THE SCIENCE & PHOTOGRAPHY ISSUE

WHY SCIENTISTS ARE COLLABORATING WITH PHOTOGRAPHERS

THE BRAINS BEHIND YOUR PHOTO GEAR

3 PHOTOGRAPHERS CAPTURING THE WONDERS OF SCIENCE

HANDS-ON TEST: THE SONY a9

MAKING SPECTACULAR UNDERWATER 360-VIDEOS

PHOTOPLUS EXPO CONFERENCE PROGRAM

THE GREAT OUTDOORS WINNERS’ GALLERY

OCTOBER 2017

$7.99 US, $10.99 CAN
This spring, photographer Matthew Cicanese hiked through rain forests in Sri Lanka, following Dr. Gothamie Weerakoon, a visiting scientist at The Field Museum of Chicago and Sri Lanka’s National Institute of Fundamental Studies, as she moved from tree to tree, examining and collecting lichen. When she found a specimen she wanted to collect for further study, Cicanese would first photograph it in its natural state. With Weerakoon waiting behind him, her specimen knife in hand, Cicanese recalls, “I’m trying to make sure I work the scene to the best of my abilities before she collects the species.”

Shooting quickly was not easy. Cicanese’s priority was to provide Weerakoon with detailed, well-lit, high-resolution images that she and her colleagues could use as they identify new lichen species and share their work. He was also making photographs that Weerakoon could use in reports and public talks to show “the beauty of these overlooked, underdog species” of flora. He frequently shot with a Canon MP-E 65mm f/2.8 1-5x Macro lens, “which is a microscope on the end of your camera, basically,” he explains. (Canon supplied gear for his trip.) Shooting handheld, “It’s ridiculously challenging to use, but the results you can achieve are wonderful.” Getting a tack-sharp image could be affected by any subtle movement—his breath, his heartbeat or other factors, such as “when mosquitoes land on my knuckle while I am trying to take the picture.”

He was also contending with soil leeches crawling up his legs from the floor of the lowland rainforest. Cicanese, who has followed scientists studying lichen in Iceland and moss in British Columbia notes, “I’m used to just laying on the ground when I photograph.”

A National Geographic Explorer and one of the Emerging League Photographers with the International League of Conservation Photographers (iLCP), Cicanese has long been fascinated by tiny organisms, but is particularly interested in cryptogams: organisms such as ferns, lichen and moss that reproduce with spores, rather than seeds or pollen. After he presented his images from the Iceland expedition to the National Geographic Society, a program officer there suggested he get in touch with Weerakoon, who had previously received a National Geographic research grant to support her lichen studies. He contacted her, and suggested ways she and her colleagues could use his images. This spring, Weerakoon won a second National Geographic grant. With additional support from Dilmah Conservation and the British Lichen Society, she was able to undertake more fieldwork and have Cicanese along to document it.

Cicanese travels with 4-terabyte hard drives, and during the Sri Lanka trip he produced an estimated 23,000 images. In addition to making 100MB technical images that Weerakoon uses as references, he made other, more artistic images. “One of my goals is to create work that rekindles the childlike curiosity you get when you go outside and you flip over a log,” he says. Lichen are found on all seven continents. Because they don’t require soil, they grow in habitats inhospitable to other flora or fauna, and are also found...
Anand Varma, who was fascinated with nature as a kid growing up in Atlanta, now follows his curiosity from one laboratory to another by finding scientists who appreciate the power of photography to inform and inspire lay audiences about their often-esoteric work. “A lot of [scientists] are thinking about how to communicate more effectively, and I’m in this process of trying to meet [them and figure out] how can I contribute to this movement of science communication evangelism,” Varma says.

Over the last decade, he has worked periodically with Christopher J. Clark, a biologist at University of California, Riverside (and a former college instructor of Varma’s) who studies hummingbirds. National Geographic recently featured Varma’s striking slow-motion videos of hummingbirds in action against black backgrounds. The videos bring out details that on rocks, trees, fence posts and other organic substrates. So common are lichen that they’re often overlooked by both photographers and the science community. Cicanese strives to highlight what makes them interesting. “They vary in shape, color, size, structure and chemical composition,” he says. “Some are as tiny as the period on your keyboard, and some are the size of your keyboard.”

To bring out the structure and detail in a specimen, he’ll often use twin flashes off camera, or bounced into a white plastic card he carries. Cicanese also uses a fisheye lens when he wants to make wider views of the environments: “It paints a better picture of where these species live and what these ecosystems look like,” he says.

Cicanese has been interested in science and nature since he was a kid. A bout of infant meningitis left him deaf in his right ear and blind in his left eye. He started making photos 12 years ago, at age 14. “My camera was the ‘missing link’ I needed to make up for those lost senses. When people say to make the camera an extension of your body—it happened quite literally in my case.” He says, “Although I have losses in sight and sound, I think my acuity in those areas has greatly increased to compensate for my losses.” When making macro images, he says, “I’m transported to that world when I look through the viewfinder.”

In explaining how he wants to share that experience with viewers, he recalls the words of his ILCP mentor, microscopic photographer Piotr Naskrecki: “He says he doesn’t want to enlarge his subjects, but to shrink his viewers. It’s beautifully put, because that’s what I try to do as well, using lighting and scale.”

Cicanese wants his images to support not only scientific research, but the conservation of organisms and their ecosystems. “If my images inspire people to simply get outside, look closer and marvel at the natural world around them, that’s a step in the right direction when it comes to education and conservation of lichens and other cryptogamic species.”

—HOLLY STUART HUGHES
scientists have never been able to observe before, because they go by in a blur to the unaided eye.

In return for the scientific expertise and lab access that his scientist-collaborators provide, Varma offers photographs they can use in their scientific papers and other communications, including publicity. Sometimes, the scientists may also glean valuable information from Varma’s photographs that contributes to their research. His slow-motion hummingbird videos, for instance, showed feather structure during flight that scientists had been previously unable to see, much less measure.

*National Geographic* previously featured Varma’s photographs in the November 2014 cover story called “Mindsuckers,” which shows the drama, detail and vivid color of parasites in action on the bodies of a variety of insect hosts.

“I find so much satisfaction in learning about the natural world, and discovering these mysteries for myself, that I want to inspire [that curiosity] in other people,” he says. “I want to do that by showing them something completely unexpected.”

He’s currently at work on a story for *National Geographic* about a species he doesn’t want to name. Suffice it to say, a lot of people find it repulsive. Varma’s challenge is to make it look beautiful and “really cool,” thereby enthralling *National Geographic* readers.

“I don’t necessarily have one creature or subject I like more than others. When I see an opportunity either through a scientist’s expertise or something that I read or imagery that I saw, I think, oh, I could apply my skill set to this subject, to show it in a new way. That’s kind of how I pick my next story,” he says.

He writes to scientists who are doing the work he’s interested in to ask if he can spend a couple of weeks in their laboratories making photographs. (His long-term collaboration with Clark was the exception, not the rule.)

“There are people who are like, ‘Yes, I want you in my lab. Tell me what you need,’” Varma says. “I don’t necessarily have one creature or subject I like more than others. When I see an opportunity either through a scientist’s expertise or something that I read or imagery that I saw, I think, oh, I could apply my skill set to this subject, to show it in a new way. That’s kind of how I pick my next story,” he says.

He writes to scientists who are doing the work he’s interested in to ask if he can spend a couple of weeks in their laboratories making photographs. (His long-term collaboration with Clark was the exception, not the rule.)

“There are people who are like, ‘Yes, I want you in my lab. Tell me what you need,’” Varma says.

He’s now in the exploratory stages of a project about jellyfish, a subject that piqued his interest after he met City University of New York marine biology professor David Gruber at an event for *National Geographic*’s Emerging Explorers. (Varma is one of the 2017 Emerging Explorers; Gruber was one of the 2014 group.)

“He saw my hummingbird work, and mentioned work he was doing” with jellyfish, says Varma, who is interested in the difficult-to-observe details of the jellyfish lifecycle. “They’ve got an interesting story to tell if you can just figure out what’s the hidden mystery we don’t get to appreciate. To find a way to clearly show that would really be surprising to people.”

Because he looks for new and surprising ways to photograph his subjects, Varma says his process “involves just an enormous amount of experimentation and iteration. You start with what you know.” For the hummingbirds story, he knew the magic of hummingbirds was in their motion. So he started to think of techniques for visualizing that.

He considered what’s been done previously, starting with the motion studies of Eadweard Muybridge and the high-speed stroboscopic photography of Doc Edgerton. They figured out how to trigger a camera and flash multiple times in succession, Varma explains. “So I thought: What if I figure out how to do that, but independently control each of those flashes at a different power level, and different angle, and use that level of control to more carefully illustrate the science that’s going on?”

With help from *National Geographic* engineers and lighting vendors, Varma figured out what special gear he needed. From there, he says, “It took many, many weeks of trial and error and figuring out how to get the [gear] to perform in a way that looked very beautiful in the end.” It was all a matter of looking at what worked and what didn’t, and pruning whatever looked “boring and ugly and horrible… and pushing toward those little hints of something in a draft picture where you think: Hey this looks new.”

Usually, Varma and his collaborators don’t share funding. The exception so far was the hummingbird work with Clark, whose recent National Science Foundation (NSF) grants included some money to support Varma’s work. Clark procured that money under an NSF “broader impacts” requirement, for which scientists have to explain how their work will advance scientific knowledge and achieve “societally relevant outcomes.” Among relevant outcomes that NSF specifies are “increased public scientific literacy and public engagement with science and technology.”

While Varma continues to pursue other projects, he has also started teaching photo workshops to scientists this year. “There’s not enough time in 100 of my lifetimes to go out and photograph all the compelling stories that exist, so the next step is sharing that tool set [I use] with scientists themselves so they can be empowered to tell their own stories.” —DAVID WALKER
For more than two decades, photographer Felice Frankel has worked as a research scientist at MIT’s Center for Materials Science and Engineering. Her scientist colleagues—at MIT and at other institutions—call on her to create photographs that visually describe their work to audiences both inside and outside the scientific community. When researchers are preparing to publish their findings, for instance, they’ll approach Frankel to make images that are both descriptive and interesting to look at, which might land them the cover of a journal or magazine, or lead to a news feature.

Frankel’s macro image of a fabric that is modeled on the structure of sea otter fur, for instance, landed on the cover of Popular Science last year. Her images have also been on the covers of the scientific journals Nature and Nature Materials this year. Despite the fact that many people read articles digitally, covers remain important, especially for young researchers who are seeking tenure, Frankel says. Mainstream news journalists are also more likely to write about a discovery if it’s on the cover of a science publication. The Popular Science cover story, for instance, which was about the work of MIT mechanical engineer Alice Nasto and her team to improve wetsuit technology, led to coverage in several other media outlets, from Smithsonian to Fox News.

Frankel first discovered how useful photography could be in explaining scientists’ work while collaborating with chemist George W. Whitesides. The two met when Frankel was a Loeb Fellow at Harvard’s Graduate School of Design. She sat in on Whitesides’ molecular biology courses, then volunteered to make images for a paper he was publishing in Science. They got the cover, and Whitesides encouraged her to keep photographing science subjects. They went on to work together on, among other projects, the book No Small Matter: Science on the Nanoscale. The book explained, through images and text, advances in the fields of nano- and microtechnology. Whitesides has said, according to Frankel, that by pushing him for better, more photogenic samples of his work, Frankel was “actually asking [Whitesides and his colleagues] to refine the science, and that the process of making more photographic work got them thinking further about the science,” Frankel recalls. She’s built her career around similar collaborations with a number of scientists at MIT and elsewhere. “The best part is when I push the questions to them,” she adds. “In order to develop better pictures, they have to think about their work differently.”

Recently Frankel has worked with scientists to create digital composite images that explain a scientific idea or concept that isn’t photogenic, such as her image for an article about rodent and non-human primate immune system responses to implanted biomaterials, which ran on the cover of Nature Materials earlier this year. That image was developed through conversations with scientists about how to “communicate the science” behind their research. “We try to figure out what should that picture be, because I’m basically starting from scratch when I’m developing a metaphor,” Frankel explains. Those conversations about the image-making process “get the scientist to once again think deeper about what the science is.”

Frankel has made improving the visual literacy of the science community a major part of her work. She won a grant from the National Science Foundation to develop a program with science and design students and faculty to create drawings that teach science. Though the outcomes were drawings not photography, the project still made clear that visualizing science contributes to understanding. “The very nature of making an image in order to communicate the science is a learning tool,” Frankel says. “We could see, for example [the students’] misconceptions [when they drew] something incorrectly.”

She also developed an online course meant to teach students, faculty and researchers how to photograph science subjects. Making Science and Engineering Pictures, A Practical Guide to Presenting Your Work debuted in 2015 on MIT’s open education platform, and Frankel is currently working on Picturing Science and Engineering, a book based on the course that’s due out from MIT Press next year.

She says she’s frustrated that there isn’t a program “that teaches researchers how to develop better approaches to imaging their work. They learn on their own and they are lacking in very basic knowledge of the camera,” she says. Frankel believes it’s important to “raise the standards of what a good [science] picture should be,” and the technical science imaging courses at some schools aren’t enough. “It’s more than [technical imaging],” she says. Science images also have to be engaging to scientists and general audiences alike. “There’s an esthetic component that I think needs to be part of this conversation.” —CONOR RISCH