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IN THIS WEEK'S ISSUE

Through DNA Editing, Researchers Hope to Alter the Genetic Destiny of Species and Eliminate Diseases

In the January 2, 2017, issue of *The New Yorker*, in "Rewriting the Code of Life" (p. 34), Michael Specter reports on gene-drive technology and the biologists who are working to deter devastating pests, protect endangered species, and vanquish diseases that have killed billions of people. Kevin Esvelt directs the "sculpting evolution" group at M.I.T., where he and his colleagues are attempting to design molecular tools capable of fundamentally altering the natural world. In 2014, Esvelt and his colleagues were the first to describe how the revolutionary gene-editing tool CRISPR could combine with a natural phenomenon known as a gene drive to alter the genetic destiny of a species. This summer, Specter accompanied Esvelt to Nantucket, Massachusetts, where more than a quarter of the residents have been infected with Lyme disease, one of the most rapidly spreading diseases in the United States. If the residents of Nantucket agree, Esvelt intends to edit the DNA of white-footed mice to make them immune to the bacteria that causes Lyme and other tick-borne diseases. If enough immune mice mate with wild mice, the entire population would become resistant—and the antibodies in the mice would kill the Lyme bacterium in any ticks that bite them. Without infected ticks, there would be no infected people. "Take out the mice," Esvelt told Specter, "and the entire transmission cycle collapses." Life without Lyme disease would bring relief to millions of Americans, but creating a mosquito that might eliminate malaria, yellow fever, dengue fever, chikungunya, and several types of encephalitis, "would rank, along with the eradication of smallpox, as one of public health's signature achievements," Specter writes. Esvelt says, "For a lot of people, the goal is to eradicate malaria, and I am behind that a hundred per cent . . . But I would submit that the single most important application of gene drive is not to eradicate malaria or schistosomiasis or Lyme or any other specific project. It is to change the way we do science." Esvelt hopes to pry open what he sees as the often secretive and needlessly duplicative process of scientific research. "The only way to conduct an experiment that could wipe an entire species from the Earth is with complete transparency," he told Specter.

For four billion years, evolution, driven by natural selection and random mutation, has insured that the most efficient genes would survive and that the weakest would disappear. But, propelled by CRISPR and other tools of synthetic biology, intelligent design threatens to transcend Darwin—because evolution may soon be guided by us. "Imagine that an insect is eating your crops. If you have a gene drive and you understand how olfaction works in that pest, you could just reprogram it to go on its merry way. The pest would still be in the ecosystem, but it would just dislike the taste of your crop. That is a much more elegant way of interacting with nature than anything we do now," Esvelt says.

Virtually any technology that can serve a species can also harm it, either by accident or by design. Aviv Regev, of the Broad Institute of M.I.T. and Harvard, stressed that she was not opposed to gene-drive research, but told Specter, "gene drives affect entire communities, not single individuals. And it can be almost impossible to predict the dynamics of any ecosystem, because it is not simply additive. That is exactly why gene drives are so scary." Esvelt says, "My greatest fear is that something terrible will happen before something wonderful happens. It keeps me up at night more than I would like to admit."

A Failing Dam Threatens Millions of Iraqis

In "Before the Flood" (p. 22), **Dexter Filkins** reports from the Mosul Dam, which is on the verge of collapse, threatening to cause a catastrophe of Biblical proportions. Twenty-five-miles north of Mosul, the dam regulates the flow of water to the city, and to millions of Iraqis who live along the Tigris. Completed in 1984, the dam sits on a foundation of soluble rock and to keep it stable, hundreds of employees have to work around the clock, pumping a cement mixture into the earth below, a process called "grouting." Filkins visits the "gallery," a tunnel that runs inside the base, four hundred feet below the top, where the work of maintaining the dam is performed. Without continuous maintenance, the rock beneath would wash away, causing the dam to sink and then break apart—but Iraq's recent history has not been conducive to that kind of vigilance. In 2014, when ISIS fighters took the dam, they drove away the overwhelming majority of the dam's workers, and captured the main grout-manufacturing plant in Mosul. The grouting came to a standstill—but the passage of water underneath the dam did not. Ten days later, Kurdish forces pushed out ISIS fighters to take control of the dam, and in the months that followed American officials inspected the dam and became concerned that it was on the brink of collapse.

In January, a team of American scientists reported that a thirty-metre-wide block on the western side of the dam had tilted, with one end sinking into the earth a tenth of an inch. To engineers, uneven movement of a dam means that the ground underneath may be falling away; the uneven pressure could ultimately cause a breach. In February, the U.S. Embassy in Baghdad is-



sued a warning of the consequences of a breach in the dam. The United Nations released its own warning, predicting that "hundreds of thousands of people could be killed" if the dam failed. "Iraq's leaders, apparently fearful of public reaction, have refused to acknowledge the extent of the danger," Filkins writes. In 2015, Mohsen al-Shammari, then the Minister for Water Resources, said there was no chance that the dam would collapse: "Whoever is saying it's about to collapse is only talking." But Azzam Alwash, an Iraqi-American civil engineer who has advised on the dam, tells Filkins that nearly everyone outside the Iraqi government who has examined the dam believes that time is running out: in the spring, snowmelt flows into the Tigris, putting immense pressure on the retaining wall. Nasrat Adamo, a former senior official at the Iraqi Ministry of Irrigation, told Filkins, "I am convinced the dam could fail tomorrow."

If the dam failed, large parts of Mosul would be submerged in less than three hours; along the riverbanks, towns and cities containing the heart of Iraq's population would be flooded; in four days, a wave as high as sixteen feet would crash into Baghdad. By the time the flood wave exhausted itself, as many as one and a half million people could be dead. But in this part of the world people "are accustomed to having their lives upended," Filkins writes. Mohammed Nazir, a Kurdish farmer, tells Filkins, "We survived Saddam, we survived ISIS, and we will survive the Mosul Dam."

President Sisi Has Unwittingly Revealed More About the Way Egypt Now Works Than Anyone Could Have Imagined

In "The Shadow General" (p. 44), **Peter Hessler** reports from Egypt on President Abdel Fattah El-Sisi—the first foreign leader to call with congratulations after Donald Trump won the election—who came to power in a coup that resulted in the massacre of more than a thousand supporters of his predecessor. When Egypt's first democratic Presidential election, in 2012, was won by Mohamed Morsi, he appointed Sisi as the new Minister of Defense. As tensions in Egypt grew, Sisi opened a dialogue with former U.S. Secretary of Defense Chuck Hagel, who recalls, "We were literally talking, like, once a week. These would be hour-long conversations, sometimes more." Many people believe that the military had always planned to overthrow Morsi, but Hagel is convinced that Sisi initially had no intention of taking power. "The biggest question about Sisi is whether he can grow from a commander-in-chief into a politician," a European diplomat told Hessler.

Since becoming President, in 2014, Sisi has "unwittingly revealed more about himself and Egypt's political structures than anybody could have imagined," Hessler writes. A string of secretly recorded videos and audiotapes, known as SisiLeaks, have featured the President talking openly about sensitive subjects that range from manipulating the media to extracting cash from the Gulf states. Under Sisi, dozens of journalists and bloggers have been arrested, including one of the board members of the Egyptian Journalists Syndicate. Human-rights violations have become much worse than they were under President Mubarak. On February 3, 2016, the body of Giulio Regeni, an Italian graduate student, was discovered in a ditch beside the Cairo-Alexandria Desert Road. Anwar Sadat, a nephew of the former President Sadat and former head of the parliament's human-rights committee, told Hessler, "Every day, it's not only Regeni. Every day, with Egyptians." In the past year, instances of disappearance and torture have spiked, and Egypt currently has more than forty thousand political prisoners.

The youth—who are much more skeptical of Sisi than older Egyptians are—represent the sector that is most affected by Sisi's greatest weakness: his economic policies. "If you're a foreign country that's relying on Sisi as a provider of stability," a foreign businessman told Hessler, "and he is consistently failing to create sustainable jobs for young Egyptians, then what kind of stability is he offering?" Sisi mostly focusses on grandiose mega-projects, like the expansion of the Suez Canal, which cost more than eight billion dollars. "Sisi thinks, like all military men, that the economy is a collection of projects that the military runs," Robert Springborg, an expert on the Egyptian military who is currently a visiting scholar at Harvard University, told Hessler. "He hasn't got a clue." Hessler writes, "With every illusion stripped away, Egypt is revealed to be a state without real institutions, led by a man who is not a real politician."

Plus: In Comment, Amy Davidson reflects on Michelle Obama's time as First Lady, a tenure she completes as one of the most popular political figures in recent memory (p. 17); in Shouts & Murmurs, Ian Frazier imagines a mashup of "Sully" and "Star Trek Beyond" (p. 29); in an essay, Yiyun Li, who disowned Chinese, her native tongue, to write in English, explores why there is something unnatural about her switch from one language to another: "It's the absoluteness of my abandonment of Chinese, undertaken with such determination that it is a kind of suicide" (p. 30); Alex Ross reads several books about Johann Sebastian Bach's religiosity (p. 66); Joan Acocella reviews "Pavement" and "Untitled America," two dances by Kyle Abraham (p. 76); Anthony Lane watches the new Jim Jarmusch film, "Paterson," and Pablo Larraín's "Neruda" (p. 76); poetry by Jonathan Galassi (p. 40) and Andrea Cohen (p. 53); and new fiction by Camille Bordas (p. 56).

Podcasts: Parker Henry speaks with Paul Muldoon about fact-checking poems for *The New Yorker*; Joshua Yaffa joins Dorothy Wickenden from Moscow to discuss Russian cyber attacks on the United States and the Russian-backed Syrian soldiers who were accused of massacring civilians in Aleppo; David Remnick, Amy Davidson, and Ryan Lizza discuss President Obama's legacy; and Camille Bordas reads her short story "Most Die Young."

Digital Extras: Additional images of Mosul Dam; poetry readings by Jonathan Galassi and Andrea Cohen.

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