

# Books & arts

## Will AI jeopardize science photography?

Generative artificial-intelligence illustrations can be helpful but fall short as scientific records. **By Felice Frankel**

**O**ne of the privileges of being on the campus of the Massachusetts Institute of Technology (MIT) in Cambridge is seeing glimpses of the future, from advances in quantum computing and energy sustainability and production, to designing new antibiotics. Do I understand it all deeply? No, but I am able to wrap my head around much of it when I am asked to create an image to document the research.

The joy of being a science photographer is that I must learn about the things I am documenting to produce communicative and trustworthy images, intended as a form of data, for the researchers who welcome me into their laboratories.

But now, with the wide availability of generative artificial intelligence (genAI) tools, lots of questions must be asked. Will there be a point at which, with just a few keystrokes and prompts, a scientist can create an ‘image’ of their research, as I do with my camera, and consider that image a record of the work? Will researchers, journals and readers be able to spot artificially created images and understand that they do not truly document the work? And finally, from a personal point of view, will there still be a place for a science photographer like me to advance the communication of research? Here’s what I have found out while experimenting with artificial intelligence (AI) image generators.

### Reality and representation

First, let’s remind ourselves of the differences between a photograph, in which each pixel corresponds to real-world photons, and a genAI visual, created with a ‘diffusion model’ – a complex computational process that generates something that looks real but might never have existed.

To explore these differences, I decided to experiment with genAI visuals made with Midjourney and OpenAI’s DALL-E diffusion models to reproduce the work shown in one of my most popular science photographs



Iron particles in an oil drop on a glass slide respond to magnets placed underneath.

(with help from scientific-visualization researcher Gaël McGill at Harvard University in Cambridge, Massachusetts).

In 1997, Mounqi Bawendi, a chemist at MIT, asked me to create an image of his nanocrystals (quantum dots). When excited with ultraviolet light, these crystals fluoresce at different wavelengths depending on their size. Bawendi, who later shared a Nobel prize for this work, did not like the first image (see ‘Three views’), in which I had placed the vials flat on the lab bench, taking the picture from above. You can tell that was how I had placed them, because you can see the air bubbles in the tubes. It was intentional; I thought it made the image more interesting.

The second iteration was used on the November 1997 cover of the *Journal of Physical Chemistry B* (see ‘Three views’). That photograph provides a straightforward record of the research and highlights the importance of collaborating with the scientist – an essential part of my process.

To generate a comparable image in DALL-E,

I used the prompt “create a photo of Mounqi Bawendi’s nanocrystals in vials against a black background, fluorescing at different wavelengths, depending on their size, when excited with UV light.”

People might think that the image the program produced is attractive (see ‘Three views’), but it is not even close to the reality captured in the original photograph. DALL-E introduced bead-like dots that were not in the prompt. The algorithm presumably found the words “quantum dots” in the data set of the AI model that underlies it and used that information to replace the words “nanocrystals”.

More troubling is the fact that, in each vial, there are dots with different colours, implying that the samples contain a mix of materials that fluoresce at a range of wavelengths – this is inaccurate. Furthermore, some of the dots are shown lying on the surface of the table. Was that an aesthetic decision made by the model? I find the resulting visual fascinating (see Supplementary Information).

## Books & arts

The results of my AI experimentation are often cartoon-like images that can hardly pass as reality – let alone documentation – but there will be a time when they will be. In conversations with colleagues in research and computer-science communities, all agree that we should have clear standards on what is and is not allowed. In my opinion, a genAI visual should never be allowed as documentation.

### Manipulated versus AI generated

The advent of AI means that we need to clarify three core issues related to visual communication: the difference between illustration and documentation, the ethics of image manipulation and the desperate need for visual-communication training for scientists and engineers.

Decisions about how to frame an image, what to include or leave out, are already a manipulation of reality. The tools that people decide to use are also part of the manipulation. Each digital camera creates a distinct photograph. An Apple iPhone's algorithm enhances image colours differently from that of a Samsung phone. Similarly, the near-infrared images produced by the James Webb Space Telescope are designed to be different from yet complement the Hubble Space Telescope's optical views.

Taking the point even further, the colours we see in all of those amazing images of the Universe are digitally enhanced and give us yet more renditions of reality. Seen through this lens, it is clear that humans have been, in effect, artificially generating images for years, without necessarily labelling them as such. However, there is a crucial difference between enhancing a photograph with software to depict reality and creating a reality from trained data sets.

As a science photographer, I am acutely aware of the difference between an illustration and a documentary photograph, but I am less confident that AI programs can make this distinction. An illustration or diagram is a representation of something, subjectively translating and visually describing a concept

or structure using notations, colours, shapes and so on. A documentary optical photograph, or one made using scanning or transmission electron microscopy, is created with photons and electrons and is therefore a representation of an item, even if it is not the item itself. The difference between the two is in the intent.

With illustration, the intent is to describe and clarify the work. GenAI visuals will probably excel in that task. But for a documentary photograph, the intent is to bring us as close to reality as we can. Both are, in essence, already a form of manipulation or an act of artificial generation, and therein lies the importance of defining and discussing their ethics before we include genAI tools.

Publishers now have software in place to identify various manipulations in images

### “Scientists need to be trained in the ethics of visual communication.”

that already exist (see *Nature* **626**, 697–698; 2024), but, frankly, AI programs will eventually be able to circumvent these fail-safes. There are efforts under way to find ways to trace the provenance of a photograph or to document any manipulation of the original. For example, the forensic photography community, through the global Coalition for Content Provenance and Authenticity, provides technical information to camera manufacturers regarding the ability to trace the provenance of a photograph by keeping a record, in the camera, of any manipulation. As one can imagine, not all manufacturers are on board.

The scientific community still has time to create a system of transparency and form guidelines regarding AI-generated images. At a minimum, every genAI visual should be clearly labelled as such, and the process and tools used to create it should be clearly stated and include, where possible, credit for any source images provided to the AI engine. However, listing the sources poses a challenge.

Two articles have raised an important issue by highlighting potential privacy and copyright violations when using diffusion models (N. Carlini *et al.* Preprint at arXiv <https://doi.org/grqmsb> (2023); and see [go.nature.com/4jqyevn](https://go.nature.com/4jqyevn)). Credit is only feasible in a closed system (which diffusion models are not) for which the training data are known and fully documented. For example, Springer Nature, which publishes *Nature* (*Nature* is independent of its publisher), has recently included an exception into its policy for Google DeepMind's AlphaFold program to cover this sort of use (for models trained on a specific set of scientific data). However, people should keep in mind that AlphaFold is not a genAI tool that creates images – it generates structural models (coordinate data) that are then turned into images by people (not by genAI tools).

Happily, efforts are addressing privacy issues. Creators can now use a kind of ‘tamper-evident’ metadata called Content Credentials to, as Adobe explains in its manual, “obtain proper recognition and promote transparency in the content creation process” (see [go.nature.com/3wx92ng](https://go.nature.com/3wx92ng)).

### Ethical standards

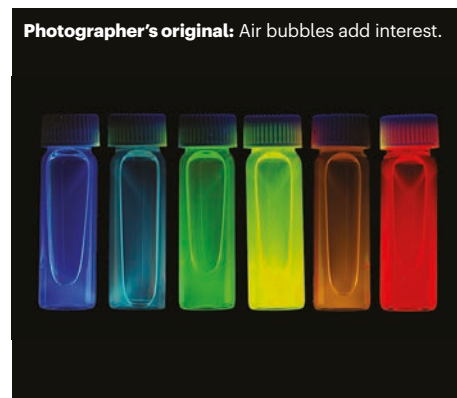
For years, I have suggested that scientists need to be trained in the ethics of visual communication, and the easy availability of AI image-creation software adds urgency to this discussion.

For example, I recall one experience with an engineer who altered a photograph that I had made of their research and wanted to publish it, along with the submitted article (see Supplementary Information). The researcher did not consider that altering the image was, in fact, similar to changing their data because they had not been taught the basic ethics of image manipulation and visual communication.

My computer-science colleagues note that conversations about AI ethics are already prevalent, but that they are discussed mainly outside the scientific community. I am concerned that the research community,

### THREE VIEWS

Decisions made during the imaging process result in distinct representations of vials containing fluorescing nanocrystals. The photographs of the real vials contrast sharply with a visual created by prompting an artificial intelligence (AI) program.



as a whole, does not understand that image manipulation is not just an aesthetic issue but also an ethical one.

How much, if at all, can an image be manipulated and still be considered documentation? How do we know whether data are being faithfully represented in an image or if there are deliberate or inadvertent omissions? How do we approach the ethics of GenAI visuals, created from scratch for the purpose of documentation, with only algorithmically selected source materials from the real world? There's a lot we still need to work out.

## Looking forward

It is clear that genAI visuals are part of our future. Most will probably fall into the illustration category; but we should consider the possibility that some will be used as documentation. For this reason, researchers need to create guidelines that require us, at the very least, to respond to the following questions when submitting a paper with images.

First, has this image been generated by AI? If so, it should be labelled and contain metadata indicating that it is.

Second, what genAI model and version did you use?

Third, what prompts did you use to generate this image?

And finally: did you include an image to help with the prompt? If so, please include that image and associated credit.

## Photographer's role

And, to answer the question I posed at the start – is there still a place for a science photographer in the world of AI? – I decided to ask OpenAI's ChatGPT model. Here is its abbreviated answer (see Supplementary Information).

"A science photographer who documents scientific subjects plays a unique role in the world of AI-generated images, providing expertise, authenticity, and a critical perspective that is especially relevant in fields where accuracy and representation matter."

It went on: "In short, science photographers remain crucial in the AI era, guiding responsible practices, providing high-quality input data, and ensuring that AI-generated images serve to inform and educate rather than mislead. They act as both guardians of authenticity and pioneers of new visual frontiers in scientific imagery."

Sounds good to me.

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Supplementary information accompanies this article: see [go.nature.com/3ehzdw](https://go.nature.com/3ehzdw).

# Books & arts

Supplementary information to:

## Will AI jeopardize science photography?

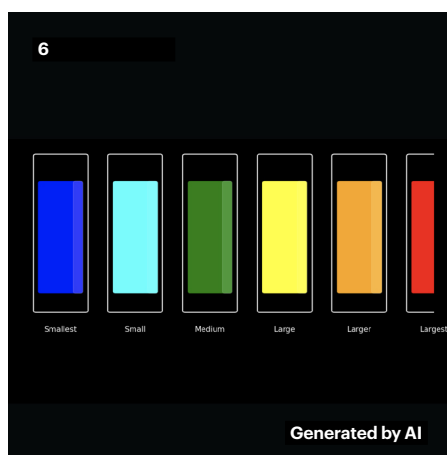
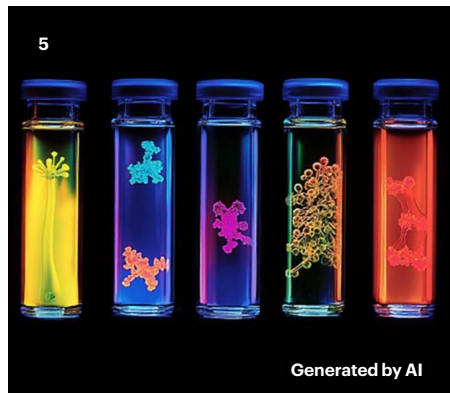
An Essay published in *Nature* 638, 881–883 (2025)

<https://doi.org/10.1038/d41586-025-00532-2>

Felice Frankel

### Further genAI tests:

It was an eye-opener to further create more AI-generated images, using MidJourney and Dall-e, with help from Gael McGill. The first round of generated images is included in the main body of text. Here, I decided to include my “real” photograph as a reference, along with the same prompt as before for the next go-round: “create a photo of Moungi Bawendi’s nanocrystals in vials against a black background, fluorescing at different wavelengths, depending on their size, when excited with UV light.”



With all three, the “black background” in the prompt was taken literally without adding a black surface with reflections. In this regard, they are closer to the original photograph, but the similarities end there. Images 4 and 5 are limited to only five vials and now include crystal-like formations—perhaps an attempt to interpret the term “nanocrystals.” Image 6 outputted an incomplete juvenile illustration with the attached text: “Here is the enhanced illustration with added realism: each vial has a glass-like outline with a white highlight to simulate reflections, making the vials appear more three-dimensional. The colored liquid inside each vial represent different nanocrystal sized shifting from blue to red. Let me know if you need any further refinements of additional labels.”

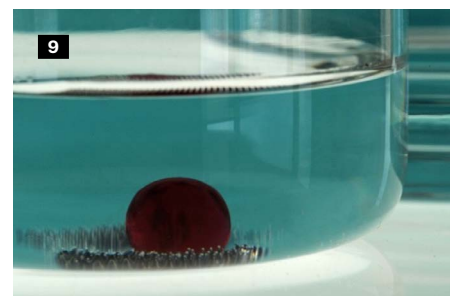
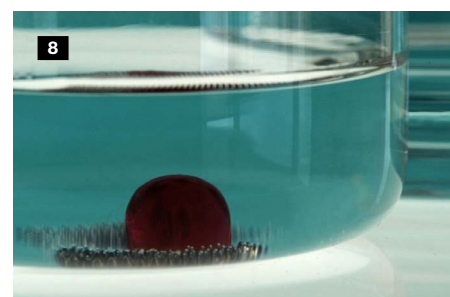
I also decided to try DeepSeek, with all the attention it has been getting suggesting that it will have a profound effect on the present Silicon Valley models. Here is the image from DeepSeek which uses an AI image generator named Janus-Pro.

See what you think for 7.



### Visual ethics matter

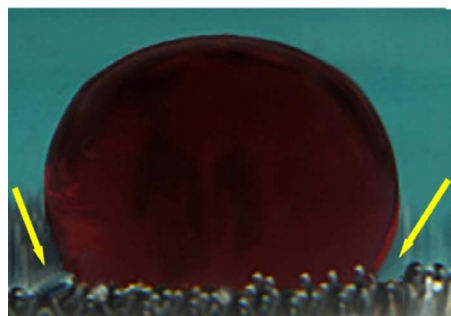
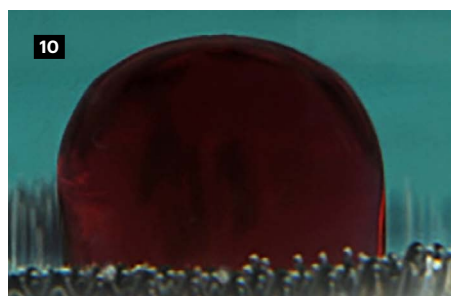
Below is an image (8) I made showing the hydrophobicity of the metallic material’s surface, which causes the shape of the red colored material to turn into a ball. The second image (9) was altered, without my permission, by the



## Books & arts

researcher to exaggerate the ball-like shape of the material.

If we zoom in on the images (10), it's clear that in the altered image (below) the ball was re-formed to look rounder (which artificially depicts a more hydrophobic surface—the point of the research.) While it is true that software would have picked up the alteration, a serious problem remains: this researcher clearly did not understand that altering the image is the same as altering the data. A trained scientist would never find it acceptable to alter their dataset arbitrarily, but that is exactly what happened in this case.



I didn't permit the lab to use the altered image. The researchers argued that the image could be used to illustrate the concept, but I disagreed. Even if the researcher informed the viewer that the image had been altered to "better" explain the science, a photograph appearing in a journal is generally considered to be documentary in nature. An image that has been manipulated to change the way the science appears has no place in a scientific publication.

### **"Is there still a place for a science photographer"**

ChatGPT's response to the topic of this article, is remarkably thorough and, surprisingly – or unsurprisingly, I guess – supports the argument that we need ethical standards and an understanding of the difference between illustration and documentary images. Here is its edited version.

"A science photographer who documents scientific subjects plays a unique role in the world of AI-generated images, providing expertise, authenticity, and a critical perspective that is especially relevant in fields where accuracy and representation matter. Here are

some key roles they can fulfill:

1. **Expertise in Authentic Representation:** Science photographers possess a deep understanding of their subjects, whether it's microbiology, astrophysics, or geology. This expertise helps ensure that AI-generated images intended for scientific representation are accurate and respectful of the data.

2. **Curators and Contributors of High-Quality Datasets:** Science photographers can contribute their work to datasets that train AI models, especially when images of rare phenomena or complex scientific subjects are needed. By curating datasets, they help ensure that AI learns from images that are not only visually compelling but scientifically accurate.

3. **Ensuring Ethical Standards:** In scientific communication, ethical accuracy is paramount, and AI image generation can blur lines if not guided carefully. Science photographers can advocate for ethical standards in how AI is used to represent scientific images, ensuring transparency about when AI has altered an image or created a visualization from data.

4. **Innovation in Visualization Techniques:** Science photographers can also collaborate with AI researchers to push the boundaries of how we visualize scientific data. For instance, they could help develop AI tools that analyze large datasets of visual information or produce simulations based on real-world photographs.

In short, science photographers remain crucial in the AI era, guiding responsible practices, providing high-quality input data, and ensuring that AI-generated images serve to inform and educate rather than mislead. They act as both guardians of authenticity and pioneers of new visual frontiers in scientific imagery."