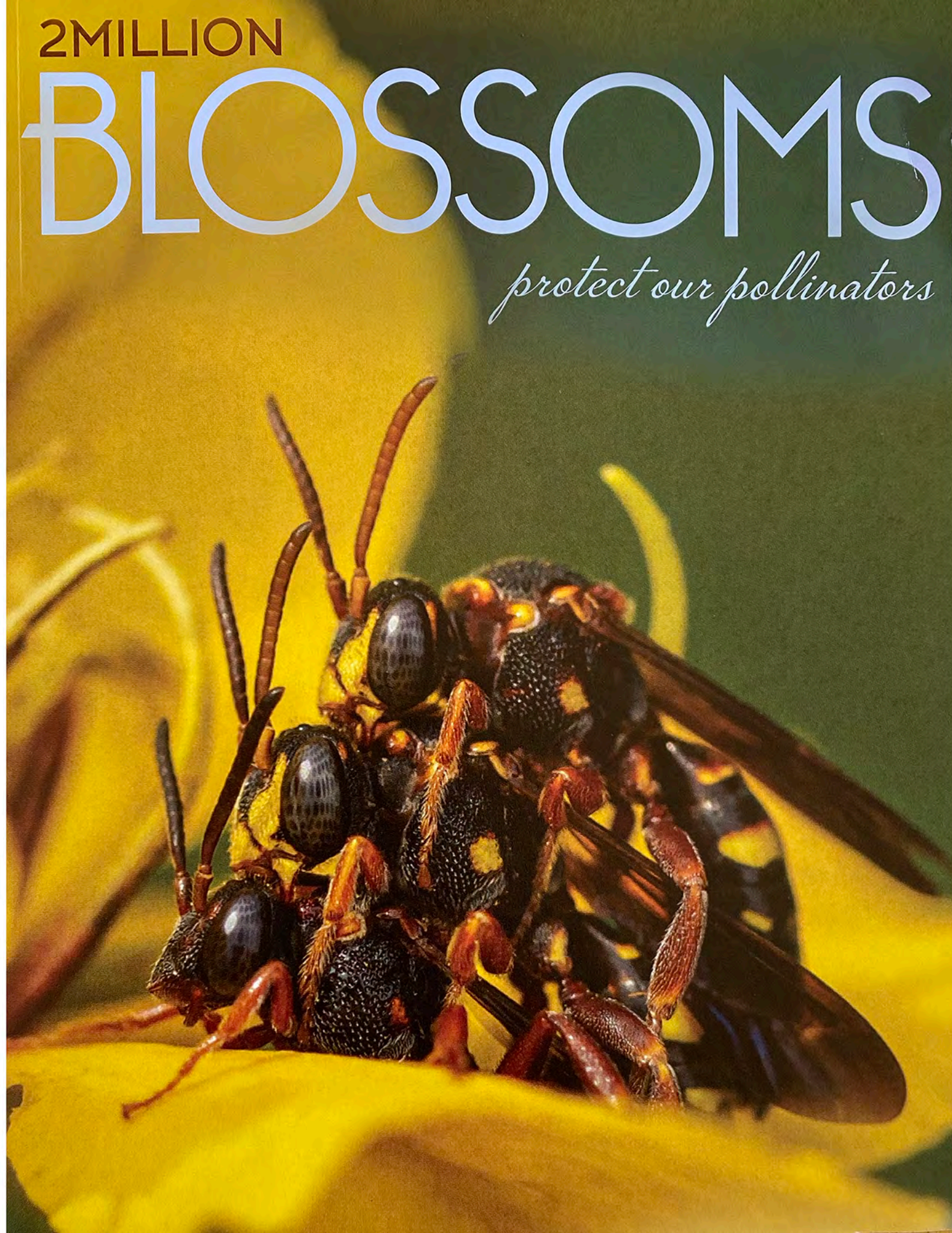


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To Capture a Bee:

Women, Entomology and Science Illustration

by Joan Meiners

How does one capture a bee? They move about so furtively. A net can catch a bee mid-flight. A pin may preserve it for the microscope light. But to capture the essence and grandeur of a bee, you may need, as Emily Dickenson put it, a dose of reverie.

From my first week of graduate school, I watched Molly draw. She would sit at her microscope, examining a solitary bee from the genus *Osmia*, her specialty, at high magnification. Her hand would manifest the bee on a pad of paper next to the scope while her eyes moved imperceptibly from their vantage point on the real thing. Her renderings were excellent, but that wasn't really the point. The point was to truly see.

Molly Rightmyer was a postdoc when I was in my first year of graduate school at the USDA's Logan Bee Lab. By the time I graduate, I told myself, I'll be able to draw a bee. To capture a bit of its magic on the page. Turns out this very goal



Above: From Maria Sibylla Merian's work on the metamorphosis of insects in Surinam. This plate shows the life stages of the *Thysania agrippina* moth.

has been a pursuit of female entomologists long before I ever came along to marvel at the way Molly could will an *Osmia* specimen back to life with pencil strokes.

The first entomologists were illustrators. Before cameras, before label printers and barcode scanners, before databases, insects were captured as drawings. Maria Sibylla Merian (1647-1717) recorded the life stages and morphology of moths and butterflies in intricate engravings and watercolors long before women were allowed to participate in science in any other way. Her careful work illustrating insects at different life

stages helped convince her European contemporaries that Lepidopterans did not just spring forth from plants fully formed, but instead underwent a fascinating metamorphosis from caterpillars to the flighty creatures we all adore.

In 1699, Merian embarked on an expedition to the jungles of Surinam to illustrate new species of tropical insects. This trip, funded by her host city of Amsterdam, may have been



Above: A Parrot Tulip, Auriculas, and Red Currants, with a Magpie Moth, its Caterpillar and Pupa by Maria Sibylla Merian



Above: Plate 13 of Australian *lepidoptera* and their transformations, drawn from the life illustrated by the sisters Harriet and Helena Scott

the first major journey ever undertaken by a woman solely for the purpose of science. Her works, which document specific associations of insects and plants, are still featured in collections all over the world.

More than a century later in Australia, Harriet (1830–1907) and Helena (1832–1910) Scott produced lifelike illustrations of snakes, mammals, and shells. But the sisters took a special interest in pollinators, undertaking a project to illustrate all known species of butterflies and moths in Australia at the time. These detailed drawings form the basis of a Special Collections dataset at the Australia Museum that has been deemed so historically and educationally valuable that it was also turned into a free mobile app called “The Art of Science: Butterfly and moth paintings by the Scott sisters.”

Nearly a century after that, the botanical illustrations of Margaret Mee (1909–1988) not only served as an early scientific record of tropical plants, they also ignited awareness of mining and deforestation in the Amazon basin. Her art, therefore, doubled as both data and conservation activism. During her fifteen expeditions from the U.K. to Brazil, Mee completed over 400 pages of illustrations, 40 sketchbooks, and 15 botanical diaries, many of which are now archived at the Kew Gardens World Heritage Site in London. Several of the plants she documented are now named after her. In some cases, her illustrations are the last known record of extirpated species.

The broadly beloved Beatrix Potter was an older contemporary of Mee’s. In addition to authoring and illustrating the adventures of Peter the Rabbit, Potter was also an accomplished and meticulous natural history illustrator. Her private Victorian-era education enabled her to explore her artistic talents while focusing on botany, then entomology and eventually, mycology. Her acute attention to the structure of various microscopic fungi spores led her to develop a theory about their germination that was ignored during her lifetime, because women were not yet recognized as contributors to science. She was later proved correct. Her detailed illustrations are still used by mycologists to identify fungi.

Discounted throughout history as a frivolous pastime of upper-class women, illustrations from the past now help advance scientific theories and research in myriad ways. Scientists can use dated illustrations to reconstruct which plants and animals coexisted in bygone ecosystems. They attest to the roles of insect species since lost to our world. Drawings from before the era of extensive numerical data collection paint a literal picture of how the status of pollinators has changed.

Even today, with all manner of new technologies, the role of illustration in science endures.



Top: Narcissus, forget-me-nots, and butterflies by Maria Sibylla Merian from the archives of the Academy of Science in St Petersburg.

Bottom: Plate 7 of Australian *lepidoptera* and their transformations, drawn from the life illustrated by the sisters Harriet and Helena Scott.



Above: An example of Erin Hunter's illustrations for the picture book *Multiply on the Fly*.

Erin E. Hunter is a science illustrator based in the Monterey Bay area of California. She spends four days a week illustrating scientific concepts for an academic publisher and devotes Fridays to personal projects documenting local species of pollinators and the flowers they visit.

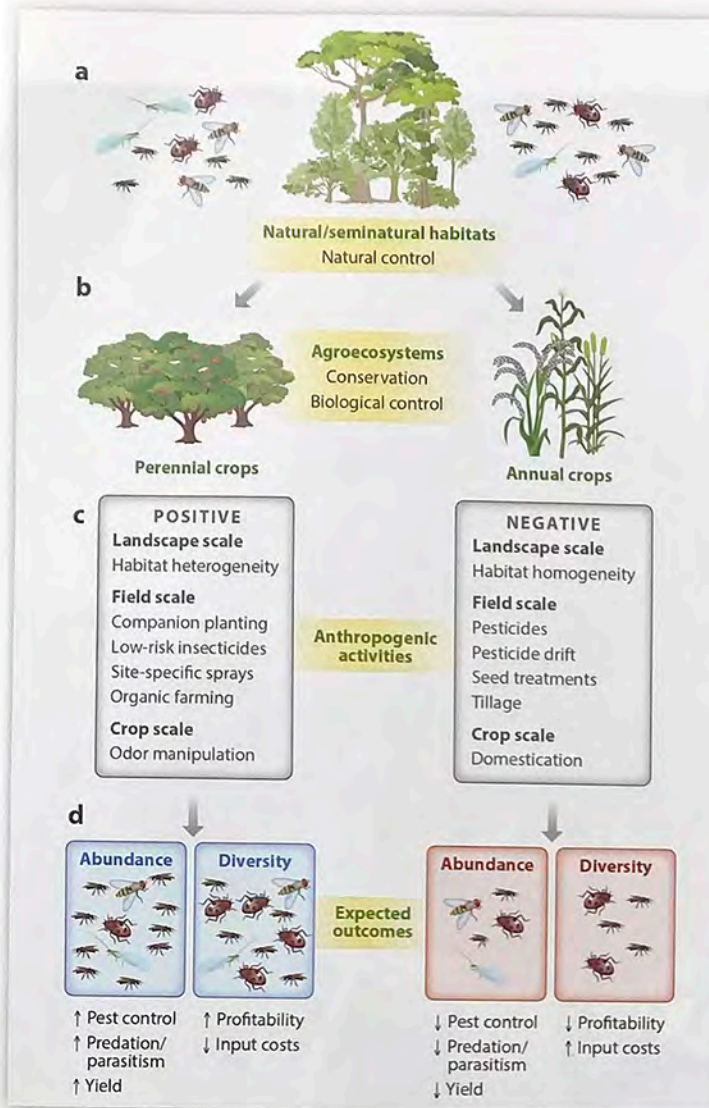
"For me, science illustration is taking a scientific concept and translating it visually," Hunter said. "When I was in grad school, people would say 'well, everything can be photographed now, why would you hire an illustrator?' But there is so much that can't be photographed. You call a science illustrator when you need to illustrate Pluto's orbit, or when you need to communicate the concept of photosynthesis, or if you need to show the internal anatomy of any kind of animal. Using the tools of illustration, you can communicate an idea that's really complex."

For more than a year, Hunter has been spending her Fridays working on a large painting of native California bees flitting in and out of a wooden frame entwined with local California blooms. The composition includes 40 different species of bees, each drawn at exactly three times their true size, each visiting flower species with which they truly interact in real life. It's both fanciful and factual.

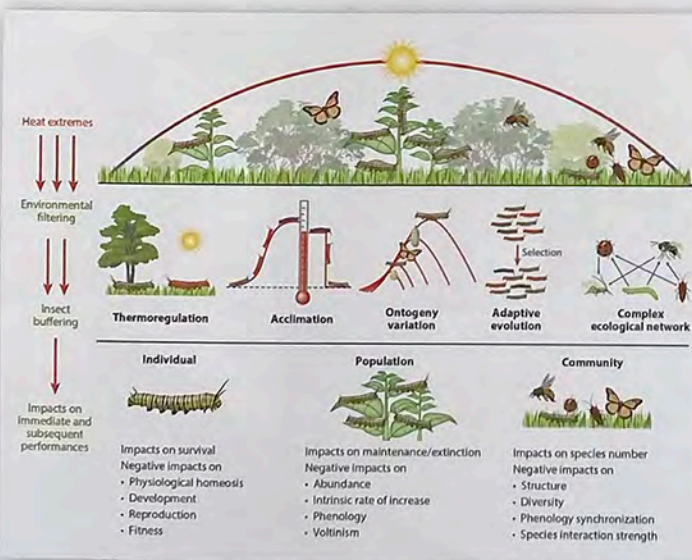
"Most of us have some kind of ecological bent to our work to bring attention to the things we think are most



Above: Erin Hunter recreates each pollinator and its preferred plant at 3x its actual size, using a magnifying glass for the intricate details.
Left: Erin adds the finishing touches to the season daisy (*Erigeron glaucus*).



Above: An example of Erin Hunter's scientific illustration comparing perennial and annual crops. Reproduced with permission from the Annual Review of Entomology, Volume 65; copyright 2020 Annual Reviews, <https://www.annualreviews.org/>



Above: Hunter illustrated how high temperatures impact insects. Reproduced with permission from the Annual Review of Entomology, Volume 66; copyright 2021 Annual Reviews, <https://www.annualreviews.org/>

valuable," Hunter said. "Mine is bees for some reason. I'm a little fixated on them."

To ensure the accuracy of her passion project, Hunter did her homework. She took a class on native plants and began researching bee species off a list of local bee biodiversity. She combed through posts on the taxonomy website, Bug Guide. She even reached out to experts across the country for help deciding which species of bees and blooms to include. One scientist even mailed her a bee.

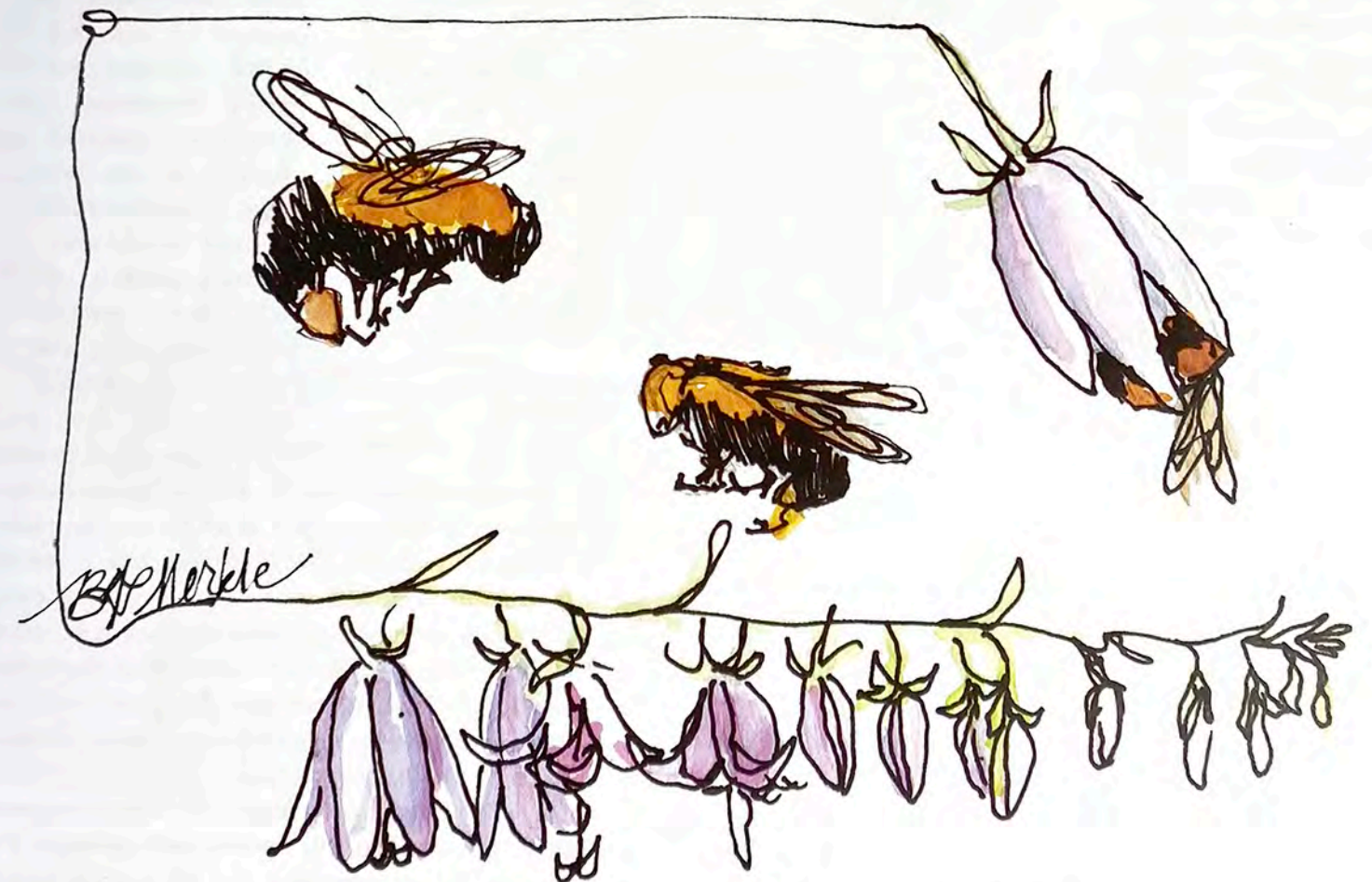
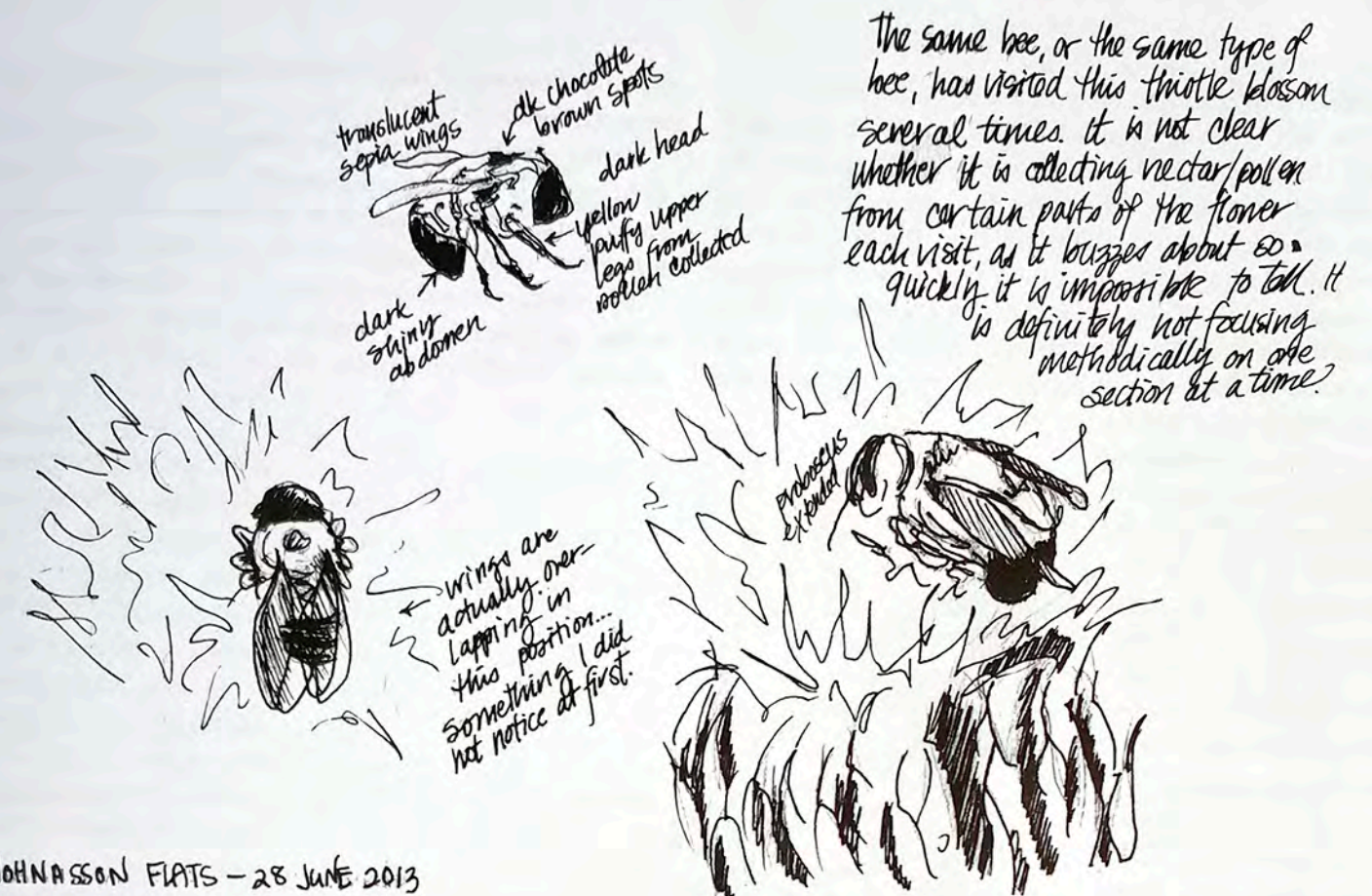
"I took this video of a *Megachile* and sent it to Vincent Tepedino, professor emeritus at Utah State University," Hunter recalled. "But he wanted me to use a different species that was specifically associated with this cactus flower, so he actually mailed me a *Diadasia*."

That *Diadasia* specimen's journey is the place where art and science blur. Hunter's studio is filled with many of the same items that crowded the systematics laboratory across the academic hallway from Tepedino's office at the time: pinned bee specimens, detailed notes about wing morphology, literature on pollinators, measuring tools. The same *Diadasia* that left a museum of research and entered a hall of art may be the subject of both academic papers and natural history illustrations. Both are useful, but one is beautiful.

Hunter sees her professional role as helping to organize and visualize the ideas scientists already have in their heads. If you've ever visited a seasoned professor in his or her office, you have an image of the mental chaos at issue: stacks of journal articles going back decades, piles of notes for projects half finished, jars of specimens waiting to be described. She's been handed cocktail napkins with rough sketches of scientific concepts and been asked, please, help make it make sense.

"The things that scientists maybe need a little help with sometimes is figuring out how to organize their ideas, so they are not cluttered," Hunter said. "I really enjoy kind of cleaning up their research and simplifying it visually."

Bethann Garramon Merkle is on a mission to help scientists visualize their own ideas and extend the tools of art in science to all aspiring illustrators, especially those who might not recognize themselves as such yet. As the Director of the Wyoming Science Communication Initiative at the University of Wyoming in Laramie, Merkle seeks to integrate the wisdom of art and humanities into the growing movement for effective, public-facing science communication. She teaches basic drawing and storytelling techniques to science students and professors alike. She's had faculty tell her things like 'we used to have the students draw and they didn't like it, so now we let them take pictures but I think their test scores are lower.' Merkle's work aims to correct for the strange ways in which technological advances, brought to us by science, have sometimes



Top: Merkle's sketchbook illustrations from a field day observing bees in 2013. Bottom: A study of garden bees by Merkle.

also derailed us from our roots in scientific discovery.

"I'm not working as much in that space on technical skills," Merkle explained. "We're not really talking about the extreme accuracy that you would want if you were illustrating a type specimen or something like that. But for someone who's just starting, what can we do to get them started so that drawing is a learning tool and not an impediment. These include things like tracing and contour drawing, where you're not actually looking at your paper, you're just looking at the object. The point is getting you to look at something really carefully instead of being concerned about the outcome of the drawing. The idea is to get them drawing, first of all, and also help them see that it doesn't have to be a perfect drawing to help them focus their attention."

As a first-generation college graduate, Merkle is also passionate about opening up this pathway into science to a broader diversity of interested students. She celebrates how illustration helped women like Merian, the Scott Sisters, Mee, and Potter sneak past gatekeepers into the exclusive world of research. But she thinks it's critical to also recognize that these women we remember as early science pioneers were all white and privileged, with the time and means to travel and draw.

"The history of science has so been written by white European men, that it is freakishly easy to forget that everyone around the world has been recording things for a long, long time," Merkle said. "We are often really leaving out whole conversations when we talk about the history of science illustration."

Even now, Merkle says, the academic standard often requires researchers to have access to specific and very expensive camera equipment to render an image of a new pollinator species. In her opinion, drawing could often represent the pollinator better. Illustration is not just an artifact of science history. She's also interested in recent

scientific evidence that supports its persistence in our research future.

"One of the things I've done over the last five to eight years is try to find research that explains why this stuff works, and a lot of it is in neuroscience that studies how the mind and eyes work together," Merkle said. "Apparently, our understanding of the ways our eyes work is that we actually see things in ways that are closer to line drawings than photographs. We are distilling what we see down to lines and shapes."

Scientific illustration, then, is embedded into the very core of our mental processing. As Oscar Wilde famously wrote, "Life imitates Art far more than Art imitates Life."

During my graduate fieldwork, I captured thousands of bee specimens with pan traps and aerial nets. But I recently embarked on a new project to capture them on paper with graphite. I enrolled in a free, six-week natural history illustration class online and conjured up sketches of my favorite species. Needless to say, it is harder than it looks.

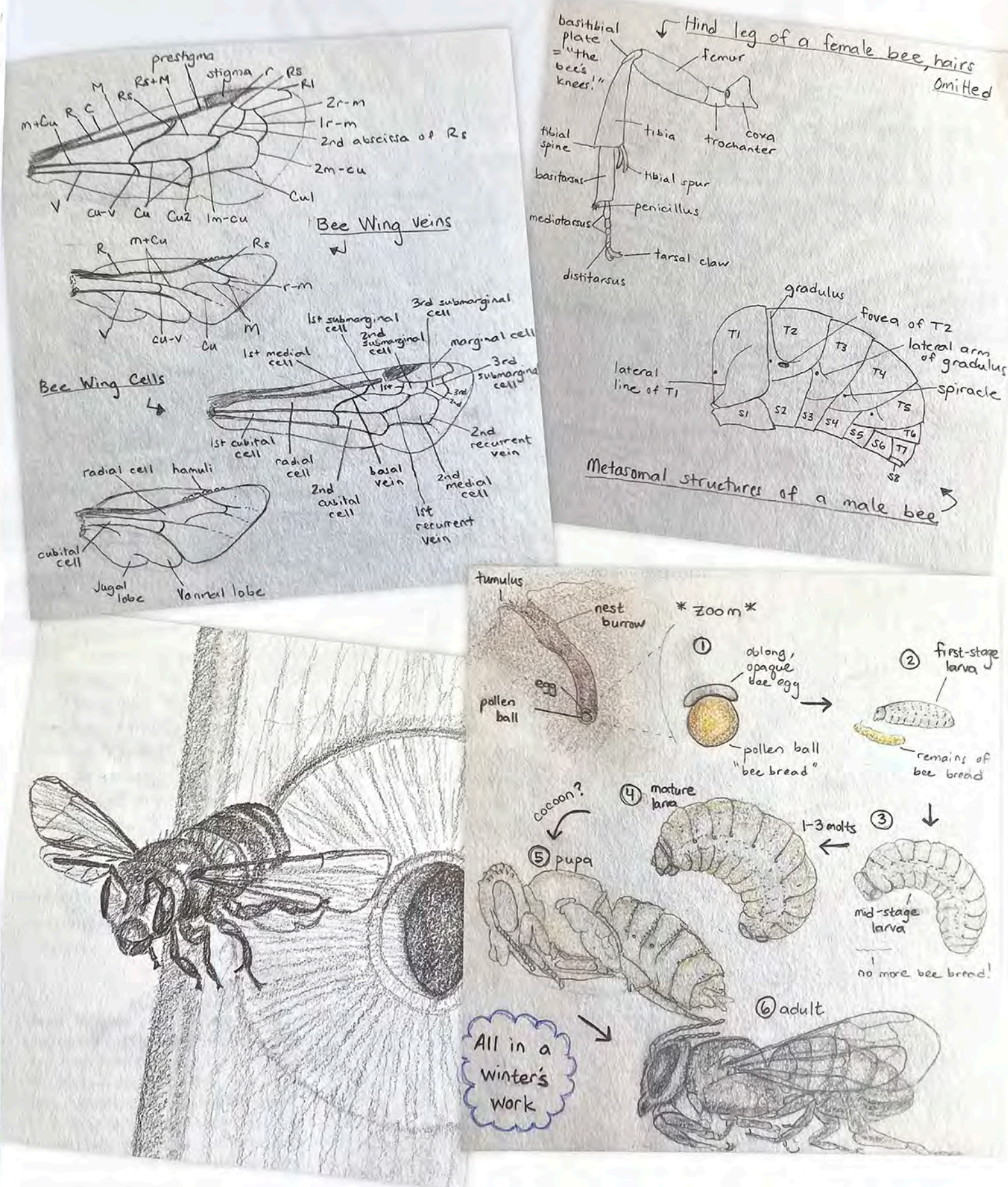
But regardless of the end result, researching this story taught me to believe in the process of art as science. Even after countless hours of pinning

specimens in a lab and examining them under a microscope, to draw a species is truly to see it as if for the first time. After sketching the outline of a foveal hair patch or agonizing over the contour of an arcuate wing vein, you will not easily forget its detailed morphology. Studying how legs attach to the thorax will help you identify where other illustrators went wrong, just as learning to shade the layered wings of a hymenopteran will curse you to forever notice when a drawing includes only one of two pair.

"Any time I have drawn something I will always recognize it everywhere," Hunter said. "In working with scientists, I've had times where I drew something, and the scientist looked at what I drew and said that it didn't look right. But then they



Above: A page from the author's sketchbook, a study of a monarch butterfly on an echinacea bloom.



Clockwise from top left: A series of illustrations by the author Joan Meiners, including a wing study, the hind leg of a female bee and the tergites and sternites of a male bee, bee development from egg to adult, and a bee in flight.



This image: The detailed drawing by Louise Bestea, a French PhD student of animal behavior and artist, whose detailed illustrations are much appreciated by her scientific colleagues.

"In working with scientists, I've had times where I drew something, and the scientist looked at what I drew and said that it didn't look right. But then they looked back in their microscope and they saw this detail that I saw that they hadn't seen before."

Erin E. Hunter, science illustrator

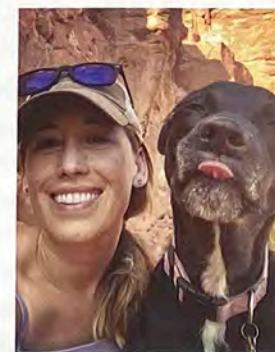
looked back in their microscope and they saw this detail that I saw that they hadn't seen before."

We can all get stuck in our mental chaos, beneath our towering stacks or open internet tabs of journal articles, amid our scribbled notes about half-finished projects. Picking up a drawing pad is one way to start anew, to cleanse your lens, to step into the field like an energetic graduate student. The illustrators we remember and countless indigenous ones we don't made mistakes in their work, but still recorded invaluable research contributions. Those who were not afforded the luxury of travel or living on site have sometimes been criticized for failing to capture the lifelike qualities of their taxidermized subjects, but their work remains an essential part of the historical and scientific record. Just as the progress of contributing new scientific knowledge is slow and iterative, so is the process of learning to draw.

"Creativity, we think it's something that scientists don't do. But we wouldn't have anyone on the moon, we wouldn't have vaccines. There are all kinds of things we wouldn't have if scientists hadn't stepped outside of those boxes," Merkle said. "I would like people to understand that drawing can be part of a process of pushing back against that siloing in science."

So, grab a drawing pad and take it into the garden. Wield a pencil, not a net, to capture a bee, then give it pardon. Notice features you previously failed to see. And, in the process, reignite a dose of reverie. ✨

Joan Meiners completed her Master's degree in the USDA Logan Bee Lab at Utah State University and her PhD in Ecology at the University of Florida. While she still loves bees and data, she has since left academia for science journalism. She works as an environment reporter in southern Utah and spends her free time exploring desert canyons with her dog, Laila. Connect with her on Twitter @beecycles, on Instagram @bee_cycles, or follow her work at www.joanmeiners.com.



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