The Eye of Hubble

Framing Astronomical Images

by Evan Snider

Abstract

This paper examines images of deep space captured by the Hubble Space Telescope in terms of the aesthetics and the rhetorics attached these images. Hubble images distributed to the public — often called "pretty pictures" by astronomers — employ an aesthetics of shock and awe that works to efface the production practices that result in finished distributed images. In this paper, I investigate the framing of Hubble images in one particular type of popular artifact: the coffee table book. I begin by theorizing and historicizing what I call a rhetoric of objectivity. I continue by discussing the aesthetic and rhetorical decisions made by astronomers in the construction of images for both scientific and public purposes. Finally, I present original research in the form of textual analysis. I analyze the textual framing of Hubble images in printed anthologies, especially high-quality glossy anthologies known as coffee table books. I focus on "The Pillars of Creation," one of the most immediately recognizable Hubble images, as paradigmatic of the ways images are contextualized. I conclude that coffee table books, because of the constraints of their audience, tend to perpetuate simplistic notions of Hubble images as photographic, as direct representations of visual reality.

Introduction

In January 2011, the European Southern Observatory (ESO) announced the results of a contest called "Hidden Treasures."[1] The contest, conducted in late 2010 and open to the public, asked entrants to "dig through [the] huge collection of images from some of the best telescopes in the world, and reveal its hidden treasures."[2] Participants were invited to comb through the publicly available ESO Science Archive — with its "many terabytes of data . . . spanning many years, different instruments and technologies" — for raw data frames, which they would then process, combine, and colorize to create "beau-

[1] "ESO – Hidden Treasures Competition," *European Southern Observatory*, last modified January 12, 2011, http://www.eso.org/public/outreach/hidden-treasures/index.html.

[2] Ibid.

tiful images of the night sky using real astronomical data."[3] Entries were judged "on the basis of their aesthetic and technical quality and originality," and the winners were offered extravagant prizes, including a grand prize trip to the aptly named Very Large Telescope in Chile.[4] Entries were displayed on Flickr and Facebook, and the winning images were trumpeted by the ESO, popular science publications, and the mainstream press (for example, see NPR's blog *The Picture Show*).[5]

I relate this story not only because it shows us that astronomical images are currently making news — they are, in fact, always currently making news — but because it offers a moment for (scholarly) reflection on the production and circulation of astronomical images. Who makes them, and how? Why are they made, and for what audiences are they intended? What ideologies — about science, technology, space, photography, vision, etc. — are wrapped up in their production and circulation? What rhetorics and aesthetics are employed in discourses about astronomical images, and how do they work to perpetuate those ideologies? And, in the end, what difference does it make? Put glibly, why get all worked up about pictures of space?

This paper offers one set of possible answers to these questions. I frame the project in the introduction, then discuss, through secondary literature, how digitally processed images are constructed and the rhetorics and aesthetics attached to them, as well as the ideological implications of those rhetorics and aesthetics. I argue that naturalistic rhetorics of objectivity efface the complex — and deeply human — modes of production behind digitally processed astronomical images. I conclude by presenting original research into one particular publication context for images captured by the Hubble telescope: glossy full-color anthologies, ones you would likely keep in a prized position on the shelf or on your coffee table. If, as Roland Barthes has argued, text serves to fix the denotations and connotations of a polysemous image, then publications like Hubble books are important objects of study for the ways they construct and perpetuate certain rhetorics, aesthetics, and ideologies.[6]

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[3] Ibid.

[4] Ibid.

[5] Jonathan Makiri, "Astrophotography: Searching Data for Hidden Treasures," *The Picture Show* (blog), *NPR*, January 22, 2011, http://www.npr.org/blogs/pictureshow/2011/01/22/133120650/atrophotography?ps=cprs.

6 Roland Barthes, *Image – Music – Text*, trans. Stephen Heath (New York: Hill and Wang, 1977), 40.

Hubble images may seem like a peculiar object of inquiry. But, images from the multi-billion dollar observatory satellite saturate our society and are one of the primary sources for the contemporary public conception of space. The images of deep space from Hubble that trickle down to the public are often visually stunning: we see galaxies collide and stars explode, and we cannot help but be rendered momentarily speechless, an aesthetic of shock and awe at work. But, this sheer beauty has a downside: we stop at shock and awe and never move beyond that initial reaction to a critical understanding of these images. I would like to say that this lack of reflective viewing is restricted to public audiences, but scholars have long ignored these images, as well. Only a smattering of academic texts address astronomical images, and many of those historicize earlier image production technologies.

The temptation might be to consider these images benign records of actual events or direct representations of some form of visual reality.[7] Scholars like Mitchell and Benjamin have long problematized this approach to photography, though, and Hubble images are not photographs as we would traditionally conceive of that term: rather, they are digitally processed images.[8] The moment we begin to naturalize these images is when they become most dangerous. As Barton and Barton have shown in "Ideology and the Map," the most naturalized visual representations are often the ones most ideologically loaded.[9] This is particularly relevant now, when space has lost much of its nationalistic character. For another generation, space *was* politics, but, since the Cold War, space has become seemingly innocent, our discourse of space devoid of obvious imperial overtones. As long as the visual scholarship continues to ignore the ideological consequences of these

[7] One could make the argument that visual reality does not exist, since vision is a perceptual system that organizes certain natural phenomena like light. If we consider the fact that we have access to these natural phenomena only through our own conceptual categories (e.g., light, wavelengths, etc.), then we could extend the argument to claim that reality is inaccessible through any direct means. This is not the place for ontological arguments, though.

[8] I recognize that there is a vast body of scholarship problematizing photography and the ways photographs are constructed and disseminated. Given the scope of this paper, as well as the fact that Hubble images are not really photographs, I have elected not to dip into this scholarship. There are, nevertheless, interesting parallels just waiting to be made.

[9] Ben F. Barton and Marthalee S. Barton, "Ideology and the Map: Toward a Postmodern Visual Design Practice," in *Professional Communication: The Social Perspective*, ed. Nancy Roundy Blyler and Charlotte Thralls (Newbury Park, CA: Sage Publications, 1993), 49-78. It is possible to conceive of Hubble images as both photograph and map, though they are not technically either. Numerical information attached to Hubble images about telescope positioning, object distance, and so on, serves to organize space in a way not dramatically different from maps.

images, then there is little hope of problematizing images of space in the public sphere. And, as the analysis I present in the following section shows, they are desperately in need of such problematizing.

Rhetorics of Objectivity

The Hubble Space Telescope was designed with a single hope in mind: by launching a powerful observatory into space, we could see more of the universe, untainted by Earth's own atmosphere. Michael Kemp was thus able to historicize Hubble as the latest "in a long succession of human endeavours to create the ultimate form of sight — one that is all powerful and rigorously objective, untouched, as it were by human hand and more importantly uncontaminated by the fallibilities of our limited visual apparatus."[10] This historical quest for the ultimate mechanical eye is deeply rooted in the practices of astronomy. While it would be tempting to trace its origins to photographic technologies, it actually emerged from the post-Enlightenment positivistic turn in astronomy.[11] Before photographic technology existed, astronomers kept records through sketches and finished drawings. These drawings involved extensive work by astronomers, and publications often described that work in order to verify the image's scientific content. Simon Schaffer has argued, though, that these drawings were often viewed as direct representations of visual reality and "the observatory [was viewed] as a kind of institutionalized retina where celestial sights were immediately, almost effortlessly, recorded without prior judgment or experience."[12] This view of the observatory and the expert operating within it should be familiar to historians of science, since the laboratory has been cast in the same terms as the bench from which scientists observe and impartially record the world. I subsume the discursive constructions of this perspective under the heading of "naturalistic rhetorics of objectivity." I occasionally shorten the phrase to "rhetorics of objectivity," but the naturalistic aspects — the idea that we have access to nature and can apprehend and quantify nature — never disappears entirely. And, while naturalistic rhetorics of scientific objectivity have taken on their own peculiar character and history in astronomy, they share much in common with other observational sciences.

[10] Michael Kemp, *Seen/Unseen: Art, Science, and Intuition from Leonardo to the Hubble Telescope* (Oxford: Oxford University Press, 2006), 242.

[11] Simon Schaffer, "On Astronomical Drawing," in *Picturing Science, Producing Art*, ed. Caroline A. Jones and Peter Galison (New York: Routledge, 1998), 442.

[12] Ibid.

The arrival of photoengraving technologies was heralded as the most important breakthrough in astronomy — and the quest for objectivity — since Galileo's invention of the telescope. Photography offered astronomers the ability to record images and review changes between them. As Alex Pang has shown, though, early photo printing technologies were finicky and required an expert hand to operate them. As with drawing, astronomers effaced instead of highlighted the human element, setting a benchmark of images "so skillfully worked that they betrayed no evidence of human intervention."[13] Astronomers could not completely disregard the skill involved in reproducing images, but, rather, sought to redefine "aesthetics and craft skill … in a way that made them self-effacing."[14] As photographic technologies have improved, the need for skilled printing has diminished significantly. It is possible, then, to see the human element — aesthetics and craft skill — as progressively decreasing in value, from explicit public descriptions of astronomers' processes (as in drawing) to self-effacing aesthetics (as in early photography) to an entirely mechanical stance toward image capture technologies. Digital images are most often cast in this mechanical rhetoric, and we can see that play out in discussions of Hubble.

We don't have to turn very far to see contemporary evidence that a mechanical rhetoric of objectivity is alive and well. While we might think of this rhetoric as exclusively the purview of scientists, it actually appears prominently in popular science publications. Headlines from major science news publications often cast Hubble as a mechanical eye, one that "sees," "captures," or "views" visual reality. "Hubble Sees All the Light There Is," declares one *Science* headline.[15] Two *Science News* headlines — "Hubble Space Telescope: Eye Wide Open" and "Hubble Finally Has the Stars in Its Eyes" — extend the metaphor of the mechanical eye even further, the latter anthropomorphizing Hubble by pluralizing "eyes."[16]

Another common vision metaphor, that of the mirror held up to nature, highlights the focus in the rhetoric of neutrality on immediacy and access to reality. In their eerily similar titles alone, two popular books on Hubble — a history of Hubble

[13] Alex Pang, "Technology, Aesthetics, and the Development of Astrophotography at the Lick Observatory," in *Inscribing Science: Scientific Texts and the Materiality of Communication*, ed. Timothy Lenoir (Stanford, CA: Stanford University Press, 1998), 225.

[14] Ibid., 226.

[15] Robert Irion, "Hubble Sees All the Light There Is," *Science*, January 16, 1998.

[16] Ron Cowen, "Hubble Space Telescope: Eye Wide Open," *Science News*, January 22, 2000.Jonathan Eberhart, "Hubble Finally Has the Stars in Its Eyes," *Science News*, May 26, 1990.

entitled *The Universe in a Mirror* and an image anthology entitled *Hubble: The Mirror on the Universe* — employ this metaphor.[17] These titles may seem benign at first, but they cast Hubble and images from Hubble in naturalistic terms: Hubble is a device that reflects nature down to us. The danger, then, is that we will forget that images from Hubble are *not* direct representations of visual reality. Kemp has argued that any image designed with a naturalistic character or set in naturalistic signifying systems "asks to be taken on trust, and we are generally only too willing to acquiesce."[18] Hubble images cast in this light, then, are ideologically fraught with assumptions about nature, reality, space, and human technology. Lest we think that modern viewers are too savvy to fall into the trap of machinistic rhetoric, Kemp warns that "this popular reaction … dies hard."[19] I would argue that as digital image technologies advance, this approach to images as natural representations of visual reality becomes further entrenched in popular discourses.

Aesthetics and Image Construction

Like any rhetoric, this rhetoric of objectivity is discursively constructed, and it serves a distinct purpose: to support the scientific edifice by eliding the ways images are mediated and constructed. Images, even taken by a machine, begin and end with what Kemp has called "the human visual system" and thus are "irredeemably subject to our ways and habits of seeing."[20] How, then, does the human vision system factor into astronomical images? While that depends on the type of image, there are some commonalities: astronomical images are always constructed, whether through drawing, photography, or digital image processing. In the process of constructing these images, astronomers make significant aesthetic decisions, though the context of the images dictates the aesthetic paradigms they employ. In conjunction with these aesthetic decisions, astronomers make significant rhetorical decisions about audience, purpose, and context, decisions that would not be considered in the objective model above.

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[17] Robert Zimmerman, *The Universe in a Mirror: The Saga of the Hubble Telescope and the Visionaries Who Built It* (Princeton, NJ: Princeton University Press, 2008).
Robin Kerrod, *Hubble: The Mirror on the Universe* (Buffalo, NY: Firefly Books, 2003).

[18] Kemp, *Seen/Unseen*, 243.

[19] Ibid., 245.

[20] Ibid., 268-269.

What little scholarship on astronomical images exists revolves almost exclusively around the theme of aesthetics. It is possible to trace that scholarship back to a single landmark article, Michael Lynch and Samuel Edgerton's "Aesthetics in Digital Image Processing: Representational Craft in Contemporary Astronomy." Following in the ethnomethodological footsteps of Latour and Woolgar, Lynch and Edgerton conducted a study of practitioners at digital image processing facilities — usually astronomers and technicians — to discover to what extent they engaged in a "craft" of visual representation. They conclude that this craft was "hidden within the ordinary details of scientific practice."[21] In other words, while they may not call what they do "art" or what they are concerned with "aesthetics," astronomers frequently engage in practices that require aesthetic judgments. Put simply (and a bit reductively), digital image processing is the method by which practitioners take various values — up to 256 discrete values — encoded into individual pixels and create a usable image from that data through filtering, combining, colorizing, and more. The array of different choices practitioners have is staggering, and Lynch and Edgerton found that these choices allowed practitioners artistic and creative freedom, including "actively play[ing] with gestalt properties."[22]

The great value of Lynch and Edgerton's study, though, is not just to pull back the curtain on astronomy, but to account for how practitioners talk about aesthetics and science, the categories they discursively construct for understanding the processes by which they create images from data. One such category that dominates discussions of popular astronomy is that of "pretty pictures." The authors interviewed a number of astronomers who would use what are called "false color schemes" (color palettes that diverge from what astronomers conceive of as an object's intrinsic colors).[23] The creators of these images would consistently refer to them as "pretty pictures" and distance them from the "real" scientific work of image processing. These pretty pictures are occasionally constructed for artistic purposes, but most frequently for distribution to a lay audience (e.g., in news media or semi-popular magazines like *Sky and Telescope*) or for promotional litera-

[21] Michael Lynch and Samuel Y. Edgerton, "Aesthetics and Digital Image Processing: Representational Craft in Contemporary Astronomy," in *Picturing Power: Visual Depiction and Social Relations*, ed. Gordon Fyfe and John Law (London: Routledge, 1988), 186.

[22] Ibid., 189.

[23] A true color scheme, then, is utilized when an image appears exactly as the subject would appear to the naked human eye. That distinction is complicated further by the fact that many Hubble images are of subjects outside the spectrum of human vision. Kemp has argued that false color schemes are not really false in any sense of the word, but only a matter of different visual codes.

ture (e.g., grant proposal covers). Lynch and Edgerton found that astronomers would distinguish between the production of pretty pictures through qualitative (subjective) methods and the production of images of scientific value through quantitative (objective) methods.

While Lynch and Edgerton found that astronomers would manipulate pretty pictures more freely than scientific pictures (with less concern for scientific content), they also argue that the qualitative-quantitative and art-science binaries belied astronomers' actual practices. They observed that practitioners, like all other scientists, would often pick and choose among data to create a certain visual representation that suits their research. By choosing certain color schemes, adjusting image qualities like contrast, and filtering out various data, astronomers would make significant aesthetic decisions even in images for "scientific" purposes. Similarly, the aesthetic decisions involved in the creation of "pretty pictures" for popular consumption were tethered to "scientific" content, and often involved finding ways to strikingly represent that content in a relatively "accurate" way. Lynch and Edgerton thus characterize the aesthetic involved in digital image processing as "practical Cartesianism": "it is the very fabric of realism: the work of composing visible coherences, discriminating differences, consolidating entities, and establishing evident relations."[24] In other words, the aesthetics involved in digital image processing are not aesthetics for their own sake, but part of an interpretive craft of visual representation "situated within the performance of scientific practice."[25]

Other scholars have followed Lynch and Edgerton and shown that aesthetic judgments are embedded in the scientific practices of astronomy at all levels. In his historical study of astrophotography at the Lick Observatory in Santa Cruz, Pang notes, "the development of a similar aesthetic helped stabilize astrophotography in the late nineteenth and early twentieth centuries, and became a resource for turning natural images into natural facts."[26] This aesthetic, parallel to the one Lynch and Edgerton note, had its own particular flavor, given the mechanistic rhetoric attached to early developments in photographic technology. The choices astronomers asked printers to make, however, were not significantly different: while the processes they had to work with were different, astronomers still dictated issues like contrast and sharpness. Pang also notes a similar discursive construction to that of digital image processors: astronomers would frequently draw a clear line

[24] Lynch and Edgerton, "Aesthetics and Digital Image Processing," 208, 212.

[25] Ibid., 212.

[26] Pang, "Technology, Aesthetics," 228.

between improvement and alteration of an image. In communications with printers, astronomers demarcated clear boundaries between improving an image by retouching the space (background) around the subject and altering it by retouching the actual subject (stars, comets, lunar features, etc.). While this line was undoubtedly clear, it was also negotiated, and astronomers frequently invoked its authority when communicating with printers.

In her comparative study of drawings and digital images of the M51 nebular, Elizabeth A. Kessler echoes the aesthetic distinctions Lynch and Edgerton previously made: "While 'pretty pictures' reflect aesthetics principles such as beauty and expressiveness, the scientific representations embrace an aesthetics informed by realism."[27] This distinction, Kessler claims, has blurred, as scientific images often contain beauty and expressiveness and "pretty pictures" are constructed with some notion of scientific realism in mind. She extends this argument further, though, saying that astronomical images can be interpreted simultaneously as "scientifically significant and aesthetically attractive."[28] In this view, there is not a significant difference between the construction of "pretty pictures" and scientific images: since there is no way to achieve total realism, efforts at realism in scientific images always carry with them aesthetic judgments about ways to make underlying structures visible. The resultant images, then, "*relate* to forms and structures, but … are not, strictly speaking, *records* of them."[29]

Pretty pictures and scientific images share similar elements of choice, and the processes by which individuals alter images to reveal underlying structures and to make them aesthetically attractive are not entirely distinct. This seems to be especially true in digital image processing, where a single "image" can be altered to receive vastly different results. No matter the circumstances, though, one thing is abundantly clear: the line between improvement and alteration, a line that was discursively created and inscribed in scientific practice, has historically been hazy and ill-defined and becomes even more so in a digital age.

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[27] Elizabeth A. Kessler, "Resolving the Nebulae: The Science and Art of Representing M51," *Studies in History and Philosophy of Science* 38 (2007): 478.

[28] Ibid., 488. Since they serve promotional purposes, pretty pictures are also "very much a part of 'doing science,' although they may not lead to conclusions that are written up for a scientific journal" (486). In order to serve this promotional purpose, Kessler concludes, these images draw on an "aesthetic of wonder and awe" (486). Wonder, awe, and beauty, then, are an integral part of science, even as they are marginalized within scientific discourses.

[29] Kemp, *Seen/Unseen*, 63 (my italics).

One distinction between pretty pictures and scientific images does have significant bearing: that of audience. Pretty pictures are most often distributed to public audiences, and rhetorical issues of audience, purpose, and context dictate the kinds of aesthetics practitioners employ and the decisions they make. In their discussions of context with practitioners, Lynch and Edgerton found that they would often include both numerical and narrative information with images, with the latter more commonly found in popular publications. Narratives, though, were not solely accounts of preexistint images: the authors found that practitioners would frequently manipulate an image to fit a narrative already constructed in captions and other texts. These narratives were crafted with particular audiences in mind, and they would differ depending on the purpose of the publication. Likewise, Pang notes that the printing process in early astrophotography was rhetorical in nature: "context, use, and audience had to be taken into account when deciding how much brilliance, contrast, sharpness, flatness, snap, and life a picture should have."[30] Aesthetic and rhetorical decisions, then, were virtually inseparable.

The common theme is that aesthetics are flexible and bend to rhetorical considerations. For example, Kessler writes that "astronomers shift their emphasis according to the intended audience for an image."[31] In all cases, various meanings get attached to images through their communication in specific contexts. To illustrate this principle, Kessler cited J. P. Nichol's metaphor-laced Romantic description of an engraving of M51, a case in which the textual narrative attached to an image dramatically altered its meaning and reception.

Lest my extensive borrowing from historical arguments glosses over the importance of material technologies, I should note that the processes available do alter the construction of images. This becomes especially important in the context of Hubble images. The invention of the camera once offered a seemingly immediate and neutral apparatus that could capture and record astronomical images, but what does digital image processing offer? It is possible to conceive of digital image processing as a ramped-up form of photography, and, thus, to see Hubble as a more advanced mechanical eye than any before it. But, as William J. Mitchell has argued, digital image processing provides a radical split from the fragile, material existence of photographic technology. For Mitchell, digital images "cannot adequately be understood as primarily a matter of capture and printing … immediate *processing* of images plays

[30] Pang, "Technology, Aesthetics," 245.

[31] Kessler, "Resolving the Nebulae," 490.

a central role."[32] It is equally possible, then, to conceive of digital image processing as a return to the immediately constructed nature of astronomical drawing. Ultimately, though, the difference is in terms of the layers of mediation: the human eye and vision system, the telescope, the human hand, the camera, the image processor, and the computer.

The Framing of Hubble Images

I said before that meanings get attached to astronomical images depending on their publication and circulation in various contexts. That simple and somewhat commonsensical statement is what drives the remainder of this paper. While digital technologies (only) add new layers to the construction of images, they radically alter the ways those images are circulated. In *The Reconfigured Eye: Visual Truth in the Post-Photographic Era*, Mitchell justifies the study of the use contexts of images. To understand images, he argues, we must trace what is done with them as much as how they are created: we must focus on "not only how photographs and pseudo-photographs are *made*, but also how they are *used* — how their potential uses are established, how they are appropriated and exchanged, how they are combined with words and other pictures and made to play roles in narratives, and how they may have the effect of creating beliefs and desires."[33]

By making this argument, Mitchell echoes Roland Barthes. In the "Rhetoric of the Image," Barthes elaborates a systematic approach to visual rhetoric, looking particularly at advertisements. He spends a good deal of time focusing on the "linguistic message" of the image, located in captions and ad copy. Of particular interest to the issue at hand is his assertion that the "text *directs* the reader through the signifieds of the image, causing him to avoid some and receive others . . . it remote-controls him towards a meaning chosen in advance."[34] Barthes envisions a polysemous image with a floating chain of possible signifieds, in which the text serves to focus attention to a particular set of signifieds. He calls this function of the linguistic message "anchorage," and he characterizes anchorage as "repressive," since it fixes meaning and thus invests the image with "the morality and ideology of a society."[35]

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[32] William J. Mitchell, *The Reconfigured Eye: Visual Truth in the Post-Photographic Era* (Cambridge, MA: The MIT Press, 1992), 7 (my italics).

[33] Ibid., 192.

[34] Barthes, *Image – Music – Text*, 40.

35 Ibid.

Barthes' comments, though, were meant to apply to advertising images, which often did not circulate with different linguistic messages attached to them. Astronomical images — and, one could argue, digital images more broadly — circulate in a much more open fashion and, thus, have numerous different linguistic messages attached to them. The same image, then, will have many different lives: it will be shown on CNN, distributed by Astronomy Picture of the Day (APOD), printed in *Sky and Telescope*, printed on the cover of a grant proposal, archived on NASA and the ESO's websites, included in coffee table books, and so on. In each of those different contexts, the "same" image has different linguistic message, and, so, different meanings.

In this section, I answer Mitchell's call by charting one context for the distribution of Hubble images, the printed anthology. I chose to focus on printed anthologies for a number of reasons, most importantly that they often include narrative descriptions about the pictures inside them. While another study might look at news media, the purpose of this study is to compare similar types of texts with an eye for differences between those texts. I will, however, draw briefly on NASA's digital image archive, the Hubble digital archive, and the website for PBS's *Nova: Origins* to make an argument that Hubble images can and should be contextualized for viewers in certain ways. Given the rhetorical progression from expertly constructed to purely mechanical discussed above, I expected to find the latter account of Hubble images to dominate. In other words, I expected to find images referred to in terms of their scientific content (their discoveries) and, perhaps, their beauty, but never in terms of their origins (except perhaps through numerical data). Of course, the ways publications characterize images varies vastly depending on audience, purpose, and context. That variation is what this section is meant to address: What contexts allow for complex accounts of Hubble images, ones that accommodate the mediated and constructed nature of images? Are these accounts more likely to appear in scientific publications or in popularizations? What contexts result in the opposite approach, perpetuating rhetorics of scientific objectivity?

It is important to note that images, once released to the public, often function differently than astronomers intended. Joshua M. Greenberg has studied the meanings attached to one of the most famous Hubble images, the "Pillars of Creation" **(Fig. 1)**. He found that the origins of Hubble images were of-

tenblack-boxed — that is, obscured by other information and not made available to the public — when those images were disseminated to the public. "Thus, convinced of their scientific purity, members of the public generally treat such pictures with a sense of reverence," imbuing them with a wholly representational quality. Greenberg argues that while the effort to black-box the creation of the "Pillars" was supported by television news media, it also resulted in alternative meanings that were counter to those intended by the scientists involved. After CNN aired a segment introducing the "Pillars," a small group of individuals called in claiming to have seen the image of Jesus Christ in the picture. Later publications expounding these religious meanings relied heavily on the black-boxing of the image's origins. Thus, the rhetorical technique of omitting any information about the construction of the image had unintended consequences and led to a plurality of meanings.

The "Pillars of Creation" is a good place to begin analyzing the differences in various contexts, for it is one of the most ubiquitous Hubble images. The "Pillars" underwent extensive alteration prior to its release to the public, and Greenberg has charted these changes.[36] This section includes textual analysis of eight anthologies published between 1995 and 2008 (see the bibliography for individual entries). I selected these eight anthologies based on their public availability, as well as their publishers (a mix of popular and scientific presses). Of those eight, six included the "Pillars of Creation," with all but one of them dedicating a full-page spread to the image and text about the image. I began by loosely coding the information attached to images. I settled on six categories of information: descriptions of the *subject* (far and away the most common, these contaie narrative information about what viewers see in the image, the "scientific" content), *metaphor*-laced descriptions of the image, *meta-narratives* about the lives of stars or other natural phenomena, *technological narratives* about Hubble, *numerical data* about the subject's position in space, the image, etc., and *image construction* narratives accounting for the processes by which the image was made (e.g., see footnote 36). **Fig. 2** shows which of these six categories appear in reference to the "Pillars of Creation." Every anthology I analyzed described the scientific content of the image, whether in a short caption or in multiple paragraphs of text. Beyond that, though, there were few commonalities. Notably, none of the anthologies referred to the "Pillars" in the context of technological narratives about Hubble. Those narratives tend to be isolated to the beginning sections of anthologies, so this finding is not surprising.

[36] The image was colorized using three main colors, red, green, and blue. It was also reframed to make the pillars appear vertical. It was contrast-enhanced and diffraction spikes were added to make the stars twinkle in the background (86).

Given the variety of different information attached to the "Pillars," I decided to take a more holistic approach and see if certain audiences, purposes, or contexts led to certain types of information. I also wanted to explore whether or not the types of information I list above led, in certain combinations, to commonalities in *meaning*. In an effort to understand the ways these texts position images, I divided them into three categories, which represent three different stances toward images and, thus, three different arrangements of meaning (or, as Barthes might say, sets of potential signifieds). **Fig. 3** summarizes these categories, which are by no means definitive, but do complicate understandings of context for Hubble images.

In the first category, images tend to serve as *illustrations* for larger meta-narratives about Hubble or our scientific knowledge of the cosmos. Texts that take this approach may appear staid and traditional, as the emphasis is on textual meaning more than visual meaning. These texts are usually directed at an audience interested in scientific knowledge and in the Hubble as a technological artifact. Contextualized within larger meta-narratives, images tend to provide evidence of both the technological prowess of Hubble and its contributions to scientific knowledge. This approach, then, could lead to an uncritical acceptance of the scientific content of images, as those images come to stand in for what they depict. When they serve as illustrations, Hubble images evoke an aesthetic of shock and awe not necessarily for their beauty (although partially for that), but for what they represent in terms of scientific achievement and progress.

In the second category, images serve predominantly as *pictures*: employing full-page spreads and visually stunning images, books that take this approach are often the most professionally designed, with multiple images per page. While they occasionally provide meta-narratives, most of the images and text are self-contained. In other words, they are designed to be viewed (quickly glanced through), rather than read. These are coffee table books, meant to be displayed in a prominent place as an artistic artifact. Not surprisingly, the number of Hubble coffee table books far outweighs the number of other Hubble anthologies. The descriptions of individual images in these anthologies are often metaphorical in nature, and figurative language often sits uncomfortably next to scientific temi-

nology. **Fig. 4** demonstrates some of these features in a full-page spread of the "Pillars."

In the final category, images are treated as genuine *content*: anthologies that take this approach place the most emphasis on individual images. They are often even more traditional in layout than illustrative texts, with images on one page and long descriptions on the facing page. They rarely contextualize images within meta-narratives, but, rather, provide details about the scientific content of individual images. They may or may not contain numerical data, but they often provide narratives about the construction of images. They mostly avoid figurative language. **Fig. 5** illustrates these concepts: notably, the images are labeled as "plates" and numbered, both of which signal their importance as genuine content.

These categories suggest that the context for images changes the types of meanings they convey. An audience's presumed level of interest, engagement, and expertise dictates the types of information authors include with images and the ways they position those images in the text. For example, authors may choose to include a glossary of terms, depending on the presumed motivations of their audience. Likewise, they may decide to include true color images, images from various steps in the process, or even unfiltered "raw" images. As context changes, so, too does the use of figurative language. Greenberg has shown that this metaphorical content often originates in press releases. The press release for the "Pillars," for example, described the image as "eerie" and "dramatic," words that carry through in other accounts.[37] Elsewhere, authors consistently employ the metaphor of stalagmites rising from a cave floor that appears in the press release. The one commonality, though, between all the texts I analyzed was their borrowing of the language of the press release in descriptions of the scientific content of images.

At the heart of this paper is an interest in the communication of information about the construction of images, whether numerical or narrative in nature. Rarely do the anthologies I analyzed account for the complicated procedures and aesthetic decisions astronomers make when constructing images for public release. I had to go further afield for significant accounts of image construction. NASA's image archive contains a significant number of Hubble images, with both narrative descriptions and large amounts of numerical data, ranging from telescope positioning to camera and filter information.[38]

[37] "Embryonic Stars Emerge from Interstellar 'Eggs,'" *HubbleSite*, published November 2, 1995, http://hubblesite.org/newscenter/archive/releases/1995/44/text/.

[38] Internet Archive, *NASA Images*, http://www.nasaimages.org/.

Elsewhere, PBS's *Nova: Origins* website provides extensive narrative information about the construction of the "Pillars."[39] The electronic medium is crucial here, since printing restrictions do not allow for this kind of information to take up so much space.

More important, though, is the issue of context: publications directed at lay-experts frequently recognize the amount of labor and intuitive decisions that go into making a Hubble image. As an example, the tagline for an article in *Sky and Telescope* magazine, which caters to amateur astronomers and astrophotographers, entitled "Creating Hubble's Technicolor Universe" declared, "Behind every gorgeous Hubble Space Telescope image, there's much unsung work — and a lot of judgment calls."[40] That sentence may seem trivial, and it can be in a different context, but when paired with images from various stages of processing and information about the construction of images, it is powerful and radically alters our perception of Hubble images. By taking image construction of the black box in which it has so long been encased, accounts like these provide a better understanding of Hubble images and can also cut off many of the unintended consequences that Greenberg noted.

This research is necessarily abbreviated and cannot address all aspects of printed Hubble anthologies, much less other contexts for images from Hubble. Future research could address these other contexts, expanding to include news media and popular culture contexts. The "Pillars of Creation" graces coffee mugs and t-shirts, yet we have little conception of the meanings attached to it — and images like it — in virtually any context. To date, most of the studies on Hubble images have addressed their origins without addressing how, if at all, those origins are communicated to lay audiences. Only Greenberg's study addresses the meanings attached to images after distribution to the public. The more we pay attention to the framing of Hubble images, the more we will find that these images are complicated and flexible, that they mean dramatically different things to different groups of people. Until we understand those meanings, then Hubble images will remain simply "pretty pictures" of space. They will continue to be black-boxed, and they will continue to perpetuate naturalistic ideologies of technological progress and scientific knowledge. And, given the complexity of these images and their place in the popular consciousness, that's something none of us can afford.

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[39] "The Pillars of Creation," *PBS*, last modified July 2004, http://www.pbs.org/wgbh/nova/ origins/hubb-nf.html/.

[40] Ray Villard and Zolt Levay, "Creating Hubble's Technicolor Universe," *Sky and Telescope* 104, no. 3 (2002): 29.

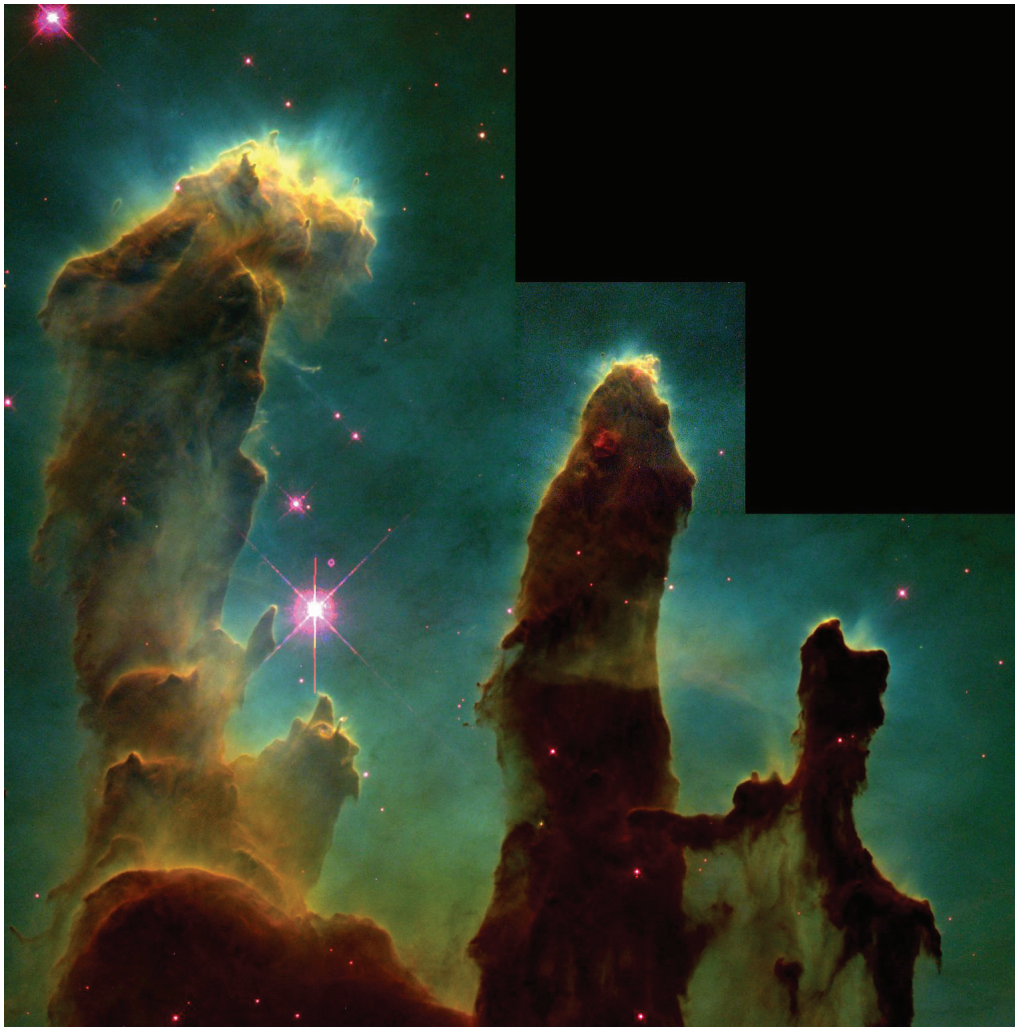


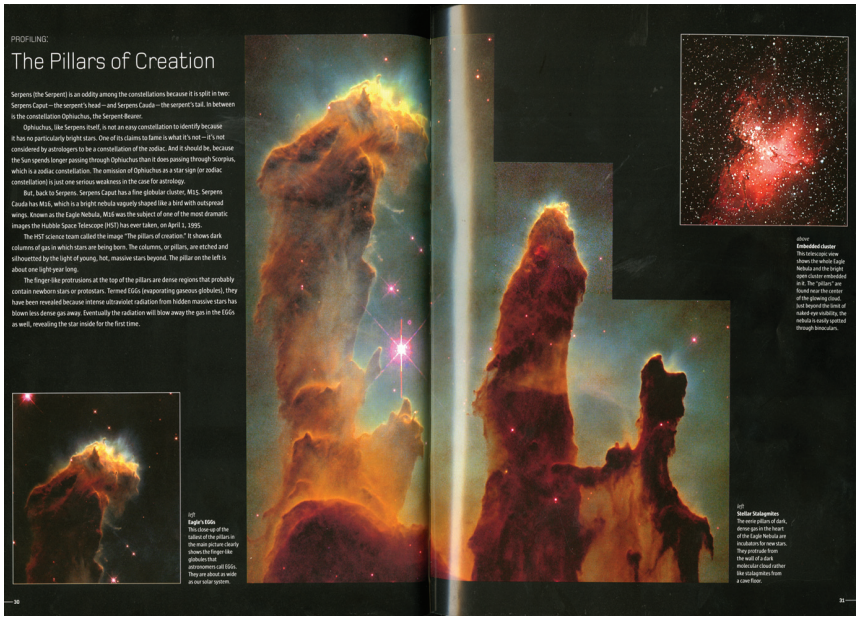
Fig. 1: The original "Pillars of Creation" released by NASA.

	Subject	Metaphor	Meta-narrative	Technological narratives	Numerical data	Image construction
Devorkin and Smith (2008)	x	x				
Fischer and Duerbeck (1998)	x					
Goodwin (1996)	x				x	x
Kerrod (2003)	x	x				
Mitton and Maran (1996)	x					x

Fig. 2: A chart showing the types of information attached to the "Pillars of Creation" in various anthologies.

	Features	Examples
Images as Illustrations	Embedded in larger meta-narratives Emphasis on textual meaning Images provide evidence for the text Support "scientific" readings of the text	Barbree and Caidin (1995) Fischer and Duerbeck (1998) Petersen and Brandt (1995)
Images as Pictures	Full-page spreads with stunning visuals Metaphor-laced descriptions Meant to be viewed, not read Scientific content secondary to beauty	Christensen and Fosbury (2006) Devorkin and Smith (2008) Kerrod (2003)
Images as Content	Focus on the images, including scientific content and image construction Long descriptions accompanying images Almost no meta-narratives	Goodwin (1996) Mitton and Maran (1996)

Fig. 3: Three different approaches to Hubble images.



PROFILING:

The Pillars of Creation

Serpens (the Serpent) is an oddity among the constellations because it is split in two: Serpens Caput – the serpent's head – and Serpens Cauda – the serpent's tail. In between is the constellation Ophiuchus, the Serpent-Bearer.

Ophiuchus, like Serpens itself, is not an easy constellation to identify because it has no particularly bright stars. One of its claims to fame is what it's not – it's not considered by astrologers to be a constellation of the zodiac. And it should be, because the Sun spends longer passing through Ophiuchus than it does passing through Scorpius, which is a zodiac constellation. The omission of Ophiuchus as a star sign (or zodiac constellation) is just one serious weakness in the case for astrology.

But, back to Serpens. Serpens Caput has a fine globular cluster, M15. Serpens Cauda has M16, which is a bright nebula vaguely shaped like a bird with outspread wings. Known as the Eagle Nebula, M16 was the subject of one of the most dramatic images the Hubble Space Telescope (HST) has ever taken, on April 1, 1995.

The HST science team called the image "The pillars of creation." It shows dark columns of gas in which stars are being born. The columns, or pillars, are etched and silhouetted by the light of young, hot, massive stars beyond. The pillar on the left is about one light-year long.

The finger-like protrusions at the top of the pillars are dense regions that probably contain newborn stars or protostars. Termed EGGs (evaporating gaseous globules), they have been revealed because intense ultraviolet radiation from hidden massive stars has blown less dense gas away. Eventually the radiation will blow away the gas in the EGGs as well, revealing the star inside for the first time.

left
Eagle's EGGs
This close-up of the tallest of the pillars in the main picture clearly shows the finger-like globules that astronomers call EGGs. They are about as wide as our solar system.

above
Embedded cluster
This telescopic view shows the whole Eagle Nebula and the bright open cluster embedded in it. The "pillars" are found near the center of the glowing cloud. Just beyond the limit of naked-eye visibility, the nebula is easily spotted through binoculars.

left
Stellar Stalagmites
The eerie pillars of dark, dense gas in the heart of the Eagle Nebula are incubators for new stars. They protrude from the wall of a dark molecular cloud rather like stalagmites from a cave floor.

30 31

Fig. 4: A full-page spread that approaches "Pillars" as a picture (Kerrod, 30-31).

PLATE 17

EAGLE NEBULA (M16)

The Eagle Nebula is another star-forming nebula much like the Orion Nebula. At 7000 light years away in the constellation of Serpens, it is much further away than the Orion Nebula. Its alternative name, M16, is its designation in Charles Messier's catalogue of 1781. Messier compiled a list of objects in the sky that were 'fuzzy' and extended, unlike the pin-point images of stars. Objects with an M number (which are nebulae, star clusters or galaxies) can be seen with a small telescope or binoculars, or even the naked eye.

These pictures, taken with WF/PC2 on 1 April 1995, show vast columns of cool, dense gas about a light year in height. These columns are so dense that the stars within them are hidden from sight, their light unable to penetrate the gas surrounding them. The columns are mostly molecular hydrogen, two hydrogen atoms joined together, which is normally too fragile to exist outside of nebulae. This fragility arises from the fact that energetic light (such as ultraviolet light) is able to split the molecules when it hits them. The columns also contain a lot of microscopic particles mostly made of carbon, known as 'dust', that are able to form in the protective environment of a nebula.

The columns have such a strange shape because there are a few very young, massive stars just off the top of the picture which are 'blowing away' the gas and dust (in the same way as the Trapezium stars in the Orion Nebula). Their light is breaking up the molecular hydrogen and heating up the gas in the cloud. When the gas gets hotter, it starts moving faster and eventually escapes from the nebula. The less dense parts of the nebula are evaporated by the stars' radiation first, leaving behind these columns.

In this image, again, the colours of the gas indicate which atoms are emitting light in that area. This time red is sulphur, green is hydrogen and blue is oxygen.

48

EAGLE NEBULA (M16)

49

Fig. 5: A full-page spread that approaches "Pillars" as content (Goodwin, 48-49).