



What is observation? What is seeing? What counts as “right depiction”? Are images today now *doing* more than showing? What is objectivity? What does the future of imaging hold?

Peter Galison, one of the world’s leading historians of science, has written widely on how visual representation shapes our understanding of the world. Trevor Paglen is an artist whose work with photography has explored governmental secrecy and the limits of seeing. For his most recent project, *The Last Pictures*, Paglen worked with a group of scientists to create a disc of images marking our historical moment; the project culminated in last year’s launch of a satellite, carrying those images, that will remain in Earth’s orbit perpetually. The following conversation took place at Aperture’s office earlier this year.

The Lives of Images
Peter Galison in conversation
with Trevor Paglen

Photograph of Peter Galison
by Matthew Monteith,
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Rudolf Grashey, X-ray of skull, from *Atlas typischer Röntgenbilder vom normalen Menschen* (Atlas of typical X-rays of a normal person), 6th ed. (Lehmann, 1939)
Credit

It seems that we're moving away from thinking about images in terms of representation and toward thinking about their creation as part of a networked process, guided by political or economic "scripts" embedded in the algorithms controlling these image-making networks.

Trevor Paglen: A number of historians have pointed out that over the last few hundred years, vision has taken on a much more prominent role as a purveyor of truth in Western thought. When Galileo saw and then claimed that the moon was craggy and pockmarked, it was heresy. His contemporaries held that the moon was smooth, because Aristotelian physics said as much. The idea of sight being a privileged path to knowledge, the argument goes, is a relatively recent occurrence, but we are living at a time when vision is absolutely central to how we understand and manipulate the world. Do you think this is true: does it all go back to Galileo's telescope?

Peter Galison: Seeing has been important to science for a very long time, certainly back into the medieval and Renaissance eras. But what counts as seeing, *systematic* seeing, natural-philosophical or scientific seeing, does change. My view is that the scientific category, the scientific self, and what counts as vision are very closely allied. Since I think that the scientific self is constantly in mutation, vision also alters in radical ways. So when we say that Galileo observes a ball on an inclined plane, or that the 2,500 physicists of the ATLAS collaboration observe the Higgs boson at CERN [the European Organization for Nuclear Research], we mean radically different things. It is crucial to understand what's changing about the phrase "we see"—who (or what) the seeing subject is.

TP: One of the things you discuss in your book *Objectivity* is the relationships among seeing images, representation, and knowledge. You use the history of scientific atlases to understand the changing relationship between vision and knowledge, how different models of "ideal" vision were developed and discarded over a relatively brief period between the eighteenth and twentieth centuries. The reason for these continually changing ideals has to do with the fact that they all seemed limited. All of them fell flat in various ways. Can you outline briefly the argument of that book?

PG: Within the sciences and medicine, there are volumes of systematically collected images that define the basic working objects of a domain of inquiry. There are atlases of clouds, there are atlases of skulls, there are atlases of hands, of brains, of elementary particles, of crystals—there are atlases of almost any object category you can think of. Historically, they were used to categorize and organize our encounter with nature. These atlases were not, in general, decorative volumes. They were often printed on archival paper with special kinds of bindings. They were considered to be a lasting legacy of knowledge. This kind of object goes back to the eighteenth century and in some instances earlier. So these picture books give us a window onto science and medicine that allows us to look at changing ideas of representation, sight, and right depiction. What do we want from our scientific images?

In the eighteenth century, the most appropriate scientist to draw or depict the world was a kind of sage, or a genius, who could part the curtains of experience and draw the basic forms of objects as they should be—to see the platonic forms, if you will, that lay behind any particular oak or clover or cloud. In the nineteenth century, there was a different ideal of what the scientist should be. Not a genius or sage, but rather a kind of trained, self-restrained worker. The workers of the era were supposed to know enough to help keep the machines running, but weren't going to interfere and, say, customize a bullet or a fork that was coming off of the metal presses of the time. You didn't want somebody making by hand his or her particular



idea of what an ideal item should be. In fact, there emerged in the machine age an aesthetic fascination with the identical quality of machine-produced objects.

And so it was for the scientists, too. Mid-to-late-nineteenth-century scientists didn't want to know what you or I or somebody else *thought* a clover should look like. They wanted to see an image of a specific clover with as much fidelity as possible to the actual object. They wanted by any means possible to transfer a particular entity—a skull or a skeleton, whatever it was—to the page. You say: “Well, does that have to be chemical-based photography?” No. It could be tracing. It could be inking a leaf and sticking and then pressing it onto a piece of paper. There were many other mechanical modes of transfer. “Mechanical” back then meant any process that did not involve personal intervention.

Once chemical-based photography entered the scene, it became part of this desire for mechanical objectivity, but chemical photography did not cause the turn to objective depiction. In fact, when photographs were first used in science, people would, for example, take several pictures of a cell and then cut out different pieces and glue them together to make the ideal form of the cell. So you actually see analog photography being pulled into the ideal of representation that was characteristic of the *eighteenth* century.

Then, in the twentieth century, you have a third epoch of “right depiction.” There emerges the persona of a trained expert, one who doesn't think: “I am a genius like Goethe, and I can improve the image to its ideal form.” Nor: “I am a faithful technician of supreme self-restraint.” Instead, he or she says: “I have been trained in such a careful way, I have apprenticed myself to the craft so fastidiously, that I will know if an artifact being produced by the machine needs correction.” When the first magnetic-resonance machines were used to make images, doctors did a lot of unnecessary surgery on people's backs because those who were using the machines didn't really understand the method: you might think somebody needed back surgery who *didn't* need it. That was a situation where you

Still from the film *Leviathan*
(dir. Lucien Castaing-Taylor
and Véréna Paravel), 2012
Courtesy Cinema Guild

wanted a trained observer who would say: “Oh, that distortion in the backbone, that’s not real.” Depiction by the trained expert is not a slavish adherence to the mechanically produced image. Nor is the expert declaiming: “I know the true form of a back.” The expert says: “I know this machine; I’ve worked with this machine; I’ve apprenticed myself to its functions, and I know that under certain conditions you get this distortion.” So you have a trained observer—not a genius, not a self-abnegating worker, but a trained worker—who begins to produce images that are corrected in this way, with expert knowledge—an expertly produced image.

TP: What you alluded to just now is a move away from a representational paradigm altogether. You’re talking about practices in which seeing and doing are the same thing.

PG: In the current moment, there is another kind of image making that’s become very important, that isn’t any of the ones we’ve talked about: neither an ideal, nor a mechanical, nor an expert-altered image. The surgeon, the electronics fabricator, or somebody working with toxic materials—they are all using the image to *manipulate* something. I think that images actively used as part of manipulation mean we are no longer concerned with *re*-presentation, but rather with *presentation*. Images are a part of the primary intervention into the world. In that world, which is more engineering or surgery or sampling, the fundamental question is not, as with the classic from particle physics: “Does this exist?” Instead, it’s: “Does our evidence demonstrate to a reasonable probability that there are particles of the type that we’ve described?”

We are no longer wondering if our re-presentation of the thing matches something out there. Today, more and more, we want images that do things. An evidentiary image is no longer sufficient for many scientists. We want images that help us organize information, that are accessible, that may not be a copy of something “out there” at all. Taking the data from CERN and mapping it in novel mathematical-physical spaces, or using false

“Landscape of Thorns,”
concept by Michael Brill,
art by Safdar Abidi,
from *Expert Judgement
on Markers to Deter
Inadvertent Human
Intrusion into the Waste
Isolation Pilot Plant*, Sandia
National Laboratories
report, SAND92-1382/
UC-721
Courtesy Mike Brill Archive



colors in astronomy to demonstrate heat are simple examples. But, more than that, images become tools, like a video-monitor image used by a distant doctor to conduct tele-surgery. When images are there to cut, fold, connect, manufacture, their purpose is to help us do things beyond the classical task of categorizing and confirming.

TP: We've both spent a lot of time considering extreme-case studies of what images can do, and what sorts of information they can and cannot transmit. I'm thinking here of the effort to design warning signs for the distant future at the WIPP [Waste Isolation Pilot Plant] site in New Mexico, which are meant to warn future generations that radioactive waste is buried there. I'm also thinking about the collection of images attached to the *Voyager* space probes in the 1970s, which were meant to explain something about life on Earth to extraterrestrials. Both of these are collections of images that are meant to work outside of history; the idea underlying them is that images are able to transmit information and even instructions across vast amount of time, and in the case of *Voyager*, even across planets and species. What do you make of these very strange uses of images?

PG: I am in the midst of writing and making a film about nuclear waste. I'm working on it with my longtime collaborator Robb Moss. We're interested, for example, in the only licensed, operational underground nuclear-waste repository in the world—an astonishing site located in southeastern New Mexico, near the city of Carlsbad. The repository is located in a five-hundred-million-year-old bedded salt layer, about two thousand feet underground. As a condition for opening this radiological storage site, Congress demanded that the Environmental Protection Agency stipulate that people should be warned, for a period of ten thousand years, against inadvertent intrusion into the site. The Department of Energy then had to ask: How can you mark the plutonium-infested in a *legible* way? They brought in materials scientists, semioticians, linguists, and scientific illustrators like Jon Lomberg, who worked on marking the “Golden Record” [the phonographic record of selections from Earth's culture, sent up with the *Voyager* spacecraft]. The SETI [Search for Extraterrestrial Intelligence] founding fathers, including Carl Sagan and Frank Drake, were brought in, too. Warn the future for four hundred generations? Necessary and impossible.

In marking the WIPP site there was a fundamental split of opinion. One group said: “Make the best *universal* images.” Spiky things, for example, would communicate danger of harm to the far future. Images of the human form will communicate with whatever human civilization succeeds us ten thousand years from now. Facial expressions of disgust, for example, seem to cut across cultures and times, according to certain ethnographers and ethnologists.

That universalism was disputed by others on the team. The anti-universalists said: “If you try to make something so abstracted from the specificity of culture and history, it becomes a kind of abstract art that won't communicate worth a damn.” The future might see these images as art or religion or just about anything. Suppose, the skeptics said, you have a sequence of images of somebody—like a graphic novel—going toward a cask of stuff, opening it up and falling down. Well, what if you read them backwards? Then it's someone cured from being sick: the radiologically “cured” victim looks as happy as a clam after exposure. Even today, people read from right to left, down to up, and up to down. So it's very hard to know how to make a universal sequence. In fact, they took some of the images and showed them

Buried canisters of classified high-level nuclear waste at the Savannah River Site
Photograph by Peter Galison



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to residents of Carlsbad, who misinterpreted them—and that’s just spitting distance from the site of the waste.

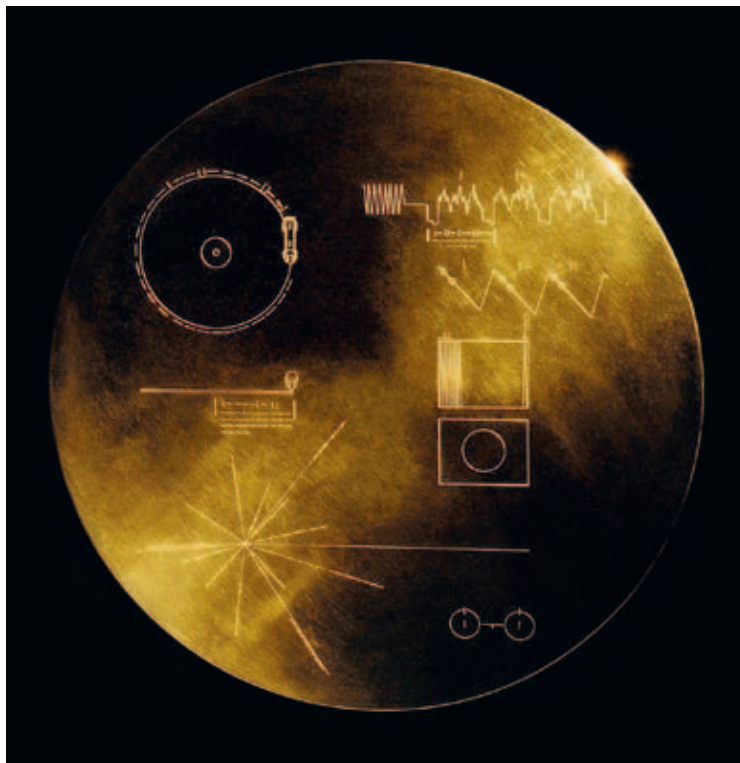
The anti-universalists said: “Look, we decoded the Rosetta Stone. Put down in stone our science, our verbal warnings. Use different languages accepted by the U.N. Put it in Arabic and Hebrew, in English, German, and French, put it in Hopi and Navajo. With enough context, enough length, enough variations in the way you express it, people in the future will be clever enough to decrypt it. They will decode it the way we cracked the Rosetta Stone. Forget the dream of universal images.”

This battle runs deeply, and I think that it appears in debate about the status of the image in art, and representation, and mimesis. Should art imitate life or not? What’s the role of painting? The idea of abstraction in photography, in film, in painting and sculpture is something that is not just fought in the moment of high modernism. It’s fought again and again, because it’s deeply rooted in the contradictory desires that we have for images, and for what we want them to do in the world.

TP: To bring things back to the present day, and to the near-term future of photography and image making, I want to pick up your comments about images becoming more about processes than distinct things we look at and learn from. Here is an example of what I mean. Last year, information about a system called TrapWire started to become public. TrapWire is meant to involve networks of surveillance cameras around “high-value” sites all over the country. The network would be able to link, for example, a camera in a Las Vegas casino to one at Heathrow Airport to another on Wall Street, all of which are linked to centralized law-enforcement and intelligence databases. The imagery is constantly monitored by algorithms designed to look for “suspicious” behavior, such as people taking pictures. It seems to me that whether or not this particular system works, this is a vision of the near future. It seems that we’re moving away from thinking about images in terms of representation and toward thinking about their creation as part of a networked process, guided by political or economic “scripts” embedded in the algorithms controlling these image-making networks. If we look at Facebook’s facial-recognition and search technologies, or at Instagram, we see similar things going on, but in a commercial context.

PG: Well, what is it that the digital really does? There are many ways in which the digital is shaped by the legacy of analog photography and film. Both for political reasons and aesthetic reasons, what’s really important is the fact that digital is small, cheap, and searchable. The combination of these three features is dramatic. It means that your smartphone does facial recognition—no longer is that an inaccessible and futuristic piece of the state-security apparatus. It’s ubiquitous.

Aesthetically, this can mean a kind of decentering, a vision of the world that is not directly human. It also means that cameras are everywhere, and you’re not even aware of them. There’s an interesting film by a colleague and friend, Lucien Castaing-Taylor, working with Véréna Paravel, called *Leviathan* (2012), filmed on fishing boats in the North Atlantic. A lot of the film would have been completely unimaginable just a generation ago. They use little high-resolution digital cameras to achieve points of view in places that would previously have been impossible: amidst the pile of dead fish, or underwater as the tank is being filled, or looking back at the front of the boat. These are not impossible camera angles, but they’re *nonhuman* points of view. I think that is interesting. Looking at the Mars rover pictures, we’re still trying to imagine that we are there. What’s shocking about some of these new kinds of images,



View of the inscriptions on the “Golden Record,” a twelve-inch gold-plated copper phonographic disk containing sounds and images selected to portray the diversity of life and culture on Earth, carried into outer space by the Voyager 1 and 2 missions, launched in 1977
Courtesy NASA/JPL-Caltech

The searchable, cheap image, the archives of our digital lives—these will, I am sure, transform our way of life and our concepts of power.

aesthetically speaking, is that they put you where you couldn't or wouldn't ever be: the dead fish's POV.

In the early days of security cameras, people would make maps depicting how you could walk through Manhattan to avoid them. Today that would be a fool's errand. It's meaningless. The digital technology not only makes these cameras tiny, cheap, and ubiquitous, it also makes the results searchable, combinable with other kinds of sources—the whole is archiveable for the indefinite future. This archive of ubiquitous imagery raises privacy concerns, of course.

The final thing I want to say about the politics of this is that a lot of my work—and your work, too, Trevor—has been about state power. I think it is important to consider state power, because actions by the government are in our name, and we pay for them. But it may well be that the real threat to privacy, the real power of image-based surveillance, is tipping toward the private sector. Secretive as governments might be, corporations can be even more so.

There are incredibly powerful tools to mine data from images, and facial recognition is just the beginning of that. How people move, where they are, what they buy, what they search for, who they contact, what they say over lines of communication ... all this is the new frontier of privacy, surveillance, and control. The image is an integral part of this new matrix of power, and I think that we don't really understand where it is going or what it will become. The searchable, cheap image, the archives of our digital lives—these will, I am sure, transform our way of life and our concepts of power.

TP: We can invert that line of thinking when we consider certain kinds of scientific imaging. As those technologies advance, a number of scientists are beginning to think of the images they produce as works of art.

PG: Yes. If images become tools, it's easier to see them as stepping-stones to other things. For me, the fundamental separation between art and science is not an eternal characteristic of science. The split happened in a historical moment. If you said to Leonardo da Vinci—pardon me, historians—“Are your studies of turbulent water art or science?” he would reply (so I imagine): “You're crazy! What are you talking about? I don't even recognize this choice.” But in the nineteenth century, you begin to have the idea of an objective image and of a scientist who is defined by being self-restrained, followed by the idea of maximal detachment from the image. At that moment, Charles Baudelaire criticized photography, saying (approximately): “You know, this isn't really part of art because it's insufficiently modulated by the person who says he's an artist.” In that sense, what Baudelaire is saying and what late-nineteenth-century scientists are saying is the same thing, except they come to opposite conclusions. What they agree on is that art is defined by intervention and science is defined by lack of intervention.

I believe the trunk split, at that point, into two branches. But in many ways the branches are coming back together again in our moment. People in the art world aren't frightened, in the way they once were, of having a scientific dimension to what they do. It's not destabilizing for Matthew Ritchie to collaborate with scientists, nor is it a professional disqualification for scientists to work with artists.

TP: That's a great point. I think photographers in particular would do well to abandon some of the preconceived notions we all have of what photography is, or should be. The relationship between a photograph and what it may

or may not represent out in the world is something we should continually question.

PG: For a long time, photography has been understood as part of everyday practice in a way that particle physics isn't—and, for that matter, even sculpture isn't. The popular notion of photography, this idea that it represents something *as it was*, lingers. Ansel Adams spent his whole life trying to tell people: “No! If you go to Yosemite's Half Dome, you can snap all the pictures you like and still wonder—‘Why can't I make my image look like an Ansel Adams?’” Adams was anything but secretive about his work. He said repeatedly how *fashioned* his images were, and even demonstrated many of his steps along the way: “This is what it takes.” He was proud of his modulation of the images, never embarrassed by it.

TP: In the darkroom, Adams worked like a kind of painter.

PG: Yes. But I think something of the old conception of photography is still with us. The high and low are never radically disjunct, and I think the fascination with what I call, in a more technical sense, the “subjective image,” the idea of a re-presentation with a minimum of intervention, lingers in the background of popular understanding about what a photograph is or should be. Even though it was perfectly obvious during the nineteenth century that if you made a long exposure (as photographers were obliged to do), moving people disappeared. Photographs are not and never were mimetic representations—and yet this poetic epistemology never seems to die.

We want it to be so, even though we know perfectly well it's not so! And despite the fact that Photoshop has exponentially increased the number of people who know it's not so. Photoshop is everywhere. It's on your phone and it's in your computer, and everybody has the experience of Photoshopping somebody into a group picture, so that the photographer can be in the image. We know! And yet we still have this idea, this *ideal*, this nearly indestructible belief in the mimetic photograph. We're only slowly arriving at a moment where the manipulated image is part of our perception. Not just in worried newsrooms and anxious scientific-journal headquarters—not (or not just) in the sense of a dreaded onslaught of fraud.

I don't mean manipulation as the devil's intervention. I mean manipulation in the centuries-old sense of the hand being able to intervene, and that images are part of the flux of our way of interacting with the world. I think the rest of the twenty-first century will be characterized by this shift. Not just in arcane branches of science, but in every part of people's visual encounter with the world. Where we come out of that, where that leads—I don't know. I can't wait to see.

Trevor Paglen is an artist, writer, and scholar working across multiple disciplines in a variety of media. Among his books are *Torture Taxi* (Melville House, 2006), *Blank Spots on the Map* (Dutton, 2009), and *I Could Tell You But Then You Would Have to Be Destroyed by Me* (Melville House, 2010). His most recent book is *The Last Pictures* (University of California Press, 2012).

✕ Paglen's book *Invisible: Covert Operations and Classified Landscapes* was published by Aperture in 2010.

Peter Galison is the Pellegrino University Professor at Harvard University. His work explores the relation between material circumstances and abstract theories of physics. Among his books are *How Experiments End* (University of Chicago Press, 1987); *Image and Logic* (University of Chicago Press, 1997); *Einstein's Clocks, Poincaré's Maps* (Norton, 2003); and (with Lorraine Daston) *Objectivity* (Zone, 2007). His film with Robb Moss, *Secrecy*, premiered at the 2008 Sundance Film Festival; they are currently completing a feature documentary on nuclear waste, *Containment*.