Photographic Art in the Age of Digital Manipulation

Back to the Darkroom with Michael Lynch and Bruno Latour

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In scientific study, representation by photograph, diagram, or graph, is an almost universal tool for sharing the outcome of experiments, quickly demonstrating results, and convincing skeptical audiences. The unparalleled discursive and rhetorical function of images in scientific texts is emphasized in work by Michael Lynch and Bruno Latour. Both authors suggest that images are generally regarded as inherently authoritative sources—that is, that they are a factual depiction of an actual event. However, this view fails to recognize that images are liable to being manipulated. Lynch's essay "Science in the Age of Mechanical Reproduction: Moral and Epistemic Relations Between Diagrams and Photographs," examines the case of photograph-diagram pairs in scientific texts. These pairings preserve the "pure deictic language" of the photograph while still allowing the scientist to promote the essential details of the image in the diagram.[1] However, when the diagram is superimposed over the photograph—as is the case in photographic manipulation—the authority of the document is undermined. While photographic manipulation has existed since the earliest days of the medium, digital cameras and computer software have simplified and refined the process to the extent that nearly anyone can create a convincingly 'photorealistic' image. In the age of digital manipulation, photography threatens to lose its credibility as a method of authentic representation. The struggle to preserve the public perception of photographs as reliable has led to the rise of new fields such as digital forensics, as well as the proliferation of ethical codes and guidelines to determine the limits of permissible photographic manipulation. This paper will examine the guidelines for submissions to The Journal of Cell Biology as an illumination of Lynch's and Latour's respective positions on the use of images in scientific representation. By questioning the historical perception of photographic 'truth' in light of the contemporary trend towards digitally manipulated images, I suggest a move away from perfection in scientific representation as a means to preserve the authority of the image.

For ethnomethodologist Michael Lynch, images and representation play a crucial role in scientific research and process. Through representations, specimens are rendered observable and analyzable. In an essay entitled "Discipline and the Material Form of Images: An Analysis of Scientific Visibility," Lynch discusses the 'rendering practices' by which an object of study is refigured as a representation. Representations, for Lynch, are more than just helpful tools for scientific inquiry; rather, they "constitute the material form of scientific phenomena."[2] Some fields

[1] Michael Lynch, "Science in the Age of Mechanical Reproduction: Moral and Epistemic Relations Between Diagrams and Photographs," Biology and Philosophy (1991), 216.

[2] Michael Lynch, "Discipline and the Material Form of Images: An Analysis of Scientific Visibility," Social Studies of Science (Feb., 1985), 43.

of study, such as electron microscopy, are not possible at all without the "artificial appearance of a specimen" allowing the phenomenon to be observed at all.[3] Much of scientific representation entails the creation of 'docile objects,' or representations that depict the normalized findings of an inquiry. Lynch writes, "The docile object provides the material template that variously supports or frustrates the operations performed upon it. Its properties become observable-reportable in reference to the practices for revealing them."[4] The various forms of representation (graphs, photographs, diagrams, etc.) reveal different properties of the data and render them measurable in accordingly different ways. Lynch gives the example of a graphic display of findings in a study conducted on laboratory rats. In this representation, "the animal is 'sacrificed' along with a cohort of others for the sake of an aggregate line on the graph."[5] However gruesome the imagery, the charted data is much more available for scrutiny, analysis, and critique than a pile of dead rats. According to Lynch,

> The chart can be read as ... an idealized account of the lab's work. It bears both overt and hidden impressions of the labour constructive of it, and can be read by practitioners to evaluate whether the constructive practices were performed well, mistakes were made, or improvements should be devised.[6]

Representation, in Lynch's study, allows scientific information to be shared and used for further investigation.

Agreeing with Lynch on the importance of representation in science, Bruno Latour's essay "Visualisation and Cognition: Drawing Things Together" discusses the use of images as 'immutable mobiles'—that is, things that do not lose their meaning in transmission. Images act as a sort of souvenir of scientific exploration. He writes,

> If you wish to go out of your way and come back heavily equipped so as to force others to go out of their ways ... you have to go and to come back with the 'things' if your moves are not to be wasted. But the 'things' have to be able to withstand the return trip without withering away .... [and] be presentable all at once to those you want to convince
> and who did not go there.[7]

For Latour, representations (which he sometimes calls 'inscriptions') are a necessary rhetorical aid, allowing the scientist to represent a wide array of contingent ideas simultaneously. Scientists work with "two-dimensional inscriptions instead of the sky, the air, health, or the brain" for a number of reasons: "Inscriptions are mobile ... immutable when they move ... flat ... [their scale] may be modified at will ... They can be reproduced and spread at little cost ... they can be reshuffled and recombined ... it is possible to superimpose several images of totally different origins and scales ... [they can] be made part of a written text."[8] Just as Lynch demonstrates the usefulness of a graph over a pile of dead rats, Latour emphasizes the fact that inscriptions are less cumbersome, and therefore more helpful, than the original object of study. The creation of inscriptions offers a "second-degree advantage ... or surplus value," meaning that some aspects of scientific study are

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[3] Lynch, "Discipline", 38.
[4] Ibid., 44.
[5] Ibid., 58.
[6] Ibid.
[7] Bruno Latour, "Visualisation and Cognition: Drawing Things Together," <www.bruno-latour.fr>, 6.
[8] Latour, "Visualisation", 18-19.

enhanced when rendered as representations. Tellingly, Latour states: "You cannot measure the sun, but you can measure a photograph of the sun with a ruler."[9]

Furthering the discussion of scientific representation, Lynch's essay "Science in the Age of Mechanical Reproduction" explores the use of images in scientific texts, specifically the relationship entailed in diagram-photograph pairings. In their study, scientists and researchers rely on "picturable, graphable, mappable, or measurable" representations of scientific phenomena, either drawn (manual reproductions) or made by an instrument (mechanical reproduction).[10] These two methods of reproduction serve distinct purposes. Mechanical reproductions, such as photographs, offer a certain objective view of the subject: supposedly untouched by human hands, photographs allow the viewer to "regard the original object as if it stood before us."[11] A photograph is "hyper-realistic" and offers "surplus details" which can "transform the very meaning of the 'original' or 'unmediated' scene."[12] A diagram, on the other hand, "[aids] identification and classification by isolating or targeting 'essential details' of a specimen."[13] Presented side-by-side, a photograph of a subject and a diagrammatic depiction of the subject's essential features can provide visual evidence in a legitimate and easily understandable way. Lynch writes that, since

> the diagram provides a continuous field in which no clear demarcation is made between conceptually assumed and concretely seen detail, it is often regarded as a suspect form of original evidence. In contrast, we often assume that mechanical reproduction provides a direct transfer from nature to image, untouched by human hands and uncontaminated by preconceived ideas.[14]

Taken together, the photograph gives proof of reality and the diagram is a helpful didactic tool. The diagram is "parasitic" on the photograph and provides a schematization of important details that may be obscured in the photograph's surplus data.[15] However, Lynch holds crucial that the photograph and diagram are juxtaposed rather than superimposed—this structure maintains a "moral segregation between manually and mechanically reproduced surfaces, while at the same time it establishes a set of detailed correspondences between them."[16] Observing the segregated images exhibits a sort of conversation between them. The viewer can refer to one or the other, creating a full sense of what the diagram intends to demonstrate about the contents of the photograph. In the conversation between reproduced images, the viewer acts as an "overseer" of the interplay between images and text.[17] Lynch maintains that photo-diagram pairings are not the definitive method of communicating concepts in scientific texts, but are rather one of many visual modes of persuasion employed by scientists.

While Lynch and Latour both emphasize the importance of photographs both in revealing and in misrepresenting the objects of scientific study, it is also worth investigating whether or not photographs have an authentic claim to the truth. Dino A. Brugioni's book Photo Fakery traces instances of photo-manipulation back to the very earliest days of the medium. Daguerrotypes, invented in 1839, required extremely long exposures, during which time it was impossible for

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[9] Latour, "Visualisation", 20.
[10] Ibid., 208.
[11] Lynch, "Science", 214.
[12] Ibid.
[13] Ibid., 211.
[14] Ibid., 213.
[15] Ibid., 216.
[16] Ibid.
[17] Ibid., 219.

human subjects to refrain from blinking. Thus, the earliest example of manipulation is the photographer drawing the subject's open eyes onto the final image.[18] The first photographic portraits horrified their viewers, who were accustomed to the flattery of painted portraits and opposed to the photographic rendering their images "truthfully."[19] According to Brugioni, the "art of photo fakery" was created in order to rescue photography from a common reproach that it did not "present the soul" as paintings did.[20] The process became so widespread that the Journal of the London Photographic Society banned manipulated photographs from society exhibits in 1856.[21] Regardless of the fact that the history of photographic manipulation is as old as the history of photography itself, these mechanical reproductions are still often regarded as images of the truth. Brugioni writes that, "Photography is graphically apparent and readily relatable and is taken prima facie as being the truth in court cases ... a photo serves as a 'mirror with a memory.'"[22] In Brian Winston's essay "'The Camera Never Lies': The Partiality of Photographic Evidence," the author argues that our readiness to accept the authority of photographs is because, "Most of us would simply not know how to alter the photographic record even if we so desired."[23] Our everyday experience of photography is as a simple recording of our lives as they occur – representations of family gatherings, momentous events, or vacations. However, Winston gives the example of asking a crotchety old uncle to smile for a photograph. A stranger regarding the image of a smiling man would have reason to believe that the man smiled freely, or even frequently, when in reality neither of these assumptions may be true. In Winston's reading, it is crucial to remember that although the photograph may represent a real occurrence, this does not mean it is true.[24]

Demonstrating that photographic authority historically reigned triumphant over photographic liability, the French physiologist E.J. Marey dreamed, in 1878, of a science communicated wordlessly, through "high-speed photographs and mechanically generated curves," images which would themselves become the language of scientific phenomena.[25] In this early era of mechanical reproduction, Marey and his contemporaries turned from conventional hand drawing to favour representations they considered to be more objective. The widespread adoption of photography in scientific representation rose from these attempts to create images of natural objects free of human interference. In an essay detailing the changing forms of representation in scientific atlases, Lorraine Daston and Peter Galison write that, "By 1900, the photograph did wield a powerful ideological force as the very symbol of neutral, exquisitely detailed truth."[26] Manual representations often presented idealized forms – especially in the example of atlases given by Daston and Galison—and are always subject to distortion by the artist's intruding ideas. However, the turn from 'suspect' manual representation to 'authoritative' mechanical

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[18] A. Dino Brugioni, *Photo Fakery: The History and Techniques of Photographic Deception and Manipulation* (USA: Brassy's, 1999), 25.
[19] Ibid., 24.
[20] Ibid., 27.
[21] Ibid.
[22] Ibid., 4.
[23] Brian Winston, "'The Camera Never Lies': The Partiality of Photographic Evidence," in *Image-based Research: A Sourcebook for Qualitative Research*, ed. Jon Prosser (Philadelphia: Falmer Press, 1998), 61.
[24] Ibid., 66. For more examples of 'real' but not 'true' photographs, see Brugioni, 32-33, for a discussion of the photography of staged scenes.
[25] Lorraine Daston and Peter Galison, "The Image of Objectivity," *Representations*, No. 40, Special Issue: Seeing Science (Autumn, 1992), 81.
[26] Ibid., 111.

representation sparked further debate, questioning whether the crisp edges of scientific photographs were an accurate representation of the scientific findings. The response to this idea that "crispness and truth are not coextensive" sparked a backlash movement of intentionally imperfect scientific images which were supposed to demonstrate the scientist's "abstinence from intervention."[27] Scientists such as Edwin Christeller created scientific images which did not eliminate the object's rough edges [Fig. 1] to combat the deceptive hyper-reality of perfected photographs.

Figure 1. "By not omitting the fibrous edges of his sections, Erwin Christeller made visually explicit his abstinence from intervention – the figure therefore wore its authenticity, so to speak, on its sleeve."[28]

These dueling movements concerning photographic perfection—on the one hand, that photographs provide a degree of accuracy not previously possible; on the other, that this accuracy detracts from the visceral reality of scientific practice—point to the photograph's unique ability to disclose reality while simultaneously distracting from it. Winston outlines the dilemma we face when considering this duality, claiming that, "photographic images in general can only be considered as evidence of the real world in limited and complex ways."[29] Making a photographic image first entails the choice of a lens, lighting, method of framing the subject, angle of composition, shutter speed and aperture. Some of these choices carry semantic force—for example, whether the subject is approached from above or below (connoting power or subservience) or in dim or bright lighting (suggesting suspicion or innocence).[30] These choices are all made even before the photographer closes the camera's shutter to render the image on film. Even before digital manipulation was possible, the darkroom process offers a myriad of opportunities for further distortions of the image, as evidenced by the Metropolitan Museum of Art's recent exhibition "Faking It: Manipulated Photography Before Photoshop." The display of more than 200 photographs taken between 1840 and 1990 showcases methods of manual photo-manipulation such as photomontage, combination printing, overpainting, and retouching.[31] The

[27] Daston and Galison, "The Image of Objectivity", 111; 113.
[28] Ibid., 113.
[29] Winston, "'The Camera Never Lies'", 66.
[30] Ibid., 63.
[31] "Faking It: Manipulated Photography Before Photoshop," Metropolitan Museum of Art (Oct. 11, 2012-January 27, 2013), Accessed March 21, 2013, <http://www.metmuseum.org/exhibitions/listings/2012/faking-it>

manipulated photographs "adopt the seamlessly realistic appearance of conventional photographs. They aim to convince the eye, even if the mind rebels at the scenarios they conjure."[32] If this is the case, there has never been a time before it was possible to manipulate images, or a time when photographs could unwaveringly be referred to as documents of truth. A manipulated photograph is, to use Lynch's terms, a superimposition of a diagram on a photograph and introduces doubt into both methods of representation.

While Lynch stresses the importance of maintaining the segregation between mechanical and manual reproductions, he also acknowledges that digital technology offers a merger of the two. Through the use of computer programs, photographs can easily be turned into diagrams in a process that, "[breaks] down the distinction between manual and mechanical reproductions."[33] As an example of the problems created when the diagram intrudes on the photograph, Lynch refers to an instance of photographic manipulation created long before the existence of digital technology. In an investigation into the 1912 study by Henry H. Goddard on a family of "feebleminded" individuals, it was discovered that several photographs had been altered to heighten their "moronic" expressions [Fig. 2]. Lynch writes, "The discovery of the artist's handiwork undermined the authority of the document. The discredited photograph no longer occupied a privileged space as a stand-in for the 'original' object. Moreover, the fraud was exposed as a deliberate misstatement within the 'pure deictic language' of the photograph."[34]

Figure 2. A detail of the photograph as it appears in Goddard's book reveals the allegedly altered "moronic" expressions.[35]

Presented as an authoritative image, Goddard's photographs of the Kallikak family support his claims of their limited mental capacity. This example demonstrates Lynch's reasons for objecting to the intrusion of the diagram on the photograph, whether by digital or manual means. When the dialogue between images, text, and viewer is disallowed, the viewer simply consumes the

[32] "Faking it".
[33] Lynch, "Science", 221; 219.
[34] Ibid., 216.
[35] Original image from: Henry Herbert Goddard, *The Kallikak Family: A Study of the Heredity of Feeble-Mindedness* (Buck v Bell Documents 2009), Accessed March 18, 2013, <http://digitalarchive.gsu.edu/col_facpub/7> p. 89. Detail from "The Kallikak Family," Wikipedia. Feb. 28, 2013, Accessed March 21, 2013. http://en.wikipedia.org/wiki/The_Kallikak_Family.

scientist/artist's ideological prescription. Only the most discerning eye (or computer program, as the case may be) can determine the intrusion of the diagram on the photograph, while the less educated viewer may blithely believe in the authority of an image which gives no indication that it had been altered. While Lynch takes no issue with the process of 'cleaning up' images for publication, he maintains the need for continued segregation of mechanical and manual reproductions, even in the digital age. As he writes, "both the excesses of hyper-realism and the extremes of conceptual hallucination are kept at bay by the internal dialogue between the paired representations."[36]

Written in 1991, Lynch's paper treats digital manipulation as a developing problem, and not as the ubiquitous threat it is today. While it has always been possible to manipulate photographs, manual methods left a 'paper trail'—an original negative that could be referred to to find evidence of fabrication.[37] Digital photographs, however, can be modified in highly convincing ways while leaving no trace of the original image. The new field of digital forensics has emerged as a watchdog to safeguard the possibility of maintaining the perhaps obsolete idea that photographs represent real events, thereby helping to "restore some trust to digital images."[38] While digitally manipulated images leave no physical evidence of tampering, it is possible to find evidence in the photograph's underlying statistics.[39] In a paper explaining a new method for identifying digitally manipulated images, Siwei Lyu and Hany Farid stress the importance of developing technologies that can detect manipulated images "[i]f we are to have any hope that photographs will again hold the unique stature of being a definitive recording of events."[40] The difference between 'photographic' (that is, authentic) and 'photorealistic' images (constructed or manipulated) cannot be determined by the viewer, but rather requires sophisticated computer programs for investigation. In their paper, Lyu and Farid describe "a statistical model for photographic images that is built upon a wavelet-like decomposition [which] consists of first-order and higher-order statistics that capture regularities that are inherent to photographic images," and then use this program to try to identify manipulated images from a database of 46,000 manipulated and untouched photographs.[41] In the study, the researchers "correctly classify approximately 67% of the photorealistic images while only misclassifying 1% of photographic images."[42] By interpolation, we find that 33% of the photorealistic images passed the test undetected, meaning not only a human, but a computer algorithm can be tricked into believing the authority of a photorealistic image. Farid acknowledges that rapidly-evolving methods of digital photographic manipulation create an "arms race between the forger and forensic analyst," wherein forensic techniques must keep pace with new technologies.[43] The field of digital forensics, according to Farid, "has made and will continue to make it harder and more time-consuming (but never impossible) to create a forgery that cannot be detected."[44]

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[36] Lynch, "Science", 222.
[37] Winston, "'The Camera Never Lies'", 67.
[38] Hany Farid, "Image Forgery Detection: A Survey," IEEE Signal Processing Magazine, March 2009, 16.
[39] Ibid., 16.
[40] Siwei Lyu and Hany Farid, "How Realistic is Photorealistic?" IEEE Transactions on Signal Processing, 53.2 (Feb., 2005), 845.
[41] Ibid.
[42] Ibid.
[43] Farid, "Image Forgery Detection", 24.
[44] Ibid.

In the light of the simultaneous ease of digital photo-manipulation and difficulty of forgery detection, how is the scientific community to retain trust in its mechanical representations? A multitude of ethical guides have arisen in response to the proliferation of digitally manipulated images, both in scientific and in journalistic contexts. Most of these guides take the general position that it is permissible to profit from new photo-manipulation technologies, but not to an extent which deceives the viewer. Some scientific publications, such as The Journal of Cell Biology, take stringent measures to avoid the publication of manuscripts with unacceptably manipulated images. Since 2002, the Journal has subjected all of its submissions to a 30-minute screening process during which the illustrations in the manuscript are examined in Photoshop, adjusting the controls to see if new features are revealed.[45] The test revealed that 25% of submissions examined between 2002 and 2006 included images that had been manipulated in an unacceptable way, and led to the rejection of 14 papers (1% of submissions).[46] The Journal published an extensive set of guidelines for digital manipulation in 2004, acknowledging the profound temptation posed to scientists by digital photo-manipulation programs such as Photoshop.[47] The Journal of Cell Biology deems permissible adjustments that apply equally to the whole photo (such as brightness or colour balance), but nothing that manipulates a specific part of an image.[48] While it is possible to create convincing data digitally, the journal's editors maintain that, "good science requires reliable data" – that is, data that does not mislead the viewer.[49] Unregulated manipulated images risk misleading the viewer by obscuring 'surplus detail' in order to highlight the preferred focal point [Fig. 3].

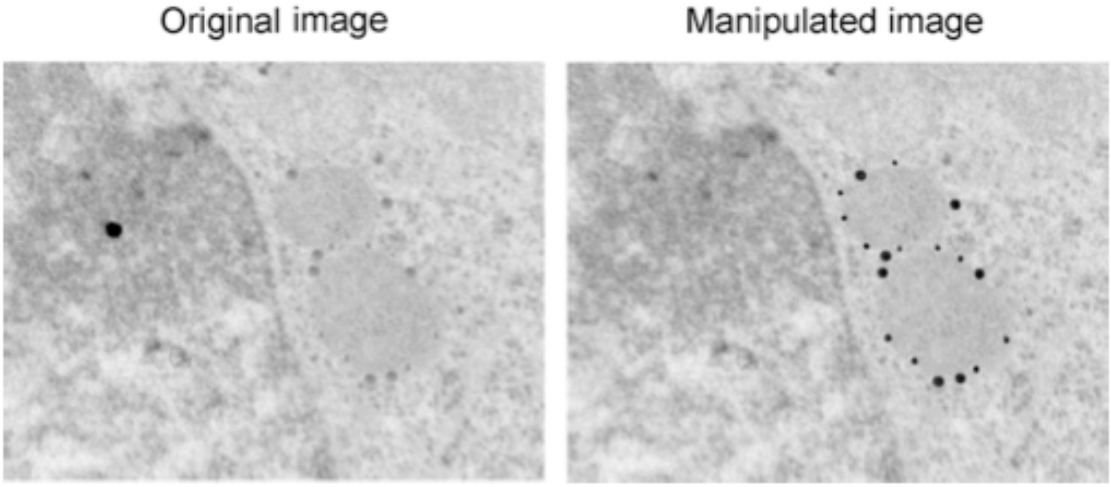

Figure 3. Exemplar image from The Journal of Cell Biology's guidelines for digital manipulation shows an enhanced image of immunogold data which emphasizes faint gold particles (on the right of

[45] Nicholas Wade, "It May Look Authentic; Here's How to Tell It Isn't," *New York Times*. Jan. 24, 2006, Accessed March 21, 2013. <http://www.nytimes.com/2006/01/24/science/24frau.html?pagewanted=1;%20Heres%20How%20to%20Tell%20It%20Isnt%20&_r=2&sq=It%20May%20Look%20Authentic&st=cse&scp=1&> At the time of the article's publication, The Journal of Cell Biology was working with Hany Farid to develop a digital forensics program which would conduct the screening by computer.

[46] Ibid.

[47] Mike Rossner and Kenneth M. Yamada, "What's in a picture? The temptation of image manipulation," *The Journal of Cell Biology*, July 6, 2004, Accessed Feb. 27, 2013, <jcb.rupress.org> pp. 11-15.

[48] Wade, "It May Look Authentic".

[49] Rossner and Yamada, "What's in a picture?", 11.

> each image) and de-emphasizes the particle on the left. "This type of manipulation misrepresents your original data and is thus misconduct."[50]

The guidelines urge scientists to keep their original data intact to allow cross-referencing between the research as it was done and as it appears 'cleaned-up' in publications. As well, scientists are encouraged not to allow the ease of digital enhancement to make them lazy, hence the admonishment, "If you would have redone an experiment to generate a presentation-quality image in the days before the digital age, you should probably redo it now."[51] By providing an extensive set of rules for permissible digital image manipulation, The Journal of Cell Biology permits scientists to benefit from digital technologies without compromising the integrity of the published document.

Apart from maintaining the correlation between the experiment its representation, the foremost reason offered by the Journal for its extensive investigation is the preservation of trust within the scientific community. The guidelines state:

> If you misrepresent your data, you are deceiving your colleagues, who expect and assume basic scientific honesty – that is, that each image you present is an accurate representation of what you actually observed ... Manipulating images to make figures more simple and more convincing may also deprive you and your colleagues of seeing other information that is often hidden in a picture or other primary data.[52]

The Journal's stress upon the importance of accurately representing scientific findings to other members of the community demonstrates a cooperative nature of scientific study founded in images. Just as Latour emphasizes the usefulness of inscriptions to communicate scientific findings, the Journal of Cell Biology emphasizes the cooperation between scientists who, reading the Journal, may find previously unnoticed relevance in a part of an image that may otherwise have been edited out. Latourian inscriptions allow scientists to demonstrate their findings without having to bring their entire laboratory with them, but to remove an 'irrelevant' piece of data from an inscription is akin to draping a sheet over a seldom-used machine or lab bench. Latour demonstrates the rhetorical usefulness of images or inscriptions by imagining a scientist's response to doubt: "You doubt of what I say? I'll show you."[53] In Latour's demonstration of proof, images in scientific texts offer rhetorical authority to the skeptical reader – Latour takes this demonstration to its extreme when he follows the skeptic into the laboratory.[54] If the images obscure some of the experiment's findings, the inclusion of the image is nothing more than an exploitation of the commonly accepted authority of photographic evidence. By rigorously requiring that all images submitted to The Journal of Cell Biology be accurate representations of the experiments described, the guidelines seek to preserve a legitimate authority of images in scientific texts.

Digital image manipulation, which Lynch calls 'post-mechanical reproduction,' signifies a merger of the conversational photograph-diagram pairing. With a computer program and a few keyboard strokes, a photograph can be digitally developed into a diagram. Lynch doesn't express any explicit disapproval for the use of digital manipulation; rather, he accepts that retouching may improve an image. Speaking in support of 'cleaning-up' images for publication, he writes:

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[50] Rossner and Yamada, "What's in a picture?", 14.
[51] Ibid., 15.
[52] Ibid., 11.
[53] Latour, "Visualization", 13.
[54] Bruno Latour, "Laboratories" in *Science in Action: How to Follow Scientists and Engineers Through Society* (Cambridge, Mass: Harvard University Press, 1987).

"Assuming that the software functions are justified by accepted mathematics and physics, the processed image can help to provide more 'trustworthy' or 'authentic' evidence than the raw data."[55] Eliminating some surplus detail from a photograph can render it more readable and explicit. However, with the digital break-down of the boundaries between manual and mechanical reproduction, Lynch stresses that we keep in mind that fact that "no single visible rendering 'stands for' the original object. Instead, complex series of images are composed and re-arranged in a syntax we have yet to decipher."[56] This new syntax cannot be explained in Lynch's language of dialogue and conversation between reader and images. Rather, the dialogue shifts to a conversation between the scientist and the image. In the age of digital manipulation, it takes a relatively narrow skill set to create an explicitly convincing image. Facing pressure to produce "faultless images to present convincing evidence," digital manipulation tempts many scientists.[57] The syntax of reading digitally manipulated images, then, must be expressed in terms of guidelines like that in The Journal of Cell Biology. Rather than a dialogue between scientists and viewers, this new syntax takes place between scientists and authoritative publications, and serves to reinforce the idea that representing data accurately is more important than presenting 'perfect' data.

In the quest to create immaculate, perfectly convincing images, it is worthwhile to return to Edwin Christeller's early 20th century rejection of photographic perfection in scientific representation. If, as Christeller believed, "crispness and truth are not coextensive," the implications for digital photo-manipulation are extensive. [58] In readings of Latour and Lynch, as well as the guidelines from The Journal of Cell Biology, it seems that the most important function of representation in science is to convince skeptical viewers by allowing them to see the evidence for themselves. As a rhetorical device, images are more accessible than allowing the skeptic into the laboratory, but serve the same function: allowing the viewer to form their own conclusions based on consideration of the experiment's supposedly undeniable outcome. For this rhetoric to function properly, and for the viewer's interaction with the image to be meaningful, the image must be an accurate representation of the scientific experiment. In the age of digital manipulation, and subsequently the age in which perfectly photorealistic images are widespread, perfection should again inspire doubt. In light of the radical skepticism which threatens to envelope scientific representation, Lynch's exploration of the conversational rhetoric of photo-diagram pairings begins to seem like the most viable option for re-inspiring the viewer's confidence in the authority of images.

[55] Lynch, "Science", 221.
[56] Ibid.
[57] Helen Pearson, "CSI: Cell Biology," *Nature*, Vol. 434 (April 21, 2005), 953.
[58] Daston and Galison, "The Image of Objectivity", 111.

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