

## MITOCW | Episode 4 FeliceFrankel v4 4K

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**SARAH** Today on *Chalk Radio*, we're talking to award-winning science photographer Felice Frankel. Her work has been featured in publications like *Nature*, *Science*, and Ang Lee's 2003 masterpiece, *Hulk*.

**HANSEN:**

**FELICE** Oh, my God. I forgot about that.

**FRANKEL:**

**SARAH** We discuss what makes her so good at effectively communicating complex, scientific information in her images.

**HANSEN:**

**FELICE** The primary purpose of making this image is to communicate the science, period.

**FRANKEL:**

**SARAH** And of course, we ask her the burning question, is AI coming for her job? So would you like to show your answer?

**HANSEN:**

**FELICE** So you asked that question.

**FRANKEL:**

**SARAH** Yeah, what's your answer? All this and more on *Chalk Radio*. Felice, thank you so much for being with me today.

**HANSEN:**

**FELICE** It's a joy to be here.

**FRANKEL:**

**SARAH** I feel like we should cheers.

**HANSEN:**

**FELICE** Yes. Hello. Hello.

**FRANKEL:**

**SARAH** Hi. Welcome to our set and to our world.

**HANSEN:**

**FELICE** This is fun. I'm already having fun.

**FRANKEL:**

**SARAH** I know. I'm so glad. Let's start at the very beginning. So you are a science photographer. What is science photography?

**HANSEN:**

**FELICE** I call myself a science photographer because I photograph science. If it's optical, if it's something that we can see-- which is not necessarily the case-- I use my camera and capture photons, as it is the documenting the research, if it's about stuff, things that we could see. Sometimes we have to use electrons. That's using a scanning electron microscope. And with that, I have help with people who know much more than I do.

**FRANKEL:**

But for the most part, the photographic work is of engineered material, documenting what happens on surfaces, and a whole slew of things that-- the best part of this is that I am learning every day. The thing is I do have a background in science. And that's not trivial.

And the dialogue that goes between me and the scientist is not only invigorating for me, but I could tell that the researcher enjoys discussing why I should photograph it, for example. And what is it, in fact, that is the most important piece of the science? So it's the best position in the whole world. I'm serious.

**SARAH** I believe you. And what is the reason you do it? Is it because the images are beautiful? Are you trying to help  
**HANSEN:** those of us who are not in the lab see the products of scientific research? What's your motivation?

**FELICE** All of the above. And the most important part of what I do is to communicate research, mostly to colleagues, to  
**FRANKEL:** the experts in various fields for journal submissions. But also, I'm deeply involved with getting the public to see the beauty of science, not to be frightened by asking questions.

It's sort of a seduction for the public to look at some of these pictures and say, that's really cool. What is that? And that's my primary goal these days.

First of all, everybody takes pictures. So making images is no big deal. But it is a language that people can participate in-- and all sorts of visualizations-- graphs, as well.

But images of stuff is enticing. Because even if you don't know what you're looking at, you want to know what you're looking at. And that's pretty much what I'm doing.

**SARAH** Yeah. And I think when you look at an image, it becomes co-created in a way. You bring your history of what you  
**HANSEN:** know about the world into your experience seeing the image.

**FELICE** That's wonderful. You're absolutely right. When I give a talk to the kids-- they're all kids to me these days-- I  
**FRANKEL:** show an image without the text on top.

And I ask, what do you think you're looking at? And it's almost like a Rorschach test. It depends upon what world you're coming from.

**SARAH** Sure.  
**HANSEN:**

**FELICE** You decide on what scale this image is.  
**FRANKEL:**

**SARAH** Wow.  
**HANSEN:**

**FELICE** And so it's kind of personal. It gets personal initially. You're drawn to it. At least, I hope you're drawn to it.  
**FRANKEL:**

And then you start asking questions. And then, of course, for the researcher, it's different, in the sense that I am here to document real things. Now, this is really important-- a distinction I'm going to make.

I make images of a thing. I re-present that thing in an image. But keep in mind that my process is somewhat of a manipulation, in that I decide on the cropping, how much I should put in the picture, how much I should leave out, my lighting-- if, in fact, it is lit. And so I have to be very, very careful in not manipulating the data.

**SARAH** The photons.

**HANSEN:**

**FELICE** Yes. Yeah, in the sense of, I can't do this, and that, and Photoshop like crazy-- what people are doing. We can't do  
**FRANKEL:** that. And so I have to make decisions about what I can do that has integrity but also communicative.

The communicative piece is about the way I-- I'm going to say-- design the image, what lens I use, what angle, what lighting. But as long as I'm not mucking up with the thing, the image is acceptable. Yeah, it's exciting.

**SARAH** It is exciting, and complex, and so interesting. How did you find your way to science photography? If it's not even  
**HANSEN:** a field that many other people do, how did you forge your way?

**FELICE** Oh, well, I don't know, in fact, if there is a field called science photography, to tell you the truth. I haven't met  
**FRANKEL:** very many science photographers. It's what I call myself, because it's what I do.

There's no course in it. There are schools. Rochester has a wonderful school teaching mostly optics and technical aspects of photography and science. But there is nobody teaching what I do. And that's one of the things I've tried to change. But I give up.

But the fact is, life is all about luck. What else is new? My background-- I only have an undergraduate degree. I majored in biology and chemistry when they called it biology at that time from Brooklyn College.

And then I went right into the lab. I went into a research lab at Columbia Cancer Research Institute looking at how drugs affect transfer RNA translations. And then life came over.

**SARAH** As it does.

**HANSEN:**

**FELICE** As it does. And to cut to years later, I started becoming an architectural photographer. But I did, in fact,  
**FRANKEL:** photograph landscape architecture and architecture. We're looking at the Salk Institute, for example. Everybody needs to go there at some point.

**SARAH** Where is that?

**HANSEN:**

**FELICE** That's in California, Louis Kahn, a classic place. And then this one is at PepsiCo. And the next one is also at  
**FRANKEL:** PepsiCo.

This is my first endeavor into using the camera professionally. This is Isamu Noguchi's California scenario, taken under one condition of light. And the next one is a few hours later.

What I'm showing you is that these are the decisions that photographers have to make, when to shoot something, for example. Should I wait for that? This is a winery in California, which is very cool. We'll look at the next one.

Talking about time-- when do you make the image? The one on the left is in the winter time. And the one on the right-- identically shot. I had to remember where I sat or placed a tripod.

And the next one is also about decision making. Should I take this beautiful fountain-- it's called Ira's Fountain. Should I take it with kids playing in it? Or shall I take it without?

**SARAH** It's totally different feeling.

**HANSEN:**

**FELICE** Yeah, it's a whole different thing.

**FRANKEL:**

**SARAH** Wow.

**HANSEN:**

**FELICE** But these are the kinds of-- it was almost the way I taught myself. Frankly, most photographers teach themselves-- and just understanding time, lighting, and all that.

**FRANKEL:**

And then what happened was I lucked out. I got this fellowship at the Harvard Graduate School of Design because of the work as an architectural photographer. I missed science like crazy, took as many courses as I could.

And what happened was I took a course where the lecturer, the faculty, was clearly very visual in how he depicted the work. I had the audacity to invite myself up to go to his lab and see what he's doing. And I didn't know him at all, by the way. I didn't know who he was, just clearly very visual.

He said yeah, sure, let's get rid of this woman. I show up. I was introduced to the postdoc, Nick Abbott. And they just got a paper accepted to science.

I looked at their image. I said, we could do better. And we got the cover.

**SARAH** Wow.

**HANSEN:**

**FELICE** And that was my first entree into this world.

**FRANKEL:**

**SARAH** Wow.

**HANSEN:**

**FELICE** And George Whitesides, who is the chemist whose work it was about and who was the lecturer, it turned out he was very prominent. I didn't know that. And he said to me, stay with this. You're doing something that no one else is doing. And that was the beginning.

**FRANKEL:**

**SARAH** Wow.

**HANSEN:**

**FELICE** So it was serendipity, luck. And I grabbed at it.

**FRANKEL:**

**SARAH** Yes.

**HANSEN:**

**FELICE** Because I was getting too formulaic in the architectural photography. I knew exactly where to stand. I wasn't  
**FRANKEL:** being as creative as I thought I wanted to be. And you have to be careful about how much creativity you want to put into your science image. But it was the beginning.

And then, again, the other lucky part was something opened up at MIT at the Edgerton Center. They were looking for an artist in residence, which we might talk about the word artist later.

**SARAH** OK.  
**HANSEN:**

**FELICE** Basically, I was taking the baby pictures of researchers' work. At first, they would say, what does she want from  
**FRANKEL:** me? And what is the key here is that-- and I'm not embarrassed to say-- I am serving the research community.

This is not about me. It's not about my making art. It's about making images to describe and communicate the research that researchers are doing.

This is, by the way, 1994. I can't believe it. Eventually, then Bob Silby, who is the dean of science, he then said, let's bring you into the department and into the school. And we'll give you the title of research scientist.

If people ever want to try to do something like this in any field, you have to show what you can do. You can't talk about it. And I was able to say, this is what you do. This is what I've done with it. And it was a soft sell.

It's been wonderful. Now, of course, I'm working in material science, chemical engineering, and mechanical engineering. I'm supported by those three departments.

**SARAH** That's fantastic.  
**HANSEN:**

**FELICE** It's fantastic.  
**FRANKEL:**

**SARAH** In a little bit. I really want to ask you how you collaborate with scientists. But I want to go back one second to the  
**HANSEN:** beginning before the beginning.

**FELICE** Right.  
**FRANKEL:**

**SARAH** So, I'm curious, when you first discovered photography or when you were first wowed by something you caught  
**HANSEN:** through a photograph and the curiosity that was sparked?

**FELICE** Well, I have to say-- it's a very good question. I have to really think about this. I was very lucky when I first held a  
**FRANKEL:** camera.

Actually, my husband was in Vietnam during the Tet Offensive, I will have you know. And he sent me a Nikon camera. I had never photographed before.

And that was not trivial, because it was a very good piece of equipment. I saw a broken mirror in the street and saw the reflections. And I was completely drawn to that image that I thought I was going to make.

What I'm angry about is I never found-- I'm dying to see it. I don't know where that is. It was with slide (by the way) film, F-I-L-M. Have you heard of it?

**SARAH** Yes, I have heard of that.

**HANSEN:**

**FELICE** But right away, I saw what an image of some thing can do. Later on, when we started at MIT, it was always about  
**FRANKEL:** my curiosity. Why is this happening? What is it about this thing that is showing this and that?

And that's why I'm so excited about speaking with the researchers. Because they explain it to me. And they sometimes it's over my head, and I tell them. At MIT, you never fake what you don't know.

**SARAH** Yes, I've learned that.

**HANSEN:**

**FELICE** And the best part of what I do is getting the information about the science that I'm imaging. So for example, at  
**FRANKEL:** the very beginning when I first started, this was for a book that George Whitesides and I decided to do. Ferrofluid is oil that has suspended iron particles. And so it responds to magnetic fields.

So this is a drop. It's about 2 centimeters across. I dropped it on a glass slide. Under the glass slide is a yellow Post-It-- very high tech. And under the yellow Post-It are seven circular magnets.

And what you're seeing is the iron particles responding to the magnetic field. And we explained it in the book. And then I also held a green card over it. It was highly reflective. So I decided to add some color, which didn't change anything, really.

And then you see the shapes that are forming. And if you really, really look carefully, you can see the sign of a very bad photographer.

**SARAH** What's that?

**HANSEN:**

**FELICE** I'm in the picture.

**FRANKEL:**

**SARAH** You are?

**HANSEN:**

**FELICE** If you look carefully, you could see a lens that's doubling up. And that's my head of hair. But that was the  
**FRANKEL:** beginning of realizing, oh, boy, I could have fun with this.

**SARAH** You can have fun.

**HANSEN:**

**FELICE** Yeah. And what's very interesting is that this particular image got a lot of attention. This is, again, many years  
**FRANKEL:** ago. People are drawn to it. I don't understand it, but it is unusual.

**SARAH** It looks like a flower.

**HANSEN:**

**FELICE** It looks like a flower, yeah. And then here's the thing. They want to say, what is this? That's what I'm trying to do.

**FRANKEL:**

**SARAH** And then that leads them into the science.

**HANSEN:**

**FELICE** Precisely.

**FRANKEL:**

**SARAH** Yeah. That's so interesting. Do you want to use this image to distinguish for us documentation versus illustration

**HANSEN:** and how manipulation intersects with these two elements?

**FELICE** Yeah. This is, in fact-- I haven't thought about this, actually. This is a documentation. I'm not adding any-- well,

**FRANKEL:** yes, I added some color. But if we're only looking at the way the particles are responding to the magnetic field, I am not manipulating that at all. This is exactly what this is about.

There is a very serious issue about, how far can we go-- and maybe we'll talk about that later-- in manipulating an image? That's what I'm very, very careful about as a science photographer. Sometimes I use images to explain something.

For example, I have a number of covers that-- I can't draw for beans. But what I can do is I can make pictures. And I take pieces of pictures and put it together to create an image that doesn't exist, but it's explaining the science.

**SARAH** So that would be an illustration.

**HANSEN:**

**FELICE** Exactly. That is a very big difference between an illustration and documentation. And thank you for concentrating

**FRANKEL:** on that. Because that is the issue that we're going to have to deal with when we look at AI.

**SARAH** Before we get into that, could you talk about some of the tools that you use in your work?

**HANSEN:**

**FELICE** Mostly my camera. I use I use a F3 Nikon with film and working up to digital. It took me a while to accept it. But

**FRANKEL:** yes, I have. I'm still with Nikon, an 850.

And I use microscopes. I attach my camera to microscopes, which is always incredibly exciting. I also use a scanner, a flatbed scanner, not the highest brand. But it's the kind that allows me-- and this is important-- to tell it what DPI, Dots Per Inch. So I could get a very large file with this scanner.

And it's almost like a microscope. It's just crazy. And it's 3D objects you can put on the scanner.

**SARAH** OK. How do you put them on the scanner without squashing them?

**HANSEN:**

**FELICE** Well, you're very careful. You carefully-- don't put the lid down.

**FRANKEL:**

**SARAH** You don't put the lid down.

**HANSEN:**

**FELICE** You put something else over it. And that becomes the background.

**FRANKEL:**

**SARAH** I see. So, interesting-- so you have your tools. Do you have your own lab? Where do you do this?

**HANSEN:**

**FELICE** I have a studio in my condominium, yeah. My microscopes, all my equipment is there.

**FRANKEL:**

**SARAH** So, then, does a researcher come to you and say, I would like help documenting this scientific concept that I

**HANSEN:** would like to communicate to my peers?

**FELICE** No, they don't come to me. I go to them.

**FRANKEL:**

**SARAH** OK.

**HANSEN:**

**FELICE** So they write to me, we are looking for a potential cover. I didn't think they would still be interested in getting covers, because everybody looks at the articles online now. But getting a cover is important, because it brings attention to the work.

**FRANKEL:**

And we sit down. And they show me what they have. Most of what they do is they show me their pictures. And I say, oh, my God.

I gave a talk to students last week. And they asked me, do you have a process, the way you compose? And I don't.

I'll give you an example. This was a slide with luminescence going on. And I put it on a CD. Do you remember what a CD is?

**SARAH** I do. For those of you who don't remember--

**HANSEN:**

**FELICE** It's a disk.

**FRANKEL:**

**SARAH** It's about this big.

**HANSEN:**

**FELICE** That's right. That's right. And it was reflecting light. And so was this reflecting light.

**FRANKEL:**

**SARAH** Ah, I see. I see.

**HANSEN:**

**FELICE** I was sort of saying compare this to this in this image. I'm telling you the size-- so those kind of things of how to  
**FRANKEL:** inform the reader about what it is that you're documenting.

**SARAH** I know you're not going to this very much. But those sound an awful lot like artistic decisions.  
**HANSEN:**

**FELICE** I call them design decisions.  
**FRANKEL:**

**SARAH** Design decisions.  
**HANSEN:**

**FELICE** You want to talk about the difference?  
**FRANKEL:**

**SARAH** Yes.  
**HANSEN:**

**FELICE** OK.  
**FRANKEL:**

**SARAH** I do.  
**HANSEN:**

**FELICE** I'm not an artist, because it's not my intention.  
**FRANKEL:**

**SARAH** OK, that's so interesting. Intent has everything to do with this.  
**HANSEN:**

**FELICE** I think so. For me, it does. The primary purpose of making this image is to communicate the science, period.  
**FRANKEL:**

It is not to communicate me. It's not my political feelings. Although, I'd like to talk about that someday.

**SARAH** Sure.  
**HANSEN:**

**FELICE** But it's not about how I view things in life. It's about the science. That is what I am communicating.  
**FRANKEL:**

**SARAH** I see.  
**HANSEN:**

**FELICE** And so, therefore, I generally see an artist-- there is an agenda behind what they produce that is more about  
**FRANKEL:** who they are. And this is not about who I am. This is about what I am communicating. That's the key, key difference, I'd like to say.

**SARAH** That's so interesting. I'm curious what happens when you and the scientists disagree about design decisions and  
**HANSEN:** what those conversations are like.

**FELICE** That's a great question-- no surprise. All right, I will tell you-- we might see it later. Mounji Bawendi was working  
**FRANKEL:** with nanocrystals, for which he got a Nobel Prize, by the way. He asked me to photograph the vials that contain the nanocrystals. Each vial had nanocrystals of different size, so they fluoresce at different wavelengths.

**SARAH** So beautiful.  
**HANSEN:**

**FELICE** Thank you so much.  
**FRANKEL:**

**SARAH** Good design decisions.  
**HANSEN:**

**FELICE** Guess what?  
**FRANKEL:**

**SARAH** What?  
**HANSEN:**

**FELICE** He didn't like it.  
**FRANKEL:**

**SARAH** Oh, no!  
**HANSEN:**

**FELICE** But I asked my kids when I give a talk, show me where the camera is in relation to the vials. So most of them get  
**FRANKEL:** it right. The vials are laying down on a surface. And the camera is from above.

And how do we know that? Because of the air bubbles. And I specifically photographed it that way, because I brought in what I thought was an interesting-- not but interesting-- design decision.

Moonji didn't like it. He asked me to shoot straight on, which we're going to see next, I think. And that is a highly documentary image of the-- again, we're looking at vials that contain nanocrystals at different sizes. And that's what got on the cover of *J Phys Chem*. And that's what he wanted.

I yield to the researcher. However, the image that he has hanging up in his office is my first image.

**SARAH** Is it?  
**HANSEN:**

**FELICE** So there you go.  
**FRANKEL:**

**SARAH** Ah, interesting.  
**HANSEN:**

**FELICE** But I get it. I overdid it. That was a while ago. I'd like to think I'm more careful now.  
**FRANKEL:**

**SARAH** So there's another image you made of yeast colonies, where you had a slightly different design perspective than  
**HANSEN:** the researcher.

**FELICE** So Gerry Fink was studying yeast. And he asked me to come by to take a look. And I was blown away by this  
**FRANKEL:** morphology of the yeast colony.

These cells are telling each other where to grow because of the environment that they're growing in. And I went nuts when I saw it. And I brought it home and started photographing.

And this was also on film. And I then decided, I want the viewer to look at the morphology of the colony. It's mind blowing. And I'm not going to change the data if I digitally delete the Petri dish. Here we go.

**SARAH** Oh, yeah. Look at that.

**HANSEN:**

**FELICE** I mean, that's all you're looking at. And when I showed it to Jerry, he wasn't happy with it. He felt that I was  
**FRANKEL:** deleting information. He felt that, if it were growing in a Petri dish, people who worked with Petri dishes know the size of the Petri dish, and they could then understand the size.

I said, in the caption, you could say the size of the Petri dish. I am not changing the morphology. The morphology is the data. I am not changing the data.

It took a while. But then what happened is it got the cover of *Science*. And then he came around. He did bring up an important point.

And we go back and forth on it. It's the way it has to be. It is collaborative. That's the best part. For me, it is.

**SARAH** Yeah. There was an example of when someone manipulated one of your images.

**HANSEN:**

**FELICE** Oh, gosh.

**FRANKEL:**

**SARAH** And it changed the data.

**HANSEN:**

**FELICE** Absolutely.

**FRANKEL:**

**SARAH** And I feel like that one illustrates the importance of not manipulating the data itself.

**HANSEN:**

**FELICE** Absolutely. This was a real eye opener for me. I made a quick image, nothing beautiful or brilliant. The science is  
**FRANKEL:** all about this metallic material that was considered to be highly hydrophobic. And this is in solution. And this is a drop of oil.

And they dropped the oil on the surface. And this is the image that I took. I wanted to suggest that the flask was there and all that.

So I showed the image to the researcher. This is a graduate student. And the researcher took the image and changed it. Did you see the change?

Let's go back to the original. And look at what the researcher did.

**SARAH** Oh, it's subtle.

**HANSEN:**

**FELICE** Let's enlarge both of those places.

**FRANKEL:**

**SARAH** Ah ha.

**HANSEN:**

**FELICE** What they did was, in Photoshop, made it more round. And what they did was change the data, because they  
**FRANKEL:** changed what we call contact angle. That's how you measure hydrophobicity on a surface.

They never even thought that this was wrong. And I said, nope, you cannot use this image. But it's all about-- I really believe that not enough conversation is going on with the young research community about the ethics in what you could do to an image.

This, to me-- the image that I made was documentary. The redo of that image is more illustrative. We cannot call it a documentation, because they mucked up with the data. And we have to talk about this.

**SARAH** Right. It brings up all sorts of issues of trust, both within the research community, but for us as laypeople. What  
**HANSEN:** kind of images can we trust, especially now in the era of AI-generated images?

**FELICE** Absolutely. Yeah. Yeah, trust. That's a killer. We're in a really difficult time these days, aren't we, where research  
**FRANKEL:** or scientists are not trusted.

**SARAH** Can you think of maybe three questions research consumers should ask themselves when they're looking at an  
**HANSEN:** image that would at least bring a critical lens?

**FELICE** I believe that gathering the public to understand how we make images is a means of engaging them even further  
**FRANKEL:** in trust. So for example, the first question would be, what equipment was used in this image? The second question would be, was this image changed at all? A third question would be, how was the change made?

And maybe a fourth question is, do you think that this change is changing the data? But of course, that's impossible. We're not going to have that next to every image. But at least to get at least the public to understand that some images are manipulated and that they need to know that that is OK if we say that they've done it. For example, all the glorious astronomical images that we see, they're all color enhanced.

**SARAH** Oh, I see.

**HANSEN:**

**FELICE** And that's OK. The astronomers knew how to get attention. But to educate the public that we're doing this so that  
**FRANKEL:** you're looking at it. But also, there are reasons why we're coloring it this way, as opposed to that way.

I think it's all about getting people to be interested. And I think that images are one way of opening up that interest.

**SARAH** I think so. They're just intrinsically interesting. And they feel accessible.

**HANSEN:**

**FELICE** That's great. That's the word. An image is making science accessible to allow you to ask questions. People are  
**FRANKEL:** frightened. We've got to get them to be less frightened, and let them know that we want to talk about it.

**SARAH** Yeah, that's so interesting.

**HANSEN:**

**FELICE** It's just not happening.

**FRANKEL:**

**SARAH** One thing that is really beautiful about your work at MIT is that you embody the spirit of curiosity, and humility,  
**HANSEN:** and the ability to say when you don't understand something. You have to do it in your job.

**FELICE** Oh, yes. There is no way that you could fake it on this campus. And believe me, there's a lot I don't understand. I  
**FRANKEL:** run a series of graphics workshops for graduate students and postdocs.

They come in and show their draft figures. And they need a lot help, let me tell you. And so, as a group, we look at it, and we talk about it.

And there is a point where I have no clue what they're talking about. It's just over my head. But I say to them, I don't know what you're talking about.

And they like that. They respect that in me-- that I admit that I don't know. So I have my limitations.

**SARAH** Right. Well, I like that's a great model, though. I feel like I do that a lot on this podcast. I interview people who are  
**HANSEN:** doing work in all sorts of fields. And I'm not an expert in any of them. So I have to just say when I don't understand something-- I feel like we could all learn a lot more if we felt safe admitting when we didn't know something.

**FELICE** That's terrific. Yeah, that is it. We have to feel safe. On this campus, we feel safe.

**FRANKEL:**

**SARAH** I want to shift gears and ask a question everybody wants to know these days. And that's, will AI negate the need  
**HANSEN:** for science photography? Why don't we just type in little prompts? We don't need scanners. What's going on?

**FELICE** Yep, you got it.

**FRANKEL:**

**SARAH** And so I asked you this question before we started filming. And you wrote an answer, but I haven't seen it yet.

**HANSEN:** So, would you like to show your answer?

**FELICE** Sure, with my terrible handwriting.

**FRANKEL:**

**SARAH** That's OK.

**HANSEN:**

**FELICE** So you asked that question.

**FRANKEL:**

**SARAH** Yeah, what's your answer?

**HANSEN:**

**FELICE** Not if I can help it!

**FRANKEL:**

**SARAH** Yeah, so AI will not take over the need for science photography if you can help it.

**HANSEN:**

**FELICE** So I have been worried that I will become irrelevant. And so I wrote to an editor there that I've had some correspondence with. And I told her, I'd like to try to write an article about this.

**FRANKEL:**

And she said, well, let's make it a little less personal and just think about whether you want to write about how AI is affecting photography. So it was a great opportunity for me. Because you know, when you have to write something, you have to know what in the world you want to write.

**SARAH** Yes. That's the challenge of it.

**HANSEN:**

**FELICE** It's, indeed, a challenge. And what I decided to do was to take an image that I've made and ask the model to make the image. So you will recognize that this is an image we just saw.

**FRANKEL:**

I asked, create a photo of Mounji Bawendi's nanocrystals in vials against a black background fluorescing at different wavelengths, depending on their size, when excited with UV light. So that's a pretty complicated problem.

**SARAH** Yes, it is. Let's see what it did.

**HANSEN:**

**FELICE** There we go.

**FRANKEL:**

**SARAH** Wow.

**HANSEN:**

**FELICE** Ridiculous!

**FRANKEL:**

**SARAH** It's pretty ridiculous.

**HANSEN:**

**FELICE** Totally cartoon like, totally wrong. You have multicolors in each vial. But the very interesting thing for me-- now, remember, I used the word nanocrystals.

**FRANKEL:**

The model found another word for nanocrystals. They found quantum dots. And that's where the dots come from.

**SARAH** OK.

**HANSEN:**

**FELICE** So that was the first try. And I wasn't that worried--

**FRANKEL:**

**SARAH** About your job after this.

**HANSEN:**

**FELICE** So far. Yeah, right. But I decided to try again with the identical prompt only about two weeks ago.

**FRANKEL:**

**SARAH** Oh, wow, OK.

**HANSEN:**

**FELICE** Six months later.

**FRANKEL:**

**SARAH** Oh, boy. It's pretty close.

**HANSEN:**

**FELICE** It's scarily close. And what it's telling me is that you're in trouble in the sense of I could do just almost as good as you could do. Here's the thing.

**FRANKEL:**

We must never, ever say that a photograph is documentary if we used AI. If, in fact, somebody wanted to submit this, they had to say, this is an explanatory image.

**SARAH** Yes, because this is not documenting the photons.

**HANSEN:**

**FELICE** This is not the thing.

**FRANKEL:**

**SARAH** This is not the thing. This is a generated image of the concept of that thing.

**HANSEN:**

**FELICE** That is exactly right. This is done with data from out there that they collected and decided-- the model collected-- made this from that data. And it's possible the data was one of my images.

**FRANKEL:**

**SARAH** Clearly.

**HANSEN:**

**FELICE** Yeah, I think so.

**FRANKEL:**

**SARAH** Yeah.

**HANSEN:**

**FELICE** The answer to what are we going to do about this is to just make a distinction between a documentary photograph, or SEM, or image versus an explanatory image or an illustration. Whether that's going to happen or not, I cannot tell you. I have no idea.

**FRANKEL:**

I'd like to think that the research community will follow the guidelines that every journal will set up. Each journal is now starting to ask these questions.

**SARAH** I see. That's good.

**HANSEN:**

**FELICE** Yeah, it is, but, but, but. I don't know where it will head. But I think that we have to be very clear when something is submitted to a journal.

**FRANKEL:**

And then, of course, the question is, what do we do when it's submitted to a to a magazine or online? How are we going to say to the viewer, this is a real thing, and this has been mucked around with or AI generated? I don't have an answer for it. But we have to talk about this.

**SARAH** Yeah, I think we need a lot more education on critical visual literacy.

**HANSEN:**

**FELICE** That's the best way to phrase it-- visual literacy, exactly. But we have to start first in academia. Let's talk to the researchers first, and make sure they understand what lines they cannot cross.

**FRANKEL:**

**SARAH** It's an unknown world right now. And we have to just keep asking critical questions.

**HANSEN:**

**FELICE** Yeah.

**FRANKEL:**

**SARAH** Yeah. I'm curious from a selfish standpoint, I guess, how I can use the concepts of science photography to unlock the next level of curiosity in my own life if I don't have a scanner or a camera but I still want to experience the world at a deeper level?

**HANSEN:**

**FELICE** Yay! Now I can bring in my upcoming book. Can we talk about it?

**FRANKEL:**

**SARAH** Yeah, let's talk about it.

**HANSEN:**

**FELICE** It just happens.

**FRANKEL:**

**SARAH** This one?

**HANSEN:**

**FELICE** Yeah. It just happens that I have it. So this is a book intended-- it's called *Phenomenal Moments*.

**FRANKEL:**

**SARAH** First of all, tell us about that cover. That's beautiful.

**HANSEN:**

**FELICE** This is-- do you pronounce it jer-ber or gerber? It's a flower.

**FRANKEL:**

**SARAH** The flower, mm-hmm.

**HANSEN:**

**FELICE** This is in the book. And I just plopped it on my scanner.

**FRANKEL:**

**SARAH** That's gorgeous.

**HANSEN:**

**FELICE** By the way.

**FRANKEL:**

**SARAH** By the way, I'm going to go home and plop quite a few things on my scanner now. Yeah.

**HANSEN:**

**FELICE** The book is revealing the hidden science around us. To respond to your question, everything around us is about science, everything. And what I've done is created a book for-- it's supposed to be young adults. But I want grandmas like me, and parents, and kids to look together.

**FRANKEL:**

And so, for example, this looks like a flower, but it's actually hundreds of flowers. Every piece of the flower is genetically told to create either this or this. And it's a part of something called the composite genus, where there are-- like, the daisies is also one of these. This is what's in the book. What do you see?

**SARAH** I don't know what I'm looking at, but it looks like maybe bubbles.

**HANSEN:**

**FELICE** It does look like bubbles. It's the same science about it. And you turn the page. And what you're seeing is actually opal.

**FRANKEL:**

**SARAH** Oh, wow.

**HANSEN:**

**FELICE** It's very, very cool.

**FRANKEL:**

**SARAH** Wow.

**HANSEN:**

**FELICE** And we talk about the moment when I decided to shoot it. And we talk about diffraction and interference of light without getting into very heavy stuff.

**FRANKEL:**

The fantasy is this. You see this in the book. And then when you turn the page, you see an explanation of what they are.

**SARAH** Wow.

**HANSEN:**

**FELICE** The hope is that, when you see the next oil and water being mixed on the asphalt, you'll know that there's  
**FRANKEL:** constructive interference going on. And you'll tell your mother what this is. And then the best part would be, you'll take out your phone, and you'll take a picture of it.

That's what I was hoping we were going to do with this. If you start looking at the world like I hope you will with this, and looking at things that are happening and thinking about, I'm going to take a picture of this, and then look up what it was-- why am I seeing what I'm seeing? It's about enticing you to ask questions about everything around us.

**SARAH** Yes. No, that's fascinating. Now, I have the opposite question.

**HANSEN:**

**FELICE** Oh, dear.

**FRANKEL:**

**SARAH** Yeah. So sometimes I see the most beautiful phenomena. And I'm like, if I take a picture of it, it's just never going  
**HANSEN:** to be as good as it is in real life.

**FELICE** No, it usually is never as good. But that's OK, because you still have a recollection of what it could have been. As  
**FRANKEL:** long as you are seeing-- that's the key. You're looking, and you're seeing that it is a phenomena. It's not magic.

It's something that is happening in science. That, to me, is enough. And the next time, you'll make a better picture. How's that?

**SARAH** Yeah, deal.

**HANSEN:**

**FELICE** A deal?

**FRANKEL:**

**SARAH** A deal. So if people are curious to learn more about science photography and creating images, you have some  
**HANSEN:** teaching materials available for free on MIT OpenCourseWare.

**FELICE** Yeah, well, we have a course making science and engineering pictures. It's longer than that. We have 42-- count  
**FRANKEL:** them-- 42 tutorials.

**SARAH** Wow.

**HANSEN:**

**FELICE** I am not there at all. It's all voiceover. It's all about, how do I do what I do? I'm told it's very good.

**FRANKEL:**

**SARAH** It is.

**HANSEN:**

**FELICE** The course itself is about, I'm going to say, lectures. But it's all visual. Everything you're going to see is what I'm

**FRANKEL:** teaching.

And I'm excited that it's still online. I loved making it. I loved doing it, by the way.

**SARAH** Oh, it's lovely. And you're adding an addition. You made a video recently where you talk through what we talked

**HANSEN:** about with AI.

**FELICE** Yeah. Yeah.

**FRANKEL:**

**SARAH** So that will be new.

**HANSEN:**

**FELICE** It has to be updated with that.

**FRANKEL:**

**SARAH** Of course.

**HANSEN:**

**FELICE** AI-- I don't know how long we'll be talking about this. But it sounds like we're just beginning the conversation.

**FRANKEL:** And so we had to update it somewhat.

**SARAH** I think, as we get further into the field with AI, people will be craving authenticity more and more. So I think

**HANSEN:** science photography and documentation will become more valued.

**FELICE** Ooh, I like that. Yeah, no, thank you. I think that makes a lot of sense. I think, as long as the trust is there-- and I

**FRANKEL:** can be trusted, I believe.

**SARAH** Yes. I think so. I think so, Felice.

**HANSEN:**

**FELICE** You think, Sarah? Thank you.

**FRANKEL:**

**SARAH** Is there anything that we haven't talked about that you wanted to add?

**HANSEN:**

**PRODUCER:** *The Hulk.*

**FELICE** What?

**FRANKEL:**

**SARAH** *The Hulk?*

**HANSEN:**

**PRODUCER:** Yeah, I want you talk about *The Hulk.*

**FELICE** Oh, my God. I forgot about that.

**FRANKEL:**

**SARAH** I don't know what this is.

**HANSEN:**

**FELICE** I will have you know that, in the movie, *The Hulk*, one of my photographs is on the wall in a laboratory.

**FRANKEL:**

**SARAH** That's really exciting.

**HANSEN:**

**FELICE** And, how do I know that?

**FRANKEL:**

**SARAH** Yes?

**HANSEN:**

**FELICE** Because if you sit around for the credits, you will see, image donated by Felice Frankel. Actually, now that I think  
**FRANKEL:** about it, they must have gotten my permission. Why I gave my permission to be in *The Hulk* is a whole other thing.

**SARAH** Right.

**HANSEN:**

**FELICE** Yes, that's what happened. These are important things in life.

**FRANKEL:**

**SARAH** Forget doing your stint at Harvard or at MIT. Now I know you're a big deal.

**HANSEN:**

**FELICE** Thank you very much.

**FRANKEL:**

**SARAH** Thank you so much for being here. I learned a lot. I feel more curious now. I'm going to go take some

**HANSEN:** photographs of phenomenon I see outside and inside. I feel kind of revved up about looking at the world in a new way. So thank you.

**FELICE** That's the best thing you could say. It's been a pleasure, Sarah. Thanks so much.

**FRANKEL:**

**SARAH** Thank you.

**HANSEN:**

**FELICE** You bet.

**FRANKEL:**

[THEME MUSIC]