QnAs with Marcia McNutt

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When geophysicist Marcia McNutt learned that she had been nominated to stand for election as president of the National Academy of Sciences (NAS), she modestly pointed out to the selection committee that, although she felt honored, she was surprised to be chosen from a pool of what were surely far more deserving scientists. McNutt's self-effacing remark belies the unique blend of expertise and experience she brings to the job as leader of the nation's premier advisor on science and technology. Over a career spanning more than three decades, McNutt has worn many hats—as a researcher at the forefront of discoveries in ocean science, as the director of a major research institution, as a political administrator plunged into the tumultuous heart of catastrophes, and as an editor at the leading edge of scientific publishing. After a four-year stint as director of the US Geological Survey (USGS), where she coordinated responses to several headline-nabbing natural and manmade ecological disasters, McNutt served as editor-in-chief of *Science* magazine, where she quickly cut her editorial teeth, laying claim to a legacy rich with exemplary initiatives aimed at raising the ethical standards of scientific publishing in the digital era. The array of editorials she penned while at the journal mirrors the intellectual fierceness and forthrightness that mark her distinguished career. She has been often portrayed as an aspirational icon for young female scientists, and many elements in her biography—barrel-racing equestrian, accomplished basic researcher, and level-headed leader—bolster the image. In July 2016, McNutt took the reins of the Academy from her predecessor Ralph Cicerone. McNutt spoke to PNAS about aspects of her career and her vision for the Academy.

Image caption: Marcia McNutt. Image courtesy of Stacey Pentland (photographer).

PNAS: Your scientific career began with an early interest in physics while you were an undergraduate in Colorado. Before long, you chose to focus on geophysics. How did you become interested in geophysics?

McNutt: Going into my final year as a physics major at Colorado College in the mid-1970s, I thought I would pursue one of the fields in physics that were the specialties of my instructors. These were popular fields that figured commonly in the physics lore of the time, like high-energy physics and astrophysics. But one of my physics professors advised me against entering those fields; there were queues forming, he said, for people who wanted telescope time to do astrophysics. What's more, I would be one in a crowd of people contributing to findings. He handed me an article that had just been published in *Scientific American*; it was the first paper for popular audiences on plate tectonics. Being in Colorado, I had taken some geology courses, of course, but I had not thought about majoring in geology, mostly because it seemed a largely qualitative discipline. But when I read that article on plate tectonics, I was blown away. It changed my life. Most of the plate boundaries are under water, so I decided that I would become an oceanographer. That's how I came to geophysics.

PNAS: After graduate school at the Scripps Institution of Oceanography, you spent more than 15 years in academia, specifically at Massachusetts Institute of Technology (MIT), where you headed a laboratory. You then accepted a leadership role at the Monterey Bay Aquarium Research Institute (MBARI), and have since focused on administration. What prompted the switch?

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McNutt: After 15 years of teaching at MIT, I had graduated quite a few students who were well on their way to successful careers in academia, government, and industry. Increasingly, I began to notice that I was being asked for my opinion on other people's research. Rather than doing my own research, I was spending more and more of my time offering advice on others' research. And I thought there were several things wrong with that picture. This wasn't my day job, and I wasn't in a position to make any decisions, despite giving advice. So when I got the phone call asking if I would be interested in being director of MBARI, I said, here was a chance to actually make the decisions myself and take the research into new and exciting directions. MBARI is funded by the Packard Foundation, and all of the money flows to the director, who, along with a small team of senior leaders, sets the institute's research agenda. So here was a chance to support high-risk, high-reward projects that rarely get funded by the National Science Foundation or other government funding agencies.

PNAS: Was your foray into administration seamless?

McNutt: It was an adjustment. I had gotten so much satisfaction solving research problems—going out into the field with a hypothesis, collecting data, revising my hypothesis in light of the data, experiencing the "aha" moment of discovery—I had to learn to get the same satisfaction vicariously from all of the research I was enabling. But, in the end, that turned out to be even more satisfying, because the scientists and engineers I was leading were all so creative.

PNAS: In 2009, you accepted the top job at USGS under the Obama administration and served as director of the agency for four years. What were your initial thoughts about the job: excitement, apprehension, or a mix of both?

McNutt: By that time, I was sure I already had the best job in science, so to speak. Looking back, that's quite true; to be living and working in Monterey, CA, with private funding from the Packard Foundation, to take on high-risk projects, to develop tools never before deployed in the ocean, to solve problems in the field that had remained unsolved for hundreds of years, it was an amazing opportunity. That said, as Donald Kennedy, former editor-in-chief of *Science*, said, after 12 years at MBARI, I was ready to be repotted like a plant. Going to the USGS was a chance to spread roots, expand myself intellectually, and learn about a completely different kind of organization with a much broader vision than anything I had been involved in until then.

PNAS: Your career at USGS is famously marked by manmade and natural ecological disasters: Haiti, Chile, Iceland, Fukushima, Sandy, and, perhaps most significant of all, *Deepwater Horizon*. No doubt the challenges and your strategy for dealing with each of these events were different, but, on a scale of complexity, which of these was the most daunting personally?

McNutt: Undoubtedly, it was *Deepwater Horizon*. Unlike most disasters, this one played out in slow motion—and on the nightly news. No one can forget the endless video of 60,000 barrels of oil spewing into the bottom of the Gulf of Mexico each day. For an ocean scientist who loves pristine habitat, it was like being socked in the gut. I felt powerless to plug that hole. The days in Houston at BP headquarters were long and draining; we started around 6:00 AM and ended just before midnight, trying to assess the options to contain the oil and plug the well, and the risks inherent in each option. We carefully planned what steps we needed to take and chose the safest options to pursue first. It was, personally, the most daunting experience of my life.

PNAS: As leader of the flow rate technical group, which was responsible for assessing the rate of oil discharged into the Gulf, you had a ringside view of this ecological disaster. By now, we know how the disaster unfolded, as well as BP's settlements. What did you learn from your vantage point?

McNutt: Our team of USGS and other government scientists worked with many top-notch BP engineers. Together, we had a shared purpose of wanting to bring the spill to an end. The BP folks worked just as hard as the government scientists, and I wouldn't want anyone to think that they were trying to obfuscate in any way, or delay or hinder progress on stopping the spill. They had substantial stakes in bringing the spill to an end, in fact, more so than any of us in the government; many of them had their retirement funds tied to BP stock, for example.

On the other hand, I and a few others kept stressing the importance of knowing the flow rate for plugging the well. To this day, I do not believe that BP was forthcoming with us on all of the information they had on flow rate. They were underplaying the flow rate at every chance, and we coordinated on everything except for flow rate. But the courts have now decided the matter, and damages have been assessed.

PNAS: Let's shift gears now, and talk about your time at *Science*. You went from being a high-profile administrator to leader of a publishing giant. During your three years at the journal, you spearheaded a number of initiatives. You oversaw the founding of *Science Advances*, *Science Robotics*, and *Science Immunology*. You wrote dozens of editorials on a range of initiatives, transparency and openness, data access, and additional statistical review through *Science*'s statistics board of reviewing editors (SBoRE), to name a few. Which of these accomplishments are you proudest of?

McNutt: For some of these initiatives, the time would have come in the community without me. With transparency and openness, I think it was important for a general journal like *Science* to take up the case, mostly because it gives the issue credibility across different disciplines. And transparency is an issue that cuts across disciplines.

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PNAS: Let's talk about the SBoRE initiative. What was your personal experience at *Science* on how authors address statistical bias in their papers? Is setting up such a board something you would recommend for all journals?

McNutt: Every journal likely has its own constraints and processes to consider while implementing something like this. The SBoRE was *Science*'s approach, and it worked particularly well for us, mostly because we already had the BoRE (Board of Reviewing Editors) in place. The BoRE is a board of practicing scientists who make a call on whether the work is original, groundbreaking, and of broad interest outside a narrow subspecialty, among other considerations. If the manuscript passes that test, and involves data analysis, the manuscript editor then sends it on to a member of the SBoRE, who determines whether it needs additional statistical review and suggests reviewers. Also, at *Science*, we had the further advantage that the submissions were largely competitive; authors who submit to *Science* tend to be highly self-selecting. And the SBoRE approach worked well with the process already in place.

PNAS: I'd like to talk about assessing research merit. You've written about the pitfalls of bibliometric assessment of research progress, whether it's article downloads or journal impact factors, which you might recall was something of a cause célèbre for the former editor-in-chief of PNAS. For better or worse, journal impact factors continue to influence scientists' careers. But what about article citation counts? What is their usefulness as a measure of merit?

McNutt: As far as citation counts go, I think their usefulness depends on the field. For very basic research, citation counts can be one reasonable measure of significance. But it's a very narrow measure because it scales with the size of the research community; it's not meaningful to compare citation counts across fields like planetary science and genetics, for example.

Let me recount an anecdote here that's relevant to your question. First, some background: At the USGS, the SL rank is a superrank reserved for revered researchers above pay grade, because their research is so outstanding, they receive a number of special considerations, such as being relieved of administrative duties. To evaluate candidates who are up for promotion to an SL rank, we would look not only at publications but a broad suite of factors, such as patents, societal impact, and policy implications. One young researcher, for example, had written code that, within minutes of an earthquake, would convert seismograms, which the average nonseismologist cannot decipher, to histograms that showed the probabilities of loss of life and economic loss for any earthquake in a populated area based on a number of parameters, including building codes. This meant that responders, like the White House, the State Department, embassies, and the Red Cross, could make rapid decisions about whether a local, regional, national, or international response was appropriate. Citation counts are one measure of merit, but this researcher had number of lives saved in his promotion package! And I'll take lives saved over citation counts any day.

PNAS: I'd like to talk about your role as NAS president. What was your initial reaction when you were asked to lead the Academy?

McNutt: I was dumbfounded; I thought they had probably dialed the wrong number. I was truly flattered, and I said to the search committee that I was honored that my name would even be on the list.

PNAS: It has been more than six months since you took the helm. Would you care to share your short-term and long-term goals while at the NAS?

McNutt: I think it's brilliant that the NAS starts the new president in July, which tends to be a quieter time and gave me an opportunity to find my feet. Overall, I'd like for the Academy to live up to our stated mission of being a home for science in America—intellectually, digitally, and physically. Right now, people view the Academy as a place where the government comes for advice. Increasingly, foundations and other nonprofits are coming to us for advice, too. I want the Academy to be a place to which everyone can turn for unbiased and authoritative answers to scientific questions. Take *America's Climate Choices*, our portal that summarizes information from our reports on climate change. We should have more of those on other important topics, such as energy, health, food, and transportation. When people seek authoritative information in an organized fashion, they should be able to find it at the Academy.

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