Cyrus

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Sea Change
How Marcia McNutt '70 is changing the face of science

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Combating human trafficking with art

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Inder Majumdar '12 shapes UN policy

Winter 2015

Marcia McNutt's passion for science has carried her on a powerful trajectory throughout her career, from an endowed chair in geophysics at the world-renowned Massachusetts Institute of Technology (MIT) to president and CEO of the Monterey Bay Aquarium Research Institute and then to director of the U.S. Geological Survey, where she served from 2009 to 2013 as part of President Obama's "dream team" of scientists appointed to high-level government posts. Yet for McNutt, the most exciting job is the one she holds today — that of editor-in-chief of Science.

COVER STORY

MARCIA MCNUTT '70 GOES

BEYOND THE DEEP SEA

Written by Lori L. Ferguson
Illustrated by Owen Davey

An expert on the dynamics of the upper mantle and lithosphere on geologic time scales, McNutt has traveled the world, probing the ocean's depths in search of new knowledge. She has participated in more than 12 deep-sea expeditions, earned honorary doctoral degrees from nearly half a dozen institutions, and collected awards from such august institutions as the National Academy of Sciences and the American Philosophical Society. Given her inquisitive nature, it's not surprising that McNutt is once more exploring new territory in her current position at *Science*. "I've been fortunate to have had a string of positions that allowed me to do different, but important, things in science," McNutt says, "but this job is far and away the broadest in scope in terms of the science I see every day — I feel like a kid in a candy shop! The stories that come across my desk every day are weird, wild, unusual and bizarre. They're more mind-boggling than science fiction, and yet they're all true."

As editor-in-chief at *Science*, McNutt oversees a portfolio that encompasses some of the scientific community's most prestigious journals: *Science*, an international journal that has been the flagship of the American Association for the Advancement of Science for more than 100 years; *Science Signaling; Science Translational Medicine*; and the recently introduced *Science Advances,* an online, open-access journal for all the sciences.

McNutt is particularly excited about *Advances*' debut because of its populist bent. Science needs to inform the direction that people take in complex problem solving, she asserts, and an online, open-access journal like *Advances* can make a valuable contribution to the way knowledge is shared. "So many of the important developments in science need to be communicated not only to one's scientific peers but also to the outside community: policy makers, managers and high-level decision makers," McNutt says. "Yet too much of science is accessible only to people with subscriptions to science journals. *Science Advances* is based on a new model. All of the articles will be freely available to the public, and the journal will have a much broader scope, embracing topics in technology, the social sciences and engineering as well as in the life sciences." It is through this collective harnessing of knowledge, McNutt believes, that we will master the daunting challenges that face the global community.

A QUEST FOR EXPLANATIONS

A quest for explanations has informed McNutt's career throughout the years. During her tenure at MIT, she served as director of the Joint Program in Oceanography/Applied Ocean Science and Engineering — a combined offering of MIT and the Woods Hole Oceanographic Institution — and acted as chief scientist or co-chief on numerous deep-sea expeditions. In 2010, McNutt was part of a team of government scientists and engineers called to BP headquarters in Houston, Texas, to address the Deepwater Horizon disaster, the largest accidental marine oil spill in the history of the petroleum industry. Incident Commander Thad Allen appointed McNutt the leader of the Flow Rate Technical Group and charged her with providing estimates of the rate of oil discharge during the active phase of the spill. "I was given a small, windowless office at BP headquarters, and it didn't matter at all that I had no windows," McNutt recalls. "We worked very long hours dealing with the spill. Our first meeting was at 5:30 every morning, and we walked out the door every night at around 10:30."

McNutt's role required that she attend a revolving cycle of meetings — some big, some small, some with government officials, others with BP officials. "We were constantly running through sequences of what we were trying to do: collect the oil, kill the well, predict where the oil would travel and plan for potential hurricanes," she says. "We were dealing with myriad issues." McNutt spent

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nearly four months working on-site and earned the U.S. Coast Guard's Meritorious Service Medal (the non-combat equivalent of the Bronze Star) for her efforts. Her role in the cleanup is chronicled in *Washington Post* reporter Joel Achenbach's gripping account of the tragedy: "A Hole at the Bottom of the Sea: The Race to Kill the BP Oil Gusher."

A ROLE IN THE GLOBAL DISCUSSION

Today, in her editorial role at *Science*, McNutt conducts her explorations on a global scale, working with scientists and editors from around the world to bring the scientific community's latest news and cutting-edge developments to an estimated readership in excess of one million people. Not surprisingly, she revels in the unique opportunities this position offers.

One of McNutt's most memorable encounters in her new role came about in 2014, when she was afforded the rare chance to meet with China's premier and party secretary of the State Council, Li Keqiang, the man responsible for managing the national and international concerns of the country's 1.3 billion citizens. McNutt spoke one-on-one with the premier for over an hour on matters concerning science and the economy, from space exploration to environmental protection.

Marcia McNutt '70

The Chinese have a very different perspective on the importance of science and the role of scientists in society, McNutt says. "China's leaders tend to be scientists rather than lawyers or businessmen," she notes. "The hopes and dreams of Chinese parents are that their children will do well in school and go on to become a scientist or engineer. The Chinese see education, rather than sports or entertainment, as their ticket out of poverty and obscurity. That attitude translates through all socio-economic levels, to the point where they choose as their leaders those individuals who have reached the pinnacle of scientific or technical achievement." Premier Li was himself a peasant from a poor rural part of China who excelled on his college entrance examination, thereby gaining admission to the elite Peking University where he studied economics.

In a post-meeting report of her time with the premier, McNutt noted, "In all my years as a scientist, including heading a billion-dollar U.S. research agency, this was the most significant invitation I had ever received to meet with a sitting national leader to hear his vision for science and discuss important global science matters. The fact that the Chinese premier wanted to meet with me sent strong signals as to how China is seeing science as critical to its future well-being."

McNutt is grateful to occupy a bully pulpit from which she can share the multitude of exciting scientific discussions and discoveries being made worldwide every day. "Science is a critical factor in the global economy," she asserts. "In fact, it's really hard to point to any sustained economic growth that is not fundamentally science-

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driven. Growing the economy through natural resource extraction, for example, is inherently self-limiting. Coal mining and oil drilling are finite activities because natural resources will eventually run out. If you really want to grow your economy, you have to do it with science: innovation, new product development and new idea generation lead to high-paying jobs that are a result of significant investment.”

A CALL FOR SUSTAINABLE SOLUTIONS

As Americans, we need to take a bigger world view in all the decisions we make, McNutt argues. For example, she says, we need to think more responsibly about our consumption patterns. “The early pioneers lived with everything they owned and discarded from the day they acquired it to the day they died — there was no trash removal,” McNutt observes. “I think if we were more mindful of our purchases — asking ourselves, for example, if the container holding a product is recyclable, and if not, what we’ll do with it once it’s empty — we would put less strain on our natural resources.”

We must also consider the ramifications of introducing new substances into the environment through our actions, McNutt asserts, as history is full of examples of unintended consequences. For instance,

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she explains, many fish are showing reactions to pharmaceutical chemicals that have been released into the rivers. "They're experiencing changes in sex organs. Even though the pharmaceuticals only appear in the water in minute amounts, they're having a negative effect on the ecosystem. Their toxic effect on the fish is profound, yet the problem is very tough to deal with because the chemicals appear in trace amounts. The bottom line: everything that we produce has a very long life span, and we need to take that into consideration."

"Our primary challenge is to come up with practical solutions to the world's problems," McNutt continues. "The Ebola epidemic, the Great Pacific Garbage Patch — everyone agrees that they're daunting problems; what we're lacking is solutions. Perhaps the most important question we face is that of the planet's sustainability in the face of growing population pressures — everyone on the planet is striving to achieve the quality of life that the upper echelons of the industrialized world enjoy. Everyone wants — and deserves — a healthy diet, access to clean water, reliable energy, affordable transportation and high-quality medical care. Yet virtually every scientist polled agrees that the carrying capacity of the planet simply cannot support our current lifestyle indefinitely. We need to figure out how everyone can live comfortably without driving our environmental systems into a state of collapse." And McNutt believes that the answers are within our grasp. "We've just got to let technology work for us rather than against us," she asserts.

Consider, she says, the communications revolution that has come about as a result of moving communications from copper wire to the digital realm. "Cell phones have brought communications so far globally that the number of cell phone users in some nations far exceeds the number of people with access to electricity. Yet people still find ways to charge their cell phones; they've become essential lifelines in many communities. Science can provide similar revolutions in terms of medical care, pollution control, etc.," McNutt says.

McNutt points to climate change as one such challenge that could benefit from the application of technology. "We not only need to find solutions that affordably avoid fossil fuel emissions, but we may also need to remove CO_2 that has already been emitted if we are to avoid the worst consequences of climate change," she says. Finding sufficient, high-quality water for agriculture, people, industry and ecosystems is another pressing need, as is securing raw materials to meet our industrial needs. "Science constantly needs to stay one step ahead as resources become depleted," McNutt observes. "We used to transmit information through copper wires, but copper became scarce, so now we use fiber optics. At present, society is very dependent on rare earth elements for products like cell phones, hybrid cars, windmills and the like. We need to find materials that will replace rare earths, or work on mechanisms to recycle them." These problems and many others demand attention, and the more minds that can swiftly be brought to bear on the matter, the better, McNutt believes.

As a former educator, McNutt is eager to encourage forthcoming generations to pursue careers in science. "We need science teachers who are themselves really excited about science," she asserts. "Most every scientist I know, myself included, was inspired by a great teacher. When kids are only exposed to science through the eyes of someone who's teaching out of a requirement, rather than by someone who's excited about the subject matter and understands it, something is lost. The thrill of understanding must be demonstrated to be compelling."

Lori L. Ferguson is a freelance writer based in southern New Hampshire. She enjoys writing on lifestyle and human interest topics as well as all things artistic. She may be reached through her website, writerloriferguson.com.