal to be effective, the photo-essay has to create a positive, epideictic atmosphere around the scientific enterprise as a whole. This is further reinforced, as

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<sup>122</sup> The way that Braun holds up the Erlenmeyer flask is also characteristic of the medieval image of the alchemist. See e.g. Ball.

already mentioned, by the tone of the introductory article, the superlative headlines (“Best Spectacle” and “Top Award”), and even the repetition and variation in the layout of images.

The celebratory atmosphere is also generated by the photographs’ captions in this photo-essay. In particular, the captions feature celebratory buzzwords and point to the positive implications of scientists’ research. Buzzwords include “provocative,” “new,” “valuable,” “solved,” “invented,” “discovered,” “succeeded,” and “important.” Positive implications are delivered after a quick burst of information about the research, and they often point out how that research changes previous



Figure 12: Zoologist and Cytologist. *Life* 28.2 (Jan. 9, 1950): 20-21.

beliefs, improves our understanding of complex phenomena, or has practical applications. Ultimately, these multimodal arguments (image and caption) invoke Aristotelian epideictic appeals, such as the improvement or alleviation of a problem, or proposing the value of something. For instance, the captions about the zoologist



and cytologist (see fig. 12) both link their research to improving the understanding of cancer. Irene Diller's "discovery answers no questions," the caption states bluntly, "but it suggests a possible relationship between fungi and cancer." Likewise, Ivor Cornmann has done work with sea urchins that "may have important implications in the study of cancer" ("U.S." 18). Both scientists are busy at work, peering intently at the scientific objects relating to their discoveries, which are made to sound important enough to override any public concern over science's role in society.

**"The Future Discussed: 'Security' Protested Scientists of U.S. Speak Up"**  
***Life*: Jan. 10, 1955**

Like the 1950 AAAS article, the article on the 1955 meeting of the AAAS opens by describing the "impressive scientific advances" discussed at the convention. However, the article abruptly changes subjects to address a gloomy situation for scientists, calling back to mind the 1939 article. In 1955, the scientific problem to be addressed is "a political issue: the effect of the government's security program on scientific progress" ("The Future" 15). Scientists are paraphrased in the article as saying that the government is "frightened" of supporting even unclassified research ("The Future" 15). This anxiety over unclassified research is likely related to larger concerns about the Cold War and an accompanying shift in public attitudes towards science. A later section of the article, titled "Sociability, Search for New Associates," continues to describe scientists' worries about the future of scientific research: "One thing which concerned them all was the shortage of future scientists" ("Sociability" 18). Scientists' concerns, which can be linked to a decline in the economy and consequent decrease in government funding, would soon be alleviated by the post-



Sputnik revival of scientific research. Like the 1939 “Gloom” article, this 1955 photo-essay is also devoid of images of scientists at work. The focus is instead on images of scientists at the convention.

Figures 13 and 14 from this photo-essay are quintessential images of scientists as ordinary mortals (though not quite of the same caliber as “the scientist in pajamas” from 1939). This photo-essay is the first in the group studied here that names its photographers, N.R. Farbman and Otto



Hagel, who were ostensibly [Figure 13: “The future discussed.” \*Life\* 38.2 \(Jan. 10, 1955\): 18.](#) given an assignment to capture scientists in “everyday” situations. In Figure 13, two convention-goers holding beers are in the midst of what appears to be the analysis of a problem. The caption grounds the image in an even more specific context than the surrounding article: “The cheer of beer is momentarily forgotten by two men who are scribbling on a tablecloth at a party for mathematicians. Watching them, one wife complained, ‘Look at them, still solving problems’” (“Sociability” 18). Thus, the beer-drinking photograph belongs in the same category as the scientist-in-pajamas photograph from 1939; scientists are shown diligently working even when they should be doing other things, like socializing. In other words, Figure 13 is not a typical photograph of men socializing over beer; their intense body language and expressions suggest that there is a lot at stake in their dialogue. Still, the beer-drinking photograph in the context of the AAAS convention presents a somewhat

unusual contrast. The typical characterizations of scientists in stories about their individual achievements (presented earlier in this chapter) do not include images of them drinking beers.

Similarly, Figure 14 depicts a striking image within the context of the AAAS convention. Here, a group of men who are presumed to be scientists are shown eating with chopsticks, mouths open. The grand portrayal of scientists at work, making important discoveries with impressive equipment, is nowhere to be found in this photo-essay. Granted, a part of *Life's* shtick is to portray celebrities doing everyday things (often unceremoniously), and to extend that tactic to the depiction of



Figure 14: "The future discussed." *Life* 38.2 (Jan. 10, 1955): 18.

scientists indicates that there could be some implicit assumptions being projected about the audience for these images: first, the assumption that public audiences believe scientists occupy a different category than "normal people," and correspondingly, the assumption that public audiences believe scientists do not engage in "ordinary" behaviors, like eating or sleeping or drinking beer. These portraits of scientists are not supposed to be flattering—they are supposed to be "realistic" and candid portrayals of scientists who are typically shown working in the lab.

Arguably, depicting scientists in everyday settings gives the impression that,

ultimately, scientists are no different from *Life's* readers. *Life's* editor made a choice to omit depictions of scientists at work—the major factor separating scientists from nonscientists—and to depict scientists doing things completely unrelated to scientific research. Nonscientist audiences are not positioned to look in on scientific projects from an unbridgeable distance, but rather to see scientists up close and personal, a rhetorical move that is more likely to downplay the idea of science as an elusive authority.

**“Scientists: Wide Range of Plans”**  
***Life*: Jan. 13, 1958**

Three years later, science is still hard-pressed for funding from government agencies, and scientists are portrayed discussing plans to improve their status in society (“Scientists” 16-18). Throughout the following analysis, it should be kept in mind that this photo-essay depicts scientists reacting to post-Sputnik national security concerns and lobbying for the National Defense Education Act (NDEA),<sup>123</sup> which was passed soon after this article was published. Although this article does not specifically cover the AAAS convention, it references the upcoming convention, which will be focused on improving science education (“Scientists” 18). Importantly, this photo-essay is unique in the context of this case study because of its representation of yet another visual rhetorical appeal on the part of the *Life* editor to advertise science through portraits of its community members.

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<sup>123</sup> Congress passed the National Defense Education Act in 1958 to ensure that the education system would train Americans to be able to compete with the Soviet Union in science and technology. The NDEA was geared towards improving science and mathematics from grade school to graduate school. See the US Department of Education website.

The type of portrait featured in this photo-essay does not appear in Jacobi and Schiele's list of archetypes, and it is not one that I have discussed so far either (see figs. 15-18, not to be confused with parenthetical page numbering in this section). As in the other two cases in which science was on the defensive (1939 and 1955), there



Figure 15: "A defense center for science's big ideas." *Life* 44.2 (Jan. 13, 1958): 16.

are no representations of scientists at work in this photo-essay. The “scientist as ordinary mortal” archetype does not appear either, as we do not see scientists conversing in street clothes, for example. One might make the case that the images throughout this photo-essay belong to Jacobi and Schiele’s archetype of “the scientist as teacher of humanity,” but I believe that something altogether different is being advertised. Consider Figure 15, a group of scientists deliberating about something, which appears at the top of the page and sets the tone for the portraits that follow. The photograph is captioned, “A Defense Center for Science’s Big Ideas,”<sup>124</sup> and shows the scientist in the center talking and gesturing while the others lean in and

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<sup>124</sup> The rest of the caption reads, “At Princeton meeting called by Physicist John A. Wheeler, [...] colleagues discuss his proposal for a centralized national laboratory for defense research which would also be a clearinghouse for military ideas from scientists everywhere,” and follows with the names of scientists pictured (“Scientists” 16).

listen. Two of the three images side-by-side at the bottom of the same page (fig. 16) are similar to the image of the meeting in that they show scientists with their mouths open, as if caught in mid-sentence during a deliberation or lecture (and arguably the scientist standing up in the first image is speaking, too). I will return to the captions



Figure 16: "Wide range of plans." *Life* 44.2 (Jan. 13, 1958): 16.

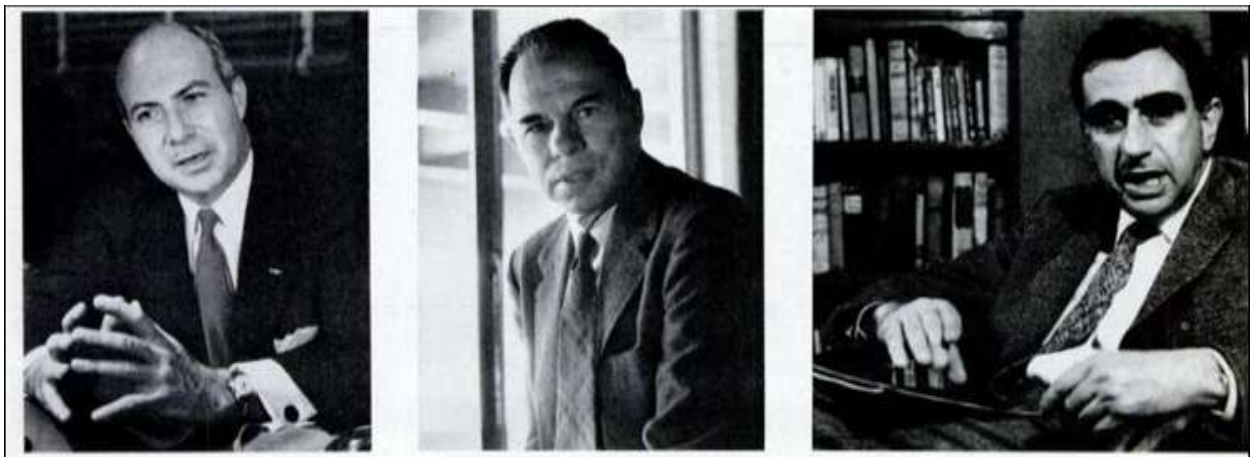


Figure 17: "Wide Range of Plans." *Life* 44.2 (Jan. 13, 1958): 17.

in a moment. Moving on to the next page, two out of three more images side-by-side show scientists gesturing and speaking, while the one in the middle stares intently at the camera (fig. 17). Finally, on the page following that one, there is a photograph of the AAAS president standing in front of a placard displaying the society's name, and even he looks as if he is in the middle of saying something from the way that his

mouth is formed (fig. 18). Now, it could be that some of the scientists in Figures 15 through 18 are simply not photogenic, that they were caught off guard by the photographer, or that they smile in a way that makes them look as though they are speaking. But the fact remains that these were the photographs of scientists specifically chosen by the editor of *Life* to circulate to a national audience—

photographs of scientists who look like they are in mid-sentence. The question is, How does this choice advertise science?

The reason I mentioned



Figure 18: "Wide range of plans." *Life* 44.2 (Jan. 13, 1958): 18.

earlier that these photographs could be mistaken for Jacobi and Schiele's "teacher of humanity" archetype is because it is possible that the scientists are in the middle of imparting knowledge about science. However, given the context provided by the article and the fact that there is no depicted audience of students, it is clear that these scientists are not in the middle of teaching—but rather in the middle of deliberating over or even *defending*—science. The scientists in this story might be put in a new category: the scientist as persuader.

For example, the caption for the first photograph in Figure 16 explains that these scientists "have stumped [the] country pleading for industry and government support of long-range planning for intelligent use of material resources and technical brain power" ("Scientists" 16). The man in the second photograph is actually quoted

in the caption on the topic of science education: “National leaders who want to kindle enthusiasm for science must fire American youth with a concept of science as a means for achieving our vision of the future, not merely as an emergency military tool” (“Scientists” 16). In the same vein, the captions for the photographs in Figure 17 are in defense of science. The first scientist pictured is arguing for a place for scientists in the Cabinet, “armed with authority, money, and duty to push through a vast complex program with maximum efficiency” (“Scientists” 17). Intriguingly, the second scientist is paraphrased in the caption as saying that the “public must revise the popular image of scientist as ‘queer’ and ‘square.’” Furthermore, “He points out the average scientist is actually ‘revoltingly normal’ in his habits, and that his intellectual curiosity is one of the highest qualities of mankind” (“Scientists” 17).<sup>125</sup> Perhaps this scientist had not been keeping up with *Life*’s coverage of previous AAAS conventions, which most certainly did portray scientists as “revoltingly normal” people. Lastly, the caption for the third scientist’s photograph explains, “He wants science to be built up—like baseball—to have its share of fans and glamor [sic] so schoolboys will not be ashamed of enjoying studies” (“Scientists” 17). Although these captions vary by topic, they all have in common an argument for science to be more respected and better-integrated in society.

It is no coincidence that images were selected in which scientists appear to be lecturing on or deliberating about a topic. These are images that depict scientists taking advantage of the moment in a post-Sputnik climate of concern for national

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<sup>125</sup> This scientist’s statement indicates that the stereotype of the “mad scientist” is still alive and well in 1950s culture. Such a characterization of scientists would likely be off-putting to students deciding on their future careers, and so this scientist is seemingly trying to reverse that stereotype in an effort to recruit more future scientists.



security and progress. Science is advertised as having a stake in education, politics, and the safety of the nation. It follows that scientists would be visualized in the midst of articulating their proposals for action. Washington passed the NDEA later that year, granting massive funding to several scientific research agencies (e.g., the NSF, NASA, and the NIH) and also providing funds for the improvement of science education in primary and secondary schools.<sup>126</sup>

## **Conclusion**

Portraits of scientists continue to play a significant role in shaping public perceptions of science. Images like the one from the *Science Daily* website (fig. 2) carry on a tradition dating back to the Middle Ages that was made “realistic” by the invention of portable cameras and photomechanical reproduction. *Life* magazine photographers and editors contributed to setting the tone for photographed scientific portraits, and they made use of a variety of visual rhetorical appeals in their coverage of AAAS conventions that seem to correlate with social and political issues in the scientific community.

In stories depicting a single scientist, *Life* editors more often than not selected images of scientists busily working. In contrast, in stories covering AAAS conventions and the scientific community as a whole, *Life* editors more often than not selected images of scientists outside of a laboratory setting. While scientists at work can be effective at strengthening public appreciation of science, *Life*'s editors only chose to include them in one of the stories on the AAAS conventions that focus on science in a broader social and political context. What does the choice to remove

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<sup>126</sup> See e.g. Geiger.



scientists from their research suggest about *Life's* projected attitudes towards the scientific community?

These candid photographs are far from aestheticized frontispieces, yet because they set scientists apart as a special “breed,” *Life's* portraits can serve as portals into unfamiliar territory. Scientists are shown in a different light in almost all of the AAAS stories—as visibly concerned, as working around the clock, as advocating for social reform, as persuading the country to increase funding for science education. Ultimately, the collage of *Life* images depicts scientists serving multiple roles, and more importantly, as occupying a clear place in society and politics—not always hiding out in a laboratory.

Still, out of all of the types of portraits represented by *Life's* editors, the image of the scientist at work remains most ingrained in popular culture, now circulated on the Internet as opposed to in a national magazine; moreover, the scientist at work image is often exaggerated into Jacobi and Schiele's archetype of the “mad scientist.” Simply searching “scientist” in Google Images turns up mainly cartoon images of scientists with crazy hair, wild eyes, and smoking test tubes (see also Schummer and Spector). Images of mad scientists only work to separate scientists from “normal” people and thus distance non-expert viewers from the scientific enterprise.

The examples in this chapter demonstrate that images of scientists have the capacity to set up different kinds of relationships between represented participants (scientists) and nonscientist viewers; some types of portraits invite identification—ones that depict scientists as ordinary people---and others do not—ones that depict a

scientist at work.<sup>127</sup> Distancing non-expert audiences from the scientific enterprise is effective if the goal is to portray Science as unreachable and mysterious, but ineffective if the goal is to engage said audiences and impart information. That is not to say that portraits of scientists at work should be abandoned today; in fact, showing non-experts a day-in-the-life-of a scientist can be a potentially inclusive gesture. However, to accomplish this goal, the genre of portraiture would likely need to be updated for the twenty-first century.

A video of a scientist working on an experiment, giving a tour of a laboratory, or demonstrating a concept could bring the genre of portraiture to life in a way that does involve non-expert viewers. The video would have to be interactive—with the scientist speaking directly to viewers—and dynamic to keep viewers’ attention. I am not suggesting that complex theorems or the history of the universe could be explained in a single video, but rather that investing in short, personal videos of scientists doing what they do might be a logical step in the direction of public outreach for scientific organizations. Videos would allow scientists to spread their enthusiasm for their research beyond their work environment, and beyond the scientific community.

The next chapter explores how a magazine cover can serve as a less literal “face” for scientific discourse. I view popular science magazine covers as modern day equivalents of frontispieces. The portal images in Chapter 4, however, have evolved to appeal to much more stratified public audiences with a new arsenal of visual techniques.

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<sup>127</sup> See Kress and van Leeuwen for more on relationships between represented participants and viewers, and see Jacobi and Schiele for more on the notion of “the scientist as ordinary mortal.”

## Chapter 4: The Visual Exordium Part II: A Study of Science

### Magazine Covers

The previous chapter evaluated the earliest, presumed-to-be candid photographs of scientists to reach a national audience and proposed that they were flexible advertisements that could either invite identification from non-expert viewers or create distance. This chapter moves forward in time to study static visual advertisements competing in the world of dynamic visuals on television, and yet it will reach back to a style of advertisement that began with the frontispiece, which, like portraits, also served as a face for science (albeit less literally). Frontispieces—engraved illustrations in the front of books—no longer exist, but in this chapter I argue that *magazine covers* serve a very similar rhetorical function and are evolved versions of frontispieces. In the same way that frontispieces featured classical symbols and allegories that audiences of early scientific texts would have recognized, magazine covers draw on an updated set of symbolic conventions to “hook” potential buyers and entice them to read about science. Rhetorically analyzing the styles and compositional designs that are specific to the genre of magazine covers will illustrate their efficacy as portals into scientific discourse.

As with frontispieces, science magazine covers are persuasive visual documents that are responsible for making potential audiences receptive, attentive, and well-disposed to the interior scientific discourse.<sup>128</sup> Thus, magazine covers are also visual *exordia*, modernized by the same advances in print technology described

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<sup>128</sup> See my discussion of the exordium in the *Rhetorica ad Herennium* in Chapter 2 on frontispieces.

in Chapter 3 (i.e. photomechanical reproduction), and now also photo-editing software.<sup>129</sup> As the magazine's "face" or "visual exordium," the cover is responsible for persuading audiences to read its interior contents. Corroborating this claim, magazine editors Johnson and Prijatel describe the magazine cover as

[...] the most important editorial and design page in a magazine. The cover, as the magazine's face, creates that all-important first impression. [...] Editors, art directors, publishers, and circulation directors spend hours trying to select the perfect cover for each issue—one that sells out at the newsstands and creates a media buzz (281).

Popular science magazine covers are very likely to be successful scientific advertisements because editors employ strategies that are intended to capture the attention of broad, non-specialist audiences. Stated bluntly, the primary editorial motivation to sell magazines may correspond to more effective techniques for the visual advertisement of science. Competing with each other and with magazines on different subjects at the newsstand and now online, popular science magazines must effectively "advertise" science to the broadest possible audience in order to stay in circulation. Thus, not only do magazines have to sell their brand, but they have to do so by making science exciting to broad audiences—a feat that merits critical attention.

In addition to competing with each other, magazines also had to compete with television when it became the primary means of receiving information visually. For example, magazine editors began using bolder graphics and more cover lines to compete with all of the other visual stimuli bombarding readers/viewers daily (see

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<sup>129</sup> The most popular type of printing used by magazines is offset lithography. According to Wells et al. in *Advertising Principles and Practice*, "Offset printing uses a smooth-surface and chemically treated plane to transfer the image. Based on the principle that oil and water don't mix, the oil-based ink adheres to parts of the image but not to other parts. The offset plates are produced photographically" (379).

e.g., Grow; Bowler 265-271). However, in spite of the visual competition and change in cover trends generally, science magazines aimed at members of the scientific community continue to feature austere, simple covers. For example, *Science*, the peer-reviewed journal published by the American Association for the Advancement of Science (AAAS) always features a “poster cover,” meaning that it has one main image and no cover lines (Johnson and Prijatel 281). Cover lines are the brief, memorable captions on the cover that often correspond to stories inside the magazine, and, according to journalism experts, the more cover lines a magazine has, the better it sells (see e.g., Johnson and Prijatel; Grow). According to Grow, although poster covers can still be found on some popular magazines, they have become a rarity (“Magazine Covers”).

In contrast to popular science magazines, science magazines often feature poster covers. Another expert publication that has a poster cover is the *Journal of the American Medical Association (JAMA)*. On top of having no cover lines, it features fine art on its covers instead of images pertaining to science and medicine. Why can expert publications get away with dismissing the conventions of competitive cover design? The main reason is that *Science*, *JAMA*, and other peer-reviewed publications have a more-or-less stable readership of experts in their fields. They do not need to compete for readers. In contrast to the poster covers of peer-reviewed journals, popular science magazines tend to feature a “multi-theme, multi-image” or “multi-theme, one image” approach—“multi-theme” meaning an abundance of cover lines (Johnson and Prijatel 281-86). In this chapter, I take a closer look at the bold graphics and cover lines of popular science magazines to analyze trends in their

structure and content—in other words, I analyze their genre conventions, and the variations that occur with changes in target audience and publishers.

First, I provide a brief history of science magazine publication and a review of the field of science communication. Then, I begin a case study of popular science magazine covers beginning with *Scientific American*, a magazine that has undergone significant changes in management that have profoundly influenced its character and reputation, and ultimately the genre to which it belongs. Beginning with *Scientific American* allows for a clearer picture of the marked differences between “popular” science magazine covers and covers on magazines targeted to members of the scientific community. As *Scientific American* shifted genres into the popular realm, broadening its target audience, its cover design also changed drastically, making it a useful model of how the visual rhetoric of magazine covers changes according to target audience. The story of *Scientific American*’s transformation from the 1950s to the present will lead into case studies of *Science Illustrated* and *New Scientist*, two popular science magazines that make use of layouts similar to the popularized version of *Scientific American*, indicating that there are some core design tactics that are used to appeal to a broad audience. However, beyond these core design tactics, *Science Illustrated* and *New Scientist* offer two different approaches to advertising science that act like templates that can be transferred from the realm of magazine covers to scientific advertisements in general. In the coda, I describe how the genre conventions of magazine covers have relevance beyond the covers of magazines and can be repurposed to communicate science in other contexts.<sup>130</sup>

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<sup>130</sup> As I discuss in my first chapter, there has been a recent burst of publications (monographs, anthologies, and articles in both scientific and communication journals) aimed towards honing the

## History of Popular Science Magazines & The “Gap”

Popular science periodicals arose out of a need for mediation between an increasingly professional and specialized scientific community and a growing, educated middle class (Lightman 652). Professionalization evolved out of gate-keeping practices, such as the peer-review system and the formation of scientific societies (Kuritz 266-267). Studying trends in popular science periodicals over the course of the nineteenth century, historians of science have found that the number of popular publications not only doubled around 1860 but also shifted their mode of address to non-specialist audiences (Barton; Sheets-Pyenson; Kuritz; Whalen and Tobin). Specifically, periodicals in the early-nineteenth century encouraged amateur participation in science, but around the 1860s, popular periodicals deemphasized amateur participation and “emphasized”—I would say *advertised*—professional science (Sheets-Pyenson 553-555). Studying popular periodicals that began “Just Before *Nature*,” Ruth Barton, following Sheets-Pyenson, clearly describes their shift in purpose:

From the 1820s to the 1850s popular journals had espoused an experiential, inductivist science to which all their readers could contribute. Sheets-Pyenson found that this participatory, republican image of the scientific community began to disappear in the new journals of the 1860s when popularizers sought not participation from amateurs, but support for professionals (3).<sup>131</sup>

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science communication process, but the field has yet to explore the persuasive potential of images. Scholars and practitioners invested in the visual communication of science can get a better sense of what styles, themes, and designs are effective at engaging broad audiences by paying attention to science magazine covers.

<sup>131</sup> Barton focuses her study on four periodicals that began in the 1860s that were considered the “most successful” of their time: *Recreative Science*, *Popular Science Review*, *Quarterly Journal of Science*, and *Scientific Opinion* (6).

Sorting through the burst of popular publications in the 1860s, Whalen and Tobin identify three categories of popularizations “which fostered the public image of science”: periodicals of general science (portraying new theories for non-specialists); periodicals of scientific study (showing the ideal of “scientific civilization” and blurring boundaries of specialized fields); and popular periodicals (relating scientific endeavors to everyday life) (196-197). Whalen and Tobin then go on to describe how periodicals across all categories transformed when they changed ownership. While they all began “under the auspices of a private, self-appointed editorship acting in the name of a scientific community of ‘cultivators’ and ‘practitioners’ who saw a need for conveying both a sense of and a meaning for the mission of science to the public and their colleagues,” they eventually were taken over by mass publishing companies,<sup>132</sup> which portrayed science as “isolated and radically apart from commonplace reality...” (197-198). Thus, the rhetoric of popular science magazines reinforced the existence of a “gap” between professional and popular science that is now so prominent today, in addition to factors like the professionalization of the scientific community, the growth of a mass audience, and the corporate takeover of scientific popularization.

The latter factor is perhaps most responsible for developing the notion that science needed to be advertised to nonscientist audiences. That is to say, the primary goal of large publishing companies was to sell magazines, regardless of their subject area, meaning that spreading awareness of science was a side effect rather than a priority. Using advertising rhetoric, Peter Broks writes in *Media Science Before the*

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<sup>132</sup> The authors focus on one company in particular, which took over several of the periodicals: the Science Press of James McKeen Cattell (198).



*Great War* that, “In popular periodicals science itself was presented as a commodity, a product not a process, to be consumed not participated in” (131). Peter Bowler writes that “Science became popular when its presentation came in a format with which people could identify” (95). Bowler zeroes in on the qualities that appealed to mass audiences for science: discovery, excitement, and a narrative framework (95). The “new journalism” of the 1880s, characterized by shorter paragraphs and more illustrations, likely changed readers expectations for the way they received information (Broks, *Media Science* 15-16). Finally, as discussed in Chapter 3, photomechanical reproduction, which allowed for images to be published on the same page as text, also changed the way that science could be conveyed to mass audiences.

Presenting a different perspective on the creation of the science/public gap, Bensaude-Vincent argues that although nineteenth century popularization did encourage a divide between science producers and science consumers, it was not until the twentieth century that the public was presumed to be knowledge-deficient and incapable of comprehending science. Bensaude-Vincent blames the gap in part on twentieth-century physics during the Cold War, “when research policies were no longer under the control of public opinion,” and all branches of science were associated with physics, and all scientists were viewed as “super heroes” (109). She also points to science journalists as being responsible for creating the notion that science is inaccessible to the average citizen. Twentieth-century popularization, she argues, is an entirely separate entity from nineteenth-century popularization because twentieth-century journalists endowed science with “quasi-supernatural power,”

which in turn depreciates nonscientists. She writes, “Never before had the public been disqualified and deprived of its faculty of judgment to such an extent” (109).

A burst of interest in scientific news and discoveries took place in the late 1970s and early 80s, leading to a proliferation of TV programs, newspaper sections, and magazines devoted to making science accessible to a wide audience. Writing in 1987 on the “boom” of popular science, Bruce V. Lewenstein attributes the sudden interest in science to a few factors, including baby boomers’ desire to know more about the science behind the monumental events they lived through (e.g., Sputnik and the War on Cancer); the rise of “specialty magazines” in general, marketed toward specific, well-defined audiences; and the abundance of science-themed news stories from the previous decade (e.g., Three Mile Island, Mount St. Helens, Love Canal, etc.) (Lewenstein 30-31). Nearly twenty-five years later, those interested in science and technology today can still choose from a wide array of popular science magazines, which generally strive to make scientific concepts appealing and accessible to broad, non-expert audiences.

I included this brief genealogy of the popular science magazine to illustrate that the “gap” between scientific communities and non-expert publics was a long time in the making, and that it was the result of many factors, including the mass media’s takeover of popular science. My purpose is not to criticize or lament the “gap” but rather to present new ideas for public outreach, namely through analyzing the genre of popular science magazine covers as a vehicle. In this chapter, I demonstrate how popular science magazine covers exemplify the potential of visual persuasion. Especially after television became the primary means of transmitting information

visually, magazine editors had to find more effective ways of persuading people to engage with their products. In addition to featuring more vivid images, increasing cover lines was a way to grab readers' attention (see e.g., Johnson and Prijatelj; Grow). The artistic concepts and layouts selected by magazine editors are successful in the main because if they are not successful, their magazines fail. In other words, because popular science magazine covers persuade audiences to read about science, the visual rhetoric of magazine covers has a history of being effective.

I will analyze the visual rhetoric of magazine covers as I analyzed frontispieces and photographed portraits, attending to thematic content, style, composition, arrangement of elements, and visual/textual interaction. The analysis of their persuasive qualities will substantiate my argument that the rhetorical techniques used for magazine covers should be extended to visual communication efforts in general. Magazine covers are significant to science communication efforts because of their fundamental purpose and calculated attempts to advertise science visually to broad audiences.

### ***Scientific American***

Once well-respected by scientists who aimed for publication in *Scientific American* to earn wider recognition for their work after being published in specialist journals, it is generally agreed that the magazine suffered a decline in status and began to resemble a popular science magazine over the course of the 1990s (see e.g., Moran; Bernstein). I will examine the visual aspect, or “cover story,” of *Scientific American's* “fall from grace” to show how changes in audience over time can correlate to changes in cover style.

*Scientific American* underwent significant changes regarding both its form and function sometime after founders Gerard Piel and Dennis Flanagan retired from their posts as publisher and editor, respectively, in 1986. Bought by German publishing group Verlagsgruppe Georg von Holtzbrinck, the magazine became part of a larger conglomerate not seriously devoted to scientific concerns. It might not occur to science fans, however, to read about the publisher of their favorite science magazine, to consider how the people pulling the strings can influence the credibility, validity, or legitimacy of the information contained within the glossy packaging. Gerard Piel was credited with reviving *Scientific American*, as the magazine's circulation reached one million during his time as publisher (Saxon). But the competition with other popular magazines and loss of advertisers likely contributed to a decrease in circulation and sales (which happened to many science magazines in the late-80s) (Lewenstein 37). The change in management to von Holtzbrinck came at a time when *Scientific American* was facing financial difficulties ("Company History"). And it was after the change in management that *Scientific American* gradually changed its approach to communicating scientific information, striving to reach a broader audience (Lewenstein 37).

A change in audience necessarily means a change in the genre of the articles within the magazine, as Jeanne Fahnestock explains in "Accommodating Science" (1986); scientific reports that are accommodated for non-expert audiences undergo a shift in rhetorical genre from forensic to epideictic, from focusing on validating observations to focusing on celebrating scientific discoveries (278-9). Unhedged claims can be made in accommodations where the goal is to make science relevant

and noteworthy to audiences with different values and concerns; in research reports, however, high level claims are rarer because arguments must conform to standards already set in place and monitored by a system of peer review (see e.g., Fahnestock, 1986; Gross, 2001; Baigrie). The genre change of the articles in *Scientific American* over the years is quite apparent; readers have noted that, while articles in the 1970s and 1980s were written in a scientific style that was often challenging to work through, “something happened” in the 1990s (see e.g., Moran; Bernstein). The “something” pertains a variety of factors including the quality and style of writing and the articles’ decreased depth and scope (Moran; Bernstein), but the changes are also manifest on the covers of *Scientific American*, indicating that visuals also change genre when a change in audience occurs.

The nature of these visual changes can shed light on the arrangement and style of images deemed most effective at reaching and captivating a broad audience, and thus have implications for the enterprise of science communication. Because of its drastic change in genre and target audience over the years, *Scientific American* provides a perfect example of the shifts in visual style that are incurred when the goal is to reach a broad, non-expert audience.

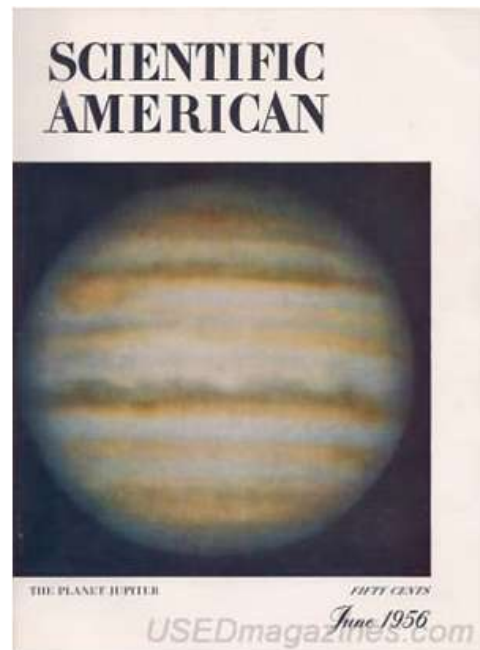


Figure 1: *Scientific American*, June 1956.

An archive of the magazine's covers from 1950 to the present can be found on the website "backissues.com," making it easy to see the cover design transformation. Once known for its austere design, characterized by a single image framed by a white boarder and very few (if any) cover lines listed under the title (see e.g., fig. 1), the visual design of *Scientific American* covers changed dramatically between 1987 and 2000. Journals aimed at audiences of scientists (like *JAMA* and *Science*) and early *Scientific American* covers seem to set an aesthetic standard elevating the scientific enterprise.

But by 1999, *Scientific American* featured bold, flashy cover lines sprayed across the page and vibrant, visually jarring images—a trend that would continue into the new millennium. Now, in 2011, *Scientific American* covers seem to be

undergoing another transformation, reverting back to a simpler style. The design change is very likely a result of the change in management that occurred in 2009, when Nature Publishing Group (NPG) bought *Scientific American* from Verlagsgruppe Georg von Holtzbrinck as a part of their new consumer media division, aiming at public outreach. Removed from the hands of the non-scientifically-oriented German

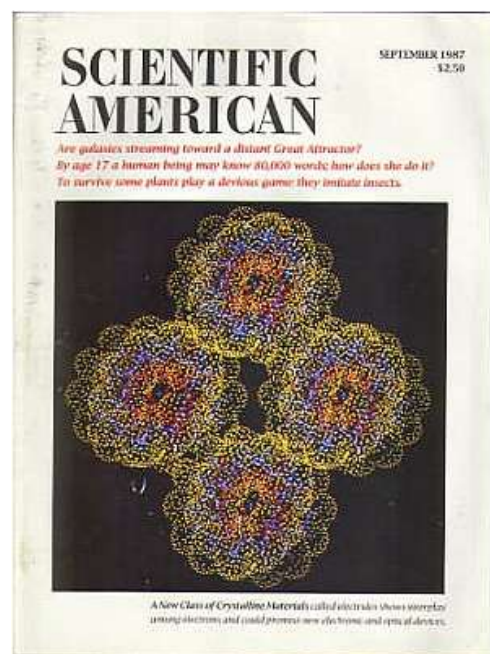


Figure 2: *Scientific American*, Sept. 1987.

publishing group and placed in the care of a long-standing and well-respected scientific organization, I suspect that *Scientific American* might once again change its

approach to communicating scientific information, especially if the covers have anything to say about it. In this section I will tell the story of how *Scientific American* covers transformed from 1987 to the present to demonstrate that cover design can indeed speak volumes about intended audience and communicative approach.

An invitation from Piel and Flanagan to write an article for *Scientific American* was considered an honor, and a great opportunity for scientists to earn a wide readership for their discoveries (Bernstein 55). But in the late 1980s, after the magazine was sold to Verlagsgruppe Georg von Holtzbrinck, it faced financial difficulties and began targeting a wider audience (Lewenstein 37).<sup>133</sup> In September 1987, *Scientific American* broke an over thirty-year trend of only featuring a single, very brief cover line and began including cover lines underneath the title in addition to the description of the illustration at the bottom-right (see e.g., fig. 2). This format would be retained through most of the 90s with the exception of “special issues” and “special reports,” occurring one or two months out of the year, which contrast sharply with the typical template of an illustration framed by a white border.

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<sup>133</sup> According to Lewenstein, Piel and Flanagan’s retirement prompted the media to focus on potential problems of the magazine-in-transition, and the negative attention led to advertisers not wanting to commit to the magazine that had fallen out of favor (37). *Scientific American* was not the only magazine to fall prey to negative media attention and lack of advertising support—*Discover*, *Science Digest*, the *Science 80s* series were all affected by similar problems to the extent that the latter two went under in the mid-eighties (Lewenstein 38).

These few special issues arguably presage what has become the standard design of the magazine, ostensibly testing the waters of a bolder approach; these issues are characterized by several bold cover lines and an image unframed by a white border. Figures 3 and 4 are typical examples of special issues, appearing in September 1992 and 1993, respectively. The main cover lines are in a font much larger than the cover lines on issues following the “normal” template at the time, like Figure 2, and a list of secondary cover lines runs down the left side of the covers, incorporating “buzzwords,” words that demand attention because of their cultural,



Figure 3: *Scientific American*, Sept. 1992



Figure 4: *Scientific American*, September 1993

political, temporal significance. But again, these issues represent design anomalies at this point—in October and November and so forth of these years, up until 1996, the other covers still feature and illustration framed by a white border with cover lines clustered top-left and bottom-right in small font. Between 1996 and 1999, several



changes occur in the cover design, as it becomes more and more comparable to popular science magazines.

In April 1996, the magazine changed its face once again to include even more cover lines (fig. 5); this time, the cover lines form a cluster at the top-right, across from the title, and there is a new, different-colored band across the top, featuring more cover lines. In 1998, the cover lines become larger and wordier, as in the

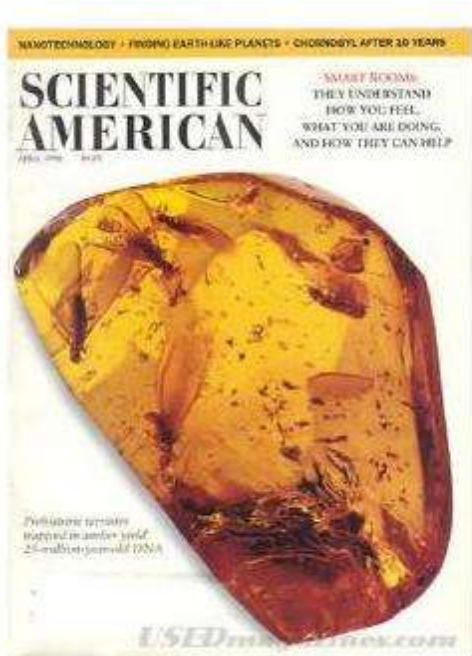


Figure 5: Scientific American, April 1996

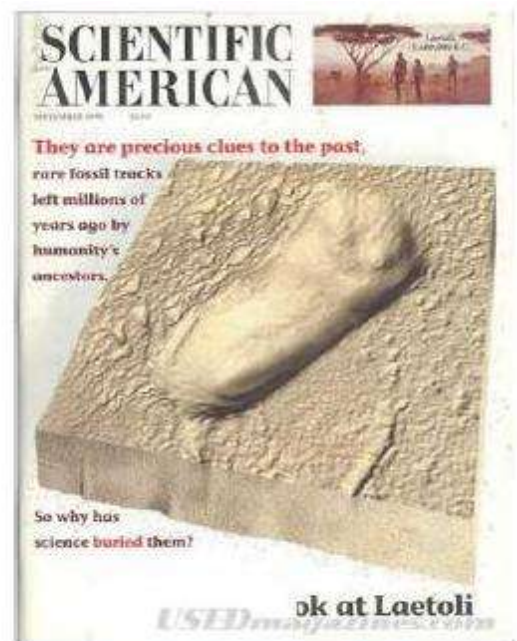


Figure 6: Scientific American, Sept. 1998

September issue (fig. 6), which has complete sentences for its cover lines, and the cover lines become riddled with buzzwords, as in the November issue (fig. 7): “Hell from the heavens” and “mysterious meteor” smack of science fiction, not science news. But it was in 1999 that *Scientific American* changed its face most drastically, permanently breaking from the tradition of the white border so that the title becomes a part of the image, sometimes even covered by it, as in the May 1999 issue (fig. 8) where a tidal wave obscures the second half of the title. This obfuscation almost seems disrespectful, as if someone has hijacked the

magazine’s editorial board and defaced the cover, given the previous tradition of keeping the title in a separate “region” from the cover illustration. The cover lines are no longer small and clustered together at the top—they are very large, bold, and generally run down the entire left side of the page. Cover lines are overrun by



Figure 7: *Scientific American*, Nov. 1998



Figure 8: *Scientific American*, May 1999

buzzwords and slang terminology, as in, “Predicting Destruction by Monster Waves” and “Prehistoric Killer Kangaroos.” Contrast that with the earlier tradition of a single cover line or word, barely describing the image, or even the cluster of cover lines in small italics at the top, not attracting a great deal of attention. The new style is magazine-stand-ready. The cover lines can be seen from far away, they are borderline-science-fiction, and the images are flashy, vibrant, and practically jump off the page.

Recalling once again the simple poster covers of *Science* and *JAMA*, it is readily apparent that covers that are less cluttered look more sophisticated. The aesthetic standard created by these magazines, which treat the single image as a work

of art framed by the rest of the cover, elevates Science. This aesthetic norm is lost with an increase in cover lines, which results in a cluttered and less sophisticated look, as Johnson and Prijatel note in their discussion of different cover styles (284-7). However, they also note that issues with several cover lines sell better than issues with just one (287). Thus, the increase in cover lines likely correlates to increased motivation to sell more magazines. Selling more magazines necessarily entails casting a broader net, marketing to a wider (read: non-expert) audience. If a cover is to be an effective portal for non-experts, then perhaps a more cluttered cover is necessary.

In this connection, in a 2007 press release, *Scientific American's* then-new president, Brian Napack, articulated what he intended the covers to convey visually: to bring the magazine “out of the ivory tower,” to meet the increasing demands of the digital age, and to effectively reach target audiences by redesigning the magazine (Valencia). A quick glance at the magazine’s archives shows a continuation of the trend begun in 1999 with buzzwords galore and giant cover lines that have migrated across the covers’ surfaces. But after years of stylistic changes, in 2007 *Scientific American's* circulation still trailed behind its competitors’, *Discover*, *Popular Science*, and *Wired* (Valencia).<sup>134</sup>

Noticeable changes in cover style occurred in 2009 after the magazine changed hands from Verlagsgruppe Georg von Holtzbrinck to Nature Publishing Group (NPG). While the images remained bold and flashy, the number of cover lines was significantly reduced from the previous decade. A decrease in cover lines

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<sup>134</sup> In 2007, *Scientific American's* circulation was 550,000 to *Discover's* 711,000, *Popular Science's* 1.3 million, and *Wired's* 656,000 (see Valencia).

indicates a move towards a more sophisticated design, less cluttered, perhaps less geared towards selling science like a product, and more focused on representing or celebrating science. In 2011, the covers feature even fewer cover lines, the header

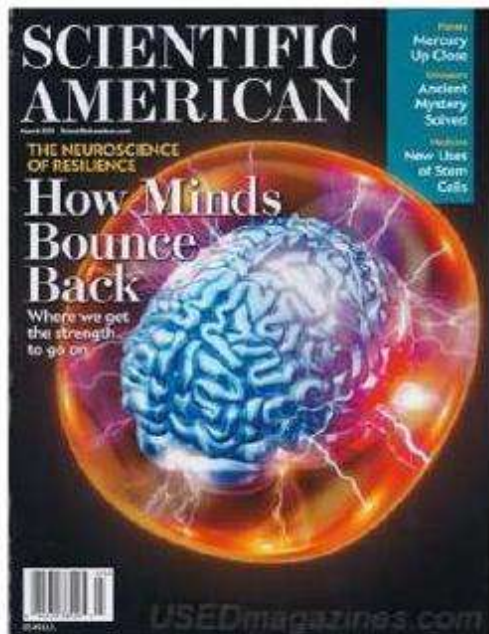


Figure 9: *Scientific American*, March 2011



Figure 10: *Scientific American*, April 2011

has disappeared, and there is now a drop-down banner in the top-right, keeping the cover lines not pertaining to the main image corralled together instead of sprayed across the page (see e.g., figs. 9 and 10). This new, simpler style is essentially an updated version of the pre-1996 covers with cover lines that were contained and less-visually demanding. It is unsurprising that Nature Publishing Group would decide to remodel the magazine's exterior to look less like a magazine owned by a non-scientific organization (like *Discover* or *Science Illustrated*, owned by *Time* and Bonnier Corporation, respectively) and more like, well, *Nature* and NPG's long list of other scientific magazines. As for the magazine's current circulation, according to the statistics posted on *Scientific American's* website, it is "read in print by 3.5

million worldwide consumers,” and “on average, 3.88 million unique users visit ScientificAmerican.com every month” (“About Scientific”).

While “selling” science is still very much a reality for a magazine intended for a broad audience, the visual changes on the covers of *Scientific American* indicate that the strategies employed towards this end vary, and they are more tactfully executed by NPG than the non-scientific publisher, Verlagsgruppe Georg von Holtzbrinck. A 2009 press release from NPG regarding the merger states that “The two iconic brands of *Nature* and *Scientific American* will position NPG to be the most authoritative and comprehensive science media group, spanning from consumer to scholar, from high school student to researcher”(Baynes). According to the press release, the merger is also expected to create more marketing opportunities for advertising and develop a more effective online presence. In theory, the merger is promising—a well-respected scientific organization is taking initiative in the realm of public outreach. However, one particular past instantiation of the same theory was not successful—in the 1980s the American Association for the Advancement of Science (AAAS) tried publishing the *Science 80s* series, an accommodation of its main publication, *Science*. The AAAS ended up selling the magazine to *Time* in 1986, right before the magazine folded, prompting *Science* 86 staff writer William Allman to charge that “scientists have declared that they don’t want to be a part of” the task of informing the public about science” (Lewenstein 38). Granted, it will take more time to realize whether or not NPG’s influence will succeed at reaching their target audience (their current circulation statistics suggest that they will). And it remains to be seen whether or not its stylistic changes will be appealing to a broad

public audience, or if such an audience requires more cover lines and flashiness to subscribe to “science.” The covers would have to be monitored over the course of the next few years to determine what tactics ostensibly work and what ones are less effective at capturing the attention of a broad audience.

### ***Science Illustrated***

The case of *Scientific American* is unique in its profound change of genre and target audience. I will now analyze the cover design of a magazine that was always intended for a broad readership to show that its visual rhetoric aligns with that of *Scientific American* under Verlagsgruppe Georg von Holtzbrinck. *Science Illustrated* was launched in the U.S. in 2008 by Bonnier Corporation, adding to their long list of magazine publications, which includes *Sport Fishing*, *Parenting*, *Skiing*, *Destination Weddings & Honeymoons*, and *Working Mother*, just to name a handful (“Bonnier”).<sup>135</sup> Suffice it to say that the corporation is not invested in science alone. And the extent to which it is actually invested in science or public outreach, compared to its obvious investment in magazine sales, is difficult to determine. *Science Illustrated* has changed its cover layout slightly since it was launched, but for the past year, the covers have followed a very similar layout pattern. These recent covers feature multiple images and cover lines to appeal to their intended readership, and each cover line is followed by a page number to directly refer readers to an article inside. In this section, I will put the magazine’s mission statement into conversation

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<sup>135</sup> According to the Bonnier Corporation website, “*Illustreret Videnskab* (Danish for “Science Illustrated”) is the highest-circulation magazine in Scandinavia and the flagship of Bonnier’s European portfolio.”

with readers' reviews to highlight editorial successes in general; then I will make editorial choices more transparent, specifically for the covers, by rhetorically analyzing a recent cover illustration that is representative of *Science Illustrated's* most recent design template.

As mentioned in the section on *Scientific American*, peer-reviewed journals like *Science* and *JAMA* have a secure readership of experts. By contrast, *Science Illustrated* does not contain peer-reviewed articles and does not have a guaranteed readership. *Science* and *JAMA* might advertise science and medicine in a certain way, but *Science Illustrated* actually has to advertise itself at the same time that it advertises science—it has to convince potential readers who have no loyalty to the magazine or inherent interest in its contents to pay attention, else magazine sales plummet. Thus, the editors of this magazine likely rely heavily on their cover designs to gain a committed audience, and ultimately to gain financially.

To find out more about the purpose and goals of the magazine, a good place to begin is with the *Science Illustrated* mission statement, stated by the magazine's editor in chief, Mark Jannot:

Launched in 2008, *Science Illustrated* is the magazine for intellectually curious men and women with a passion for science and discovery. In this age of accelerating change and discovery, to understand science is to understand the world. *Science Illustrated* delivers that understanding—delivers the world—to the entire family (Jannot).

If a single popular science magazine promises to “deliver the world” to an all-inclusive audience, the motivation is clearly sales—not dissemination of information. Jannot's promise to deliver the world to the whole family is not the only promise that *Science Illustrated* is expected to fulfill; Bonnier's website promises “to report on the



world of science in a way that's dynamic, engaging and accessible for all"; and the *Science Illustrated* "Subscribe" webpage promises to "make the world of science come alive like never before" thanks to "bold graphics, colorful photography, and fascinating stories."<sup>136</sup> One method that can be used to get a sense of whether these promises are fulfilled is by looking at readers' reviews of the magazine, and another is by finding the magazine's circulation statistics. Regarding its circulation (not published on the *Science Illustrated* website), information can be found on the "Pop Sci Media Group" website, which claims that the magazine has a total audience of 640,000.<sup>137</sup> However, the Pop Sci website also reveals that they estimate that there are five readers *per copy*. Circulation, which is the average number of copies, multiplied by readers-per-copy, equals the audience (which makes the circulation of *Science Illustrated* low in comparison to *Scientific American* and its competitors, listed above).<sup>138</sup>

As for reader reviews, Amazon.com provides a customer review section that has developed a reputation for featuring reliable, genuine feedback on its products, and several *Science Illustrated* subscribers have posted their accolades on this site. The titles to these posts alone are enough to attest to customers' complete satisfaction with *Science Illustrated*; here are some examples: "My new favorite mag," "Great for the science classroom," "Great science mag for the everyman," and "A beautifully

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<sup>136</sup> See Jannot, "Science Illustrated," and "Subscribe," respectively.

<sup>137</sup> "Pop Sci Media Group" defines itself as "an integrated media platform that provides connection points to consumers through print, online, and broadcast media." According to this source, *Science Illustrated* has 32% of its rate base through paid newsstand circulation, and it also does email marketing and consumer events ("Pop Sci").

<sup>138</sup> For information about magazine circulation, see e.g. "Understanding Magazine Circulation."



illustrated science magazine.”<sup>139</sup> The reviews are not only positive but very specific about the magazine’s positive features, which do indeed correspond to Bonnier’s promises. Granted, it is difficult to prove that readers’ comments on Amazon.com are genuine; certainly Bonnier Corporation could hire people to post positive reviews, purposefully misspelling words and making grammatical errors to create some semblance of genuineness. Some of the reviews are reproduced below (emphasis mine throughout):

*With great illustrations and down-to-earth [explanations] of concepts and theories, this magazine is great for those interested in science, nature and technology as much as people who work in those fields (April 24, 2009).*

This magazine is beautiful. Beautiful photographs, illustrations, and the articles are interesting and *pleasurable to read* (August 28, 2009).

The articles were *clearly written and informative without "technical babble"*. The magazine was also well illustrated and I believe that it *could be enjoyed by almost anybody* (November 24, 2009).

I like this magazine simply because it presents the information in a different way than the other magazines. Here I get to see the *detailed photos and presentations that make the subject of science more enjoyable* (November 9, 2010).

Wonderful publication. *Lots of information and [its] presented in a way that captures ones attention*. Gorgeous photos throughout. Not overly technical and fun to read (January 15, 2011).

According to these readers’ reviews, the magazine is a pleasure to read: the images are “beautiful” and the articles capture their attention. It must be said that the reviews on Amazon alone are not enough to attest to the effectiveness of a magazine at appealing to non-expert audiences, but these positive responses to a scientific

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<sup>139</sup> See “Science Illustrated” for Amazon.com review posting dates and information.

publication are certainly not to be overlooked.<sup>140</sup> Not to mention that the reviews could serve as advertisements for science in and of themselves and would be a dream-come-true for organizations like the National Science Foundation, which invests huge sums of money in attempts at public outreach every year.<sup>141</sup>

Although Bonnier Corporation has a wide range of publications and is ostensibly not concerned with public outreach—certainly not to the extent that a scientific organization would be—from the markedly positive customer reviews, it appears as though *Science Illustrated* is appreciated by some members of its intended audience. It is worth looking into the magazine’s strategies for reaching out to a broad nonscientist audience, including classrooms as the reviews suggest, with their cover design. Later, I discuss the lack of substance behind the colorful façade, but for the time being, it is worth focusing on the potentially effective visual strategies. Organizations interested in reaching out to broad audiences through visual means, like the NSF, might still benefit by taking stock of these techniques. The magazine’s cover is where the persuasive process begins. Amazon.com reviewers have expressed appreciation for the *Science Illustrated* covers and the ability of the articles to “live up to the cover” (“Science Illustrated”). *Science Illustrated* covers do indeed preview and correspond to further information within. Although the vibrant images would seem to take all of the credit for the success, a significant part of their success comes from the cover lines, which I will now analyze in conjunction with the images.

Figure 11 is very typical of recent *Science Illustrated* covers in terms of its compositional layout. Obviously cover lines and images change from issue to issue,

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<sup>140</sup> I intend to find more websites with consumer reviews.

<sup>141</sup> For example, the NSF started an International Science and Engineering Visualization Challenge in 2003 based on the contention that images are a means of connecting with nonscientist publics.

but the template has remained the same for the most part over the past couple of years. Even though at first glance the elements on this cover seem randomly sprayed across the composition, from a design perspective, the arrangement of elements is very deliberate and it serves a persuasive purpose. It is difficult to determine a focal point on this cover—a place in the visual composition where the eye is drawn to first—because of the sheer overload of visual stimuli. It is possible that the bright yellow spot just off-center in the main illustration, radiating up into the title, is the focal point. But there is not much time to reflect, as one’s gaze is compelled to zigzag across the composition to take in all of the other images and cover lines. When touring the cover, there are many possible paths that a viewer’s gaze could take.



Figure 11: *Science Illustrated*, Nov/Dec 2010

But the viewer’s unique perspective is only a part of the meaning-making process, and it is important to recognize that the arrangement of elements in the composition is very deliberate on the part of the editors, who hope to convey meaning with their design choices. Dondis provides insight into the process of visually communicating a message in her *Primer of Visual Literacy*, stating at the outset that “A message is composed with purpose [...] In pursuit of any purpose, choices are made, choices meant to reinforce and strengthen expressive intentions for maximum

control of response” (104). Dondis certainly channels insights from the rhetorical tradition for her critical approach, and a case in point is when she states, “Form is affected by content; content is affected by form” (104). With that in mind, we can embark on a tour of the *Science Illustrated* cover to find the persuasive strategies at work in the content and form.

After fixating on the focal point (the bright yellow spot), viewers would most likely take in the whole apocalyptic scene; the image is anchored by the main cover line, typically much larger and bolder than all of the others: “Earth on Fire.” Supplementing the main cover line is a smaller cover line to further explain the subject, but reading this might be delayed until after the other images and cover lines are attended to, as they are larger and demand more attention. The next obvious cover element, opposite the main cover line, is a bolded diamond-shaped frame containing another cover illustration of an elaborate Egyptian sarcophagus; the corresponding cover line confirms that it is King Tut, and the lines underneath, even tinier than the others, may again be delayed until other larger elements are attended to. Pulling the eyes downward diagonally are the other major cover lines, because they are the same color as the caption “King Tut”; the eyes are then drawn across the bottom of the cover to yet another illustration in a framed rectangle but bleeding out into the main illustration. Once the gaze has made its rounds, so to speak, the finer details can be focused on, such as the secondary cover lines and the smaller elements of the illustrations. Readers can also note page numbers for all of the cover stories that caught their attention. As if that was not enough, still to mention are the circular stamp near the magazine title referring to dinosaurs and the double-colored band

across the top of the cover with two more cover lines in bold, not corresponding to any cover images. Bombarded by so many cover elements, potential readers could not possibly avert their gaze before taking in at least some of the more prominent stimuli.

According to magazine editors Johnson and Prijatel, issues with several cover lines sell better than those with just one (287); they do not spend time speculating as to why that is, but advertising theorists shed light on this subject. In the advertising field, McQuarrie and Mick (1999; 2003) have published extensively on the rhetoric of ads in an effort to determine what rhetorical strategies lead to the most “elaboration” on the part of the viewer. Elaboration refers to the cognitive processes that viewers undergo when taking in visual stimuli; McQuarrie and Mick suggest that certain rhetorical strategies encourage viewers to elaborate more (for instance if information is left out, or information is conveyed in an unusual way), and elaboration leads to viewer participation in making meaning. The significance of this enthymematic process, they argue, is that “Such participation can be powerfully persuasive, as the research on omitted conclusions and self-generated inferences attests” (2003; 207). In short, inviting more elaboration can encourage interest and potentially more sales. The surplus of text and images on *Science Illustrated* covers seem to be a ploy to get viewers to elaborate, or spend more time processing everything that they see.

All of that said, the sheer number of cover lines and images represents one tactic used by the editors to capture readers’ attention and persuade them to continue reading. The arrangement of elements, which I have already begun to discuss, is another means of controlling audience participation, just as in oral or written

discourse. As already indicated by the cover “tour,” the features that guide the viewer’s gaze are color, size, and placement of elements. These features are coordinated in such a way as to create an invisible network of lines and shapes, like a blueprint, that form the underlying structure of the composition and yield a cohesive, unified visual message. For further explanation of this notion of an invisible structure, we can turn again to Dondis, who begins with the smallest, most basic visual element, the dot, and works through more complex elements such as line, shape, direction, and ultimately, movement (15). Relying on tenets of Gestalt psychology, Dondis explains that “Complexity, instability, irregularity increase visual stress and consequently attract the eye” (31). The visual elements can be deployed in a way to create this visual stress and thus affect viewers more profoundly.

One way of generating stress is to create diagonal lines either with or between visual elements in a composition; the diagonal is “the most provoking visual formulation” because it throws off our inherent sense of balance and equilibrium (Dondis 46). In the *Science Illustrated* cover, the invisible diagonal line is featured prominently. The focal point of the main image (the yellow burst of light) is the same color yellow as the cover lines that are sporadically placed around the perimeter of the cover, and the eye is drawn by imaginary diagonal vectors connecting these matching yellow elements. In the same way, the orange-pink frame around King Tut “rhymes” with the cover lines diagonally above and below it, and the diagonal lines create a triangle around the focal point. Of all the basic shapes, the triangle is the one that creates the most action and tension in a composition (44). The viewer’s gaze zigzags around the composition according to this invisible structure, but the dynamic

composition is unified by other design elements, such as the color coordination. In *Advertising Principles and Practice*, it is stated that a layout that takes the viewing process in multiple directions “works for young people” more than it does for older generations.<sup>142</sup> The tension created by stressed, dynamic elements within the composition, stabilized by a unifying color palette, is ostensibly appealing to younger audiences.

A visual composition that contains multiple communicative nodes must have both structure and “stress” to be persuasive. I will now explore the persuasiveness of these communicative nodes—both the images and the cover lines—by considering their stylistic qualities. Manipulating color saturation is just one variable, and mass publications use intensely saturated colors, which affect the modality or “realness” of the composition. Kress and van Leeuwen define modality as a socially determined construct referring to the truth value or credibility of statements—verbal, textual, or visual (160). In general, photorealism is the standard for assessing the level of realism a visual composition achieves, and therefore it has the highest modality. However, different genres of visual composition adhere to different “coding orientations” for modality. For instance, scientific visualizations are often stripped of any unnecessary detail and are unrealistic by the standards of photorealism, but these austere images are considered more “real” by scientific criteria. Kress and van Leeuwen explain that they are viewed through a technological coding orientation (170). In a technological coding orientation, images with full color saturation tend to have the lowest modality, whereas in sensory coding orientations, full color saturation conveys higher modality (170). Food advertisements are an example of when sensory

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<sup>142</sup> According to the Pop Sci Media website, the average age of a *Science Illustrated* reader is 39.

coding orientations come into play—we expect supersaturated images of food that we can practically taste off the page, and color is a source of pleasure in this case. I would argue that, despite the “science” in the title, the illustrations on and in *Science Illustrated* are also intended to be viewed through a sensory coding orientation, not a technological coding orientation. These vibrant, hyper-real illustrations convey high modality in their appropriate context, even though they would not have high modality by the standards of photorealism, and they would have the lowest possible modality by scientific standards. Clearly, the hyper-real cover illustrations are successful as scientific advertisements, and that is, after all, what they are.

In addition to the style of the cover images, the style of the cover lines must be taken into consideration as an important part of the overall visual message. The rhetorical strategies employed in the cover lines can provide insight into what persuades a nonscientist audience to become interested in scientific information. Cover lines can “hook” readers and entice them to read the magazine, so *Science Illustrated* cover lines entice readers to learn about science. Johnson and Prijatel claim that “Research has shown that a reader will buy a magazine for a single cover line” (285). So, in the off-chance that the flashy cover illustration fails to pick up readers, there is still hope thanks to the cover lines. The most popular persuasive strategies for cover lines that Johnson and Prijatel discuss are using buzzwords, using numbers (especially odd numbers), and asking questions (285-6). *Science Illustrated* editors use all of these strategies on all of their covers, and we can look again at Figure 11 to see the strategies at work. Buzzwords on this cover include *stem-cell*, *cancer*, *superorganism*, and *climate change*. It is noteworthy that these buzzwords



are located around the perimeter and are peripheral to the main illustration—they truly are intended to catch readers who are about to fall off the *Science Illustrated* bandwagon. Next, there is a random odd number: “93 Amazing Images Inside!” over the image of King Tut. Finally, there are two questions: “Climate change and wildfires may be fueling each other. Can we break the cycle?” and “How many dinosaurs were there? Details on p. 28.”

Within the rhetorical scope of this project, I have evaluated a *Science Illustrated* cover from a variety of angles, including visual design, advertising, and journalism theory. By the standards of these various fields, *Science Illustrated* puts forth effective, persuasive cover illustrations. However, *Science Illustrated* may feature covers that visually appeal to broad audiences, but Bonnier Corporation is not necessarily invested in providing the most accurate, up-to-date scientific news and research for when viewers move beyond the covers.

Although the flashy illustrations correspond to full-length articles (unlike the NSF’s Visualization Challenge covers), when readers open the magazine, they will find that the articles do not cite any sources for their information. There is no way of knowing how dated the information is or how reliable it is because both article writers’ names and references to original research reports are entirely omitted (in every case in the issue that I focused on for the cover analysis above). Curious readers would have to do their own investigation to learn more about the context and credibility of the articles. When they go through the portal, so to speak, in this case, readers would not be assured to find credible information. The question remains, *What constitutes sufficient, reliable information beyond a portal image?*

Given that *Science Illustrated* is able to create the visual conditions necessary for a chance at successful science communication, it would seem as though scientific organizations like the NSF—organizations that devote significant funds to public outreach—might benefit from picking up on some of the visual tactics used by Bonnier Corporation. One way that science organizations could adapt their visual strategies is by investing in the creation of a popular version of *Science*, geared towards non-expert audiences, that makes use of the same style of visual persuasion as *Science Illustrated*.<sup>143</sup> The important difference between Bonnier’s popular science magazine and a popular science magazine created by a scientific organization is that the latter would have the motivation and ability to put substantive scientific research behind the captivating pictures. That is, it could be trusted to offer current information accommodated from peer-reviewed articles, and not just put up a good front.

### ***New Scientist***

The final magazine that I have selected for analysis represents a middle ground between the once well-respected *Scientific American* and *Science Illustrated*, an out-and-out popular magazine aimed at non-specialists. *New Scientist* was one of the few popular science magazines that “successfully tapped into the new environment” of television media by featuring vivid illustrations, according to Peter Bowler (266-268). But the magazine was not only focused on illustrations. *New Scientist’s* mission has remained quite consistent since the magazine was launched in 1956, advertising itself as being the only popular science magazine that shows the

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<sup>143</sup> It should be noted that *Science* did have an accommodated publication in the 1980s, denoted by the year following the title: e.g. *Science85*, *Science86* etc.

social and cultural implications of scientific advancements. Its mission statement claims that the magazine is “for all those men and women who are interested in scientific discovery and in its industrial, commercial and social consequences” (“About”). Moreover, attesting to its reliability, the *New Scientist* website lists several news and media sources that have referenced the magazine as a reliable source of information.<sup>144</sup> So, while the magazine was never a *Scientific American*, its mission has always been to deliver information, not just vibrant visuals, like *Science Illustrated*.

In the study of *Science Illustrated*, I chose to focus on one recent cover illustration that typified *Science Illustrated* covers—a decision made simple by the fact that the magazine is so new (launched in 2008) and is only a bimonthly publication. By contrast, *New Scientist* has a much longer history and is published weekly; to narrow down the sample size, I focus on covers from the turn of the 21<sup>st</sup> century to the present. Judging by the way it describes and styles itself on the *New Scientist* website, the magazine has chosen to distinguish itself from other popular science magazines by highlighting its ability to show its target audience how the latest scientific and technological discoveries affect them personally. Perhaps in part for this reason, *New Scientist* cover illustrations have tended to be anthropocentric, as opposed to featuring scientific or natural phenomena—a scan of the magazine’s archives online validates this claim.<sup>145</sup>

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<sup>144</sup> See “About” *New Scientist*’s website. *New Scientist* is published by Reed Business Information, Ltd., and the magazine claims to have acquired an extensive international readership since it established itself online in 1996.

<sup>145</sup> See “Archives” on *New Scientist*’s website. I focused on covers from the year 2000 to the present.

This study will focus on *New Scientist* covers that feature a particular anthropocentric image: a human head portrayed without a body. Indeed, cover images of autonomous human heads, separate from their bodies, have recurred with alarming frequency on *New Scientist* covers, practically creating an icon for the notion of the Cartesian mind/body split, an idea that I will return to later. Given the magazine’s mission to make science “personal,” and judging by the repetition of the design, *New Scientist* apparently finds this type of image to be effective at capturing the attention of its readership.<sup>146</sup> The visual composition of *New Scientist* covers is generally less crowded than *Science Illustrated* covers, as they feature only one main



Figures 12-15: *New Scientist*, Jan. 29, 2005; Dec. 3, 2005; Aug. 26, 2006; Apr. 7, 2007

illustration and just a few cover lines (not several around the perimeter). I will analyze these cover illustrations in conjunction with the main cover lines that correspond to them in an effort to expose their persuasive qualities.

Close-ups of heads are so pervasive on the covers of *New Scientist* that they may be further classified into subgroups; for example, many of the heads are simplistic cartoon images, whereas others are rather “normal” realistic photographs

<sup>146</sup> Interestingly, *Scientific American* recently began publishing a magazine called *Scientific American Mind*, which also tends to feature bodiless heads on its covers.

(see e.g., figs. 12-15).<sup>147</sup> However, the cover illustrations that are most compelling show heads with photographically realistic human faces, juxtaposed to cranial features that are unquestionably *not* human. The jarring fusion of realistic human features and biologically incompatible nonhuman features provides the most fodder for analysis.

Figure 16, from the January 13<sup>th</sup>, 2001 issue, is one example of a human head blended together with nonhuman features. The main cover line reads: “FAST FORWARD: Why human evolution may be speeding up.” According to this textual anchorage, the illustration is intended to symbolize “evolution.” Arguably, any number of illustrations could have been used to symbolize the concept of evolution, but *New Scientist* chose to use the popular human head approach. And in this case, to convey the implications of evolution, the close-up-head approach is not necessarily effective, as I will attempt to show in the following visual explication.

The woman on the cover seems to be undergoing a physical transformation, and she has a thick seam running down the middle of her face, razor-like spikes protruding from the top of her head, and reptilian skin creeping up around her neck. Parts of her head seem to be eroding in the



Figure 16: *New Scientist*, Jan. 13, 2001

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<sup>147</sup> The covers reproduced here are just a small sample—there have been over 25 covers representing a head without a body since the year 2000.

blue flame that ensconces her, yet her facial expression is not one of terror or pain; instead, she appears tranquil, an expression that does not match the severity of the situation. Also, her eyes are cast upwards, not down to suggest defeat, and not directed at the viewer in what Kress and van Leeuwen would term a “demand gaze”; rather, she is offering herself up to be gazed at by the viewer by averting her eyes (120). By Kress and van Leeuwen’s standards, the viewer is invited to look at the woman morphing into several different creatures without feeling threatened. Viewers might also be familiar with the theme of a human subject morphing into something else (be it animal or machine), as it is certainly ubiquitous in the genre of science fiction. What makes this image unique, however, is that the woman’s head is split into sections resembling different kinds of animals—she is not simply transforming into *another* creature, but several other creatures.

In this sense, she resembles the Chimera from Greek mythology, a creature that possessed physical qualities of a few different animals. The Chimera was supposedly a female monster and was considered an omen of natural disasters. Considering that a *chimeric* image has been chosen by *New Scientist* to symbolize evolution, an interesting subtext can be appended to the message transmitted in the cover line, whether or not this choice was intentional: not only is human evolution speeding up, but it is heading for disaster. Or, taken from a definitional standpoint, today the word chimera refers to something that is fantastical or imaginary. From this perspective, a possible underlying message might be that evolution is a fantastical or imaginary concept, a message that would support religious arguments that evolution does not exist. Either way, the choice to include a chimeric, fantastical image to

symbolize the concept of evolution might actually be subversive to the scientific perspective on the subject of evolution.

There is yet another dimension to the notion of the chimera, as the word has also been appropriated into biomedical discourse to refer to hybrids of different species; according to medical anthropologist Leslie Sharp, the term *chimerism* was coined “to describe the successful integration of immunologically distinct bodies or their sectioned parts” (92). On the subject of human hybridity, Sharp discusses pigs as the preferred organ donors for human transplants (95-100). Monkeys, dogs, and rodents are also mentioned as being compatible for human transplants. Interestingly, none of these animals is represented in the *New Scientist* cover illustration of the chimeric woman; she clearly exhibits reptilian features, which places the cover illustration outside the bounds of reality. In other words, the image cannot be redeemed by a scientific explanation about human/animal biological compatibilities. It is strictly fantastical and lacking realistic implications. Not to mention, the scientific concept of evolution necessarily involves the body as a whole. For this reason primarily, an image that maps animal body characteristics onto a human head is particularly inappropriate to the subject matter at hand. The use of the close-up-head template is truly inappropriate for this case of symbolizing human evolution. It might succeed on the level of obtaining readers’ attention, but beyond that it seems to be more subversive to the general scientific perspective of evolution than emblematic of it. That *New Scientist* chose to use the head approach regardless of these incompatibilities suggests that the concept of an autonomous human head presents some kind of extrinsic appeal, a point that I will return to later in this chapter.

Figure 17, from the February 12, 2000 issue of *New Scientist*, is another example of a human head fused with nonhuman features, but in this case the fusion is botanical. A woman's profile is presented with white flowers blooming out of her head; the flowers are packed so closely together that at first glance it looks like she is wearing a swimming cap. As with the previous example, the woman's face is fairly realistic, but her head has been infiltrated, in this case by foliage. The cover line reads, "BRAIN GAIN: How to make new nerve cells bloom," which indicates that the flowers are growing out of a human head to symbolize nerve cells "blooming," if that is indeed what they do.



Figure 17: *New Scientist*, Feb. 12, 2000

This cover illustration is an example of a visual metaphor—the image in conjunction with the cover line communicates the metaphor, “nerve cells are flowers.” One important distinguishing feature of metaphors is that they can be extended, which poses potential drawbacks to using them for “scientific” purposes.

In *More than Cool Reason*, linguists George Lakoff and Mark Turner consistently return to the basic metaphor “people are plants” to show how people make sense of the world through metaphors. When applied to image metaphors, “people are plants...maps knowledge and inferences from the domain of plants onto the domain of people” (92). Lakoff and Turner explain that people will often “map”



concepts differently, and they provide an example of a surrealist poem to show that image-mappings will sometimes defy our expectations and force us to see images and concepts from fresh perspectives (92-3). The *New Scientist* cover illustration actually provides the image (as opposed to a poem), which constrains readers' image-mappings but leaves open a wealth of possibilities for mapping *concepts* from the domain of people onto the domain of plants.

The metaphor communicated by the magazine cover—"nerve cells are flowers"—is complex because it is operating on two very different planes of perception: the visible and the invisible. While nerve cells are invisible to the naked eye, flowers are visible. In *Magazine Covers*, Crowley and Beazley shed some light on *New Scientist's* decision, writing that, "Paradoxically, the challenge of representing the abstract and often invisible world of cutting-edge science or the glamourless world of industry has encouraged great cover art" (8). For Crowley and Beazley, "great cover art" may be defined as art that successfully "connect[s] with our values, dreams, and needs" (7). That *New Scientist* chose this visual metaphor for its cover instead of, for instance, an image of a nerve cell magnified and aestheticized, suggests that the element of the human head adds something to the visual appeal. In particular, this cover illustration prompts readers to associate nerve cells with flowers in an effort to foster their understanding of an invisible scientific phenomenon.

As already suggested, however, the metaphor is potentially detrimental to scientific studies because it opens up conceptual domains to interpretation and expansion. Lakoff and Turner point out that readers will inevitably provide several

different interpretations and extensions of the same metaphor. To illustrate, *New Scientist's* cover illustration prompts readers to map qualities of flowers—something they are familiar with—onto nerve cells, which are less familiar because they are invisible to the naked eye and not encountered in daily life. To begin extending concepts from the domain of flowers onto the domain of nerve cells, one could begin by saying, for instance, that flowers are planted as seeds; likewise, one might extend the metaphor to nerve cells to say that they could be “planted” in our brains for intellectual purposes, as suggested by the cover line, “brain gain.” Furthermore, one could say that flowers only sprout and bloom out of the ground when certain conditions are met (when they are watered and receive sunlight etc.); likewise, one might extend the metaphor to nerve cells to say that they require external stimuli to “bloom” and realize their full potential. The point is that the visual metaphor chosen for the cover might prompt elaborations and facilitate comparisons that are not factual or productive to an understanding of nerve cells. Still and all, the strange fusion of a human head with plants might create enough interest in the subject to entice viewers to read on and have any potential misconceptions corrected. At least the depiction of nerve cells with flowers might imply that something positive rather than something sinister or mysterious is happening, as with the chimera.

For the two examples elaborated on here, it seems as though the close-up of a human head was a strange choice for the content or message put forth by the cover lines. *New Scientist* editors could have selected any number of cover illustrations to symbolize evolution and neurobiology, but instead, they chose the head template, even though it is probably not the most appropriate design for the covers' messages.

What is the appeal of the close-up of a human head that it has been recycled time and time again to represent such disparate themes and concepts?

Earlier I mentioned that the autonomous head is seemingly an icon for Cartesian dualism. In his “Meditations on First Philosophy,” Descartes describes what has come to be known as the “mind/body split” as follows: “I possess a distinct idea of body, [and] in as far as it is only an extended and unthinking thing, it is certain that I, that is, my mind, by which I am what I am, is entirely and truly distinct from my body, and may exist without it” (9). The *New Scientist* cover template explored in this chapter seemingly valorizes the mind as distinct from the body as in the Cartesian tradition. These values might participate in the appeal of an autonomous human head.

Another possibility for its appeal is the fact that we know so little about how the mind works; perhaps featuring a head without a body on the cover visually promises some insight into the mystery of the human brain. A pictorial representation of the individual mind isolated from human corporeality and social interaction must be very compelling to be applicable to such a variety of subjects as evolution, multitasking, the five senses, and addiction (see figs. 12-17). The bodiless head is essentially used as a framing device for all of these themes, corresponding to *New Scientist*'s mission to show how scientific discoveries affect their readers personally.

Yet another possibility for the appeal of the bodiless head is elucidated by Hariman and Lucaites in their essay “Visual Tropes and Late-Modern Emotion in U.S. Public Culture” (2008). The authors propose four visual tropes—form, figure,

sign, and face—that can then be modified or visually inflected.<sup>148</sup> So, for example, the trope of the face might begin as a blank face mask and then progress through expressive deviations (e.g., a person grimacing) until it finally reaches what the authors call a “late-modern” instantiation in which the face is mediated by technology. A mechanized, mediated face, according to Hariman and Lucaites, represents a part of a larger socioeconomic machine that manages emotion in relation to public life.<sup>149</sup> The bodiless heads on *New Scientist*, with their mediated faces, could be seen as a product of our culture’s fascination with mechanization’s effects on the human condition. In this case, the effects are mapped directly onto human heads, a pronounced deviation from the baseline trope of the face, which is sure to generate intrigue and appeal to broad audiences.

## Conclusion

Earlier in this chapter I described the genealogy of the “gap” between scientific communities and non-expert publics. Currently, there is a great deal of negativity surrounding the difficult task of public outreach. The latest trend is the notion that scientific research can be “framed,” a topic published on extensively by communication professor Matthew Nisbet, who aims to help scientists more effectively appeal to wider public audiences. In the introductory chapter to this project, I explained Nisbet’s conception of a “miserly” general public, in terms of a lack of interest in learning (1769). But I would argue that younger generations are

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<sup>148</sup> They propose different levels of inflection—by rhetorical figures (e.g. metonymy, metaphor, irony) and by schemes (e.g. color, entrainment, homology).

<sup>149</sup> Their article is primarily about emotion and its associations with the public/private dichotomy. They argue that this larger machine functions “to manage emotional life within a highly complex, catastrophically interdependent society organized around industrial and economic practices of incredible scale” (79).

anything but miserly when it comes to gaining and relaying knowledge, largely due to the forum of the Internet and the vast amount of information that is easily accessible to all. Breaking away from the conception of a miserly audience and lamenting the state of scientific illiteracy,<sup>150</sup> we can focus instead on how to more effectively engage broad audiences through the digital forum.

As a more positive alternative to “framing” scientific discourse with narrative *topoi*, I have argued for using *visuals* as portals *into* scientific discourse. The examples in the chapters thus far have demonstrated the utility of such portals to both gain public interest and deliver relevant information. A portal inherently has more depth than a frame, and it can lead to communicative possibilities.

In the case of popular science magazine covers, there are certain stylistic trends that are presumably repeated because they are successful at selling magazines (and thus capturing the attention of the target audience). Thus, the busy layout of *Science Illustrated* and the iconic heads on *New Scientist* seemingly create the conditions for the possibility of effective science communication. Both the busy layout and the bodiless heads represent nodes of collective social intrigue. For example, the “busy layout” of *Science Illustrated* appeals to viewers by engaging them in a puzzle-solving activity, as the visual network formed by the repetition of color and arrangement of text sends their eyes zigzagging across the visual composition. In a very similar way, frontispieces were packed with visual stimuli that played to viewers’ knowledge of classical symbols and involved them in

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<sup>150</sup> These authors reflect on biologists Haufler and Sundberg’s assertion that 28% of American adults are scientifically illiterate in their introduction to the “Symposium on Scientific Literacy” published in the *American Journal of Botany* (1751). Haufler and Sundberg derived their data from the 2009 Pew Research Center poll.

interpretative activities. And as for the human heads on *New Scientist*, the desire to see science as a human-centered activity shows up in the tradition of scientific portraits, some of which do only show scientists' heads surrounded by scientific paraphernalia. The *New Scientist* heads, however, fuse the fascination with human-centered science with scientific apparatus in surrealistic visual compositions that evoke "what if" questions.

The stylistic conventions of popular science magazine covers could easily be transferred to other media. For example, they could appear on posters, brochures, commercials, blogs, and other social networking sites (see coda). The point is to use the visual as an entry point into scientific discourse, rather than to hide or couch scientific discourse in the rhetoric of social reform, as Nisbet and Scheufele describe in their article on framing science. Really, theirs is not a process of framing but one of disguising scientific information.

In the next chapter, I study an increasingly popular use of visuals by the scientific community to reach non-expert publics. These attempts to use visuals have potential for communicating science to broad audiences, but in the cases I study, scientific communities are not currently using visuals in an effective way. I use the flaws in these approaches to elaborate on the possibilities for using visuals as portals into scientific information and continue the discussion of scientific advertisements.

## Chapter 5: The Merger of Science and Art: Award-Winning Science/Art Images on the Web

Popular science magazine covers are an effective vehicle for communicating scientific information, as I argued in the previous chapter, because they use specific visual techniques to capture the attention of potential readers, persuade them to open the magazine, and thus, persuade them to read about science. Thus magazine covers successfully advertise science to a broad audience—broader now than ever before because their audience is no longer limited to passersby at the newsstand. Magazines have established online versions of their hardcopy publications to augment sales by increasing visibility; now all Internet users have the opportunity to see digitized cover illustrations, which still function as portals into the text. The Internet as a tool for communicating information is characterized by its speed, reach, and interactivity (Gurak 1997; 2008), but although online publication offers companies the potential to recruit a larger readership, it also presents some unique issues regarding the dispersal of scientific images.

One example will illustrate the problems. The characterizations of nanotechnology as mutating robots inside of our bodies, an idea propagated by Eric Drexler,<sup>151</sup> has led to the spread of several images online of tiny robots injecting red blood cells (see e.g., fig 1). These images have spread to other sites to the extent that



Figure 1: “Nanobot”

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<sup>151</sup> See Pitt’s discussion on the topic of metaphors for nanotechnology.

they now stand for nanotechnology on many online sources, such as Discovery Health, Sott.net (“The World for People Who Think”), and Extreme Tech.<sup>152</sup> In all three of these cases, the image of the robot injecting the cell is unexplained, as if it were a literal representation of nanotechnology, and the latter two sources do not even provide a caption for the image (See Miller; Kennedy). The image is stunning because of its bright red coloration, the easily recognizable red blood cells, and the obvious invader: the robot, a visual symbol for intrusive nanotechnology. A visual portrayal of nanotechnology as a robotic invader is even more disconcerting than the textual metaphor, and the vivid image suggests that nanotechnology is unnatural at best and frightening at worst. Yet images like Figure 1 are ubiquitous online and thus accessible to non-expert audiences who could easily gain a negative impression of nanotechnology by seeing the image before they can learn more about the subject.

In this connection, the fact that images can easily be copied from their original location and pasted into an indefinite number of new locations on the Web with a couple of mouse clicks is a particularly pressing issue for science images because they are generally more difficult to explain or contextualize than other types of images, such as product advertisements or company logos. Science images are much more reliant on their original source material for their interpretation because their visual contents are not readily decipherable by non-experts.<sup>153</sup> Esoteric scientific visualizations have been the subject of several studies in the history, philosophy, sociology, and rhetoric of science dedicated to exploring their epistemic weight and

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<sup>152</sup> See Silverman, Miller, and Kennedy, respectively.

<sup>153</sup> For example, Huppau and Weingart’s characterization of scientific images is that they “remain accessible to an expert community only” (6).



indispensability to scientific arguments.<sup>154</sup> Few studies, by contrast, have focused on science images that circulate outside of the scientific community, aimed at non-expert audiences, such as the case of the nanobots.

One important exception, however, is Huppauf and Weingart's *Science Images and Popular Images of the Sciences* (2008), perhaps the most comprehensive anthology on popular science images published to date. Huppauf and Weingart rightly acknowledge a distinction between scientific images that happened to “find their way” into popular media and scientific images that were created specifically for non-expert audiences.<sup>155</sup> This chapter is concerned with the latter type: images deliberately created for non-expert audiences. The rhetorical process of creating images for nonscientists—from the canon of invention all the way through delivery—is vastly different from the process of creating scientific visualizations aimed at the science community. In other words, there are obvious differences in the motives for creation, the way elements are arranged, the stylistic qualities, and the apparatus and venues of production and dissemination.<sup>156</sup> These differences stem from an overarching divergence in purpose, namely functionality versus visual appeal.

Science images aimed at popular audiences gain much of their force by blurring the boundaries between art and science.<sup>157</sup> Attention must be paid to how such images are used because, as Huppauf and Weingart argue, science images that

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<sup>154</sup> See e.g. Baigre; Ellenius; Lynch and Woolgar; Pauwels; Fahnestock; Gross; and Harris.

<sup>155</sup> In a taxonomy of popular science images, Huppauf and Weingart distinguish between “Science images produced in the sciences as visual elements in scientific research and processes and directed at the scientific community (e.g. mechanical illustrations that remain accessible to an expert community only),” and, “Science images produced in the sciences but directed at a broader public (e.g. colored images of the ozone hole prepared for wide distribution)” (6).

<sup>156</sup> For a very thorough exploration of the rhetorical process of scientific visualizations, see Pauwels.

<sup>157</sup> Several studies have focused on the tenuous boundary between art and science. See e.g. Ellenius's and Baigre's collections of essays for historical perspectives. See also books by Kemp, Ford, and Frankel.

circulate in popular media “can have a considerable impact on broader audiences and can be turned into powerful tools of persuasion” (5). There are two reasons for the persuasive power of these images: first, the public constructs its opinions and attitudes towards science in part through the consumption of images (4-5), and second, popular science images have “a high degree of indeterminacy and potentiality [...] that opens a space for playful combinations not dissimilar to pictures in the history of the artistic avant-garde” (16). I agree with Huppau and Weingart’s estimation that science images can be powerfully appealing to nonscientists, and that therefore they can have currency in venues outside of the scientific community. However, I would also argue that their open-endedness and the space they create for imaginative speculation as to their meaning and significance not only stimulates the aesthetic mind but invites misinterpretation if they are not properly contextualized. This chapter further explores the aesthetic appeal of scientific images and the potential consequences of their traveling without context beyond the boundaries of the scientific community, and it concludes with some ideas for improvement.

### **The Merger of Science and Art**

There is a new trend in scientific communities that capitalizes on the notion of images promoting imaginative speculation: the science/art competition. Scientific organizations have actually begun soliciting what I will call *aesthetic* scientific visuals from scientists by sponsoring visualization competitions. The images produced for these competitions are not primarily scientific—although that is not to say that they are not of scientific value. By claiming that they are not primarily

scientific, I mean that the images were never, or are no longer, of use to practitioners, often because they were aesthetically altered. What constitutes an aesthetic alteration? I contend that an *aesthetic alteration* is any purposeful manipulation of a visual that has not been executed to improve its scientific function—that is, the alteration has not been done out of necessity to aid with clarity, to aid with the presentation of a scientific argument, or to argue scientific phenomena into existence. Rather, aestheticized scientific visuals, as the name indicates, are primarily aesthetic objects, but they retain their association to the field of science by virtue of their underlying scientific content, their creators (usually scientists), and the scientific organizations sponsoring their creation. What features make a scientific visual aesthetically pleasing differ depending on the specific case. Generally speaking, an aesthetically pleasing image might feature qualities like those that Huppauf and Weingart describe—a similarity to abstract art and a certain amount of ambiguity, an open-endedness that invites multiple interpretations and imaginative speculation. Other features like relationships among elements in a composition, tension or unity in a design, salient colors, patterns or other features of repetition, and directional lines or vectors that guide the eye through an image may all produce some kind of aesthetic appeal.<sup>158</sup>

In a study of visualization competitions, I will evaluate the treatment of aesthetic scientific visuals by scientific organizations and their treatment in popular venues on the Web after they traveled from their original locations. I am concerned

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<sup>158</sup> Some of these features are taken from Dennis Dake’s “Aesthetics Theory” in *The Handbook of Visual Communication* (2005). Dake outlines six interlocking principles of “visual logic” corresponding to what he sees as universal visual appeals, prior to the subjective interference that is unavoidable when different viewers take in the same image.

with their contextualization in scientific and nonscientific venues and how their contextualization influences the way that these images advertise science to non-expert audiences. This chapter will focus on an aspect of popular science images that has been largely overlooked: that is, their potentially negative consequences. Huppauf and Weingart, and other scholars studying popular science images (e.g., Nikolow and Bluma; Northcut; and Mellor), perceive them positively as “a universalizing mode of social communication aimed at the inclusion of non-experts” (Huppauf and Weingart 19). Their theory of inclusion might well be accurate, and my aim is not to refute the positive consequences of popular science images. The negative consequences, however, also merit critical attention. A thorough understanding of the negative consequences can ultimately lead to the development of more effective scientific advertisements on the Web.

The competitions selected for this study have been created or endorsed by scientific organizations specifically for the purpose of appealing to broad, non-expert audiences, and the aestheticized scientific visuals produced from them have traveled on the web to other venues of publication, especially blogs. The following section provides an overview of the evolution of blogging and its potential to rival mainstream news media as far as credibility and coverage are concerned. Scientific images that spread into the blogosphere are likely to receive a wide viewing, which presents a valuable opportunity to raise public awareness about scientific issues. Following Huppauf and Weingart’s argument, science images participate in shaping public attitudes towards science. Whenever possible, I take into account viewers’ posts on blogs and articles throughout to provide insight into the types of responses

scientific visuals receive from non-experts. Furthermore, I will highlight the purported missions of three visualization competitions, the ways that they describe and contextualize their award-winning images, and the paths that the images took on the Web to different news media sources and blogs, often losing contextualization along the way. To trace the paths of images to other venues, I conducted searches through Google using artists' names and titles of their works, and I followed all of the "hits" to determine how the images were (re)contextualized. In most cases, as mentioned above, the images traveled to online news sources or blogs of varying professionalism and reach.

The first case overlaps with the discussion in Chapter 4—a case in which magazine cover illustrations traveled on the Internet due to their aesthetic appeal. These cover illustrations were award-winning images in the International Science and Engineering Visualization Challenge, sponsored by the AAAS and National Science Foundation (NSF), earning a place on the covers of *Science* magazine after the competition. The next two cases also focus on art/science competitions, but on a smaller scale—those hosted by universities in the US and in Europe and sponsored by scientific organizations. Regardless of the varying reach of the different competitions and images, and regardless of the varying degrees of pomp and circumstance attached to these competitions, I will show that the competition websites all share the same disregard for explaining their images. Following the case study, in a coda, I offer some possible solutions to the contextualization problem by looking at positive models of visual science communication. Given the rising popularity of scientific visualization competitions, what constitutes responsible visual communication should

be investigated more thoroughly by science communicators and scholars interested in the visual communication of science to non-expert audiences. Towards that end, by concluding this project with possibilities for effective visual science communication, I demonstrate that aesthetically pleasing scientific images, when contextualized, can serve as effective portals into scientific discourse.

### **Bloggng and Science Communication**

Science images from visualization competitions most frequently travel to blogs. It is worth briefly characterizing the current state of the “blogosphere” because of the niche that it harbors for popular science images. Although the blogging genre used to be associated with a personal, insular form of communication, typically taking the form of online diaries, within the past decade, blogs have expanded to take on more community-oriented functions (see e.g., Gurak & Antonijeic; Sobel). For example, entities from self-employed individuals to large corporations are now using blogs to promote their agendas to broad audiences, and they can use the solicitation of feedback inherent in blogs to improve their chances for success by modifying their agendas according to popular demand.<sup>159</sup> In the following overview, I aim to show that science blogs facilitate communication across global communities, they are increasingly trusted as sources of information, and they are likely to reach broad audiences. Therefore, science images can and should be at the forefront of these

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<sup>159</sup> For example, a 2008 editorial in *Nature Biotechnology* details the launch of a blog by a large biotech company (Centocor) and explains that the “two-way” communication inherent to blogs, allowing public opinions to flow in, fosters the development of new marketing strategies and product ideas (See “A Voice with no Words 358).

blogs—not as empty visual appeals, but for the purposes of persuading audiences to read more about scientific issues and research.

The benefits of blogging for science communication are beginning to be investigated not only in Journalism and Communication studies but also in scientific journals. For example, in their 2010 *Journalism Studies* article, Walejko and Ksiazek study the “sourcing practices” of science bloggers—that is, the sources from which they cite their information—to determine how the credibility of science blogs compares to that of the traditional news media. The authors find that science blogs have served to overcome the issues of science journalism—specifically, lack of specialized training, resulting in poor quality news articles that simply parrot press releases (423). Science blogs “challenge” traditional news media practices by linking to sources that “set readers along alternative paths of exploration than one finds with traditional news websites or popular political bloggers” (424). A news feature article in *Nature* (2009) by Geoff Brumfiel repeats the findings of Walejko and Ksiazek’s study. Brumfiel discusses organized blogging as helping to combat failures in science journalism, explaining that journalists writing on science stories have had to rely on press releases from public information offices, quoting them heavily in their articles and offering little substance (274-5). Taking matters of science communication into their own hands, scientists and scientific organizations have begun using blogs to discuss their research agendas, successfully reaching out to wide audiences, and scorning mainstream media because of their sensationalized versions of press releases (276). These articles point to the fact that many science blogs have actually become credible sources of information.

Many images in my case study eventually traveled beyond “science” blogs, but the blogosphere as a whole is increasingly considered a viable information source, competing with traditional news media. Providing a means of evaluating the credibility of blogs, websites like “Technorati” rank blogs in all subject areas according to their “linking practices”—the references blogs make to other sources of information, from news media sources to academic journals (see Technorati.com). (Technorati is one of the blog search engines Walejko and Ksiazek use in their study of science blogs.) Additionally, Technorati surveys thousands of bloggers every year to produce a study called “State of the Blogosphere” to analyze blogger demographics, new trends, and public trust in blogs. The 2010 survey, written by Co-Executive Editor of Blogcritics Magazine, Jon Sobel, found that the blogosphere is becoming more respected as a credible source of information because public trust in the news media is waning (Sobel). Technorati’s 2010 study also found that nearly half of all the bloggers surveyed have a graduate degree, leading Sobel to conclude that, “Overall, bloggers are a highly educated and affluent group.”

Blogging has even found a place in academia. An article appearing in *PLoS* [Public Library of Science] *Biology* (2008) lists several benefits to blogging for academic communities, such as informing the public to make important decisions about scientific research; making experimental findings accessible to broad audiences; and even providing an informal but effective forum for peer review (Batts et al. 1837). The authors of this article argue that “by combining the credibility of institutions—trusted gate-keepers for scientific truth—with the immediacy and networking infrastructure of blogs [...] they can both educate the public and advance



scientific knowledge” (1837). Academic institutions can moderate their own blogs to ensure that the information contained remains credible (1840).

Thus, blogs represent one way for scientific organizations to reach out to the community (in addition to other Internet media such as downloadable podcasts), and they are becoming accepted as credible sources of information. Blogs are also becoming trusted sources of information across the board, which means that science images appearing on "non science" blogs have a good chance of being seen by broad audiences. Therefore, science images have the *potential* to serve as “a universalizing mode of social communication aimed at the inclusion of non-experts” (Huppauf and Weingart 19). The following case study sheds light on the obstacles in the way of effective visual communication and the inclusion of non-expert audiences.

### ***Science Magazine Covers and the “Visualization Challenge”***

The National Science Foundation (NSF) and American Association for the Advancement of Science (AAAS) established their first annual International Science and Engineering Visualization Challenge in 2003, founded on the conviction that illustrations are the most effective means of fostering public interest in science (NSF). Beginning in 2006 with Figure 2, first-place visualizations have been printed on the cover of *Science* magazine<sup>160</sup>—that is now the reward promised to scientists and artists who participate in the Challenge. The stated purpose of the competition is to bridge the gap between the field of science and the so-called “general public” by encouraging and rewarding the creation of aesthetically pleasing images that also

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<sup>160</sup> *Science*, a peer-reviewed journal published by the American Association for the Advancement of Science (AAAS), defines itself as “the world’s leading journal of original scientific research, global news, and commentary” (“Science”).

serve a supposedly didactic purpose. The “Guidelines for Judging” explain that, “Entries should have scientific significance, freshness and originality, as well as have an aesthetically pleasing composition and drama. The spirit of the competition is communicating science, engineering and technology for education and journalistic purposes” (“Guidelines”).

In a brief *Science* “special feature” article, Figure 2—which appears to be a group of metallic figurines on a reflective surface—is revealed to be a depiction of five “mathematical surfaces.” The writers of this feature article proudly say of this still-life image, “It is beautiful. It can capture the imagination of nonscientists” (Nesbit and Bradford 1729). What is important for nonscientists to understand about five oddly-shaped metallic-looking figurines—or “mathematical surfaces”—sitting together on a reflective background?



Figure 2: *Science*, Sept. 2006

Although the purpose of the competition is supposedly geared towards “education,” it seems highly unlikely that nonscientist audiences would be “educated” by an image like the one represented in Figure 2, and much more likely that their imaginations would be “captured,” as the Special Feature article boasts. Capturing the attention of an audience is only the first step towards educating that audience; the Visualization Challenge cover images represent that first step, and, as I will show here, this first step is in fact the only step

taken. Although the intentions of the NSF and AAAS seem laudable, the motives they express in the Visualization Challenge manifesto do not come to fruition in their own handling of the images. I will hone in on three award-winning *Science* cover images in an effort to expose the reality behind the façade: that these images, far from fostering public understanding of science, function to reinforce the mythos of Science as an elusive authority beyond the intellectual reach of the average citizen.

As mentioned already, there is a discrepancy between intended and actual audience, and intended and actual purpose for the “challenge” visualizations. These covers would appeal to the typical *Science* reader, but the writers of the Visualization Challenge guidelines explicitly say that the images are intended for *nonscientist* audiences:

In a world where science literacy is dismayingly rare, illustrations provide the most immediate and influential connection between scientists and other citizens, and the best hope for nurturing popular interest. Indeed, they are now a necessity *for public understanding of research developments*.

The National Science Foundation (NSF) and *Science* created the International Science & Engineering Visualization Challenge to celebrate that grand tradition—and to encourage its continued growth. The spirit of the competition is for communicating science, engineering and technology *for education and journalistic purposes* (NSF “Challenge Synopsis,” emphasis mine).

The terms “public understanding” and “education” clearly indicate the mission of the challenge. Without a doubt, the NSF and *Science* claim to have the education of nonscientists at the core of their competition.

The nonscientist population that constitutes the NSF’s audience for the Visualization Challenge is *not* the general readership of *Science*. That audience is

composed of experts and practitioners across the sciences. Therefore, putting award-winning images intended for non-experts on *Science* magazine covers is perhaps not the most effective venue for public outreach, and it may be assumed that the Challenge officials intend the images to be released to the public through other venues. Some investigation with a major search engine (methodology described above) shows the validity of this assumption, as the images can be followed to popular science blogs and internet newspaper columns. Problems arise, however, when the images are viewed in light of the NSF's goals of "communicating" science and "educating" the public. While images do have the potential to communicate information, whenever images do fulfill such educational or communicative roles, they are anchored by text.<sup>161</sup> Obviously the cover illustrations are presented without explanatory captions, but viewers expect that they will be explained inside the magazine. Unfortunately, the anchoring text provided by the Visualization Challenge Special Feature articles is not sufficient to begin with, and it is especially inadequate after the images travel to other venues. To demonstrate the process of image and text transfer to alternative venues of publication, I will trace the mathematical figures cover illustration and award-winning covers from the 2007 and 2008 Challenges on the internet.

The expectation is that the Special Feature article accompanying the images in *Science* will enable readers to understand the content of the cover illustration and presumably provide some background information about its larger importance in the

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<sup>161</sup> "Anchor" is Roland Barthes' term. According to Barthes in "Rhetoric of the Image," linguistic messages are employed to fix the meaning of an image, providing a foundation for the viewer's interpretation (39). By emphasizing some aspects of the image and avoiding others, the text is thus able to "remote-control [the reader] towards a meaning chosen in advance" (Barthes 40).

field of science. However, the Special Feature articles corresponding to the award-winning images are extremely brief and provide a striking contrast to the research reports on other topics published in the same issue. For instance, in the Special Feature corresponding to the five shiny figurines, the author very briefly explains, in a style that accommodates nonscientist readers, that they represent mathematical functions that we cannot see (Chatterjee 1731). There is no explanation of what these functions are—neither dense scientific explanation nor accommodated elaboration can be found here. And it is implied that the mathematical figures are in some way valuable because they are not typically visualized at all, let alone in a computer graphic that shows sophisticated imaging of reflective surfaces. But the article does not explain why the visualization was worth doing.

Part of the reason for the inadequate explanation is that the Visualization Challenge covers share the Special Feature article with *all* of the award-winning images from that year's challenge—each image does not receive a separate article. As there are five different categories of visualizations and three different awards per category, the amount of textual explanation devoted to each image is minimal. As a result, the Special Feature articles typically do not offer any exigence for the images depicted—that is to say, they fail to connect the images to actual scientific breakthroughs or current events that would foster public understanding or even engagement.

One of the Visualization Challenge judges cited most frequently in these special feature articles, Felice Frankel, admires the ability of an image to “create

curiosity” (qtd. in Chatterjee 1731).<sup>162</sup> The problem is that there is not a full-length article to satisfy readers’ curiosity about the cover illustration. The brief description provided, grouped with descriptions of the other “Challenge” winners, does not address the issue of why general audiences *should* be interested in or curious about mathematical surfaces.

One might expect to learn about the exigence of this image in the venues where it later traveled, such as *Plus*, an online mathematics magazine, and “Science Dude,” an Orange County newspaper column.<sup>163</sup> The *Plus* article leads mathematically inclined readers to a more thorough explanation of the surfaces. Though more accessible to wider audiences than *Science*, *Plus* magazine may be too specialized for non-expert audiences, as it concludes with: “...these sorts of visualizations have an important role to play both within the mathematical community, and in helping that community reach the general public” (Thomas). Like the initial *Science* article, reaching the general public is not on the agenda for the *Plus* article either. To find an attempt at public outreach, one might turn to a publication like the *Orange County Register*, which is read by a wide audience of scientists and non-scientists alike (at least, in Orange County). The “Science Dude” column is a perfect opportunity to capture the interest of the general public—an opportunity to explain what the mathematical surfaces are and why people should care about

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<sup>162</sup> Felice Frankel is a science photographer currently holding positions at both Harvard and MIT. She explains her methodology of preparing and “redesigning” samples to produce photographs in her article “Communicating Science Through Photography.” This redesigning involves “thinking about what to include in that sample (and what is *not* necessary),” an unambiguously rhetorical process (1312). Frankel is also the author of *Envisioning Science: The Design and Craft of the Science Image* (2002), which is a guide for researchers to present their work in a way that is more appealing to “the general public” (1).

<sup>163</sup> For links to these articles, see Thomas and Robbins, respectively.

them.<sup>164</sup> Unfortunately, the short two-hundred-word article, half of which is quoted directly from the *Science* article, simply congratulates the mathematician and graphic designer who created the visualization; seemingly, the image won an award not because of its potential appeal to non-expert audiences but because it shows state of the art digital visualization. Still, the point to be taken here is that there could have been ways of engaging with the general public. Both the *Plus* and *Orange County Register* articles refer back to the *Science* article, indicating that the source article must be thorough if the accommodated versions are to educate non-expert audiences.

Figure 2 is just one example in a trend of Visualization Challenge covers that do not receive adequate textual grounding. The *Science* covers representing the 2007 and 2008 Visualization Challenges differ in content, complexity, and reception in other venues, and it is worth visiting each of them in turn to gain a fuller understanding of the operation and limitations of the Challenge. In the case of the 2007 cover illustration (fig. 3), there is less of an issue explaining the content of the image in the *Science* special feature, perhaps because of its relative simplicity, and more of an issue justifying its relevance to the field of science.

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<sup>164</sup> It should be said that no viewer comments or “tweets” appear on either *Plus* or “Science Dude,” indicating that these venues have not been measurably successful at reaching a broad audience.

After appreciating the image’s simplicity and symmetry, one can open the magazine to find out that it is a photograph of *Chondrus crispus*, or Irish sea moss. And, turning to the special feature article, one learns that the beautiful symmetry of this sea moss is an artificial construct—that the photographer, Andrea Ottesen, went to great lengths to press the curled ends of the seaweed down with stones and then let it dry for two days before photographing it (Lester 1859). Certainly there is no harm in creating beautiful art out of natural phenomena, and the practice of bringing art and science together is in vogue, despite (or perhaps because of) its controversiality. In a recent article in the magazine *Engineering & Technology*, science writer Piers Bizony celebrates the merger of art and science, arguing that “pictures speak to all of us”—

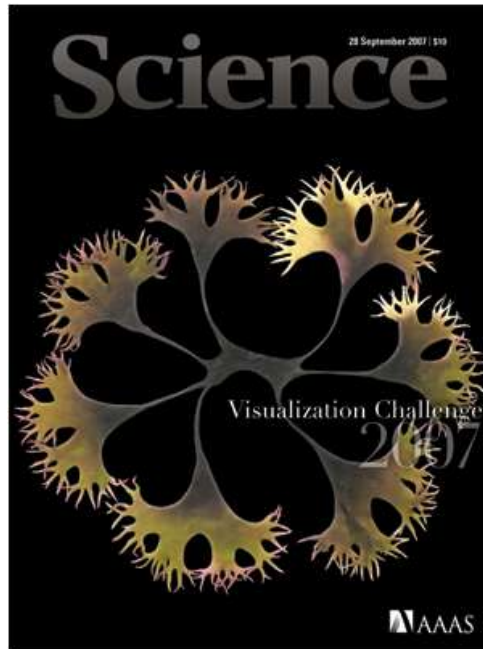


Figure 3: *Science*, Sept. 2007

even, he says, “people who aren’t so fluent in that [scientific] language” (43). Bizony’s attitude is similar to the one expressed in the NSF’s Visualization Challenge manifesto; there is this notion that visuals are a great equalizer, that everyone can comprehend visual “language.”

But there are also those who caution against aestheticizing science. For example, in an article in *Nature* magazine, Julio Ottino objects to scientists creating images that are “divorced from science and scientific plausibility” (475). Ottino calls attention to the alteration of visualizations for the sake of aesthetic appeal alone, a



type of alteration that celebrates science without explaining it. Ottino provides several examples of “scientific” images that are not realistic portrayals of scientific phenomena but that purport to aid in scientific understanding. His solution is for scientists and artists to “collaborate closely” (476). Aesthetic alterations, as in the case of the Irish moss photograph, denote a highly rhetorical process. That is, certain elements of a scientific object (or process) are emphasized, while other elements are excluded, in order to make a visual statement. The message delivered by the Irish sea moss, for example, might be expressed: “Natural objects can be simple and beautiful.”

Ottesen, the photographer of the Irish sea moss, manipulated the natural object to achieve a specific aesthetic effect, which is to show the moss uncurled and spread out to achieve radial symmetry. But Ottesen admits that, “If you pull *Chondrus* out of the ocean, it’s folded on itself—really curled up” (Lester 1859). The question must be asked then, at what point does a scientific visualization cease to be scientific? Interestingly, Felice Frankel is quoted in the *Science* Special Feature article about Ottesen’s artistically rendered sea moss, recounting the judges’ initial reactions to her photograph: “There was this gasp when this photo came up on the screen. We shouldn’t forget that we don’t need [complex equipment and techniques] to create beautiful representations.”<sup>165</sup> Her comment truly attests to the persuasive power a beautiful visual can have over an audience, because a year earlier Frankel is quoted as saying that it is necessary to think critically about “what makes an *honest* and successful representation and raising our standards” (Nesbit and Bradford 1729,

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<sup>165</sup> Frankel is quoted by Benjamin Lester in the special feature article (1859). The bracketed section represents his words. Frankel is quoted in these special feature articles more than any of the other panel judges.

emphasis added). The Irish moss on the cover of *Science* might be beautiful, but it certainly is not an *honest* representation of the seaweed found in nature, as Ottesen admits. The image of the sea moss is deemed valuable probably because of the work that went into manipulating the plant to achieve radial symmetry, and the notion that the photographer has captured natural beauty. Her artistic skill is being celebrated more so than the content of the image. What is the point of having “pressed every one of those little ends down with sea stones” other than to create a more aesthetically pleasing photograph? What ends does changing the seaweed’s appearance achieve for science? Non-scientist readers arguably learn less about science from this image than they would from an “honest” representation of the seaweed, perhaps even photographed in its natural habitat. To what extent is it possible for an image be both aesthetically pleasing and scientific?

The “Guidelines for Judging” outlined on the NSF’s website offer some useful criteria for those who wish to participate in the Visualization Challenge, but as it turns out, they are not specific enough to ensure the accuracy of the visual representations. One of their criteria is that, “The visualization portrays the phenomena, principles, concepts and research context effectively and clearly,” and it should “reflect current scientific consensus” (NSF “Guidelines”). The problem here is that they do not clearly define their terms—for instance, what is meant by “effectively and clearly”? One would expect much more precision from a group of scientists, but perhaps since these images are really only art, the judges do not see any

problem with leaving room for interpretation and rule-bending.<sup>166</sup> It could be said that the type of science promoted by the mathematical figures and sea moss reaches back to the trend of early natural history picture collections, a science of inventorying natural kinds. While this trend may have its appeal, today's fast-paced, technology-driven society also demands scientific images that appeal to current values and have significance to current issues (more about this idea later).

Just as the 2006 cover illustration traveled to other venues of publication, so too did the Irish sea moss. The two cases are quite similar: because the *Science* special feature article did not explain the significance of the cover illustration and rather focused on its aesthetic appeal, the popular venues do not explain the relevance of the image to science but they do associate the visual with a general scientific ethos. The image of the Irish sea moss appears on TreeHugger.com, a blog devoted to sustainability and “green news”; on *Smithsonian* magazine's blog; and on *National Geographic*'s “Best Science Images of 2007.”<sup>167</sup> The author of the TreeHugger post entitled “Kelp Takes Our Breath Away,” describes the image as “fractal” and “otherworldly” (McGee). The *Smithsonian* blog sets up a comparison between what the moss really looks like and what it looks like in Ottesen's rendition: “The slimy, glistening mass of seaweed washed up on a sandy beach seems light-years distant from this feathery, dendritic image of Irish moss” (Zielinski). Beyond their unique explanations of what makes this photograph visually appealing, these websites simply reproduce the information from the *Science* special feature article, offering no new

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<sup>166</sup> Another feature of their “Guidelines” that supports this claim is that the category entitled “Visual Impact” precedes “Effective Communication.” To be clear, if they are looking first and foremost for “visual impact,” which I interpret as aesthetic appeal, then accuracy is marginalized.

<sup>167</sup> For links to these articles, see McGee, Zielinski, and “Best Science,” respectively.

insights as to what the general public should learn about Irish sea moss. For example, is this species of moss endangered, or does it play a unique role in the food chain? Besides its visual appeal, why did it make the cover of *Science*?

Science journalist Alan Boyle also writes about this *Chondrus crispus* image in “Cosmic Log,” a blog run by MSNBC devoted to science news, where one might expect to learn something about the subject matter of the award-winning photograph. However, instead of discussing the subject of Irish sea moss, Boyle focuses on the “wow factor” of the image itself. He writes, “Can you find beauty by looking up someone’s nose, or inspecting a slimy mass of seaweed, or following the flight of a bat? Scientists can, and the proof is found in this year’s annual competition for the coolest images in science and engineering” (Boyle). Therefore, the “coolest images,” not their further implications, are the subject of this article. The introduction to this article also propagates the stereotype of the wacky scientist by characterizing a CT scan as “looking up someone’s nose” and “finding beauty.” Here is what he says about the Irish sea moss: “Ottesen [...] snagged a bunch of the seaweed known as Irish moss from the Nova Scotia coast – then stretched it out, dried it and snapped a beautiful picture showing the plant’s complex structure” (Boyle). Unfortunately, Alan Boyle’s “Cosmic Log” article does not offer any further insights into the potential role that these award-winning visualizations could play in the public’s understanding of science.<sup>168</sup> And this insufficient treatment of the images can be traced back to their source: the National Science Foundation and *Science* magazine. Contrary to encouraging the “public understanding” of science, as they claim to do in their

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<sup>168</sup> The blogs mentioned either have discussions that have been closed or do not show viewer comments about the images.

mission statement, it seems that the NSF is endorsing public awe of (and deference to) science in their current management of the Visualization Challenge.

The last visualization that I will discuss is the 2008 Challenge cover, which presents a different predicament from either of the other two cover illustrations in that it does not represent the winning visualization in its entirety (fig. 4). Rather, what appears to be a bunch of blue cauliflower-shaped blossoms tangled up in vines turns out to be just a small detail from a larger composition entitled “‘Mad Hatter’s Tea,’ From Alice’s Adventures in a Microscopic Wonderland,” and it was a combined effort between freelance illustrator Colleen Champ and photomicrographer Dennis Kunkel (Zelkowitz 1768). This cover thus presents an example of purposeful ambiguity, as the illustration on the cover is cropped from a larger illustration and is not what it seems to be. Champ used Photoshop to transform Kunkel’s micrograph into a scene



Figure 4: *Science*, Sept. 2008

that could belong in a children’s book. There is a “key” underneath the illustration that “identifies the source of each image, including the mold spores that make up the vast underground” (Zelkowitz 1768). The blue cauliflower blossoms and vines on the magazine cover are taken from the mold spore segment of the illustration. Perhaps the cropped section of the image was chosen because of its standard elements of aesthetic appeal—a likeness to abstract art and a strong pattern of repetition. The *full*

illustration (shown inside the magazine) is very cartoon-like; one would not expect an illustration like it to appear on the cover of *Science*, which is perhaps why it was cropped down extensively for the cover. Pictured in the full illustration are two beetles sitting at a picnic table having tea in a very whimsical looking field under a purple-hued sky (fig. 5). It is odd that the *Science* editors did not choose a different winning visualization for the cover image, since there are five categories in the competition, each awarding a first place visualization.

Although the children's illustration does not increase public understanding of science because the accompanying article does not explicate its usefulness (if it can indeed be considered useful), it received a great

deal of positive attention from broader audiences. In fact, Champ and Kunkel's award-winning visualization has received more attention in other venues than the cover illustrations from the previous two years. *The Huffington Post* and MSNBC both covered the illustration (albeit briefly), inviting blog postings that reflect peoples' desire to see more images like the "Mad Hatter's Tea."<sup>169</sup> The proposed book, *Alice's Adventures in a Microscopic Wonderland*, had not been published at the time of this image's circulation online, but interested readers could peruse Champ and



Figure 5: "Mad Hatter's Tea." From *Science*, Sept. 2008.

<sup>169</sup> See Graham for the *Huffington Post* article and Boyle for the MSNBC article.

Kunkel's website, "Microscopic Classics," to see a few more illustrations like the one featured in *Science*.<sup>170</sup> Unless the book has been reviewed and "kid tested," it is not possible to know what effect it will have on children's receptivity to science.

Nevertheless, "Mad Hatter's Tea" was well-received by audiences responding to *The Huffington Post* article. Viewers posted comments like, "Those are really cool," "I want to see more pictures!" and "Stunning new imagery" (Graham). Some viewers were more specific about the aesthetic appeal of the images: "(...) the rich and subtle colors; the anthropomorphic context with a dash of humor; great photography" (Graham). What these blog posts and viewer comments attest to is the fact that science images can and do appeal to nonscientist audiences in a variety of ways. The issue remains that they currently do not lead to any substantive information. In other words, they are portals to nowhere.

Before discussing how their portal potential can be realized, I will review some of the comments and descriptions of the three images discussed in this case study to explore their visually appealing aspects and the ways that they effectively advertise science. First, the mathematical figures "capture the imagination of nonscientists," according to the *Science* "Special Feature," and moreover, according to judge Felice Frankel, they "create curiosity."<sup>171</sup> Put another way by the *Plus* blog author, the image "grabs the eye and invites viewers to wonder what they're seeing" (Thomas). All of these descriptions focus on the image's effect on its audience, which is to specifically invite the audience to speculate about what they see. In the introduction to this chapter, I mentioned Huppauf and Weingart's supposition about

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<sup>170</sup> For a link to their website, see Champ and Kunkel.

<sup>171</sup> See Nesbit and Bradford p. 1729 and Chatterjee p. 1731, respectively.

the ability of science visualizations to open up a space for viewers' imaginations to wander (16). Thus uncertain or ambiguous images can appeal to viewers by asking them to engage with the image and conjure their own ideas about what they are seeing. In advertising theory, which borrows significantly from rhetorical theory, it is believed that using ambiguity in imagery involves the consumer and "makes the consumer look twice" (Brierley 187). Advertising theorists call the ability to stimulate consumers' thought processes by looking at an ad "elaboration" (see e.g., McQuarrie and Mick 1999). That is, viewers "elaborate" on what they are seeing, and the longer their attention remains on the ad, the more likely they will remember the product. The mathematical surfaces presumably encourage viewer elaboration through their ambiguity and eye-catching visual features.

The *Chondrus crispus* or Irish sea moss is visually appealing in a different way than the mathematical surfaces, but the image still functions to advertise science. Some of the descriptions of the sea moss are "fractal" and "otherworldly" (McGee), and "feathery" and "dendritic" (Zielinski). The photograph is also admired for its ability to showcase the moss's "complex structure" (Boyle). Judge Felice Frankel simply praises its breathtaking beauty (Lester). The TreeHugger blog author, Tim McGee, is perhaps closest to putting his finger on what makes the image appealing to viewers by using the term "fractal" as an adjective to describe it ("The fractal otherworldly image is of Irish sea moss..."). In mathematics, a fractal (noun) is a geometric shape that, when broken down, has parts that look like the whole, a quality called self-similarity. Zielinski's description of the moss as "dendritic" in the Smithsonian blog is also apt, as it conjures up images of snowflakes or crystals. The



moss's radial symmetry and its positioning on a plain, dark background also indicate that it has certain gestalt features, which appeal to the basic human desire for balance and order (see e.g., Dondis; Dake). According to Brierley, advertising theorists capitalize on the basic desire in people to complete and/or unify what they see, believing this urge to be a universal psychological phenomenon (161). It might be said, then, that the image of the moss appeals to viewers' basic desires for balance and unity, and it advertises science through that involvement tactic.

Lastly, the "Mad Hatter's Tea" micrograph gives way to yet another type of visual appeal in its advertisement of science. The entire image, which is what traveled to other venues (not the small section put on the cover of *Science*), is praised for its colors, beauty, whimsy, and as one viewer perceptively writes, "the anthropomorphic context with a dash of humor" (Graham). In essence, the scene is fantastical and, in advertising theory, "Familiar elements in fantasy and escapism allow viewers to bring their own fantasies to the [advertisements]" (Brierley 166). In this case, the viewer who points out the "anthropomorphic context" has identified the familiar elements in the fantastical scene as appealing in conjunction with the fantasy. In advertising, it is common to give brands magical qualities, tell stories, and exaggerate reality in an effort to appeal to viewers (Brierley 157). The stunning micrograph also advertises science through its ambiguity—viewers think that they are looking at a decorative motif but it turns out to be a real image of mold spores.

But a successful scientific advertisement should do more than appeal aesthetically to an audience of nonscientists; it should also stimulate interest in the science behind the images, which requires some anchoring text. Because the

science/art was so well received by readers of the Huffington Post, it seems that the Visualization Challenge organizers should encourage more media sources to feature their award-winning visualizations. But before they do that, they might consider including more extensive special feature articles in *Science*—articles that provide exigence for non-expert audiences and explain the correlation between the visualizations and current scientific issues. If there is not enough space in the magazine itself, an alternative would be to use the *Science* website to publish more information on the images. Bloggers who write about these images would then at least have a place to look for information instead of focusing solely on the aesthetic qualities of the images and disregarding their supposed didactic qualities. If the information exists in the source (*Science*), writers can be held accountable for transmitting the same information about the images to a wider public audience, and the source can escape blame for failing to contextualize the images. As it stands, without textual anchorage, these award-winning visualizations do little to stimulate scientific literacy. They truly are scientific advertisements.

It is easy to claim that a visualization is designed to “communicate science” to public audiences, as the NSF does in the “Challenge Synopsis,” but unless the image is connected to textual information, it is not fostering “public understanding of research developments”—it is perpetuating a lack of understanding. In other words, the only thing that these *Science* cover images communicate is that subjects treated by science can be stunning, and that impression unwittingly communicates that science it is beyond the reach of non-experts. It seems that the more beautiful the images are, the more unapproachable they become. Nonscientists can look but cannot touch.

Because the award-winning visualizations are imbued with scientific ethos but are only tangentially scientific and primarily aesthetic, they could not possibly be expected to communicate science or contribute to public education. Granted, the idea that “the public” can be “educated about science” is inconceivable, given the complexity of the sciences and the stratification of non-expert audiences—and this argument has already been made by science communicators (see e.g., Russell; Christensen). But although it is true that the expectations of the Visualization Challenge set out by the NSF and AAAS are over-ambitious, their treatment of images does not even tend towards the direction of education or communication. At the very least, scientific images should have some substance beyond their aesthetic appeal.

Before offering some suggestions for improving upon the structures already in place for the Visualization Challenge, I analyze some off-shoots of this larger science/art competition to demonstrate that the fusion of these two cultures is gaining in popularity.

### **Science as Art and Art of Science: Competitions in Academia**

Universities in the States and in Britain have begun their own science image competitions in the past few years, some of them garnering attention outside of their institutions’ walls and receiving recognition on well-populated science blogs. These smaller-scale competitions, whether or not they do find fame outside of their institutions, are still publicized in their local communities, crafting a particular image of “Science” from the bottom, up. Thus, smaller-scale science and art competitions

are in an even more influential position than competitions run by large scientific organizations because they are poised to reach out to and generate interest from community members who have closer ties to the participants. However, with the larger competitions, like their models the NSF and AAAS Visualization Challenge, these academic competitions are also missing an opportunity to use visuals to their fullest persuasive potential.

Clemson University is one example of an institution that began a competition by taking a leaf out of the NSF and AAAS's book. "Science as Art: A Visualization Challenge" was launched by the university in 2006, the same year *Science* magazine started featuring award-winning visualizations from the Challenge on its covers, which then spread across the web. According to the main webpage, the images solicited by Clemson's competition come from "laboratories, workspaces, learning environments," and they are intended to be "powerful and inspiring." Moreover, on the main page there is a quotation from Einstein about beauty and intrigue: "The most **beautiful** experience we can have is the **mysterious**...the fundamental emotion which stands at the cradle of true **art** and true **science**" ("Science as Art," emphasis theirs). Thus, framing the competition is the notion that, through a merger of art and science, mystery and beauty are realized. As expressed on the "About" page, "Images that researchers produce as a part of their endeavors can be truly outstanding in terms of artistic beauty as well as inherent scientific merit" ("About Science"). There are two goals, then, for the competing images—that they are beautiful, and that they have inherent scientific merit. What is Clemson's purpose for showcasing beautiful scientific images?

Clemson has its own equivalent of the “challenge synopsis” provided by the NSF’s website, and its own mission statement, but the overarching goal remains the same: to foster public interest in scientific research. The competition’s main webpage describes the contest mission as follows: “Visual representations of science and technology provide a valuable connection between scientists, artists and the general public” (“Science as Art”). The same sentiment is reiterated on the “About” page with only slight variation: “Visual representations of scientific discoveries and concepts provide a valuable connection between scientists, artists and the general public” (“About Science”). Though slight (and probably not consciously done), the variation is significant: visual representations of “scientific *discoveries* and *concepts*,” as opposed to visual representations of just “science,” promise a thoroughness that is not realized in the captions for the images, as I will show in what follows. Moreover, the amount of time and money that must have been spent on the impeccable website design—not to mention the thoroughness of the explanations of the competition itself and its goals—suggests that the same care could have been taken with the explanations of the images themselves.

The lack of precision in the area of contextualization is not surprising, given Clemson’s role model, the NSF and AAAS International Science and Engineering Visualization Challenge. This influence of the larger competition on the smaller is evidenced by Clemson’s “Guidelines” webpage that asks potential participants to first “see the NSF Science Visualization ‘Frequently Asked Questions’ website for more specifics” (“Categories”). Clearly, Clemson has structured its competition on the larger organizations’ model. Like the larger Challenge, Clemson’s competition has

several different categories for submission: illustration, photography, informational graphics, 3-D, painting, and non-interactive media.<sup>172</sup> All of the images have a place on Clemson's website, awarded or not, and all of them are accompanied by brief textual descriptions, previewed by placing the cursor over the thumbnail, and shown in full when the specific image is clicked on. However, these descriptive captions, written in language easily accessible to a broad audience, generally skimp on information.

Take Figure 6, titled "Thrombousthai,"<sup>173</sup> for example; winning first place in the photography category in 2010, this image by doctoral student Lee Sierad is described insufficiently by the following caption:

A partially activated platelet investigates the terrain... Every time you cut yourself, platelets help stop the bleeding. Suspended in action, this platelet has begun morphing from its quiescent state into a fully activated platelet that will release many clotting factors into the blood stream. These factors make it possible for the paper-cut you received yesterday to stop bleeding and become little more than a minor inconvenience today, reminding you of the impressively intricate design of our bodies ("Thrombousthai," ellipsis appears in original).

Yes, the activation of platelets is well-described for a general audience, addressed directly to them and put into a "real life" context (e.g., "the paper-cut you received yesterday"). But the image itself—the amorphous shape, the texture of its background, the method by which the photograph was taken, and even the title of the image—is left unexplained by this caption. Notice the first sentence, however. What seems to be the beginning of the explanation of the image itself is followed by an ellipsis, as if the description has been purposefully truncated for Clemson's website.

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<sup>172</sup> This is clearly a non-equivalent set, but each category is judged separately and a first-place award goes to a submission from each.

<sup>173</sup> The title of the image is not explained on the website. Perhaps the title was selected because it shares its root with "thrombosis."

There is no option to click for a longer description. For some reason, it has been omitted from general viewing, and so the image and its caption are in a permanent state of disjuncture. Though viewers can “digg this” image, “share on twitter” and post about it on “facebook,” all linked at the bottom of the webpage, they do not know what exactly they are looking at, and nobody else on these social networking sites will, either, when and if viewers spread the word.

Because these social networking sites require joining or logging

in to see whether or not people did share their thoughts about “Thrombousthai,” it is not always possible to learn what viewers found visually appealing about this award-winner. It would be possible to speculate about what qualities earned this image a first-place award. Much like the Irish sea moss in the NSF competition, the free-form shape almost glows against a dark background, creating a distinct contrast, contrast being a visual quality that generates intrigue (see e.g., Dake; Dondis). Even more captivating than the sea moss composition, this composition shows the platelet shape against a background that conveys movement: the wavy lines underscoring the platelet indicate movement on a downward diagonal. And the platelet itself, because of its curved extremities and the play of shadows on its surface, also looks as though



Figure 6: "Thrombousthai." From Clemson's Science as Art Competition.

it was caught mid-movement. A still image that is able to convey both three-dimensionality and movement is bound to be captivating. However, after appreciating the visual appeal of this image, viewers would likely wonder about the significance of the flecks, and there are no clues provided as to the significance of the scale.

Although mystery and beauty might be enough to “connect” with the “general public,” as Clemson states on its main webpage, the brief caption to accompany the image can only secure a superficial connection. And although Clemson offers viewers the option to spread the word about their “Science as Art” competition on social networking sites, their winning images have not received recognition outside of Clemson-affiliated websites. It seems that the impact of their competition has remained relatively localized, though the sponsors of the competition—Clemson University Research Foundation (CURF) and the Department of Engineering and Science Education at Clemson—have the option to broadcast their competition to a larger community via weblogs. Princeton University, for example, takes matters into its own hands when it comes to advertizing its visualization competition outside of the local community.

Begun in 2005, Princeton’s “Art of Science” competition has several sponsors within the institution from both the scientific and artistic realms: the School of Engineering and Applied Science, the Princeton Plasma Physics Laboratory, and the Arts Center all support the exhibition, which “explores the interplay between science and art” (“Art of Science”). Submissions come from departments across Princeton’s campus from undergraduates, graduate students, faculty, research staff, and alumni



(“Art of Science”). Their competition website is not as intricate or informative as Clemson’s, and their guidelines and rules are not posted for viewers to see. However, Princeton’s “About” webpage promotes the competition in a different light than either Clemson’s or the NSF and AAAS challenges; according to Princeton organizers, the science is given prominence over the art and the motive for public outreach:

The 45 works chosen for the 2010 Art of Science exhibition represent this year’s theme of “energy” which we interpret in the broadest sense. These extraordinary images are not art for art’s sake. Rather, they were produced during the course of scientific research. Entries were chosen for their aesthetic excellence<sup>174</sup> as well as scientific or technical interest (“Art of Science”).

There is no mention of creating bridges between the scientific community and the general public in the competition description, and there is no equivocation about the scientific merit of the awarded images—these are not representative of “art for art’s sake,” but rather “produced during the course of scientific research.” To be sure, Princeton is taking a step in the right direction by truly fusing science and art. In other words, unlike Ottesen’s sea moss photograph from the NSF and AAAS Visualization Challenge (see fig. 3), for example, Princeton is not enlisting scientists to conjure up aesthetically pleasing images divorced from scientific research. They even have a scientific theme for each year’s competition to focus the images, rather than having a series of random visualizations from all subfields. Given these positive qualities, one might expect the images to be fully explained by rich textual descriptions, especially since the gallery of thumbnail images tells viewers to click on each image “to learn about the science behind the art” (“Gallery”).

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<sup>174</sup> “Aesthetic excellence” is not defined anywhere on their website.

There are only three images awarded a prize each year, compared to the several first, second, and third place awards given out by the other two competitions discussed so far. All of the images on Princeton’s website, awarded or not, are given a brief textual description, most of which are disappointingly uninformative. The image winning first prize in 2010, titled “Xenon Plasma Accelerator” (fig. 7) by Jerry Ross, a Plasma Physics Laboratory post-doctoral intern, is appealing perhaps because of its simplicity and symmetry (like Ottesen’s sea moss photograph). In this particular case, however, viewers do not learn what type of image they are looking at—is it a photograph? The description calls it a “picture”:<sup>175</sup>

A picture of a Hall-effect thruster (plasma accelerator) plume. The Hall thruster, is an electric propulsion technology that uses magnetic and electric fields to ionize and accelerate propellant. In this image the plasma accelerator is operating on xenon propellant (“Xenon”).



Figure 7: “Xenon Plasma Accelerator” from Princeton’s Art of Science Competition.

This description, besides being altogether too brief, provides a stark contrast to the description of the Clemson platelet image (fig. 6) in that it is not accommodated for a non-expert audience. For instance, the audience for this caption is expected to know what a plasma accelerator does, what xenon propellant is, and what ionization by magnetic and electric fields entails. Of course, Princeton’s competition does not purport to cater to “the public,” like the

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<sup>175</sup> On PhysOrg.com, a science blog to which the image traveled, it is referred to as a photo, a detail that was probably clear to expert viewers but is not provided on the Princeton website.

other two competitions. Their target audience is the scientific community at large, evidenced by the “press” link on their website detailing the proliferation of their award-winning images across the scientific blogosphere.

Some of the most popular science blogs, according to Technorati ratings, have featured news of Princeton’s “Art of Science” competition and replicated the images. A bit of sleuthing reveals that Princeton has supplied the information to these blogs themselves, taking matters into its own hands to advertize its scientists’ work. For example, at the end of the article on PhysOrg.com—a blog ranked 44<sup>th</sup> on Technorati’s Top 100 blogs across all subject areas—there is a disclaimer that admits that the article was “Provided by Princeton University” (“Art of Science 2010”). The authorless article provides a slightly more accommodated explanation of Ross’s

Plasma Accelerator:

The glowing plume we see in this photo is generated by a Hall-effect thruster -- an electric propulsion technology that uses magnetic and electric fields to ionize and accelerate a propellant (in this case xenon) to produce thrust. These devices are used for a variety of space craft applications such as satellite stabilization (“Art of Science 2010”).

In addition to the increased readability of the sentences in this description of the image, there is also a nod towards contextualizing the image—that is, mentioning what its broader implications are (“space craft applications”). The same explanation is publicized verbatim on another well-populated science blog, EurekAlert!, run by the AAAS and ranked 73<sup>rd</sup> on Technorati’s Top 100 blog list (“Art of Science 2010”).

Princeton’s competition organizers have obviously done their work to circulate news of their event to scientific audiences in the blogosphere, but their images have found their way to other blogs as well, and the brief captions are unsuitable for broader audiences. Non-scientifically-run blogs that the Princeton

images appear on include “Skepsisfera,” written by a fan of aesthetic science images and aimed at an audience of other fans, and “io9,” a science fiction blog (see Alamino and Anders, respectively). The author of “Skepsisfera” reproduces the three award-winning images from Princeton’s 2010 “Art of Science” competition, along with their titles, and their creators’ names, but the captions are entirely omitted. At the end of the post, there are links to the competition’s website and to a “physicsworld.com” blog post by Michael Banks “to read some extra information” (Alamino). Banks’ “extra information,” if readers follow the link, is actually not “extra” at all—in fact, he provides less information about the images than Princeton’s writers (see Banks). As for the article on the blog “io9,” which “covers science, science fiction, and the future,” the same description from Princeton’s webpage is recapitulated for Ross’s “Xenon Plasma Accelerator,” albeit framed by exclamations of “Awesome!” (Anders). This blog post highlights the aesthetic appeal of the images over their scientific merit (it is titled “Black holes and xenon accelerators you’ll want to hang on your walls”) but the people who have commented on the post seem more knowledgeable about the potentials of the plasma accelerator, posing questions such as, “So as far as practical applications are concerned this would really only be useful for sustained space flight?” (Anders). The blog format allows for discussions among community members, and this person’s question was answered by another commenter: “Yup. They’re mainly used for stationkeeping for geosynchronous satellites, and very slow (but cheap) interplanetary voyages” (Anders). Other inquiries and answers appear on this blog’s discussion thread, showcasing the potential for blogs to facilitate productive discussions across Internet communities.

These discussions, opening up the content of the image to further elaboration and speculation, also showcase the inadequacy of the original description of Ross's image provided by the Princeton competition organizers.

It is probably fair to say that Princeton is using the competition for institutional self-promotion, as opposed to public engagement with science. Other universities besides Clemson and Princeton have begun hosting scientific image competitions; for example, the State University of New York at Oswego had its first "GENIUS Olympiad science and art competition" in April 2011 and the University of Florida had its third annual "Elegance of Science" art contest in February 2011. Across the Atlantic, the University of Nottingham hosted a "Science Image Competition," sponsored by SIGNET and the Center for Plant Integrative Biology (CPIB), in May 2011. Although the images from this competition did not travel through the blogosphere, the scientific organizations that sponsored the competition did reach out to the public, boasting on their webpage, "Over 200 members of the public voted for their favourite science image" (Lydon). The descriptions for the award-winning images provided on the webpage, however, were not constructed for a non-expert audience. Figure 8, for example, the first prize image by Martina Marangoni from Biomedical Sciences entitled "Fluorescent neurons reveal their secrets," has the following caption primarily written in an expert register:

YFP fluorescent neurons in the cortex layer V of an R6/2 mouse at 3-month age. R6/2 transgenic mice, model of Huntington's disease, were crossed with YFP-H mice that express a yellow fluorescent protein (YFP) in a subset of neurons. Fluorescent neurons can be traced over long distance, from the cell body and dendrites to the axon. Anti-huntington aggregates immunostaining reveals the presence of big intra-nuclear aggregates and small extracellular aggregates. The image

was acquired, in collaboration with Tim Self from ICS, with confocal imaging using a LSM 710 Laser Scanning Microscope (Lydon). The “over 200 members of the public” who voted for their “favourite” images

obviously were voting based on aesthetic criteria as opposed to scientific criteria, which is inaccessible from the caption. Presumably, the image’s catchy title about neurons revealing their secrets is the only text

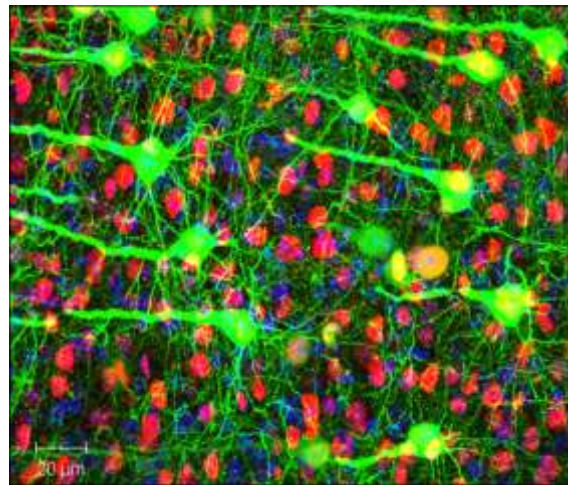


Figure 8: “Fluorescent neurons reveal their secrets” from CIGNET Science Image Competition.

that community members went on during the voting process. The wild splotches of color decorating the composition make it visually arresting. In this case, perhaps more than in any of the others, the mythos of Science is irresponsibly reinforced by scientific organizations to enlist public support for research, and no context is provided to explain the significance of the images to non-expert audiences.

## Conclusion

Captivating science images should be used to garner public support for the scientific enterprise. There is no question that images can be engaging, memorable, and persuasive on their own, but to communicate in a multimodal environment—one that includes various forms of media, such as images, text, and sound—images generally require some amount of text, be it framing, labeling, explaining, or linking. The amount of text required for effective communication depends on the image, its

purpose, placement, and previous coverage. Images that are designed to raise public awareness about scientific issues demand and deserve proper contextualization.

In this chapter, I explored the deficiencies of visually appealing scientific images from science/art competitions that have been disseminated in public venues. Without sufficient information, these images do not communicate anything more than the idea that science can be visually stunning, an effect that paradoxically makes science more esoteric and distant. The competitions put in their mission statements that they intend to connect with public audiences through their award-winning images. But they are missing a valuable opportunity to engage broad audiences with actual issues in science. First, the competition organizers reward images of Irish sea moss and blood cells, and they do not explain why anyone should care to learn more about the content of these stunning images. That leads to the second reason that competitions are missing the mark: they do not provide sufficient context for the images or link viewers to more information. These two issues are markers of irresponsible visual communication. Determining what constitutes *effective* visual science communication will require more research on the part of rhetoricians and communication scholars. What can be said with certainty for the time being is that responsible visual communication includes contextualizing images and providing links to further information. How much contextualization and what types of further information to include are variables that still need to be determined through research.

Even if, as the common wisdom states, “the public” is disinterested in learning about science, scientific organizations are still responsible for making the information available with their flashy, eye-catching images. Viewers can then decide for

themselves whether or not they will learn more about the beautiful scientific image they are looking at, rather than having it predetermined for them that they are not interested.

In the coda, I reflect back on the chapters leading up to this one to offer some positive examples and to suggest some responsible practices for effective visual science communication with non-expert audiences.



## Coda

One of the central arguments in this project is that scientific images can be beautiful and capture viewers' imaginations, but to be portals into scientific discourse, they require substance beyond their aesthetic appeal. To exceed an aesthetic appeal, popular science images require some combination of the following criteria:

- 1.) Culturally recognizable symbols or icons (i.e., that have referential significance beyond the image);
- 2.) Explanatory and/or contextualizing information that is accommodated for the target audience; and/or
- 3.) Features that facilitate audience inclusion.

To illustrate how science images intended for non-expert audiences can fulfill these criteria in various ways, I will turn to the examples in the previous chapters.

Frontispieces, my first example, made use of a system of classical symbols and allegories that audiences of early scientific texts would have recognized. Thus, readers were led into unfamiliar discourse by familiar visual conventions to put them in a potentially more accepting frame of mind.<sup>176</sup> Although classical symbols are not as recognized or readily understood today, we have an entirely new matrix of symbols and allegories that can be used in scientific images to engage nonscientist audiences and prepare them for forthcoming discourse.

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<sup>176</sup> In Chapter 2, I discuss the role of the exordium in classical orations and apply these introductory criteria to frontispieces.

Some of these current symbols are discussed in the chapter on magazine covers, such as an iconic close-up of a human head, which I argue represents a node of collective social intrigue. Thus, whatever concepts a magazine associates with these visually represented nodes of intrigue are more likely to receive attention than if the concepts were represented by something less culturally charged. At the end of Chapter 4, I suggest that design techniques considered specific to the magazine cover genre, such as the use of visual symbols and buzzwords, could be used beyond that genre. With the capabilities afforded by the Internet, a magazine cover could be transformed into an interactive experience. For example, the vivid cover illustration placed in a digital venue could feature cover lines that are hyperlinked to abstracts and/or articles, and information could appear when viewers hover their cursors over certain sections of the image. To be clear, *any* digital illustration could be designed in this fashion to offer viewers an interactive experience; magazine covers provide a suitable template for science communicators to exploit.

Regarding scientific portraits, perhaps a calculated attempt to create a new image of science is necessary to counteract public indifference, disdain, and even hostility towards the scientific community. The scientists in the last case in Chapter 3 (from the AAAS convention in 1958) were already advocating for a revised image of science to earn the respect of society and a stronger presence in educational and political forums. Using the Internet's communicative reach, it would be possible, as it was for *Life* magazine in its height of popularity, to reconstruct the face of science through calculated visual representations of scientists. Images showing scientists at work could be displayed in combination with images of the same scientists as

“ordinary” people, as teachers, as advocates; perhaps the key is in depicting the archetypes together in one cohesive unit to suggest that the role of the scientist extends beyond the scientific community and into the public sphere. At the end of Chapter 3, I also suggested that a video of a scientist walking viewers through a laboratory might bring the concept of portraiture up to speed in the twenty-first century.

The efforts that I have described just now belong in the hands of science communicators, intermediaries between the scientific community and non-expert audiences for scientific discourse. Degree programs in Science Communication are a recent development, and there is some controversy over whether they should be housed in the sciences or humanities.<sup>177</sup> In reality, the majority of science communication programs are located in communication or journalism departments on university campuses—rarely are they housed in science programs (Pearce, Romero, and Zibluck 235). The widespread acceptance of science communication programs into both science and communication departments is necessary to fostering interdisciplinary collaboration and improving the efficacy of science communication. An interdisciplinary degree with a focus on new media literacy would prepare future science communicators to take advantage of the Internet.

In this project, I have shown how past instances of visual science communication can inform current attempts to reach out to nonscientist publics. A future project will be a manual for best practices in the visual communication of

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<sup>177</sup> See e.g. Pearce, Romero, and Zibluck’s “Interdisciplinary Approach to Science Communication Education: A Case Study” in *Communicating Science* (Kahlor and Stout, eds.). The authors describe their own struggles in launching a Science Communication program at Arkansas State University, Jonesboro.

science to non-expert audiences. Before that, however, there are some additions to the current project that will begin its transformation into a book. One addition, which will require a great deal more research, is a chapter focusing on scientific advertisements particular to the nineteenth-century, in between the chapter on frontispieces and the one on twentieth-century photographed portraits. Natural history books, which were large folio books left out on display (coffee-table books), would be a possible site of analysis. Or perhaps spectacles, scientific demonstrations, or cabinets of curiosity, all of which were popular in the nineteenth century, would be appropriate for a project on portal images.

Another addition and/or modification to the current manuscript would take the form of short inter-chapters that would be dedicated to exploring current renditions of historical models discussed in each main chapter. Rather than having current iterations of past practices briefly stated at the end of each chapter and in a coda, they would be further researched, elaborated on, and given more attention the proposed inter-chapters.

Putting the ideas from this project into practice, which I foresee as the topic of a second book project, will entail collaboration between rhetoricians and scientists and a willingness to study visual persuasion. As mentioned above, one important step is advocating for more interdisciplinary college courses that bring together professors and students in the sciences and humanities. Moreover, visual persuasion and design should be taught across the academic community and should not be limited to advertising and graphic design programs. Although much more research needs to be

done before a series of best practices for communicating science can be reached, it can be said with certainty that using digital media will be essential.

As rhetoricians, we should be open-minded about extending our efforts into the digital realm. If there is no Aristotle for images, then there is certainly no Aristotle for web design.<sup>178</sup> If we want to stay current we will have to devise frameworks for analyzing new media.

This project has begun to analyze historical instances of visual science communication to find what might have been effective techniques, considering factors like audience, social and political climate, publication constraints, and, of course, the status of science as a discipline. In future projects, I hope to find answers to the questions, *What constitutes effective visual communication?* and, *What is feasible when it comes to 'communicating science' to non-expert publics?*

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<sup>178</sup> See Ball and Moeller, however, for some preliminary attempts at adapting the classical rhetorical cannon to the digital realm.

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